energy fuels nuclear, inc.

three park central • suite 900
1515 arapahoe street • denver, colorado 80202

303-623-8317
twx 910-931-2561
fax 303-595-0930

February 28, 1997

Mr. Joseph J. Holonich, Branch Chief
High Level Waste and Uranium Recovery
Projects Branch
Division of Waste Management
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
2 White Flint North, Mail Stop T-7J9
11545 Rockville Pike
Rockville, MD 20852

Re: Transmittal of Reclamation Plan for the White Mesa Uranium Mill
Source Mill License SUA-1358 - Docket No. ~~48~~-8681
40

Dear Mr. Holonich:

This letter transmits three complete copies of the Reclamation Plan (and appendices) for the White Mesa Uranium Mill. This document supersedes the Reclamation Plan submitted to the U.S. Nuclear Regulatory Commission ("NRC") by Umetco Mineral Corporation in June of 1988, although a few selected portions of that submittal are referenced in this Reclamation Plan.

The technical approaches applied by Energy Fuels Nuclear, Inc. ("EFN") in preparing this Reclamation Plan generally conform with the most current NRC regulatory guides. In addition, where appropriate, NRC staff have clarified methods for using selected guidance materials. For ease of review, key supporting documents have been reproduced as appendices.

Hopefully, the effort and care taken by Michelle Rehmann and Rick Van Horn in preparing this document will expedite the review process. After your initial review, we would like to schedule a meeting to discuss any preliminary questions. In the interim, please feel free to contact Michelle Rehmann at the letterhead phone or address, or Rick Van Horn at (970) 243-1968.

Sincerely,

Harold R. Roberts

HRR/pl
Enclosures

H MRR LETTERS 97 HOLORECPLAN LTR

cc: William N. Deal
Earl E. Hoellen
Richard A. Munson
Michelle R. Rehmann
Rick A. Van Horn

H:\MRR\LETTERS 97\HOLORECPLAN.LTR

TAILINGS COVER DESIGN

WHITE MESA MILL, OCTOBER 1996

FOR

RECLAMATION

OF

WHITE MESA FACILITIES

BLANDING, UTAH

PREPARED BY

TITAN ENVIRONMENTAL

7939 EAST ARAPAHOE ROAD, SUITE 230

ENGLEWOOD, COLORADO 80112

TITAN Environmental

TAILINGS COVER DESIGN
White Mesa Mill

Prepared For:

Energy Fuels Nuclear, Inc.
1515 Arapahoe, Suite 900
Denver, CO 80202

October 1996

By:

TITAN Environmental Corporation
7939 East Arapahoe Road, Suite 230
Englewood, Colorado 80112

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ENERGY FUELS NUCLEAR

WHITE MESA MILL

TAILINGS COVER DESIGN

1.0 SOIL COVER DESIGN

A six-foot thick soil cover for the uranium tailings Cells 2, 3 and 4A was designed using on-site materials that will contain tailings and radon emissions in compliance with regulations by the United States Nuclear Regulatory Commission (NRC) and by reference, the Environmental Protection Agency (EPA). The cover consists of a one-foot thick layer of clay, available from within the site boundaries (Section 16), below two-feet of random fill, available from stockpiles on-site. The clay is underlain with three feet (minimum) random fill soil, also available on site. The cover layers will be compacted to 95 percent maximum dry density using standard construction techniques. In addition to the soil cover, a minimum 3 inch (on the cover top) to 12-inch (on the cover slopes) layer of riprap material will be placed over the compacted random fill to stabilize slopes and provide long-term erosion resistance.

Uranium tailings soil cover design requirements for agency compliance include:

- Attenuate radon flux to an acceptable level (20 picoCuries-per meter squared-per second [pCi/m^2/sec]) (NRC, 1989);
- Minimize infiltration into the reclaimed tailings cells;
- Maintain a design life of up to 1,000 years or to the extent reasonably achievable and in any case for at least 200 years; and
- Provide long-term slope stability and geomorphic durability to withstand erosional forces of wind, the probable maximum flood event, and a horizontal ground acceleration of 0.1g due to seismic events.

Several models/analyses were utilized in simulating the soil cover effectiveness: radon flux attenuation, hydrologic evaluation of infiltration, freeze/thaw effects, soil cover erosion

protection, and static and pseudostatic slope stability analyses. These analyses and results are discussed in detail in Sections 1.1 through 1.5. The soil cover (from top to the bottom) will consist of: 1) minimum of three inches of riprap material; 2) two feet of compacted random fill; 3) one foot of compacted clay; and 4) minimum three feet of compacted random fill soil.

The soil cover design for the uranium tailings Cells 2, 3, and 4A was developed based on two construction options:

- An integrated soil cover over Disposal Cells 2, 3, and 4A; and
- A cover over Cells 2 and 3, where Cell 4A tailings are excavated and placed into Cell 3.

For modeling/analysis purposes it was assumed that the physical and radiological parameters of the tailings in Cells 2, 3, and 4A are not dependent on the tailing volume in each individual cell. Therefore, each of the two construction options above resulted in the same soil cover configuration. The only variation between the options is in the required volumes of cover materials, which is dependent only on the surface area to be covered (see Section 1.7).

The final grading plans for the two options are presented on Figures 1 and 2, respectively. As indicated on the figures, the top slope of the soil cover will be constructed at 0.2 percent and the side slopes, as well as transitional areas between cells, will be graded to five horizontal to one vertical (5H:1V).

A minimum of three feet random fill is located beneath the compacted fill and clay layers (see cross-sections on Figures 3 and 4). The purpose of the fill is to raise the base of the cover to the desired subgrade elevation. In many areas, the required fill thickness will be much greater. However, the models and analyses were performed conservatively assuming only a three-foot layer. For modeling purposes, this lower, random fill layer was considered as part of the soil cover for performing the radon flux attenuation calculation, as it effectively contributes to the reduction of radon emissions (see Section 1.1). The fill was also evaluated in the slope stability analysis (see Section 1.5). However, it is not defined as part of the soil cover for other design calculations (infiltration, freeze/thaw, and cover erosion).

The following sections describe design considerations, complete with calculations performed and parameters utilized, in developing the tailings impoundment soil cover to meet regulatory requirements.

1.1 Radon Flux Attenuation

The Environmental Protection Agency (EPA) rules in 40 Code of Federal Regulation (CFR) Part 192 require that a "uranium tailings cover be designed to produce reasonable assurance that the radon-222 release rate would not exceed 20 pCi/m^2/sec for a period of 1,000 years to the extent reasonably achievable and in any case for at least 200 years when averaged over the disposal area over at least a one year period" (NRC, 1989). NRC regulations presented in 10 CFR Part 40 also restrict radon flux to less than 20 pCi/m^2/sec. The following sections present the analyses and design for a soil cover which meets this requirement.

1.1.1 Predictive Analysis

The soil cover for the tailings cells at White Mesa Mill was evaluated for attenuation of radon gas using the digital computer program, RADON, presented in the NRC's Regulatory Guide 3.64 (Task WM 503-4) entitled "Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers". The RADON model calculates radon-222 flux attenuation by multi-layered earthen uranium mill tailings covers, and determines the minimum cover thickness required to meet NRC and EPA standards. The RADON model uses the following soil properties in the calculation process:

- Soil layer thickness [centimeters (cm)];
- Soil porosity (percent);
- Density [grams-per-cubic centimeter (gm/cm^3)];
- Weight percent moisture (percent);
- Radium activity (piC/g);
- Radon emanation coefficient (unitless); and

- Diffusion coefficient [square centimeters-per-second (cm^2/sec)].

Physical and radiological properties for tailings and random fill were analyzed by Chen and Associates (1987) and Rogers and Associates (1988). Clay physical data from Section 16 was analyzed by Advanced Terra Testing (1996) and Rogers and Associates (1996). See Appendix A for laboratory test data results.

The RADON model was performed for the following cover section (from top to bottom):

- two feet compacted random fill;
- one foot compacted clay; and
- a minimum of three feet random fill occupying the freeboard space between the tailings and clay layer.

The three layers are compacted to 95 percent maximum dry density. The top riprap layer was not included as part of the soil cover for the radon attenuation calculation.

The results of the RADON modeling exercise show that the uranium tailings cover configuration will attenuate radon flux emanating from the tailings to a level of 17.6 pCi/m^2/sec. This number was conservatively calculated as it takes into account the freeze/thaw effect on the uppermost part (6.8 inches) of the cover (Section 1.3). The soil cover and tailing parameters used to run the RADON model, in addition to the RADON input and output data files, are presented in Appendix B as part of the Radon Calculation brief. Based on the model results, the soil cover design of six-foot thickness will meet the requirements of 40 CFR Part 192 and 10 CFR Part 40.

1.1.2 Empirical Data

Radon gas flux measurements have been made at the White Mesa Mill tailings piles over Cells 2 and 3 (see Appendix C). These cells are currently covered with three to four feet of random fill. Radon flux measurements, averaged over the covered areas, were as follows (EFN, 1996):

	1994	1995
Cell 2	7.7 pCi/m^2/sec	6.1 pCi/m^2/sec
Cell 3	7.5 pCi/m^2/sec	11.1 pCi/m^2/sec

Empirical data suggest that the random fill cover, alone, is currently providing an effective barrier to Radon flux. Thus, the proposed tailings cover configuration, which is thicker, moisture adjusted, contains a clay layer and is compacted, is expected to attenuate the Radon flux to a level below that predicted by the RADON model. The field radon flux measurements confirm the conservatism of the cover design. This conservatism is necessary, however, to guarantee compliance with NRC regulations under long term climatic conditions over the required design life of 200 to 1,000 years.

1.2 Infiltration Analysis

The tailings ponds at White Mesa Mill are lined with synthetic geomembrane liners which under certain climatic conditions, could potentially lead to the long-term accumulation of water from infiltration of precipitation. Therefore, the soil cover was evaluated to estimate the potential magnitude of infiltration into the capped tailings ponds. The Hydrologic Evaluation of Landfill Performance (HELP) model, Version 3.0 (EPA, 1994) was used for the analysis. HELP is a quasi two-dimensional hydrologic model of water movement across, into, through, and out of capped and lined impoundments. The model utilizes weather, soil, and engineering design data as input to the model, to account for the effects of surface storage, snowmelt, run-off, infiltration, evapotranspiration, vegetative growth, soil moisture storage, lateral subsurface drainage, and unsaturated vertical drainage on the specific design, at the specified location.

The soil cover was evaluated based on a two-foot compacted random fill layer over a one-foot thick, compacted clay layer. The soil cover layers were modeled based on material placement at a minimum of 95 percent of the maximum dry density, and within two percent of the optimum moisture content per American society for Testing and Materials (ASTM) requirements. The top riprap layer and the bottom random fill layer were not included as part of the soil cover for infiltration calculations. These two layers are not playing any role in controlling the infiltration through the cover material.

The random fill will consist of clayey sands and silts with random amounts of gravel and rock-size materials. The average hydraulic conductivity of several samples of random fill was calculated, based on laboratory tests, to be 8.87×10^{-7} cm/sec. The hydraulic conductivity of the clay source from Section 16 was measured in the laboratory to be 3.7×10^{-8} cm/sec. Geotechnical soil properties and laboratory data are presented in Appendix A.

Key HELP model input parameters include:

- Blanding, Utah, monthly temperature and precipitation data, and HELP model default solar radiation, and evapotranspiration data from Grand Junction, Colorado. Grand Junction is located north east of Blanding in similar climate and elevation;

- Soil cover configuration identifying the number of layers, layer types, layer thickness, and the total covered surface area;

- Individual layer material characteristics identifying saturated hydraulic conductivity, porosity, wilting point, field capacity, and percent moisture; and

- Soil Conservation Service runoff curve numbers, evaporative zone depth, maximum leaf area index, and anticipated vegetation quality.

Water balance results, as calculated by the HELP model, indicate that precipitation would either run-off the soil cover or be evaporated. Thus, model simulations predict zero infiltration of surface water through the soil cover, as designed. These model results are conservative and take into account the freeze/thaw effects on the uppermost part (6.8 inches) of the cover (Section 1.3). The HELP model input and output for the tailings soil cover are presented in the HELP Model calculation brief included as Appendix D.

1.3 Freeze/Thaw Evaluation

The tailings soil cover of one foot of compacted clay covered by two feet of random fill was evaluated for freeze/thaw impacts. Repeated freeze/thaw cycles have been shown to increase the bulk soil permeability by breaking down the compacted soil structure.

The soil cover was evaluated for freeze/thaw effects using the modified Berggren equation as presented in Aitken and Berg (1968) and recommended by the NRC (U.S. Department of Energy, 1988). This evaluation was based on the properties of the random fill and clay soil, and meteorological data from both Blanding, Utah and Grand Junction, Colorado.

The results of the freeze/thaw evaluation indicate that the anticipated maximum depth of frost penetration on the soil cover would be less than 6.8 inches. Since the random fill layer is two feet thick, the frost depth would be confined to this layer and would not penetrate into the

underlying clay layer. The performance of the soil cover to attenuate radon gas flux below the prescribed standards, and prevent surface water infiltration, would not be compromised. The input data and results of the freeze/thaw evaluation are presented in the Effects of Freezing on Tailings Covers Calculation brief included as Appendix E.

1.4 Soil Cover Erosion Protection

A riprap layer was designed for erosion protection of the tailings soil cover. According to NRC guidance, the design must be adequate to protect the soil/tailings against exposure and erosion for 200 to 1,000 years (NRC, 1990). Currently, there is no standard industry practice for stabilizing tailings for 1,000 years. However, by treating the embankment slopes as wide channels, the hydraulic design principles and practices associated with channel design were used to design stable slopes that will not erode. Thus, a conservative design based on NRC guidelines was developed. Engineering details and calculations are summarized in the Erosion Protection Calculation brief provided in Appendix F.

Riprap cover specifications for the top and side slopes were determined separately as the side slopes are much steeper than the slope of the top of the cover. The size and thickness of the riprap on the top of the cover was calculated using the Safety Factor Method (NUREG/CR-4651, 1987), while the Stephenson Method (NUREG/CR-4651, 1987) was used for the side slopes. These methodologies were chosen based on NRC recommendations (1990).

By the Safety Factor Method, riprap dimensions for the top slope were calculated in order to achieve a slope "safety factor" of 1.1. For the top of the soil cover, with a slope of 0.2 percent, the Safety Factor Method indicated a median diameter (D_{50}) riprap of 0.28 inches is required to stabilize the top slope. However, this dimension must be modified based on the long-term durability of the specific rock type to be used in construction. The suitability of rock to be used as a protective cover must be assessed by laboratory tests to determine the physical characteristics of the rocks. The sandstones from the confluence of Westwater and Cottonwood Canyons require an oversizing factor of 25 percent. Therefore, riprap created from this sandstone source should have a D_{50} size of at least 0.34 inches and should have an overall layer thickness of at least three inches on the top of the cover.

Riprap dimensions for the side slopes were calculated using Stephenson Method equations. The side slopes of the cover are designed at 5H:1V. At this slope, Stephenson's Method indicated the unmodified riprap D_{50} of 3.24 inches is required. Again assuming that the on-site sandstone will be used, the modified D_{50} size of the riprap should be at least 4.05 inches with an overall layer thickness of at least 12 inches.

The potential of erosion damage due to overland flow, sheetflow, and channel scouring on the top and side slopes of the cover, including the riprap layer, has been evaluated. Overland flow calculations were performed using site meteorological data, cap design specifications, and guidelines set by the NRC (NUREG/CR-4620, 1986). These calculations are included in Appendix F. According to the guidelines, overland flow velocity estimates are to be compared to "permissible velocities", which have been suggested by the NRC, to determine the potential for erosion damage. When calculated, overland flow velocity estimates exceed permissible velocities, additional cover protection should be considered. The permissible velocity for the tailings cover (including the riprap layer) is 5.0 to 6.0 feet-per-second (ft./sec.) (NUREG/CR 4620). The overland flow velocity calculated for the top of the cover is less than 2.0 ft/sec., and the calculated velocity on the side slopes is 4.9 ft/sec. Therefore, the erosion potential of the slopes, due to overland flow/channel scouring, is within acceptable limits and no additional erosion protection is required.

1.5 Slope Stability Analysis

Static and pseudostatic analyses were performed to establish the stability of the side slopes of the tailings soil cover. The side slopes are designed at an angle of 5H:1V. Because the side slope along the southern section of Cell 4A is the longest and the ground elevation drops rapidly at its base, this slope was determined to be critical and is thus the focus of the stability analyses.

The computer software package GSLOPE, developed by MITRE Software Corporation, has been used for these analyses to determine the potential for slope failure. GSLOPE applies Bishop's Method of slices to identify the critical failure surface and calculate a factor of safety (FOS). The slope geometry and properties of the construction materials and bedrock are input into the model. These data and drawings are included in the Stability Analysis of Side Slopes Calculation brief included as Appendix G. For this analysis, competent bedrock is designated at 10 feet below the lowest point of the foundation [i.e., at a 5,540-foot elevation above mean sea

level (msl)]. This is a conservative estimate, based on the borehole logs supplied by Chen and Associates (1979), which indicate bedrock near the surface.

1.5.1 Static Analysis

For the static analysis, a FOS of 1.5 or more was used to indicate an acceptable level of stability. The calculated FOS is 2.91, which indicates that the slope should be stable under static conditions. Results of the computer model simulations are included in Appendix G.

1.5.2 Pseudostatic Analysis (Seismicity)

The slope stability analysis described above was repeated under pseudostatic conditions in order to estimate a FOS for the slope when a horizontal ground acceleration of 0.10g is applied. The slope geometry and material properties used in this analysis are identical to those used in the stability analysis. A FOS of 1.0 or more was used to indicate an acceptable level of stability under pseudostatic conditions. The calculated FOS is 1.903, which indicates that the slope should be stable under dynamic conditions. Details of the analysis and the simulation results are included in Appendix G.

Recently, Lawrence Livermore National Laboratory (LLNL) published a report on seismic activity in southern Utah, in which a horizontal ground acceleration of 0.12g was proposed for the White Mesa site. The evaluations made by LLNL were conservative to account for tectonically active regions that exist, for example, near Moab, Utah. Although, the LLNL report states that "...[Blanding] is located in a region known for its scarcity of recorded seismic events," the stability of the cap design slopes using the LLNL factor was evaluated. The results of a sensitivity analysis reveal that when considering a horizontal ground acceleration of 0.12g, the calculated FOS is 1.778 which is still above the required value of 1.0, indicating adequate safety under pseudostatic conditions. This analysis is also included in Appendix G.

1.6 Cover Material/Cover Material Volumes

Construction materials for reclamation will be obtained from on-site locations. Fill material will be available from the stockpiles that were generated from excavation of the cells for the tailings facility. If required, additional materials are available locally to the west of the site. A clay material source, identified in Section 16 at the southern end of the White Mesa Mill site, will be

used to construct the one-foot compacted clay layer. Riprap material will be taken from on-site sandstone, located at the confluence of Westwater and Cottonwood Canyons.

Material quantities have been calculated for each of the components of the reclamation cover. Volume estimates were made for the two soil cover design options, as follows:

- Option 1: an integrated soil cover which incorporates Disposal Cells 2, 3, and 4A, and
- Option 2: a cover which includes Cells 2 and 3, where Cell 4A tailings have been excavated and placed in Cell 3.

The quantity of random fill required to bring the pond elevation up to the soil cover subgrade and construct the final slope was not calculated. This layer will be a minimum of three feet in depth and is dependent on the final tailings grade, which is not known.

For Design Option 1, construction will require the following approximate quantities of materials:

Material	Volume (cubic yards)
Clay	365,082
Random Fill	737,717
Riprap (top of cover)	82,762
Riprap (side slopes)	41,588

For Design Option 2, construction will require the following approximate quantities of materials:

Material	Volume (cubic yards)
Clay	289,514
Random Fill	585,334
Riprap (top of cover)	64,984
Riprap (side slopes)	35,885

Material quantities calculations are provided in Appendix H as part of the Tailings Cover Material Volume Calculation brief.

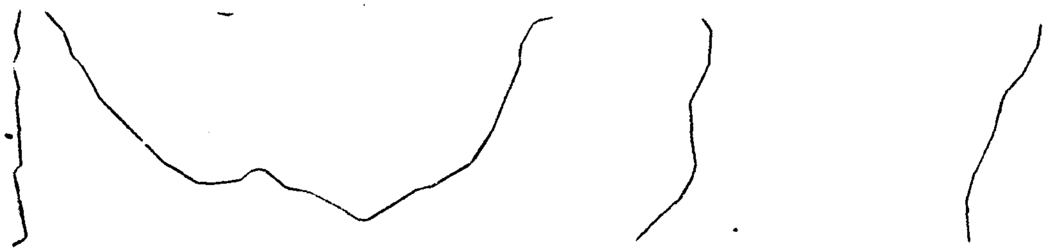
RECLAMATION COVER
GRADING PLAN FOR CELLS 2, 3 & 4A

PREPARED FOR

ENERGY FUELS NUCLEAR
BLANDING, UTAH

TITAN Environmental

DATE:	8-12-96	FIGURE 1	DRAWING NUMBER	1
SCALE:	AS SHOWN		6111-E1	



RECLAMATION COVER
GRADING PLAN FOR CELLS 2 & 3

PREPARED FOR

ENERGY FUELS NUCLEAR
BLANDING, UTAH

TITAN Environmental

ATE:	8-12-96	FIGURE 2	DRAWING NUMBER	1
CALE:	AS SHOWN		6111-E2	

HORIZONTAL SCALE

200 0 200 400 FEET

RECLAMATION COVER
CROSS SECTIONS & DETAILS

PREPARED FOR

ENERGY FUELS NUCLEAR
BLANDING, UTAH

TITAN Environmental

DATE: 8-12-96	FIGURE 3	DRAWING NUMBER	△1
SCALE: AS SHOWN		6111-E3	

HORIZONTAL SCALE

200 0 200 400 FEET

RECLAMATION COVER
CROSS SECTIONS & DETAILS
PREPARED FOR

ENERGY FUELS NUCLEAR
BLANDING, UTAH

TITAN Environmental

DATE: 8-12-96	FIGURE 4	DRAWING NUMBER 6111-E4	1
SCALE: AS SHOWN			

APPENDIX A

Laboratory Test Data

Table 3.4-1

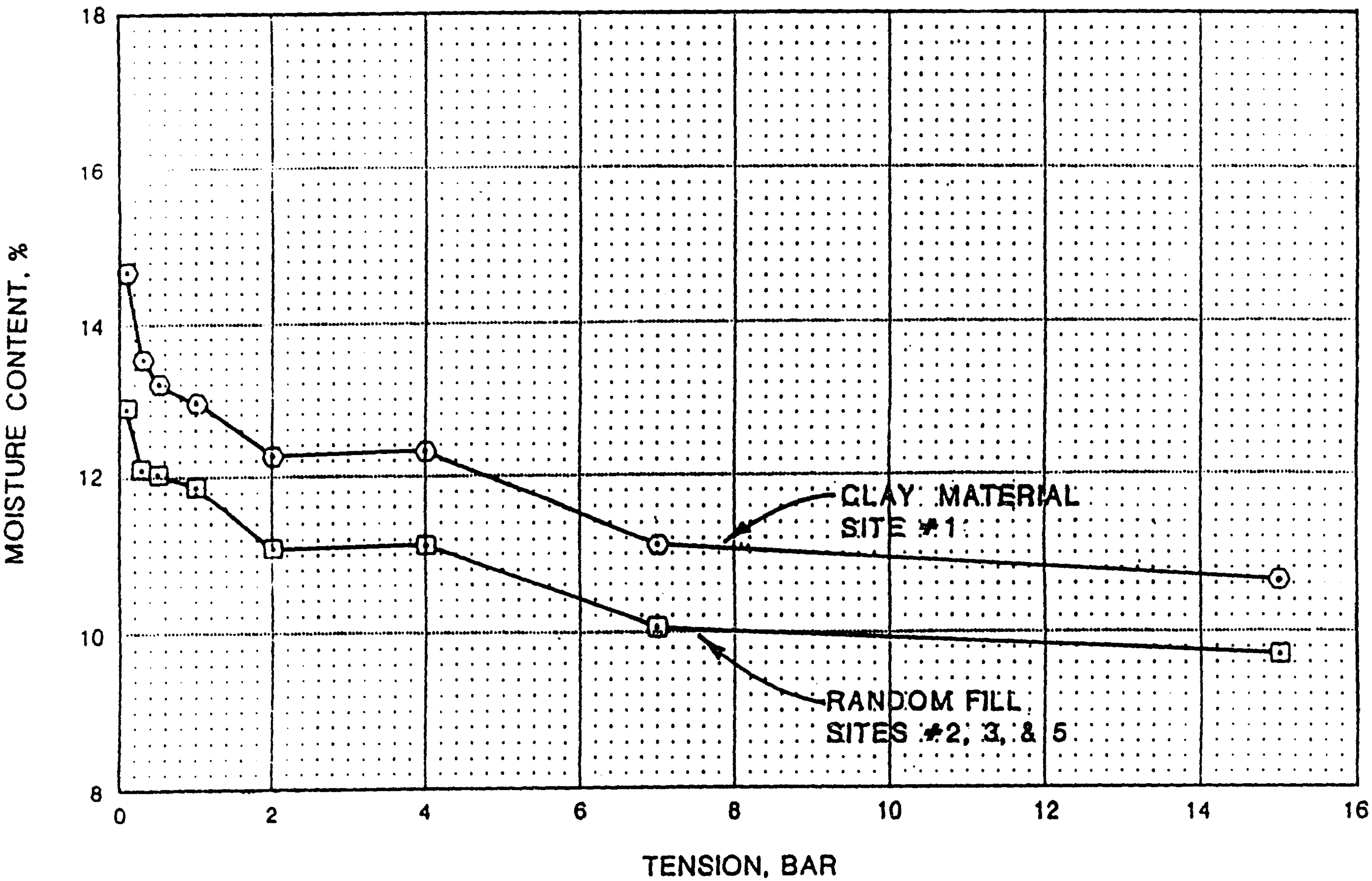
Physical Properties of Tailings

and

Proposed Cover Material

Material Type	Atterberg Limits LL	Atterberg Limits PI	Specific Gravity	% Passing No. 200 Sieve	Maximum Dry Density (pcf)	Optimum Moisture Content
Tailings	28	6	2.85	46	104.0	18.1
Random Fill	22	7	2.67	48	120.2	11.8

Note: Physical Soil Data from Chen and Associates (1987).

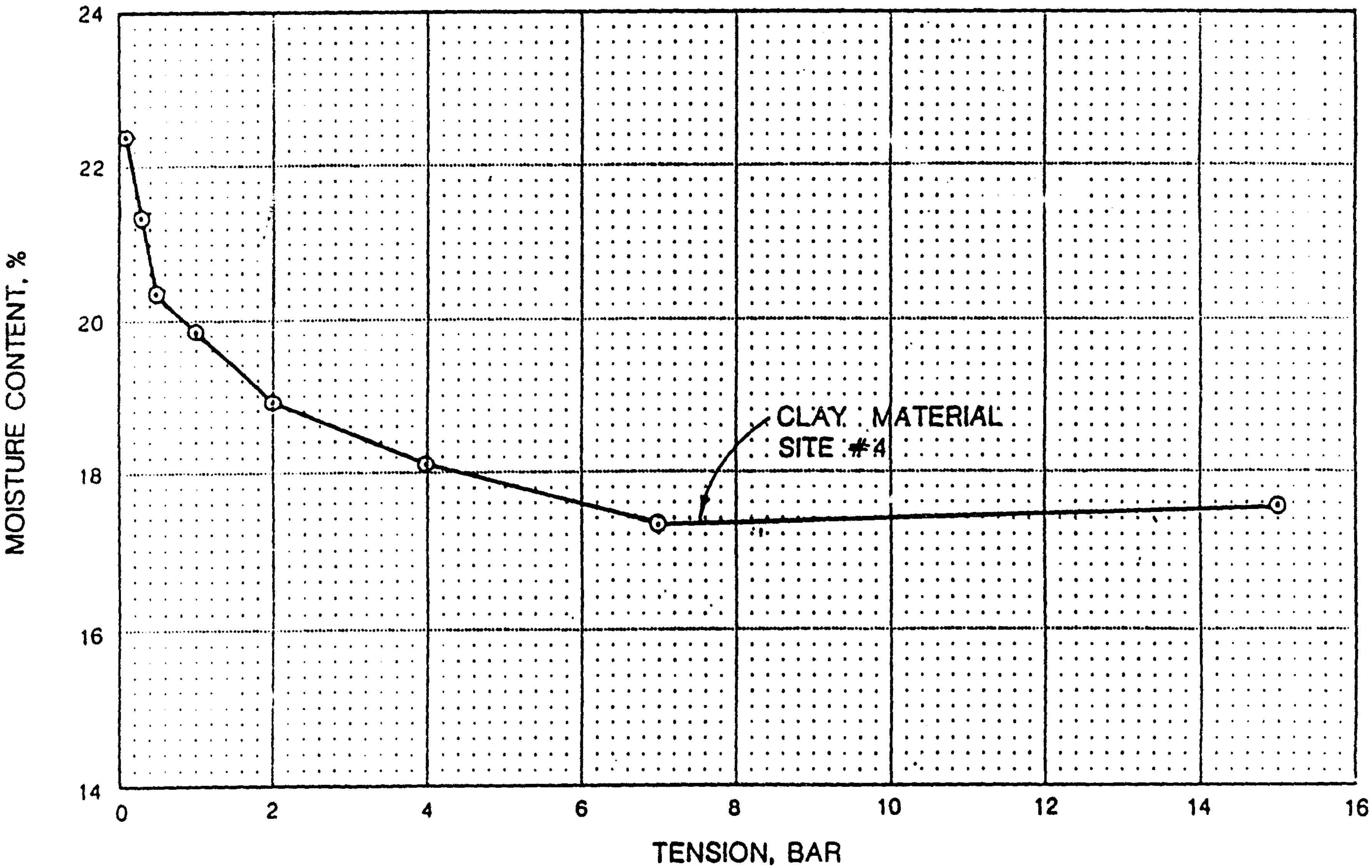


SUMMARY OF CAPILLARY MOISTURE RELATIONSHIP TEST RESULTS

WHITE MESA PROJECT

FIGURE 3.5-1

DATA FROM CHEN & ASSOCIATES



SUMMARY OF CAPILLARY MOISTURE RELATIONSHIP TEST RESULTS
WHITE MESA PROJECT

DATA FROM CHEN & ASSOCIATES

FIGURE 3.5-2

SECTION 6

ROGERS AND ASSOCIATES ENGINEERING
CORPORATION

Letter Dated March 4, 1988
Letter Dated May 9, 1988

Radiological Properties

R
A
E

Rogers & Associates Engineering Corporation

Post Office Box 330
Salt Lake City, Utah 84110
(801) 263-1600

March 4, 1988

Mr. C.O.Sealy
Umetco Minerals Corporation
P.O. Box 1029
Grand Junction, CO 81502

C8700/22

Dear Mr. Sealy:

We have completed the tests ordered on the four samples shipped to us. The results are as follows:

Sample	Radium pCi/gm	Emanation Fraction	Diffusion Coeffic.	(g/cm^3) Density	Moisture	Saturation
Tailings	981±4	0.19±0.01	2.0E-02	1.45	13.2	0.39
			8.4E-03	1.44	19.1	0.56
Composite (2,3,&5)			1.6E-02	1.85	6.5	0.40
			4.5E-04	1.84	12.5	0.75
Site #1			1.6E-02	1.85	8.1	0.48
			1.4E-03	1.84	12.6	0.76
Site #4			1.1E-02	1.65	15.4	0.63
			4.2E-04	1.65	19.3	0.80

The samples will be shipped back to you in the next few weeks. If you have any questions regarding the results on the samples please feel free to call.

Sincerely,

Renee Y. Bowser
Lab Supervisor

RYB/b

R
A
E

Rogers & Associates Engineering Corporation

Post Office Box 330
Salt Lake City, Utah 84110
(801) 263-1600

MAY 12 1988

May 9, 1988

Mr. C.O. Sealy
UMETCO Minerals Corporation
P.O. Box 1029
Grand Junction, CO 81502

C8700/22

Dear Mr. Sealy:

The tests for radium content and radon emanation coefficient in the following samples have been completed and the results are as follows:

Sample	Radium (pCi/g)	Radon Emanation Coefficient
Random (2,3 & 5)	1.9 ± 0.1	0.19 ± 0.04
Site 1	2.2 ± 0.1	0.20 ± 0.03
Site 4	2.0 ± 0.1	0.11 ± 0.04

If you have any questions regarding these results please feel free to call Dr. Kirk Nielson or me.

Sincerely,

Renee Y. Bowser
Lab Supervisor

RYB:ms

ADVANCED TERRA TESTING inc

833 Parfet Street
Lakewood, Colorado 80215
(303) 232-8308

ATTERBERG LIMITS TEST

ASTM D 4318

CLIENT Titan Env.

JOB NO. 2234-04

BORING NO.

DEPTH

DATE SAMPLED

SAMPLE NO. UT-1

DATE TESTED 7-25-96 WEB, RV

SOIL DESCR.

TEST TYPE ATTERBERG

Plastic Limit Determination

	1	2	3
Wt Dish & Wet Soil	3.34	4.06	3.42
Wt Dish & Dry Soil	2.96	3.57	3.03
Wt of Moisture	0.38	0.49	0.39
Wt of Dish	1.05	1.11	1.06
Wt of Dry Soil	1.91	2.46	1.97
Moisture Content	19.90	19.92	19.80

Liquid Limit Determination Device Number 0258

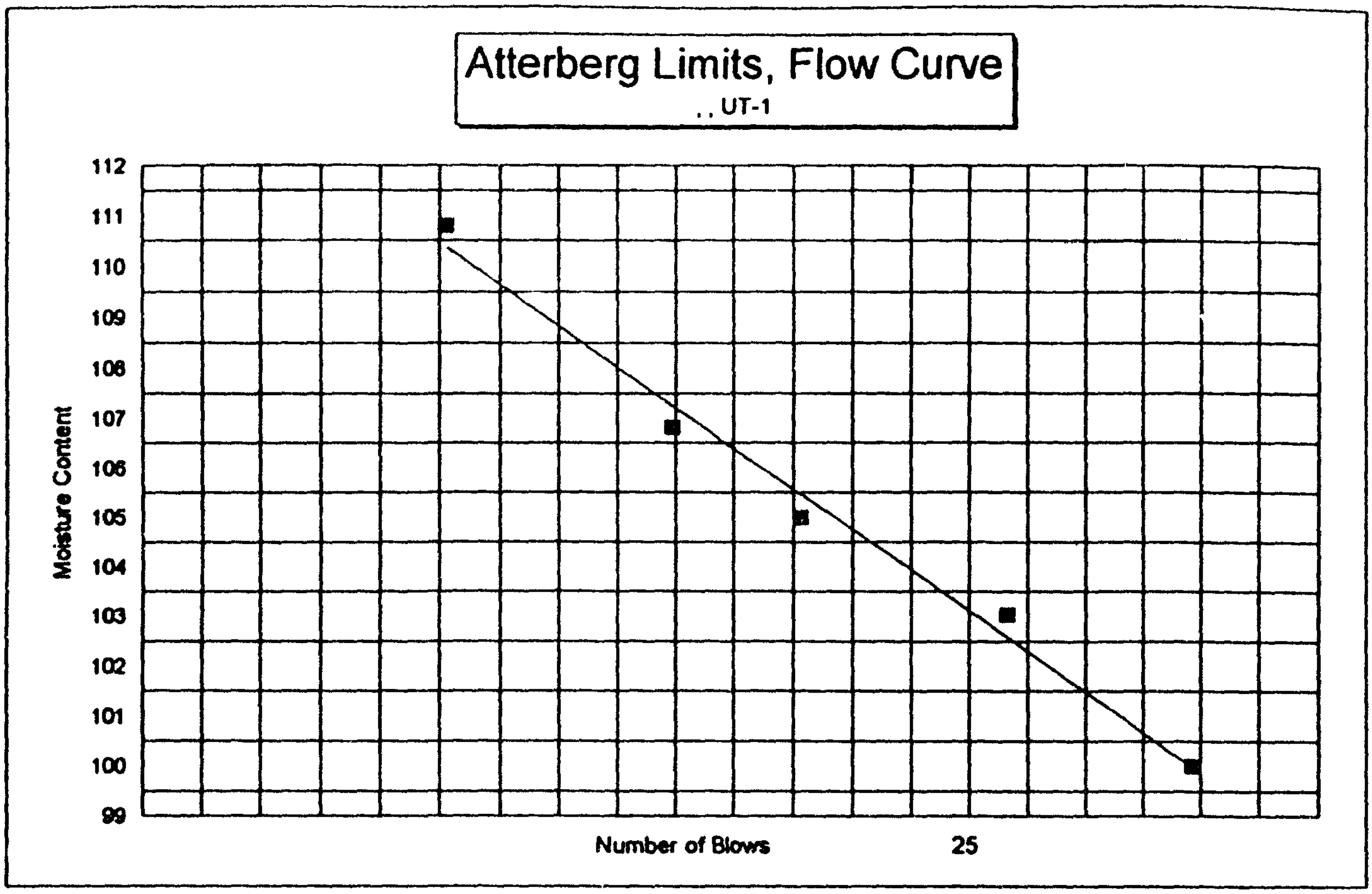
	1	2	3	4	5
Number of Blows	39	27	18	14	9
Wt Dish & Wet Soil	12.18	10.42	10.92	12.33	10.06
Wt Dish & Dry Soil	6.64	5.67	5.87	6.53	5.34
Wt of Moisture	5.54	4.75	5.05	5.80	4.72
Wt of Dish	1.10	1.06	1.06	1.10	1.08
Wt of Dry Soil	5.54	4.61	4.81	5.43	4.26
Moisture Content	100.00	103.04	104.99	106.81	110.80

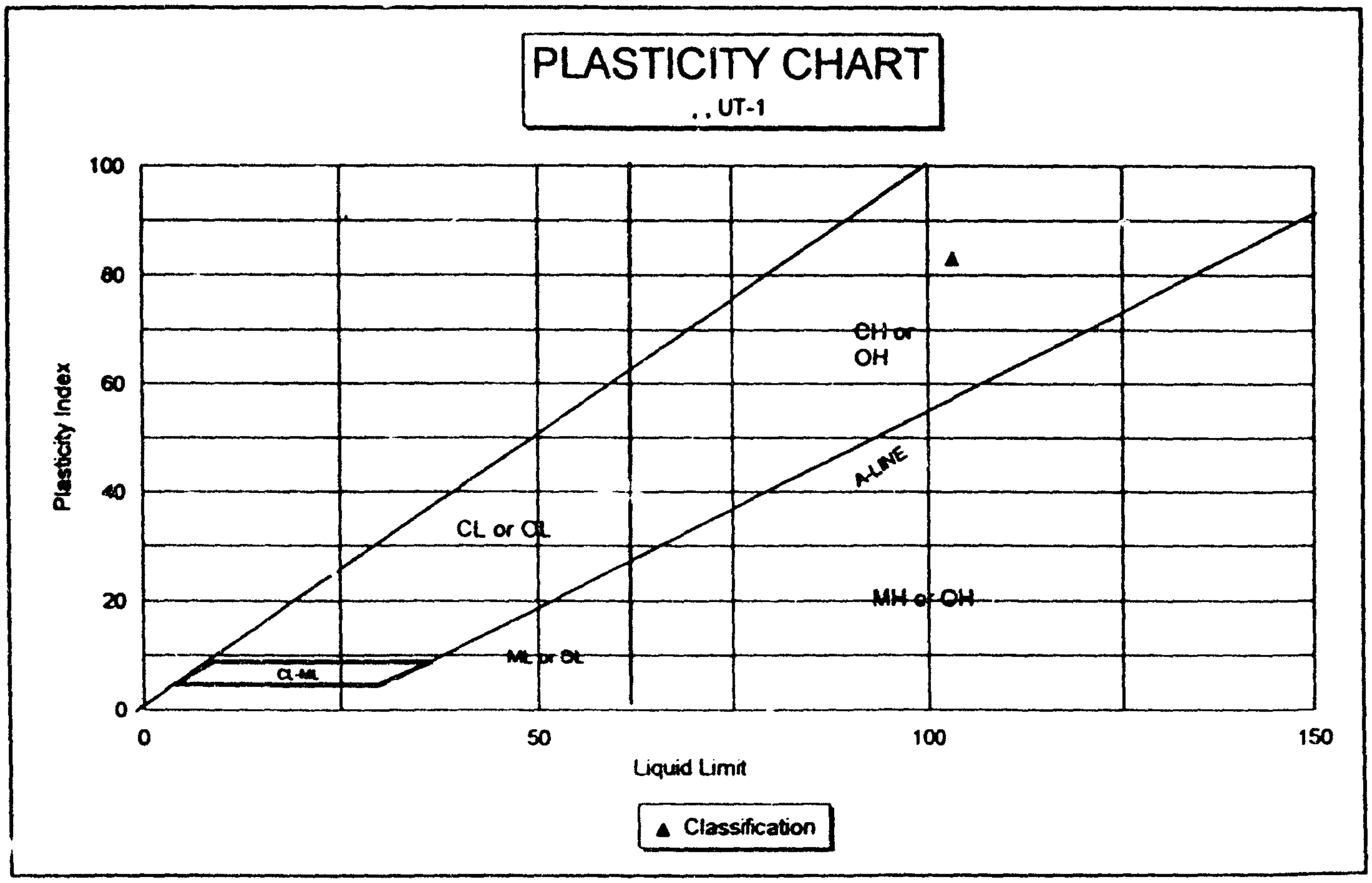
Liquid Limit 103.1
Plastic Limit 19.9
Plasticity Index 83.3

Atterberg Classification CH

Data entry by: NAA Date: 7-26-96
Checked by: [signature] Date: 7-26-96
FileName: TIGOUT1

ADVANCED TERRA TESTING, INC.


Atterberg Limits, Flow Curve
, , UT-1
Moisture Content
112
111
110
109
108
107
106
105
104
103
102
101
100
99
Number of Blows
25


PLASTICITY CHART
, , UT-1
Plasticity Index
100
80
60
40
20
0
CH or
OH
A-LINE
CL or OL
MH or OH
ML or OL
CL-ML
0
50
100
150
Liquid Limit
Classification

COMPACTION TEST
ASTM D 1557 A

CLIENT: Titan Env.

JOB NO. 2234-04

BORING NO.
PTH

SAMPLE NO. UT-1

SOIL DESCR.
DATE SAMPLED
DATE TESTED 7-25-96 RV

Moisture determination

	1	2	3	4	5
Wt of Moisture added (ml)	100.00	150.00	250.00	350.00	450.00
Wt. of soil & dish (g)	384.26	393.92	291.42	244.20	281.17
Dry wt. soil & dish (g)	350.60	355.61	251.40	202.69	225.04
Net loss of moisture (g)	33.66	38.31	40.02	41.51	56.13
Wt. of dish (g)	8.01	8.34	8.31	8.29	8.43
Net wt. of dry soil (g)	342.59	347.27	243.09	194.40	216.61
Moisture Content (%)	9.83	11.03	16.46	21.35	25.91
Corrected Moisture Content					

Density determination

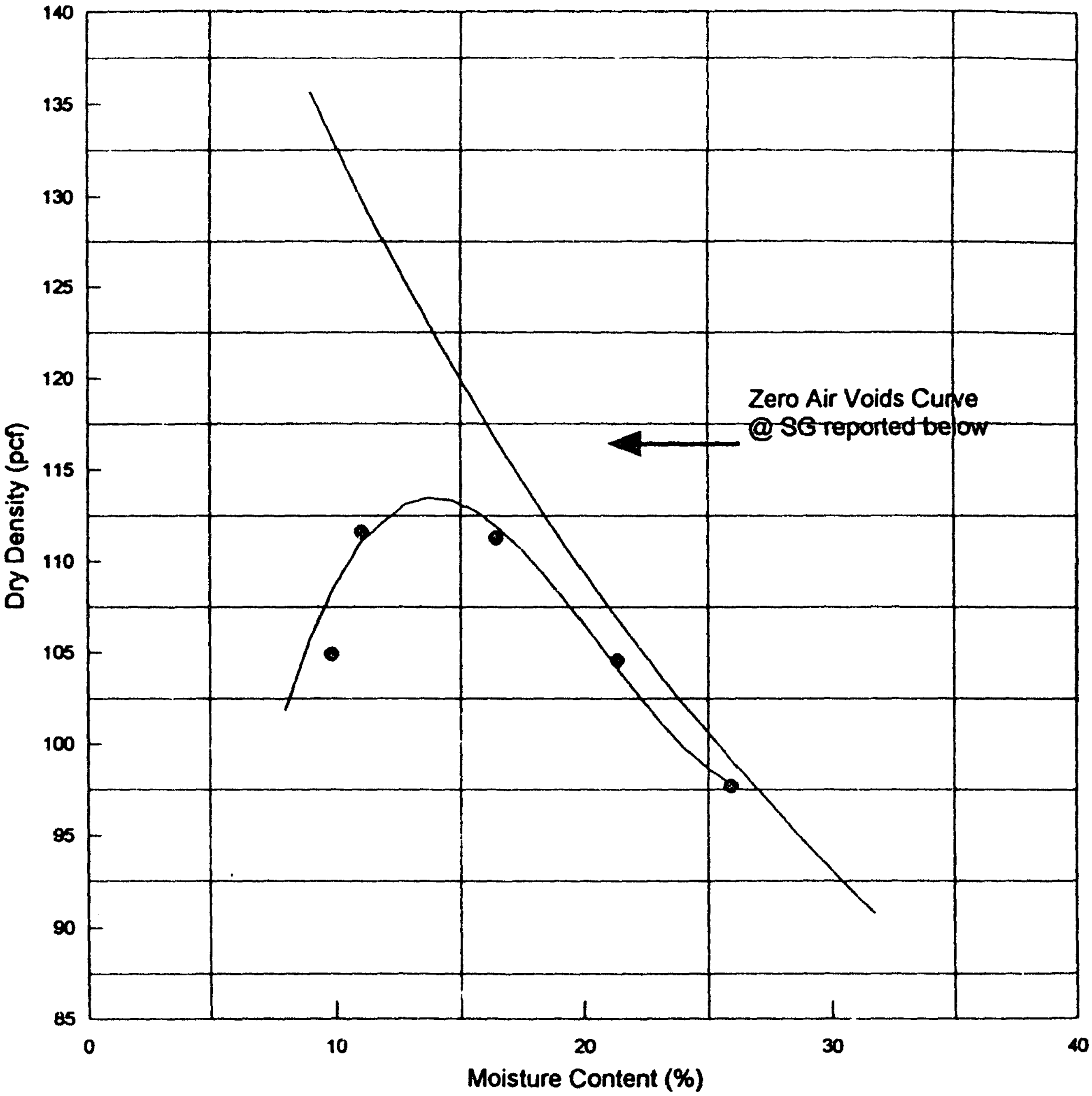
Wt of soil & mold (lb)	14.20	14.49	14.68	14.59	14.46
Wt. of mold (lb)	10.36	10.36	10.36	10.36	10.36
Net wt. of wet soil (lb)	3.84	4.13	4.32	4.23	4.10
' wt of dry soil (lb)	3.50	3.72	3.71	3.49	3.26
y Density, (pcf)	104.89	111.59	111.28	104.57	97.69
Corrected Dry Density (pcf)					
Volume Factor	30	30	30	30	30

Data entered by: RV Date: 7-26-96
a checked by: [signature] Date: 7-26-96
FileName: TIPRUT-1

ADVANCED TERRA TESTING, INC

Proctor Compaction Test

, , UT-1



- Best Fit Curve
- Actual Data
- Zero Air VoidsCurve @ SG = 2.70

OPTIMUM MOISTURE CONTENT = 13.9 MAXIMUM DRY DENSITY = 113.5
ASTM D 1557 A, Rock correction applied? N

ADVANCED TERRA TESTING, INC.

PERMEABILITY DETERMINATION
FALLING HEAD
FIXED WALL

CLIENT Titan Environmental

JOB NO. 2234-04

BORING NO.		SAMPLED	
DEPTH		TEST STARTED	7-28-96 CAL
SAMPLE NO.	UT-1	TEST FINISHED	8-7-96 CAL
SOIL DESCR.	Remolded 95% Mod Pt. @ OMC	SETUP NO.	1
SURCHARGE	200		

MOISTURE/DENSITY DATA	BEFORE TEST	AFTER TEST
Wt. Soil & Ring(s) (g)	386.9	404.5
Wt. Ring(s) (g)	93.0	93.0
Wt. Soil (g)	293.9	311.4
Wet Density PCF	122.3	120.5
Wt. Wet Soil & Pan (g)	302.4	319.9
Wt. Dry Soil & Pan (g)	266.2	266.2
Wt. Lost Moisture (g)	36.2	53.8
Wt. of Pan Only (g)	8.5	8.5
Wt. of Dry Soil (g)	257.7	257.7
Moisture Content %	14.1	20.9
Dry Density PCF	107.2	99.7
Max. Dry Density PCF	113.5	113.5
Percent Compaction	94.4	87.8

ELAPSED TIME (MIN)	BURETTE READING h1 (CC)	BURETTE READING h2 (CC)	PERCOLATION RATE FT/YEAR	PERCOLATION RATE CM/SEC
	0.2			
2599	10.8	10.8	0.14	1.4E-07
1427	14.2	14.2	0.09	8.4E-08
1440	16.8	16.8	0.07	6.5E-08
1440	18.6	18.6	0.05	4.6E-08
1440	20.2	20.2	0.04	4.1E-08
1440	21.6	21.6	0.04	3.7E-08
1469	23.0	23.0	0.04	3.6E-08
1440		24.4	0.04	3.7E-08

Data Entered By: NAA Date: 8-8-96
Date Checked By: JM Date: 8-8-96
Filename:TIFHUT1

ADVANCED TERRA TESTING, INC.

RAE

Rogers & Associates Engineering Corporation

Post Office Box 330
Salt Lake City, Utah 84110-0330
(801) 263-1600 • FAX (801) 262-1527

September 3, 1996

Pamela Anderson
Titan Environmental Corporation
7939 E. Arapahoe Rd., Suite 230
Englewood, CO 80112

C9600/9

Dear Ms. Anderson:

Enclosed are the results from the radium content, specific gravity, and radon emanation and diffusion coefficient measurements that were performed on the sample sent to our laboratory. We will be returning the sample within the month.

If you have any questions or if we can be of further assistance, please call.

Sincerely,

Bret Rogers

Bret C. Rogers
Scientist

Rogers & Associates Engineering Corporation

REPORT OF RADON DIFFUSION COEFFICIENT MEASUREMENTS
(TIME-DEPENDENT DIFFUSION TEST METHOD RAE-SQAP-3.6)

Report Date: 9/3/96

Contract: C9600/9

By: BCR

Date Received: 8/96

Sample Identification: Titan Environmental

Sample ID	Moisture (Dry Wt. %)	Density (g/cm^3)	Radon Diffusion Coefficient (cm^2/s)	Saturation (Mρ/P)	Specific Gravity (g/cm^3)
UT-1	14.5%	1.72	9.1E-03	0.89	2.39

RAE

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Salt Lake City • Utah 84110
(801) 263-1600

Rogers & Associates Engineering Corporation

REPORT OF RADIUM CONTENT AND EMANATION COEFFICIENT MEASUREMENTS

(LAB PROCEDURE RAE-SQAP-3.1)

Report Date: 9/3/96

Contract: C9600/9

By: BCR

Date Received: 8/96

Sample Identification: Titan Environmental

Sample ID	Moisture (Dry Wt. %)	Radon Emanation Coefficient	Radium-226 (pCi/g)	Comments
UT-1	14.6%	0.22 ± 0.04	1.5 ± 0.3	

RAE

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SOIL & FOUNDATION ENGINEERING
96 S. ZUNI • DENVER, COLORADO 80223 • 303/744-7105
1924 EAST FIRST STREET • CASPER, WYOMING 82601 • 307/234-2126

SECTION 2

Extracted Data From

SOIL PROPERTY STUDY
EARTH LINED TAILINGS RETENTION CELLS
WHITE MESA URANIUM PROJECT
BLANDING, UTAH

Prepared for:

ENERGY FUELS NUCLEAR, INC.

PARK CENTRAL
1515 ARAPAHOE STREET
DENVER, COLORADO 80202

Job No. 16,406

July 18, 1978

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

Test Hole	Depth (Ft.)	NATURAL Moisture Content (%)	NATURAL Dry Density (pcf)	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	ATTERBERG LIMITS Liquid Limit (%)	ATTERBERG LIMITS Plasticity Index (%)	GRADATION ANALYSIS Maximum Size	GRADATION ANALYSIS Passing #200 (%)	GRADATION ANALYSIS Less than 2 μ (%)	REMOLDED Dry Density (pcf)	REMOLDED Moisture Content (%)	PERMEABILITY ft./yr.	PERMEABILITY cm./sec.	Specific Gravity	Soil Type
2	0-5			117.5	10.8	20	3	#16	58	19	111.6	16.4	0.57	5.5×10^{-7}		Sandy Silt
3	7-8	7.2				21	6	#16	62							Sandy Clayey Silt
5	7½-10			104.1	18.5	33	8	3/4 In.	56	12	102.1	22.0	0.085	8.2×10^{-8}	2.65	Calcareous Silty Clay
6	1-2	10.3				25	7	#16	77							Sandy Clayey Silt
6	8½-9	6.1				27	8	#4	70							Sandy Clay
8	5-5½	13.1					NP	3/4 In.	62							Calcareous Sandy Silt
9	0-1	8.1					NP	#16	53							Sand - Silt
10	4-6½					24	10	#4	73							Sandy Clay
11	5½-6½	14.0				26	6	#16	65							Siltstone-Claystone
12	2-5			101.0	20.6	53	35	#16	8	59	95.0	18.3	0.068	6.6×10^{-8}	2.67	Weathered Claystone
13	7-8	13.1				39	13	#8	84							Calcareous Silt Clay
14	1-2	19.3				40	21	#4	89							Weathered Claystone
15	1½-4½			106.8	19.0	26	8	3/8 In.	65	27	103.4	18.0	0.012	1.2×10^{-8}	2.64	Mod. Calcareous Sandy Clay
17	2-3	11.4				19	4	#8	59							Sandy Silt
19	0-3			117.5	12.8	23	6	#16	70		109.9	12.4	0.035	3.4×10^{-8}		Sandy Clayey Silt
22	1-2	13.2				26	10	#4	73							Sandy Clay
23	1-3					48	24	#30	87							Weathered Claystone
23	6-8					61	30	#30	96							Claystone
25	1-3½	13.3				26	9	#4	57							Sandy Clay
26	4½-5	15.3				41	20	#4	91							Weathered Claystone
28	0-2	12.7				28	10	3/8 In.	72							Sandy Clay
29	2-3	8.5				19	2	#16	59							Sandy Silt
32	8-8½	5.6				23	6	#30	73							Sandy Clayey Silt
37	0-4			118.8	11.5	23	5	#8	72		110.5	11.5	0.63	6.1×10^{-7}		Sandy Clayey Silt
38	5-7			111.0	16.7	29	14	3/8 In.	69		102.4	17.9	0.041	4.0×10^{-8}		Sandy Clay
40	4-5½			110.0	16.2	26	9	#8	64	27	106.4	16.4	0.017	1.6×10^{-8}	2.65	Sandy Clay

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

Test Hole	Depth (Ft.)	NATURAL Moisture Content (%)	NATURAL Dry Density (pcf)	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	ATTERBERG LIMITS Liquid Limit (%)	ATTERBERG LIMITS Plasticity Index (%)	GRADATION ANALYSIS Maximum Size	GRADATION ANALYSIS Passing #200 (%)	GRADATION ANALYSIS Less than 2 μ (%)	REMOLDED Dry Density (pcf)	REMOLDED Moisture Content (%)	PERMEABILITY ft./yr.	PERMEABILITY cm./sec.	Specific Gravity	Soil Type
40	9-9½	6.8				22	8	3/8 In.	60							Sandy Clay
42	13½-14½	7.6				26	10	3/8 In.	73							Sandy Clay
43	11-12	12.1				41	22	#4	86							Claystone
43	13½-16½			110.0	16.9	40	24	3/8 In.	85	44	104.1	15.8	0.024	2.3×10^{-8}	2.62	Claystone
44	6½-7	7.5				30	11	3/8 In.	79							Calcareous Sandy Clay
46	0-2	12.3				22	6	#16	76							Sandy Clayey Silt
48	5-5½					30	9	3/8 In.	65							Sandy Clay
49	5-7			110.7	15.6	25	9	#16	71		105.2	13.9	0.33	3.2×10^{-8}		Sandy Clay
49	14-15					28	5	#8	55							Calcareous Sandy Silt
54	0-2	12.1				23	9	#8	64							Sandy Clay
55	5-5½	7.8				28	14	#30	71							Sandy Clay
55	9½-10½					28	13	#4	71							Sandy Clay
58	5½-6	12.5				35	11	#4	75							Sandy, Silty Clay
61	0-1	11.5				21	4	#16	75							Sandy Silt
62	11-11½	8.1					NP	1 In.	34							Calcareous Sand & Silt
63	4-5					30	14	#8	68							Sandy Clay
65	1-2	9.0					NP	#16	44							Silty Sand
68	7½-8	8.6				28	13	#8	67							Sandy Clay
70	3½-4½	16.4				27	4	1½ In.	46							Calcareous Sand & Silt
72	0-2	12.2				22	8	#16	59							Sandy Clay
75	10-11	12.4				41	25	#4	75							Weathered Claystone
75	12-14					45	22	#16	93							Claystone

416,406

TABLE II

LABORATORY PERMEABILITY TEST RESULTS

Sample	Soil Type	Compaction: Dry Density (pcf)	Compaction: Moisture Content (%)	Compaction: % of ASTM D698	Surcharge Pressure (psf)	Permeability (Ft/Yr)	Permeability (Cm/
TH 2 @ 0'-5'	Sandy Silt	111.6	16.4	95	500	0.57	5.5x1
TH 5 @ 7½'-10'	Calcareous Silty Clay	102.1	22.0	101	500	0.085	8.2x1
TH 12 @ 2'-5'	Weathered Claystone	95.0	18.3	94	500	0.068	6.6x1
TH 15 @ 1½'-4½'	Calcareous Sandy Clay	103.4	18.0	97	500	0.012	1.2x1
TH 19 @ 0'-3'	Sandy, Clayey Silt	109.9	12.4	94	500	0.035	3.4x1
TH 37 @ 0'-4'	Sandy, Clayey Silt	110.5	11.5	93	500	0.63	6.1x1
TH 38 @ 5'-7'	Sandy Clay	102.4	17.9	92	500	0.041	4.0x1
TH 40 @ 4'-5½'	Sandy Clay	106.4	16.4	97	500	0.017	1.6x1
TH 43 @ 13½-16½'	Claystone	104.1	15.8	95	500	0.024	2.3x1
TH 49 @ 5'-7'	Sandy Clay	105.2	13.9	95	500	0.33	3.2x1

TABLE III

RESULTS OF ATTERBERG LIMITS

SAMPLE	SOIL TYPE	PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS			SHRINKAGE RATIO
			Liquid Limit (%)	Plastic Limit (%)	Shrinkage Limit (%)	
2 @ 0 - 5'	Sandy Silt	58	20	17	17.	1.81
5 @ 7½ - 10'	Calcareous Silty Clay	56	33	25	25	1.62
15 @ 1½-4½'	Calcareous Sandy Clay	65	26	18	17.5	1.76
19 @ 0-3'	Sandy, Clayey Silt	70	23	17	18	1.80
26 @ 4½-5'	Weathered Claystone	91	41	21	12	1.90
30 @ 5 - 7'	Sandy Clay	69	29	15	14	1.89

chen and associates, inc.
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SECTION 3

Extracted Data From

SOIL PROPERTY STUDY PROPOSED TAILINGS RETENTION CELLS WHITE MESA URANIUM PROJECT BLANDING, UTAH

Prepared for:

ENERGY FUELS NUCLEAR, INC.
1515 ARAPAHOE STREET
DENVER, COLORADO 80202

Job No. 17,130

January 23, 1979

CHEN AND ASSOCIATES

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS		PERCENT PASSING NO. 200 SIEVE	SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
76	0 - 1	4.5		21	5				78	Sandy silt
	9.5 - 10	4.4			NP				26	Silty, gravelly sand
77	7.5 - 8	8.6		30	15				71	Sandy clay
79	0 - 1	4.1		20	5				83	Sandy silt
	5 - 5.5	5.5			NP				4[illegible]	Calcareous sandy clay
80	4.5 - 7			39	20				78	Calcareous sandy clay
	8 - 8.5	10.1		40	20				86	Weathered claystone
81	3 - 4	6.3		26	8				64	Silty, sandy clay
83	4 - 6			24	7				64	Sandy, clayey silt
84	0 - 2			18	2				65	Sandy silt
	9 - 9.5	2.7			NP				27	Silty sand
86	8 - 8.5	2.6			NP				12	Sandstone
87	0 - 1	3.1		16	1				61	Sandy silt
89	0 - 3			21	5				66	Sandy silt
90	8 - 8.5	12.9		35	15				61	Weathered claystone
92	0 - 1	5.9		21	5				80	Sandy silt
94	5 - 5.5	13.7		27	10				68	Sandy clay
95	6 - 7			23	5				62	Sandy silt
96	0 - 2	5.2		21	4				79	Sandy silt
	8.5 - 9.5			32	6				66	Calcareous sandy clay
98	0 - 1	3.8		20	5				74	Sandy silt
	4 - 4.5	17.8		49	25				76	Weathered claystone
99	8 - 9.5			40	20				89	Weathered claystone

CHEN AND ASSOCIATES

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS		PERCENT PASSING NO. 200 SIEVE	SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
99	11 - 12	13.5		26	10				73	Claystone
100	0 - 1			17	NP				44	Silty sand
	5.5 - 6	12.0			NP				61	Sandstone-siltstone
102	6.5 - 7	16.7		30	8				79	Calcareous sandy cla
	13.5 - 14	9.5		23	6				87	Claystone-siltstone
103	10 - 10.5	7.0		28	12				57	Sandy clay
104	8 - 8.5	9.2		33	9				70	Calcareous sandy clay
105	0 - 1	5.4		22	6				77	Sandy silt
	6.5 - 7	4.5			NP				86	Sandy silt
106	5 - 5.5	10.4		28	6				59	Claystone-sandstone
107	7.5 - 9				NP				23	Sandstone
108	0 - 1	4.0		18	3				69	Sandy silt
	9.5 - 10	9.9		38	16				93	Claystone
109	4 - 5			25	7				75	Sandy, clayey silt
111	9 - 9.5	5.8		25	10				53	Claystone
113	5 - 8			40	20				84	Weathered claystone
	10.5 - 11			24	10				54	Claystone-sandstone
114	0 - 2			22	6				58	Sandy, clayey silt
115	4.5 - 6				NP				58	Calcareous
116	0 - 3			22	5				72	Sandy silt
	7 - 8			24	10				42	Claystone-sandstone
117	1 - 2	10.6		25	5				77	Sandy silt
118	0 - 2			25	6				77	Sandy silt

CHEN AND ASSOCIATES

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS		PERCENT PASSING NO. 200 SIEVE	SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
118	6.5 - 8.5			40	20				89	Weathered claystone
119	4.5 - 5	10.0		26	12				68	Sandy clay
120	1 - 2			25	8				69	Sandy, clayey silt
	5 - 5.5	15.5		29	10				78	Sandy clay
	11 - 11.5	11.6		42	24				90	Claystone
122	4 - 6			25	8				66	Sandy, silty clay
	14.5 - 15	6.4		26	8				66	Sandy clay
123	1 - 3			23	7				71	Sandy, clayey silt
124	4.5 - 5	6.0		23	7				69	Sandy, clayey silt
125	0 - 1	3.8		22	6				67	Sandy silt
127	5 - 6			54	34				89	Claystone
128	6 - 8			41	24				90	Claystone

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LABORATORY PERMEABILITY TEST RESULTS

Sample	Classification	Compaction: Dry Density (pcf)	Compaction: Moisture Content (%)	Compaction: % of ASTM D698	Surcharge Pressure (psf)	Permeability Ft./Yr.	Permeability Cm/Sec
TH 80 @ 4½-7'	Calcareous sandy clay -200=78; LL=39; PI=20	100.2	19.4	96	500	0.81	7.8×10^{-7}
TH 84 @ 0-2'	Sandy silt -200=65; LL=18; PI=2	113.8	11.7	96	500	4.45	4.3×10^{-6}
TH 96 @ 8½-9½'	Calcareous sandy clay -200=66; LL=32; PI=6	96.9	20.7	97	500	1.55	1.5×10^{-6}
TH 96 @ 8½-9½'	Calcareous sandy clay	95.7	20.3	96	500	26.90*	2.6×10^{-5}
TH 99 @ 8-9½'	Weathered claystone -200=89; LL=40; PI=20	99.8	18.5	95	500	0.22	2.1×10^{-7}
TH 100 @ 0-1'	Very silty sand -200=44; PI=NP	117.5	9.7	98	500	0.38	3.7×10^{-7}
TH 114 @ 0-2'	Sandy, clayey silt -200=58; LL=22; PI=6	112.4	12.9	95	500	0.60	5.8×10^{-7}
TH 120 @ 1-2'	Sandy, clayey silt -200=69; LL=24; PI=6	108.2	14.7	95	500	0.11	1.1×10^{-7}
TH 122 @ 4-6'	Sandy, silty clay -200=66; LL=25; PI=8	108.8	15.5	96	500	0.43	4.2×10^{-7}
TH 123 @ 1-3'	Sandy, clayey silt -200=71; LL=23; PI=7	110.9	12.6	95	500	0.56	5.4×10^{-7}
TH 128 @ 6-7'	Claystone -200=89; LL=41; PI=24	92.4	23.9	93	500	0.12	1.2×10^{-7}
TH 128 @ 6-7'	Claystone -200=89; LL=41; PI=4	93.1	22.1	94	500	0.52*	5.0×10^{-7}*

* 1.5 pH sulfuric acid liquor used during percolation test interval.

[illegible] - GEOTECHNICAL DATA BASE FOR [illegible] CHARACTERIZATION - [illegible] CREATED [illegible]; LAST UPDATED [illegible]

AREA	DATA SOURC	BORING OR TEST PIT NUMBER	SAMPLE NUMBER & TYPE	TOP OF SAMPLE (FEET)	BASE OF SAMPLE (FEET)	SAMPLE MIDPOINT (FEET)	USCS SYMBOL	MATERIAL TYPE	IN-PLACE DRY DENSITY (PCF)	NATURAL MOISTURE CONTENT (PERCENT)	SPECIFIC GRAVITY	FRACTION PASSING #4 SIEVE (PERCENT)	FRACTION PASSING #200 SIEVE (PERCENT)	LIQUID LIMIT	PLASTICITY INDEX	ASTM D 698 MAXIMUM DRY DENSITY (PCF)	ASTM D 698 OPTIMUM MOISTURE CONTENT (PERCENT)	OTHER TESTS
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CARBONATE PILE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

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MRAP - [illegible] - GEOTECHNICAL DATA [illegible] FOR MONTICELLO MILLSITE CHARACTER[illegible]TION - R.N. MORRIS: CREATED [illegible]; LAST UPDATED [illegible]

AREA	DATA SOURC	BORING OR TEST PIT NUMBER	SAMPLE NUMBER & TYPE	TOP OF SAMPLE (FEET)	BASE OF SAMPLE (FEET)	SAMPLE MIDPOINT (FEET)	USCS SYMBOL	MATERIAL TYPE	IN-PLACE DRY DENSITY (PCF)	NATURAL MOISTURE CONTENT (PERCENT)	SPECIFIC GRAVITY	FRACTION PASSING #4 SIEVE (PERCENT)	FRACTION PASSING #200 SIEVE (PERCENT)	LIQUID LIMIT	PLASTICITY INDEX	ASTM D 698 MAXIMUM DRY DENSITY (PCF)	ASTM D 698 OPTIMUM MOISTURE CONTENT (PERCENT)	OTHER TESTS
CARBONATE PILE	DAM	TP-6	4/ST	10.0	11.1	10.75	CL	Tails-clm	73.6	40.3	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	DAM	TP-6	5/ST	17.0	17.5	17.25	SM	Tails-sns	73.3	10.8	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	DAM	TP-6	4/BULK	10.0	18.0	14.00	SM	Tails-sns(?)	NA	10.5	NA	100.0	46.4	NA	NA	93.1	18.9	
CARBONATE PILE	DAM	TP-11	4/BULK	5.0	6.0	6.00	SM	Tails-sns(?)	NA	10.7	2.78	100.0	47.8	NA	NA	103.7	16.0	Dir Shear, Perm, Mod Proct
CARBONATE PILE	DAM	TP-11	4/BULK	10.0	16.0	16.00	CL	Tails-sns	NA	23.1	NA	100.0	91.2	NA	NA	98.8	24.0	
VANADIUM PILE	BENDIX	MRAP-[illegible]	MVD-[illegible]/ST	4.0	6.0	5.00	SC	Tails-snd/slm	86.7	22.8	2.62	100.0	44.9	27.8	10.0	NA	NA	Consol w/perm, CMR @15 bar
VANADIUM PILE	BENDIX	MRAP-[illegible]	MVD-[illegible]/BULK	1.0	1.0	1.00	ML	Cover	NA	NA	NA	NA	71.6	NA	NA	114.3	13.7	
VANADIUM PILE	BENDIX	MRAP-[illegible]	MVD-[illegible]/BULK	2.0	2.0	2.00	SP	Tails-sns	NA	NA	2.67	NA	NA	NA	NA	107.8	13.2	
VANADIUM PILE	BENDIX	MRAP-[illegible]	MVD-[illegible]/BULK	7.0	7.0	7.00	ML	Tails-slm	NA	NA	2.60	NA	NA	NA	NA	112.8	15.3	
VANADIUM PILE	BENDIX	MRAP-[illegible]	MVD-[illegible]/ST	6.0	9.0	8.00	CL-ML	Tails-slm	75.1	41.7	2.63	100.0	94.9	21.0	3.8	NA	NA	
VANADIUM PILE	DAM	[illegible]	2/ST	5.5	7.5	6.50	SM	Tails-snd	NA	8.4	2.09	100.0	31.6	28.1	17.1	NA	NA	Consol w/perm, CMR @15 bar
VANADIUM PILE	DAM	[illegible]	1/SS	2.0	3.5	2.75	SM/SC	Cover	NA	10.8	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	3/SS	3.5	5.0	4.25	SM/CL	Tails-snd/slm	NA	10.9	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	5/SS	5.0	6.5	5.75	SM	Tails-sns(?)	NA	15.6	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	6/SS	6.5	10.0	8.25	ML	Tails-slm	NA	34.1	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	6/SS	10.0	11.5	10.75	SM	Tails-snd/slm	NA	11.5	2.60	100.0	21.5	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	7/SS	11.5	13.0	12.25	ML	Tails-slm	NA	23.8	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	8/SS	13.0	14.5	13.75	SM/CL	Tails-snd/slm	NA	20.8	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	10/SS	16.5	18.0	17.25	SM/CL	Tails-snd/slm	NA	10.3	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	11/SS	18.0	19.5	18.25	CL	Alluvium	NA	20.9	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	12/SS	19.5	21.0	20.25	CL	Alluvium	NA	18.7	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	13/SS	21.0	22.5	22.50	CL	Alluvium	NA	20.1	NA	NA	NA	44.3	24.0	NA	NA	
VANADIUM PILE	DAM	[illegible]	14/SS	24.0	25.5	24.50	CL	Alluvium	NA	19.6	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	15/SS	26.5	27.5	26.50	CL	Alluvium	NA	23.0	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	16/SS	27.5	29.0	28.50	CL	Alluvium	NA	17.8	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	17/SS	29.0	31.5	30.50	CL	Alluvium	NA	17.9	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	18/SS	31.0	32.5	32.00	CL	Alluvium	NA	18.5	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	19/SS	32.5	34.0	34.15	CL	Alluvium	NA	17.8	NA	NA	NA	37.9	19.1	NA	NA	
VANADIUM PILE	DAM	[illegible]	20/SS	35.5	37.0	36.00	CL	Alluvium	NA	22.7	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	21/SS	37.0	38.5	38.50	CL	Alluvium	NA	22.1	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	22/SS	39.5	41.0	40.25	CL	Alluvium	NA	23.1	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	23/SS	41.5	43.0	42.15	SC/CL	Alluvium	NA	23.2	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	24/SS	43.0	44.5	44.20	SC	Alluvium	NA	19.1	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	25/SS	45.0	46.5	45.70	SM	Shale	NA	19.0	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	3/ST	6.0	7.5	6.75	CL	Tails-clm	95.1	28.3	NA	NA	NA	46.7	24.8	NA	NA	Perm, CMR
VANADIUM PILE	DAM	[illegible]	6/SS	12.5	14.5	14.12	CL	Tails-clm	NA	20.3	2.90	NA	NA	48.7	22.5	NA	NA	
VANADIUM PILE	DAM	[illegible]	9/SS	18.1	20.5	19.80	CL	Tails-clm	NA	19.4	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	14/SS	23.5	25.3	24.40	CL	Tails-clm	NA	22.4	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	1/SS	5.5	6.0	5.80	CL	Tails(?)-clm(?)	NA	23.5	NA	NA	NA	31.7	14.9	NA	NA	
VANADIUM PILE	DAM	[illegible]	3/SS	10.5	11.5	10.88	CL	Alluvium	NA	21.3	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	5/SS	14.5	15.5	15.50	CL	Alluvium	NA	10.5	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	6/SS	24.5	25.5	25.00	CL	Alluvium	NA	14.9	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	7/SS	28.5	31.4	30.00	CL	Alluvium	NA	19.2	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	8/SS	34.5	35.5	35.25	CL	Alluvium	NA	17.7	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	9/SS	38.0	40.0	38.50	SC	Alluvium	NA	13.2	NA	100.0	40.1	NA	NA	NA	NA	
VANADIUM PILE	DAM	[illegible]	10/SS	44.0	44.5	44.25	ML	Sandstone	NA	9.3	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	TP-4	1/ST	4.5	5.0	4.75	SM	Tails-snd	90.1	7.4	NA	NA	NA	NP	NP	NA	NA	
VANADIUM PILE	DAM	TP-6	2/ST	8.5	9.0	8.75	CL	Tails-slm	70.7	61.5	NA	NA	NA	NA	NA	NA	NA	Unsatd Comp
VANADIUM PILE	DAM	TP-6	4/ST	9.0	9.5	9.25	CL	Tails-slm	71.9	40.7	NA	NA	NA	NA	NA	NA	NA	Unsatd Comp
VANADIUM PILE	DAM	TP-6	6/ST	11.0	11.5	11.25	CL	Tails-slm	84.5	16.5	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	TP-6	7/ST	14.0	14.5	14.25	CL	Tails(?)-clm(?)	69.5	61.8	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	DAM	TP-12	4/BULK	6.0	6.0	6.00	CL	Tails-clm	NA	24.3	2.75	NA	NA	29.2	12.3	115.0	14.9	Perm, Mod Proct
VANADIUM PILE	DAM	TP-12	4/BULK	12.0	12.0	12.00	CL	Tails-clm	NA	23.0	2.84	NA	NA	44.7	20.3	105.7	21.2	TAm-CU/PP, Perm, Mod Proct, CMR
EAST PILE	BENDIX	MRAP-[illegible]	MVD-[illegible]/ST	2.0	4.0	3.00	SM	Tails-snd	96.4	5.2	2.57	100.0	42.9	NP	NP	NA	NA	Consol w/perm, CMR @15 bar
EAST PILE	BENDIX	MRAP-[illegible]	MVD-[illegible]/BULK	1.0	1.0	1.00	ML	Cover	NA	NA	NA	100.0	83.0	NA	NA	111.2	14.1	
EAST PILE	BENDIX	MRAP-[illegible]	MVD-[illegible]/BULK	3.0	3.0	3.00	SM(?)	Tails-snd	NA	NA	NA	NA	NA	NA	NA	107.1	16.3	
EAST PILE	BENDIX	MRAP-[illegible]	MVD-[illegible]/BULK	15.0	15.0	15.00	SP(?)	Tails-snd(?)	NA	NA	2.70	NA	NA	NA	NA	103.6	15.5	
EAST PILE	BENDIX	MRAP-[illegible]	MVD-[illegible]/ST	2.0	4.0	3.00	SM	Tails-snd	94.9	9.9	2.61	100.0	19.6	NP	NP	NA	NA	Consol w/perm, CMR @15 bar
EAST PILE	BENDIX	MRAP-[illegible]	MVD-[illegible]/ST	12.0	14.0	13.00	CL	Tails-slm	102.8	34.4	2.70	100.0	61.0	41.0	22.0	NA	NA	Consol w/perm, CMR @15 bar
EAST PILE	BENDIX	MRAP-[illegible]	MVD-[illegible]/ST	4.0	6.0	5.00	ML	Tails-slm	103.7	21.4	2.63	100.0	86.0	42.0	13.0	NA	NA	Consol w/perm, CMR @15 bar
EAST PILE	DAM	[illegible]	1/SS	3.0	5.5	4.00	SP	Tails-snd	NA	12.4	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	DAM	[illegible]	2/SS	8.0	10.5	9.25	SM/ML	Tails-snd/slm	NA	16.8	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	DAM	[illegible]	3/SS	13.5	15.3	14.50	SM/ML	Tails-snd/slm	NA	18.3	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	DAM	[illegible]	NA	24.0	25.0	24.50	CL	Alluvium	NA	19.5	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	DAM	[illegible]	10/SS	28.0	30.0	29.00	CL	Alluvium	NA	16.5	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	DAM	[illegible]	3/SS	7.0	8.3	7.65	ML	MVP sand	NA	7.2	NA	NA	NA	NA	NA	NA	NA	

MRAP - [illegible] - GEOTECHNICAL DATA [illegible] FOR MONTICELLO MILLSITE CHARACTERIZATION - R.N. MORRIS: CREATED [illegible]; LAST UPDATED [illegible]

AREA	DATA SOURC	BORING OR TEST PIT NUMBER	SAMPLE NUMBER & TYPE	TOP OF SAMPLE (FEET)	BASE OF SAMPLE (FEET)	SAMPLE MIDPOINT (FEET)	USCS SYMBOL	MATERIAL TYPE	IN-PLACE DRY DENSITY (PCF)	NATURAL MOISTURE CONTENT (PERCENT)	SPECIFIC GRAVITY	FRACTION PASSING #4 SIEVE (PERCENT)	FRACTION PASSING #200 SIEVE (PERCENT)	LIQUID LIMIT	PLASTICITY INDEX	ASTM D 698 MAXIMUM DRY DENSITY (PCF)	ASTM D 698 OPTIMUM MOISTURE CONTENT (PERCENT)	OTHER TESTS

Other tests noted: Triax-CU/PP; Unsat Cons, Consol, Perm, Chill; Unsat Cons; Triax-CU/PP, Consol; Dir Shear

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MRAP - 71000000 - GEOTECHNICAL DATA BASE FOR MONTICELLO MILLSITE CHARACTERIZATION - R.H. MORRIS: CREATED 00/00/91; LAST UPDATED 11/00/91

AREA	DATA SOURC	BORING OR TEST PIT NUMBER	SAMPLE NUMBER & TYPE	TOP OF SAMPLE (FEET)	BASE OF SAMPLE (FEET)	SAMPLE MIDPOINT (FEET)	USCS SYMBOL	MATERIAL TYPE	IN-PLACE DRY DENSITY (PCF)	NATURAL MOISTURE CONTENT (PERCENT)	SPECIFIC GRAVITY	FRACTION PASSING #4 SIEVE (PERCENT)	FRACTION PASSING #200 SIEVE (PERCENT)	LIQUID LIMIT	PLASTICITY INDEX	ASTM D 698 MAXIMUM DRY DENSITY (PCF)	ASTM D 698 OPTIMUM MOISTURE CONTENT (PERCENT)	OTHER TESTS
EAST PILE	D&M	TP-1	1/ST	6.5	7.0	6.75	CL	MVP sand	103.3	11.1	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	TP-1	-/BULK	7.0	7.0	7.00	CL	MVP sand	NA	10.2	NA	NA	NA	NA	NA	103.1	10.1	Perm, Mod Proc
EAST PILE	D&M	TP-1	2/ST	9.0	9.5	9.25	CL	MVP sand	90.3	28.4	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	TP-1	3/ST	14.0	14.5	14.25	SM	Tails-sand	101.3	7.4	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	TP-1	-/BULK	15.6	15.9	15.60	SM	Tails-sand	NA	16.0	NA	99.0	31.0	NA	NA	108.4	14.2	
EAST PILE	D&M	TP-2	1/ST	8.0	8.5	8.25	SM	Tails-silt	91.5	27.9	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	TP-2	-/BULK	10.0	10.0	10.00	ML	Tails-silt	NA	23.0	NA	NA	NA	NA	NA	108.5	20.0	Consol, CMR
EAST PILE	D&M	TP-2	2/ST	10.5	11.0	10.75	SM	Tails-sand	97.3	1.7	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	TP-3	3/ST	13.5	14.0	13.75	ML	Tails-sand/slime(?)	86.5	26.5	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	TP-3	-/BULK	14.0	14.0	14.00	ML	Tails-sand/slime(?)	NA	7.5	NA	100.0	84.4	NA	NA	108.5	17.1	CMR
EAST PILE	D&M	TP-3	4/ST	14.5	15.0	14.75	ML	Tails-sand/slime(?)	74.0	25.4	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	TP-4	-/BULK	8.0	8.0	8.00	ML	Tails-sand/slime	NA	22.4	NA	100.0	61.0	NA	NA	88.0	21.0	Dir Shear, Perm, CMR
EAST PILE	D&M	TP-4	2/ST	8.5	9.0	8.75	ML	Tails-sand/slime	91.5	7.9	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	TP-4	-/BULK	14.0	14.0	14.00	ML	Tails-sand/slime	NA	14.7	2.71	100.0	96.0	NA	NA	101.0	17.3	Perm, CMR
EAST PILE	D&M	TP-4	5/ST	14.5	15.0	14.75	ML	Tails-sand/slime	81.0	27.1	NA	100.0	84.1	NA	NA	NA	NA	
ACID PILE	BENDIX	MRAP-86-10	MRB-72/ST	4.0	6.0	5.00	CL	Tails-slime	86.1	41.0	2.83	100.0	70.0	29.0	11.0	NA	NA	
ACID PILE	BENDIX	MRAP-86-10P	MRB-79/BULK	1.0	1.0	1.00	SM	Cover	NA	NA	NA	100.0	40.0	NA	NA	111.5	10.9	
ACID PILE	BENDIX	MRAP-86-10P	MRB-79/BULK	3.0	3.0	3.00	SP	Tails-sand	NA	NA	NA	NA	NA	NA	NA	119.4	12.4	
ACID PILE	BENDIX	MRAP-86-10P	MRB-79/BULK	6.0	6.0	6.00	CL	Tails-slime	NA	NA	2.73	NA	NA	NA	NA	94.5	26.3	
ACID PILE	BENDIX	MRAP-86-11	MRB-74/ST	4.0	6.0	5.00	CL	Tails-slime	74.5	39.0	2.80	100.0	72.0	44.0	30.0	NA	NA	Consol w/perm, CMR @15 bar
ACID PILE	BENDIX	MRAP-86-12	MRB-73/ST	4.0	6.0	5.00	ML	Tails-slime	78.4	48.0	2.80	100.0	87.0	47.0	16.0	NA	NA	Consol w/perm, CMR @15 bar
ACID PILE	D&M	31GW01-428	1/SS	4.5	5.0	4.75	CL	Tails-sand/slime	NA	28.0	NA	NA	NA	33.0	13.1	NA	NA	
ACID PILE	D&M	31GW01-428	2/SS	6.5	9.0	6.75	CL	Alluvium	NA	12.0	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-428	3/SS	12.5	14.5	14.50	CL	Alluvium	NA	17.1	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-427	2/ST	6.0	8.0	7.00	CH	Alluvium	71.5	42.0	NA	NA	NA	66.0	28.7	NA	NA	Triax-CUPP, Unstand Comp, Perm, CMR
ACID PILE	D&M	31GW01-427	4/ST	9.0	11.5	10.25	CH	Alluvium	90.0	71.2	NA	NA	NA	66.0	31.4	NA	NA	Triax-CUPP, Unstand Comp, Consol
ACID PILE	D&M	31GW01-427	6/ST	19.0	20.5	19.75	CL/SC	Alluvium	103.3	16.5	NA	NA	NA	27.4	11.0	NA	NA	Triax-CUPP, Unstand Comp, Perm, CMR
ACID PILE	D&M	31GW01-4[illegible]	2/SS	4.0	6.0	5.00	SM	Tails-sand(?)	NA	17.2	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	3/SS	6.0	6.0	6.44	SM	Tails-sand	NA	17.2	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	4/SS	8.0	10.0	9.50	CL-ML	Tails-slime	NA	27.0	2.70	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	5/SS	10.5	12.0	11.25	ML	Tails-slime	NA	28.0	NA	NA	NA	34.0	9.0	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	6/SS	13.5	15.0	14.25	ML	Tails-sand/slime	NA	27.0	NA	100.0	91.7	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	7/SS	15.0	17.0	16.00	SM	Tails-sand/slime	NA	10.0	NA	100.0	34.7	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	8/SS	18.0	19.0	18.50	ML	Tails-slime	NA	43.0	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	9/SS	19.0	21.0	20.00	ML	Tails-slime	NA	28.0	NA	100.0	65.0	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	10/SS	22.0	23.5	22.75	SM	Tails-sand	NA	62.0	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	11/SS	24.0	25.0	24.50	ML/CL	Tails-sand/slime	NA	53.1	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	12/SS	25.0	27.0	26.00	ML/CL	Tails-sand/slime	NA	51.3	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	13/SS	27.0	29.0	28.00	CL	Tails-sand/slime	NA	35.0	NA	100.0	92.0	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	14/SS	28.0	29.5	28.75	ML/CL	Tails-sand/slime	NA	61.4	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	15/SS	31.0	33.0	32.00	CL	Tails-sand/slime	NA	64.7	NA	NA	NA	48.0	21.2	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	16/SS	33.0	34.0	33.75	ML	Tails-sand/slime	NA	41.3	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	17/SS	35.0	37.0	36.00	ML/SC	Alluvium(?)	NA	18.1	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	18/SS	37.5	39.0	38.25	SC/CL	Alluvium	NA	29.9	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	19/SS	39.0	41.0	40.00	CL	Alluvium	NA	24.5	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]A	1/SS	5.0	6.0	5.50	ML/CL	Tails-slime	NA	57.2	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]A	3/SS	14.0	14.5	14.00	CL-ML	Tails-slime	NA	57.3	2.80	NA	NA	47.4	17.3	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	7/SS	29.0	29.5	29.25	Rm	Shale	NA	10.1	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	2/SS	5.0	6.5	6.25	SM	Tails-sand	NA	4.0	NA	100.0	28.7	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	4/SS	10.0	10.5	10.25	SM	Tails-sand	NA	5.1	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	5/SS	10.0	15.5	12.75	SM	Tails-sand	NA	10.3	NA	100.0	23.9	NA	NA	NA	NA	
ACID PILE	D&M	31GW01-4[illegible]	6/ST	19.0	20.0	19.50	SM	Tails-sand	100.8	13.4	NA	100.0	17.2	NA	NA	NA	NA	Dir Shear, Perm, CMR
ACID PILE	D&M	31GW01-4[illegible]	13/SS	24.5	25.0	24.75	CL-ML	Tails-slime	NA	59.4	NA	NA	NA	46.0	16.3	NA	NA	
ACID PILE	D&M	TP-7	-/BULK	2.0	2.0	2.00	SM	Tails-sand	NA	8.4	2.71	100.0	42.3	NP	NP	108.0	14.5	Triax-CUPP, Consol, Perm, Mod Proc, CMR
ACID PILE	D&M	TP-7	2/ST	5.0	5.5	5.25	CL	Tails-slime	62.5	62.0	NA	NA	NA	NA	NA	NA	NA	Unstand Shear
ACID PILE	D&M	TP-7	3/ST	6.5	7.0	6.75	CL	Tails-slime	66.1	64.4	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	TP-7	4/ST	8.5	10.0	9.75	CL	Tails-slime	61.3	68.0	NA	NA	NA	NA	NA	NA	NA	Unstand Shear
ACID PILE	D&M	TP-7	5/ST	12.5	13.0	12.75	CL	Tails-slime	63.1	54.1	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	TP-7	6/ST	16.5	17.0	16.75	CL	Tails-slime	61.4	58.1	NA	NA	NA	NA	NA	NA	NA	Unstand Shear
ACID PILE	D&M	TP-8	1/ST	2.5	3.0	2.75	SM/ML	Tails-sand/slime	70.5	11.0	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	TP-8	2/ST	4.5	5.0	4.75	SM	Tails-sand	98.0	6.5	2.62	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	TP-8	-/BULK	4.5	4.5	4.50	SM	Tails-sand	NA	7.5	NA	100.0	25.9	NA	NA	103.0	15.0	Dir Shear, Perm, Mod Proc, CMR
ACID PILE	D&M	TP-8	3/ST	6.0	6.5	6.25	SM	Tails-sand(?)	92.5	14.3	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	TP-8	4/ST	10.0	10.5	10.25	ML	Tails-slime	80.7	38.0	2.70	100.0	63.5	NA	NA	NA	NA	
ACID PILE	D&M	TP-8	5/ST	12.0	12.5	12.25	CL	Tails-slime	80.2	70.9	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	TP-8	-/BULK	13.0	13.0	13.00	CL	Tails-slime	NA	NA	NA	NA	NA	NA	NA	NA	NA	Perm

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MAAP - [illegible] - GEOTECHNICAL DATA BASE FOR MONTICELLO MILLSITE CHARACTERIZATION -- S.K. MORRIS: CREATED [illegible]: LAST UPDATED [illegible]

TJS 6/94

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AREA	DATA SOURC	BORING OR TEST PIT NUMBER	SAMPLE NUMBER & TYPE	TOP OF SAMPLE (FEET)	BASE OF SAMPLE (FEET)	SAMPLE MIDPOINT (FEET)	USCS SYMBOL	MATERIAL TYPE	INPLACE DRY DENSITY (PCF)	NATURAL MOISTURE CONTENT (PERCENT)	SPECIFIC GRAVITY	FRACTION PASSING #4 SIEVE (PERCENT)	FRACTION PASSING #200 SIEVE (PERCENT)	LIQUID LIMIT	PLASTICITY INDEX	ASTM D 698 MAXIMUM DRY DENSITY (PCF)	ASTM D 698 OPTIMUM MOISTURE CONTENT (PERCENT)	OTHER TESTS
ACID PILE	D&M	TP-6	1/6T	1.5	2.0	1.75	SM	Tailsand	88.6	4.6	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	TP-6	2/6T	2.6	3.5	3.25	SM	Tailsand	88.8	8.8	NA	100.0	10.5	NA	NA	NA	NA	
ACID PILE	D&M	TP-6	4/BULK	10.0	10.0	10.00	ML	Alluvium	NA	23.4	NA	93.5	84.0	24.2	10.1	114.0	14.0	Perm, Med Prec, CMR
SOMERVILLE TRACT	BENDIX	MAAP-88-17	MHD-[illegible]	0.0	2.5	1.00	SC	Alluvium	NA	40.5	2.61	100.0	31.0	33.0	16.0	NA	NA	Perm, CMR @15 bar
SOMERVILLE TRACT	BENDIX	MAAP-88-17	MHD-[illegible]/BULK	0.0	5.0	2.50	ML	Alluvium(Shale?)	NA	NA	NA	87.8	91.0	NA	NA	108.3	17.8	
SOMERVILLE TRACT	BENDIX	MAAP-88-16	MHD-[illegible]	0.0	2.0	1.00	CL	Alluvium	NA	14.3	2.56	100.0	88.0	22.0	14.0	NA	NA	Perm, Consol w/perm, CMR @15 bar
SOMERVILLE TRACT	BENDIX	MAAP-88-16	MHD-[illegible]/BULK	0.0	5.0	2.50	ML	Alluvium	NA	NA	NA	100.0	88.0	NA	NA	105.3	18.0	
BLM COMPOUND	BENDIX	MAAP-88-[illegible]	MHD-[illegible]	0.0	2.0	1.00	CL	Alluvium	NA	16.6	2.62	100.0	88.5	40.0	7.8	NA	NA	Perm, CMR @15 bar
BLM COMPOUND	BENDIX	MAAP-88-[illegible]	MHD-[illegible]/BULK	0.0	3.0	1.50	CL	Alluvium	NA	NA	NA	100.0	71.0	NA	NA	101.9	18.0	
BLM COMPOUND	D&M	[illegible]	3/[illegible]	3.5	4.5	4.00	CL	Alluvium	NA	25.4	NA	NA	NA	40.7	29.0	NA	NA	
BLM COMPOUND	D&M	[illegible]	3/[illegible]	4.5	5.5	5.00	CL	Alluvium	NA	21.0	NA	NA	NA	35.0	16.0	NA	NA	
BLM COMPOUND	D&M	[illegible]	4/[illegible]	8.0	10.5	8.75	ML	Alluvium	NA	17.1	NA	100.0	71.2	NA	NA	NA	NA	
VALLEY BOTTOM	BENDIX	MAAP-88-21	MHD-[illegible]	0.0	2.0	1.00	CL	Alluvium	NA	7.8	2.69	NA	NA	30.0	13.0	NA	NA	Perm, CMR @15 bar
VALLEY BOTTOM	BENDIX	MAAP-88-21	MHD-[illegible]/BULK	0.0	3.5	1.50	SM	Tailsand	NA	NA	NA	100.0	43.0	NA	NA	115.2	13.8	
VALLEY BOTTOM	D&M	[illegible]	3/[illegible]	3.5	4.0	4.10	CL	Alluvium	NA	12.0	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	[illegible]	7/[illegible]	8.5	10.0	9.25	CL	Alluvium	NA	16.2	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	[illegible]	8/[illegible]	12.0	14.3	13.00	CL	Alluvium	NA	16.3	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	[illegible]	11/BULK	24.0	25.0	24.00	GC	Alluvium	NA	16.6	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	[illegible]	3/[illegible]	8.5	8.9	8.75	SC	Alluvium	NA	9.9	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	[illegible]	3/[illegible]	13.0	13.0	12.00	SW	Alluvium	NA	6.4	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	[illegible]	1/[illegible]	4.0	6.0	5.00	CL	Alluvium	NA	16.0	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	[illegible]	3/[illegible]	8.5	11.0	10.25	SC	Alluvium	NA	12.5	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	[illegible]	3/[illegible]	14.3	14.7	14.50	[illegible]	Shale	NA	12.3	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	[illegible]	1/[illegible]	3.5	4.0	3.75	SM	Alluvium	NA	10.2	NA	83.1	40.7	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	[illegible]	4/[illegible]	8.5	10.0	8.75	SP	Alluvium	NA	8.1	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	[illegible]	8/[illegible]	14.0	14.5	14.25	SM	Alluvium	NA	13.0	NA	88.4	15.5	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	[illegible]	1/[illegible]	4.5	5.0	4.75	ML	Alluvium	NA	10.7	NA	97.3	71.3	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	[illegible]	2/[illegible]	8.0	8.6	8.25	ML	Alluvium(?)	NA	8.8	NA	100.0	91.6	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	[illegible]	4/[illegible]	10.0	10.5	10.25	ML	Alluvium(?)	NA	8.6	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	[illegible]	3/[illegible]	12.0	14.0	14.00	CL	Alluvium(?)	NA	12.2	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	TP-13	4/BULK	2.0	8.0	5.00	GC	Alluvium	NA	20.2	NA	46.1	40.8	25.4	17.8	116.1	13.2	
MAIN MILLSITE	D&M	[illegible]	3/[illegible]	6.0	6.5	6.25	CL	Alluvium	NA	27.7	NA	NA	NA	NA	NA	NA	NA	
MAIN MILLSITE	D&M	[illegible]	9/[illegible]	8.1	9.5	8.80	CL	Alluvium	NA	20.5	NA	NA	NA	NA	NA	NA	NA	
MAIN MILLSITE	D&M	[illegible]	10/[illegible]	13.5	15.0	14.21	CL	Alluvium	NA	21.5	NA	NA	NA	NA	NA	NA	NA	
MAIN MILLSITE	D&M	[illegible]	3/[illegible]	3.5	4.5	4.18	CL	Alluvium(Shale?)	NA	22.9	NA	NA	NA	NA	NA	NA	NA	
MAIN MILLSITE	D&M	[illegible]	1/[illegible]	0.6	2.0	1.25	CL	Fill	NA	11.8	NA	NA	NA	46.3	22.9	NA	NA	
SOUTH VALLEY WALL	D&M	[illegible]	3/[illegible]	10.0	10.5	10.25	CL	Alluvium(Shale?)	NA	12.6	NA	NA	NA	NA	NA	NA	NA	
SOUTH VALLEY WALL	D&M	[illegible]	4/[illegible]	8.5	9.0	8.75	CL	Alluvium	NA	7.3	NA	NA	NA	NA	NA	NA	NA	
SOUTH VALLEY WALL	D&M	[illegible]	4/[illegible]	10.0	10.5	10.25	CL	Alluvium	NA	10.0	NA	NA	NA	NA	NA	NA	NA	
SOUTH VALLEY WALL	D&M	[illegible]	1/[illegible]	2.0	2.5	2.25	CL	Alluvium	NA	8.6	NA	NA	NA	NA	NA	NA	NA	
SOUTH VALLEY WALL	D&M	[illegible]	3/[illegible]	9.0	10.3	9.66	CL	Alluvium	NA	14.2	NA	NA	NA	NA	NA	NA	NA	
SOUTH VALLEY WALL	D&M	[illegible]	4/[illegible]	10.3	11.4	10.86	SC	Alluvium	NA	14.0	NA	NA	NA	NA	NA	NA	NA	
SOUTH VALLEY WALL	D&M	[illegible]	5/[illegible]	14.0	14.2	14.10	CL	Alluvium	NA	12.2	NA	NA	NA	NA	NA	NA	NA	
SOUTH VALLEY WALL	D&M	[illegible]	4/[illegible]	4.5	5.0	4.75	CL	Alluvium	NA	11.4	NA	100.0	85.4	43.3	22.4	NA	NA	
NORTH VALLEY WALL	D&M	[illegible]	1/[illegible]	3.5	5.5	4.50	CL	Alluvium(?)	NA	12.9	NA	NA	NA	38.3	17.1	NA	NA	
NORTH VALLEY WALL	D&M	[illegible]	2/[illegible]	8.5	10.5	9.50	CL	Alluvium(?)	NA	20.1	NA	100.0	87.8	NA	NA	NA	NA	
NORTH VALLEY WALL	D&M	[illegible]	1/[illegible]	2.0	4.0	3.00	CL	Alluvium	NA	14.2	NA	NA	NA	NA	NA	NA	NA	
NORTH VALLEY WALL	D&M	[illegible]	3/[illegible]	8.0	11.0	10.00	CL	Alluvium	NA	18.9	NA	NA	NA	32.4	13.8	NA	NA	
NORTH VALLEY WALL	D&M	[illegible]	3/[illegible]	8.5	8.8	8.75	CL	Alluvium(?)	NA	21.2	NA	NA	NA	NA	NA	NA	NA	
NORTH VALLEY WALL	D&M	[illegible]	[illegible]	14.5	15.0	14.75	CL	Alluvium(?)	NA	23.3	2.70	NA	NA	40.2	25.0	NA	NA	
NORTH VALLEY WALL	D&M	[illegible]	7/[illegible]	16.5	16.8	16.75	CL	Alluvium(?)	NA	23.8	NA	NA	NA	NA	NA	NA	NA	
BLM PROPERTY-NORTH	D&M	[illegible]	1/[illegible]	3.0	3.9	3.45	CL	Alluvium	NA	11.9	NA	NA	NA	30.1	18.8	NA	NA	
BLM PROPERTY-NORTH	D&M	[illegible]	3/[illegible]	12.5	14.3	13.50	CL	Alluvium	NA	13.8	NA	NA	NA	NA	NA	NA	NA	
BLM PROPERTY-NORTH	D&M	[illegible]	4/[illegible]	20.0	20.3	20.25	CL	Alluvium	NA	20.1	NA	NA	NA	44.3	22.8	NA	NA	
BLM PROPERTY-NORTH	D&M	[illegible]	3/[illegible]	8.0	8.5	8.25	CL	Alluvium	NA	23.0	NA	NA	NA	41.3	20.7	NA	NA	
BLM PROPERTY-NORTH	D&M	[illegible]	4/[illegible]	9.5	10.0	9.75	CL	Alluvium	NA	17.5	NA	NA	NA	NA	NA	NA	NA	
BLM PROPERTY-NORTH	D&M	[illegible]	6/[illegible]	15.0	15.5	15.25	CL	Alluvium	NA	16.8	NA	NA	NA	27.3	8.4	NA	NA	
BLM PROPERTY-NORTH	D&M	[illegible]	7/[illegible]	20.0	20.3	20.25	CL	Alluvium	NA	18.1	NA	NA	NA	NA	NA	NA	NA	
BLM PROPERTY-NORTH	D&M	[illegible]	2/[illegible]	3.5	4.5	3.90	CL	Alluvium(Loess?)	NA	17.4	NA	NA	NA	49.9	22.7	NA	NA	
BLM PROPERTY-NORTH	D&M	[illegible]	3/[illegible]	8.1	9.5	9.00	CL	Alluvium(Loess?)	NA	15.6	NA	NA	NA	NA	NA	NA	NA	
BLM PROPERTY-NORTH	D&M	[illegible]	2/[illegible]	8.5	9.0	8.80	CL	Alluvium	NA	18.0	NA	NA	NA	NA	NA	NA	NA	
BLM PROPERTY-NORTH	D&M	[illegible]	3/[illegible]	12.5	14.3	13.50	CL	Alluvium	NA	18.6	NA	NA	NA	NA	NA	NA	NA	
BLM PROPERTY-NORTH	D&M	[illegible]	3/[illegible]	2.0	2.8	2.50	CL	Alluvium	NA	15.9	NA	NA	NA	44.7	22.4	NA	NA	
BLM PROPERTY-NORTH	D&M	[illegible]	3/[illegible]	10.0	10.5	10.40	SW	Alluvium	NA	8.9	NA	NA	NA	NA	NA	NA	NA	
BLM PROPERTY-NORTH	D&M	[illegible]	3/[illegible]	3.5	4.0	3.75	SM	Alluvium	NA	6.1	NA	80.9	30.4	NA	NA	NA	NA	
BLM PROPERTY-NORTH	D&M	[illegible]	3/[illegible]	8.5	10.5	9.50	CL	Alluvium(?)	NA	23.5	NA	NA	NA	NA	NA	NA	NA	

TKS 8/6/96

MAP - 71[illegible] - GEOTECHNICAL DATA ...ES FOR MONTICELLO MILLSITE CHARACTE... ...TION - R.H. MORRIS; CREATED 08/20/91; LAST UPDATED 11/22/91

AREA	DATA SOURC	BORING OR TEST PIT NUMBER	SAMPLE NUMBER & TYPE	TOP OF SAMPLE (FEET)	BASE OF SAMPLE (FEET)	SAMPLE MIDPOINT (FEET)	USCS SYMBOL	MATERIAL TYPE	IN-PLACE DRY DENSITY (PCF)	NATURAL MOISTURE CONTENT (PERCENT)	SPECIFIC GRAVITY	FRACTION PASSING #4 SIEVE (PERCENT)	FRACTION PASSING #200 SIEVE (PERCENT)	LIQUID LIMIT	PLASTICITY INDEX	ASTM D 698 MAXIMUM DRY DENSITY (PCF)	ASTM D 698 OPTIMUM MOISTURE CONTENT (PERCENT)	OTHER TESTS
BLM PROPERTY-NORT	D&M	TP-10	1BULK	5.0	6.0	5.50	CL	Loess(?)	NA	18.8	NA	100.0	88.8	29.5	11.1	107.7	14.2	Mod Proct
BLM PROPERTY-NORT	D&M	TP-10	2ST	6.0	6.5	6.25	CL	Loess(?)	91.7	8.2	NA	NA	NA	27.3	9.8	NA	NA	Unconf Comp
BLM PROPERTY-NORT	D&M	TP-10	4ST	11.0	11.5	11.25	CL	Loess(?)	100.3	18.7	NA	NA	NA	48.5	21.8	NA	NA	Perm

KEY:

USCS Unified Soil Classification System group symbol, ASTM D 2487 or D2488 (For [illegible], symbol indicates [illegible])
ASTM The designation of the American Society for Testing and Materials
SFPEC "Data Collection for Engineering for the Uranium Mill Tailings Site and Adjacent Peripheral Properties, Monticello, Utah," Sergent [illegible] Engineering Corporation, September 1988
D&M "Peat [illegible], Monticello Remedial Action Project, 1991 Millsite Characterization Study," Dames & Moore, September 17, 1991
* Sample taken from a test pit [illegible] next to the designated borehole.
(?) Questionable value or identification

MATERIAL TYPE:

Tails-sand	Tailings sands
Tails-slm	Tailings slimes
Tails-[illegible]	Tailings sands and slimes, interbedded
Tails-[illegible]	Tailings sands and slimes, mixed
Cover	Cover material in place on tailings piles
MVP spoils	Material removed from Monticello Vicinity Properties
Alluvium	Miscellaneous surficial deposits, mostly [illegible]
Loess	Windblown fine-grained deposits
Shale	Mancos Shale, mostly weathered
Sandstone	Dakota Sandstone
Fill	Miscellaneous man-made fill

OTHER TESTS:

Mod Proct	Modified Proctor compaction
Unconf Comp	Unconfined compressive strength
Dir Shear	Direct shear, [illegible]-drained
Triax-CUPP	Triaxial shear, consolidated-undrained with pore pressure measurements
Consol	One-dimensional consolidation
Perm	Permeability, falling-head or flexible-membrane
CMR	Capillary moisture [illegible]

SAMPLE TYPES:

BULK	Disturbed bag sample of loose cuttings or materials from test pit
SS	Disturbed sample from 2.0" O.D. standard split-spoon drive sampler
ST	Relatively undisturbed sample from 3.0" O.D. thin-walled (Shelby) tube sampler
U	Relatively undisturbed sample from Dames & Moore Type "U" ring-lined drive sampler

All data in this table compiled or interpreted from consultant's reports by R.H. Morris, Chen-Northern Geotech, Inc., October 1991. Checked by L.H. Dotson & corrected by R.H. Morris, November 1991.

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APPENDIX B

Radon Calculation

TITAN Environmental

By	TAM	Date 9/11/96	Subject	EFN - White Mesa	Page 1 of 32
Chkd By	[illegible]	Date 9/11/96		Radon Calculation	Proj No 6111-001

Purpose: To determine the required soil cover thicknesses to limit radon emissions from the White Mesa tailings impoundments to 20 pCi/m^2/sec using United States Nuclear Regulatory Commission (NRC) approved methods and inputs. The White Mesa Mill site is located in Blanding, Utah.

Method: Determine the geotechnical and radiological properties of the tailings and cover materials based on NRC-accepted methods and existing database values previously collected. Input parameters into the computer modeling program "RADON" to determine the radon flux values through the cover materials. A variety of scenarios adjusting cover thicknesses were run to determine the optimum thickness of cover materials to meet NRC specifications. It was assumed that the tailings located in the three cells at the White Mesa Mill site (Cells 2, 3, and 4A) have similar properties (Figure 1). Therefore, cover layer configurations as determined by the RADON model are applicable to the three tailings cells.

Results: A 2-layer uranium mill tailings cover composed of (from top to bottom) a 2-foot layer of random fill and a 1-foot compacted clay layer will meet NRC specifications. In addition to the tailings cover materials, a minimum of 3 feet of random fill will be placed between the tailings and soil cover to fill the currently existing freeboard. This 3 foot layer was included for modeling purposes since it will assist in reducing the radon flux from the tailings impoundments. This layer, however, is not considered a part of the actual soil cover. The resulting radon flux exiting the top cover layer of the tailings impoundment will be 13.6 pCi/m^2/sec (see Appendix A1 for RADON output).

As indicated in the "Effects of Freezing on Uranium Mill Tailings Covers Calculation Brief" (6/17/96), 6.8 inches of the top random fill cover layer will be effected by freeze/thaw conditions at Blanding Utah. This suggests that 6.8 inches of the top layer may not contribute to reductions of radon emanation from the tailings covers. To conservatively compensate for effects from freezing and thawing, 6.8 inches were subtracted from the top random fill cover layer. Executing the RADON model based on this cover configuration resulted in a radon flux emanation of 17.6 pCi/m^2/sec (see Appendix A2 for RADON output).

NRC specifications (Regulatory Guide 3.64) requires that a uranium tailings cover "..produce resonable assurance that the radon-222 release rate would not exceed 20 pCi/m^2/sec for a period of 1,000 years to the extent reasonably achievable and in any case for at least 200 years when averaged over the disposal area over at

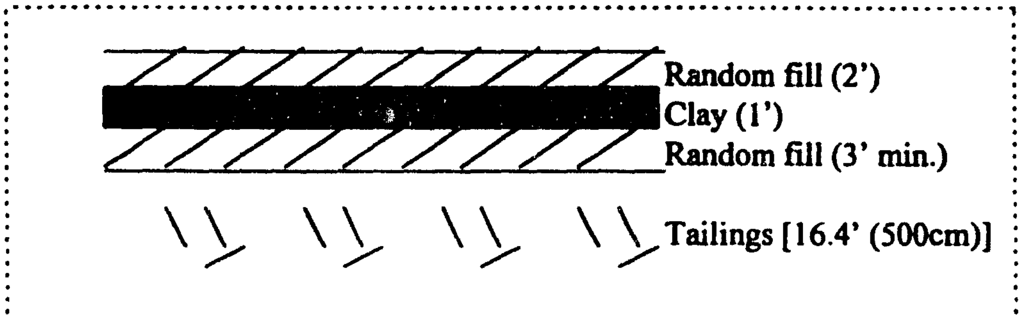
least a one-year period" (NRC, 1989). Therefore, the above design with accounting for freezing and thawing conditions is adequate.

Parameters: The RADON model requires input of the following parameters for all tailings and soil cover layers:

- layer thickness (centimeter (cm));
- porosity;
- mass density (g/cm^3);
- radium activity (pCi/gr), source term, or ore grade percentage;
- emanation coefficient;
- weight percent moisture (long-term) (percent), and;
- diffusion coefficient (cm^2/sec).

Physical and radiological properties for Tailings and Random Fill were analyzed by Chen and Associates (1987) and Rogers and Associates (1988) respectively. See Appendix B1 for analysis results. Clay physical data input for RADON modeling are included in Appendix B2 and were analyzed by Advanced Terra Testing (1996) and Rogers and Associates (1996).

The following cover profile was modeled.



This cover configuration represents the actual cover layer thicknesses which would be constructed on site. The cover profile above was adjusting for modeling purposes to account for freezing and thawing conditions. The modeled profile is identical to the one above with the exception of the top random fill layer which was reduced to 1.4 feet (2 feet minus 6.8 inches). It is assumed that 6.8 inches of the top cover layer effected by freeze/thaw conditions will not contribute to reductions in radon emanation from the tailings covers.

Layer thicknesses

The thickness of the tailings was assumed to be effectively an infinitely thick radon source. In accordance with NRC criteria (Reg. Guide 3.64, p. 3.64-5) a tailings thickness greater than about 100-200 cm is considered to be effectively, infinitely thick. A value of 500 cm represents an equivalent infinitely thick tailings source. The actual tailings thickness of Cell 3 at White Mesa is approximately 28 feet (850 cm), therefore, a value of 500 cm was used for the RADON model.

A minimum of 3-feet (91.5 cm) of random fill will cover the tailings to fill the existing freeboard and bring the tailings piles up to the subgrade elevation of the soil cover. A 1-foot (30.5 cm) layer of compacted clay covers the random fill with an additional 2 feet (61 cm) of random fill overlying the clay layer. Adjusting for freeze/thaw conditions results in a (43 cm) random fill layer overlaying the clay layer.

Porosity

Porosity is calculated from the specific gravity and dry bulk density according to the following equations;

1. Dry bulk density = [(specific gravity)(density of water)]/[1 + e] (Ref.: Principles & Practice of Civil Engineering, 1996, equation 14.5.6). See Appendix C.
2. Porosity = [e / (1+e)] x 100 (Ref.: Principles & Practice of Civil Engineering, 1996, equation 14.5.4). See Appendix C.

	Max. Dry Density (lb/ft^3)	Bulk Dry Density (lb/ft^3) (1)	Specific Gravity	Density of Water (lb/ft^3)	"e" (2)	porosity (3)
Tailings (4)	104.0	98.8	2.85	62.4	0.80	44%
Clay (5)	113.5	107.8	2.39	62.4	0.38	28%
Random fill (4)	120.2	114.2	2.67	62.4	0.46	31.5%

Notes:

1. Bulk dry density is 95% of the ASTM Proctor maximum dry density for all materials.
2. Calculated using Equation 1 above where "e" is the volume of voids per volume of solids.
3. Calculated using Equation 2 above.
4. Physical tailings and random fill data from Chen and Associates (1987) included in Appendix B1.
5. Clay physical data from Advanced Terra Testing (1996) and Rogers and Associates (1996) included in Appendix B2.

Mass Density

Mass densities were measured by Rogers and Associates (1988 and 1996) to be (see Appendix B1 and B2):

Tailings	= 1.45 g/cm^3
Clay	= 1.72 g/cm^3
Random Fill	= 1.85 g/cm^3

Radium Activity, Source Term, or Ore Grade %

Radium activity values from Rogers & Associates (1988 and 1996), were input for White Mesa tailings and cover materials (Appendix B1 and B2). The radium activity values are:

Tailings	= 981 pCi/gm
Clay	= 1.5 pCi/gm
Random Fill	= 1.9 pCi/gm.

Emanation Coefficient

Emanation coefficient input for the tailings and cover materials are measured values from Rogers & Associates (1988 and 1996), included in Appendix B1 and B2. The coefficients are:

Tailings	= 0.19
Clay	= 0.22
Random Fill	= 0.19

Note: Use of NRC's default value of E=0.35 is not considered appropriate since laboratory analyses of emanation coefficients are available.

Weight Percent Moisture

Long-term moisture content (weight percent moisture) was assumed to be 6% for the tailings. NRC Regulatory Guide 3.64 states, "if acceptable documented alternative information is not furnished by the applicant, the staff will use a reference value of 6% for the tailings moisture content because 6% is a lower bound for moisture in western soils" (NRC, 1989). Laboratory data does not exist to determine the actual weight percent moisture of tailings therefore, this is a conservative assumption.

The weight percent moisture of the new clay source (UT-1) is also unknown therefore, it was assumed that the average weight percent moisture from clay (site #1 and site #4) would be equivalent to the new clay source (UT-1). This is also a conservative assumption as the new clay

source is believed to be of better quality. Weight percent moisture values for clay and random fill were derived from the "Summary of Capillary Moisture Relationship Test Results" figures included in Appendix B1. Weight percent moisture values used for modeling purposes are:

Tailings	= 6%
Clay	= 14.1%
Random Fill	= 9.8%

Diffusion Coefficient

Diffusion coefficient input for the tailings and cover materials are measured values from Rogers & Associates (1988 and 1996), included in Appendix B1 and B2. The coefficients used for tailings and random fill were an average of the two values presented. The coefficients for each material are as follows:

Tailings	= 0.0142 cm^2/sec
Clay	= 0.0091 cm^2/sec
Random Fill	= 0.0082 cm^2/sec

References:

Advanced Terra Testing, 1996, Physical soil data, White Mesa Project, Blanding Utah, July 25, 1996.

Chen and Associates, 1987. Physical soil data, White Mesa Project Blanding Utah.

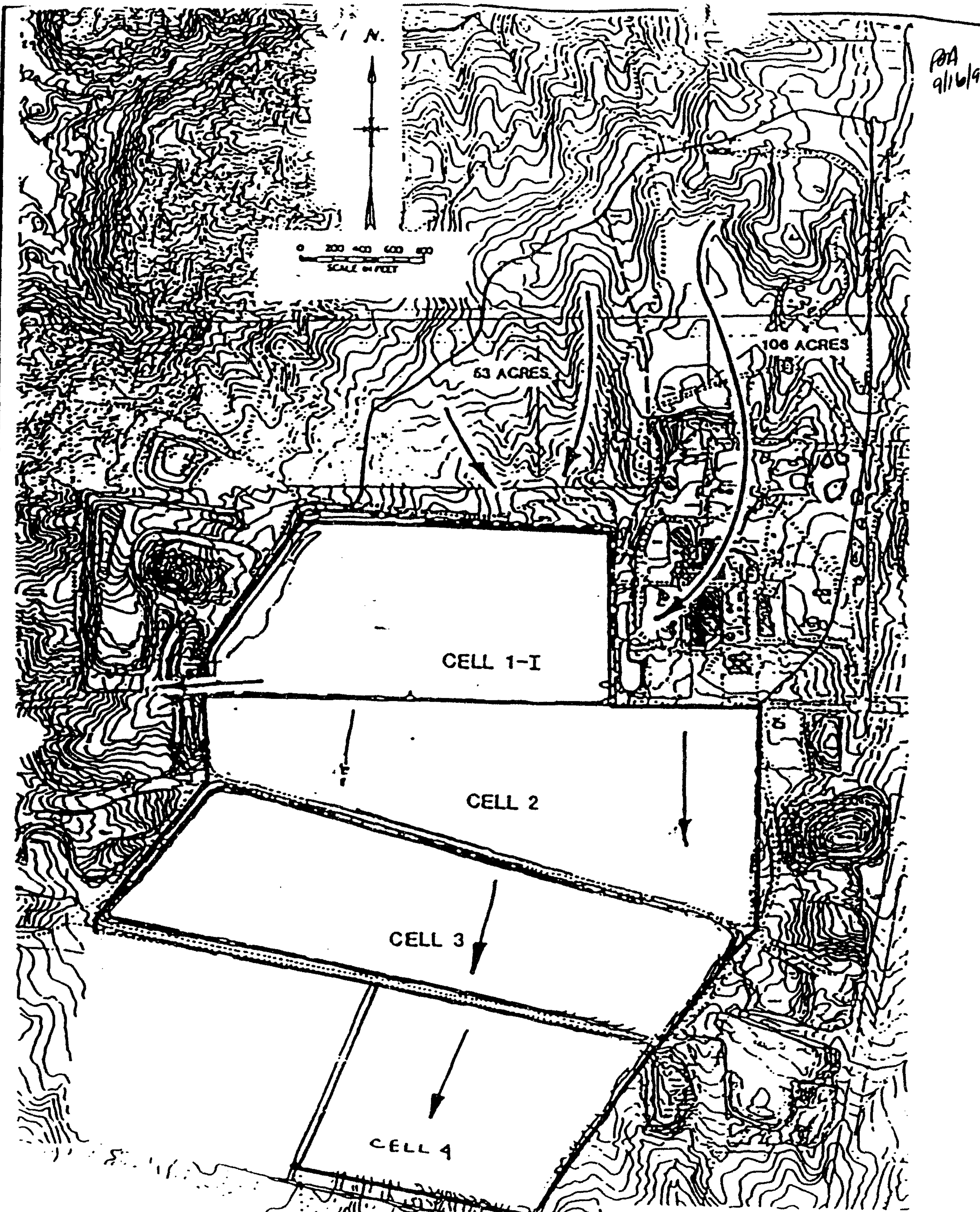
Freeze R. Allan and Cherry, John A., 1979, "Groundwater".

Principles & Practice of Civil Engineering, 2nd Edition, 1996.

Rogers and Associates Engineering Company, 1988. Radiological Properties Letters to C.O. Sealy from R.Y. Bowser dated March 4 and May 9, 1988.

Rogers and Associates Engineering Company, 1996. Report of Radon Diffusion Coefficient Measurements, Radium Content, and Emanation Coefficient Measurements, September 3, 1996.

U.S. Nuclear Regulatory Commission (NRC), 1989. "Regulatory Guide 3.64 (Task WM 503-4) Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers", March 1989.



WHITE MESA PROJECT

SITE DRAINAGE

FIGURE: 1

Appendix A1

-----*****! RADON !*****-----

8/32

Version 1.2 - MAY 22, 1989 - G.F. Birchard tel.# (301)492-7000
U.S. Nuclear Regulatory Commission Office of Research

RADON FLUX, CONCENTRATION AND TAILINGS COVER THICKNESS

DATE/TIME OF THIS RUN
09-10-1996/18:06:33

EFN - WHITE MESA

CONSTANTS

RADON DECAY CONSTANT	.0000021	s^-1
RADON WATER/AIR PARTITION COEFFICIENT	.26	
SPECIFIC GRAVITY OF COVER & TAILINGS	2.65	

GENERAL INPUT PARAMETERS

LAYERS OF COVER AND TAILINGS	4	
DESIRED RADON FLUX LIMIT	20	pCi m^-2 s^-1
LAYER THICKNESS NOT OPTIMIZED		
DEFAULT SURFACE RADON CONCENTRATION	0	pCi l^-1
RADON FLUX INTO LAYER 1	0	pCi m^-2 s^-1
SURFACE FLUX PRECISION	.001	pCi m^-2 s^-1

LAYER INPUT PARAMETERS

LAYER 1 TAILINGS

THICKNESS	500	cm
POROSITY	.44	
MEASURED MASS DENSITY	1.45	g cm^-3
MEASURED RADIUM ACTIVITY	981	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.19	
CALCULATED SOURCE TERM CONCENTRATION	1.290D-03	pCi cm^-3 s^-1
WEIGHT % MOISTURE	6	%
MOISTURE SATURATION FRACTION	.198	
MEASURED DIFFUSION COEFFICIENT	.0142	cm^2 s^-1

LAYER 2 RANDOM FILL (FILL FREEBOARD)

THICKNESS	91.5	cm
POROSITY	.315	
MEASURED MASS DENSITY	1.85	g cm^-3
MEASURED RADIUM ACTIVITY	1.9	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.19	
CALCULATED SOURCE TERM CONCENTRATION	4.452D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	9.800000000000001	%
MOISTURE SATURATION FRACTION	.576	
MEASURED DIFFUSION COEFFICIENT	8.200000000000001D-03	cm^2 s^-1

LAYER 3 CLAY (UT-1)

THICKNESS	30.5	cm
ROSITY	.28	
MEASURED MASS DENSITY	1.72	g cm^-3
MEASURED RADIUM ACTIVITY	1.5	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.22	
CALCULATED SOURCE TERM CONCENTRATION	4.257D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	14.1	%
MOISTURE SATURATION FRACTION	.866	
MEASURED DIFFUSION COEFFICIENT	.0091	cm^2 s^-1

LAYER 4 RANDOM FILL

THICKNESS	61	cm
POROSITY	.315	
MEASURED MASS DENSITY	1.85	g cm^-3
MEASURED RADIUM ACTIVITY	1.9	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.19	
CALCULATED SOURCE TERM CONCENTRATION	4.452D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	9.800000000000001	%
MOISTURE SATURATION FRACTION	.576	
MEASURED DIFFUSION COEFFICIENT	8.200000000000001D-03	cm^2 s^-1

DATA SENT TO THE FILE 'RNDATA' ON DEFAULT DRIVE

N	F01	CN1	ICOST	CRITJ	ACC
4	0.000D+00	0.000D+00	0	2.000D+01	1.000D-03

LAYER	DX	D	P	Q	XMS	RHO
1	5.000D+02	1.420D-02	4.400D-01	1.290D-03	1.977D-01	1.450
2	9.150D+01	8.200D-03	3.150D-01	4.452D-06	5.756D-01	1.850
3	3.050D+01	9.100D-03	2.800D-01	4.257D-06	8.661D-01	1.720
4	6.100D+01	8.200D-03	3.150D-01	4.452D-06	5.756D-01	1.850

BARE SOURCE FLUX FROM LAYER 1: 4.667D+02 pCi m^-2 s^-1

10/32

RESULTS OF THE RADON DIFFUSION CALCULATIONS

LAYER	THICKNESS (cm)	EXIT FLUX (pCi m^-2 s^-1)	EXIT CONC. (pCi l^-1)
1	5.000D+02	1.233D+02	4.519D+05
2	9.150D+01	2.562D+01	7.892D+04
3	3.050D+01	1.962D+01	2.276D+04
4	6.100D+01	1.361D+01	0.000D+00

Appendix A2

-----*****! RADON !*****-----

Version 1.2 - MAY 22, 1989 - G.F. Birchard tel.# (301)492-7000
U.S. Nuclear Regulatory Commission Office of Research

12/32

RADON FLUX, CONCENTRATION AND TAILINGS COVER THICKNESS

DATE/TIME OF THIS RUN
09-10-1996/14:46:46

EFN - WHITE MESA (ACCOUNTING FOR FREEZE/THAW CONDITIONS)

CONSTANTS

RADON DECAY CONSTANT	.0000021	s^-1
RADON WATER/AIR PARTITION COEFFICIENT	.26	
SPECIFIC GRAVITY OF COVER & TAILINGS	2.65	

GENERAL INPUT PARAMETERS

LAYERS OF COVER AND TAILINGS	4	
DESIRED RADON FLUX LIMIT	20	pCi m^-2 s^-1
LAYER THICKNESS NOT OPTIMIZED		
DEFAULT SURFACE RADON CONCENTRATION	0	pCi l^-1
RADON FLUX INTO LAYER 1	0	pCi m^-2 s^-1
SURFACE FLUX PRECISION	.001	pCi m^-2 s^-1

LAYER INPUT PARAMETERS

LAYER 1 TAILINGS

THICKNESS	500	cm
POROSITY	.44	
MEASURED MASS DENSITY	1.45	g cm^-3
MEASURED RADIUM ACTIVITY	981	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.19	
CALCULATED SOURCE TERM CONCENTRATION	1.290D-03	pCi cm^-3 s^-1
WEIGHT % MOISTURE	6	%
MOISTURE SATURATION FRACTION	.198	
MEASURED DIFFUSION COEFFICIENT	.0142	cm^2 s^-1

LAYER 2 RANDOM FILL

THICKNESS	91.5	cm
POROSITY	.315	
MEASURED MASS DENSITY	1.85	g cm^-3
MEASURED RADIUM ACTIVITY	1.9	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.19	
CALCULATED SOURCE TERM CONCENTRATION	4.452D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	9.800000000000001	%
STURE SATURATION FRACTION	.576	
MEASURED DIFFUSION COEFFICIENT	8.200000000000001D-03	cm^2 s^-1

13/32

LAYER 3 CLAY

THICKNESS	30.5	cm
POROSITY	.28	
MEASURED MASS DENSITY	1.72	g cm^-3
MEASURED RADIUM ACTIVITY	1.5	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.22	
CALCULATED SOURCE TERM CONCENTRATION	4.257D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	14.1	%
MOISTURE SATURATION FRACTION	.866	
MEASURED DIFFUSION COEFFICIENT	.0091	cm^2 s^-1

LAYER 4 RANDOM FILL

THICKNESS	43	cm
POROSITY	.315	
MEASURED MASS DENSITY	1.85	g cm^-3
MEASURED RADIUM ACTIVITY	1.9	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.19	
CALCULATED SOURCE TERM CONCENTRATION	4.452D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	9.800000000000001	%
MOISTURE SATURATION FRACTION	.576	
MEASURED DIFFUSION COEFFICIENT	8.200000000000001D-03	cm^2 s^-1

DATA SENT TO THE FILE 'RNDATA' ON DEFAULT DRIVE

N	F01	CN1	ICOST	CRITJ	ACC
4	0.000D+00	0.000D+00	0	2.000D+01	1.000D-03

LAYER	DX	D	P	Q	XMS	RHO
1	5.000D+02	1.420D-02	4.400D-01	1.290D-03	1.977D-01	1.450
2	9.150D+01	8.200D-03	3.150D-01	4.452D-06	5.756D-01	1.850
3	3.050D+01	9.100D-03	2.800D-01	4.257D-06	8.661D-01	1.720
4	4.300D+01	8.200D-03	3.150D-01	4.452D-06	5.756D-01	1.850

BARE SOURCE FLUX FROM LAYER 1: 4.667D+02 pCi m^-2 s^-1

RESULTS OF THE RADON DIFFUSION CALCULATIONS

LAYER	THICKNESS (cm)	EXIT FLUX (pCi m^-2 s^-1)	EXIT CONC. (pCi l^-1)
1	5.000D+02	1.237D+02	4.514D+05
2	9.150D+01	2.679D+01	7.622D+04
3	3.050D+01	2.123D+01	1.944D+04
4	4.300D+01	1.756D+01	0.000D+00

Appendix B1

TAILINGS AND RANDOM FILL PROPERTIES

Table 3.4-1

Physical Properties of Tailings

and

Proposed Cover Materials

Material Type	Atterberg Limits LL	Atterberg Limits PI	Specific Gravity	% Passing No. 200 Sieve	Maximum Dry Density (pcf)	Optimum Moisture Content
Tailings	28	6	2.85	46	104.0	18.1
Random Fill	22	7	2.67	48	120.2	11.8
Clay	29	14	2.69	56	121.3	12.1
Clay	36	19	2.75	68	108.7	18.5

Note: Physical Soil Data from Chen and Associates (1987).

R
A
E

Rogers & Associates Engineering Corporation

Post Office Box 330
Salt Lake City, Utah 84110
(801) 263-1600

17/32

March 4, 1988

Mr. C.O.S aly
Umetco Min rals Corporation
P.O. Box 10
Grand Junct n, CO 81502

C8700/22

Dear Mr. Sealy:

We have completed the tests ordered on the four samples shipped to us. The results are as follows:

Sample	Radium pCi/gm	Emanation Fraction	Diffusion Coeffic.	(g/cm^3) Density	Moisture	Saturation
Tailings	981±4	0.19±0.01	2.0E-02	1.45	13.2	0.39
Composite (2,3,&5)			8.4E-03	1.44	19.1	0.56
			1.6E-02	1.85	6.5	0.40
Site #1			4.5E-04	1.84	12.5	0.75
			1.6E-02	1.85	8.1	0.48
Site #4			1.4E-03	1.84	12.6	0.76
			1.1E-02	1.65	15.4	0.63
			4.2E-04	1.65	19.3	0.80

The samples will be shipped back to you in the next few weeks. If you have any questions regarding the results on the samples please feel free to call.

Sincerely,

Renee Y. Bowser
Lab Supervisor

RYB/b

R
A
E
Rogers & Associates Engineering Corporation

Post Office Box 330
Salt Lake City, Utah 84110
(801) 263-1600

18/32

MAY 12 1988

May 9, 1988

Mr. C.O. Sealy
UMETCO Minerals Corporation
P.O. Box 1029
Grand Junction, CO 81502

C8700/22

Dear Mr. Sealy:

The tests for radium content and radon emanation coefficient in the following samples have been completed and the results are as follows:

Sample	Radium (pCi/g)	Radon Emanation Coefficient
Random (2,3 & 5)	1.9 $\pm$ 0.1	0.19 $\pm$ 0.04
Site 1	2.2 $\pm$ 0.1	0.20 $\pm$ 0.03
Site 4	2.0 $\pm$ 0.1	0.11 $\pm$ 0.04

If you have any questions regarding these results please feel free to call Dr. Kirk Nielson or me.

Sincerely,

Renee Y. Bowser
Lab Supervisor

RYB:ms

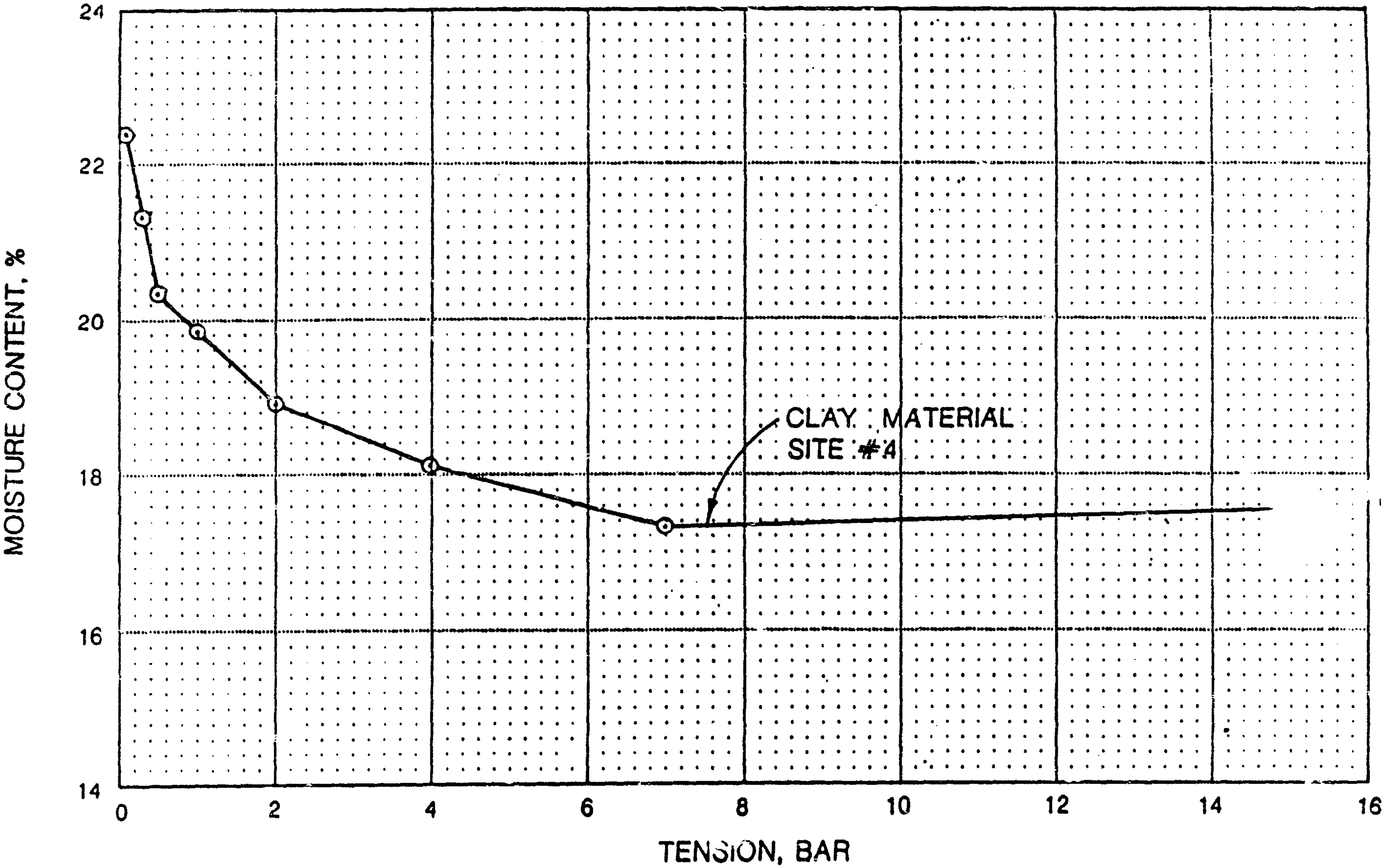


FIGURE 4.4-2
SUMMARY OF CAPILLARY MOISTURE
RELATIONSHIP TEST RESULTS
WHITE MESA PROJECT

DATA FROM CHEN & ASSOCIATES.

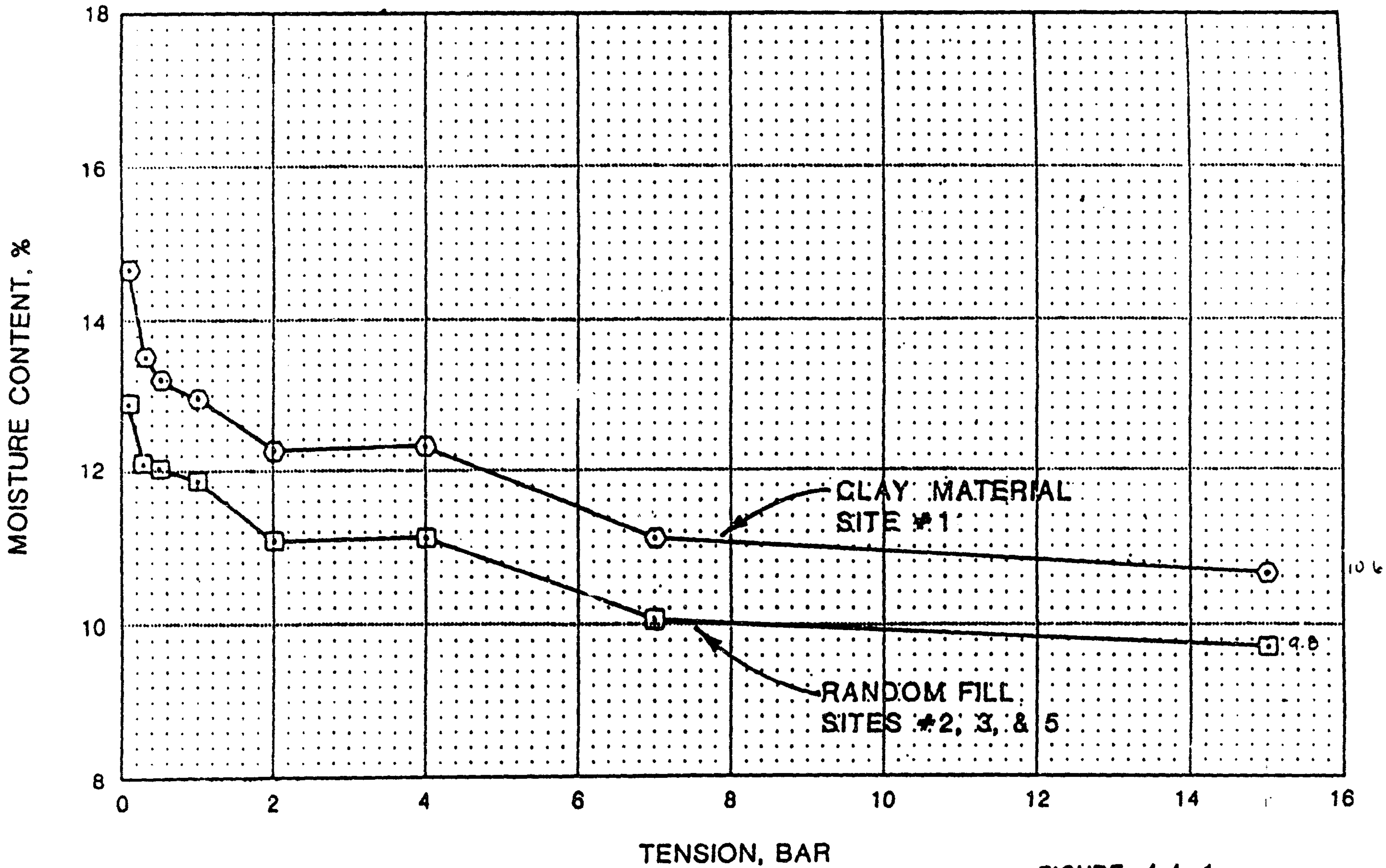


FIGURE 4.4-1

SUMMARY OF CAPILLARY MOISTURE RELATIONSHIP TEST RESULTS

WHITE MESA PROJECT

DATA FROM CHEN & ASSOCIATES

Appendix B2

22/32

833 Parfet Street
Lakewood, Colorado 80215
(303) 232-8308

23/32

ATTERBERG LIMITS TEST
ASTM D 4318

CLIENT Titan Env.

JOB NO. 2234-04

BORING NO.
DEPTH

DATE SAMPLED
DATE TESTED 7-25-96 WEB, RV

SAMPLE NO. UT-1
SOIL DESCR.
TEST TYPE ATTERBERG

Plastic Limit
Determination

	1	2	3
Wt Dish & Wet Soil	3.34	4.06	3.42
Wt Dish & Dry Soil	2.96	3.57	3.03
Wt of Moisture	0.38	0.49	0.39
Wt of Dish	1.05	1.11	1.06
Wt of Dry Soil	1.91	2.46	1.97
Moisture Content	19.90	19.92	19.80

Liquid Limit Device Number 0258
Determination

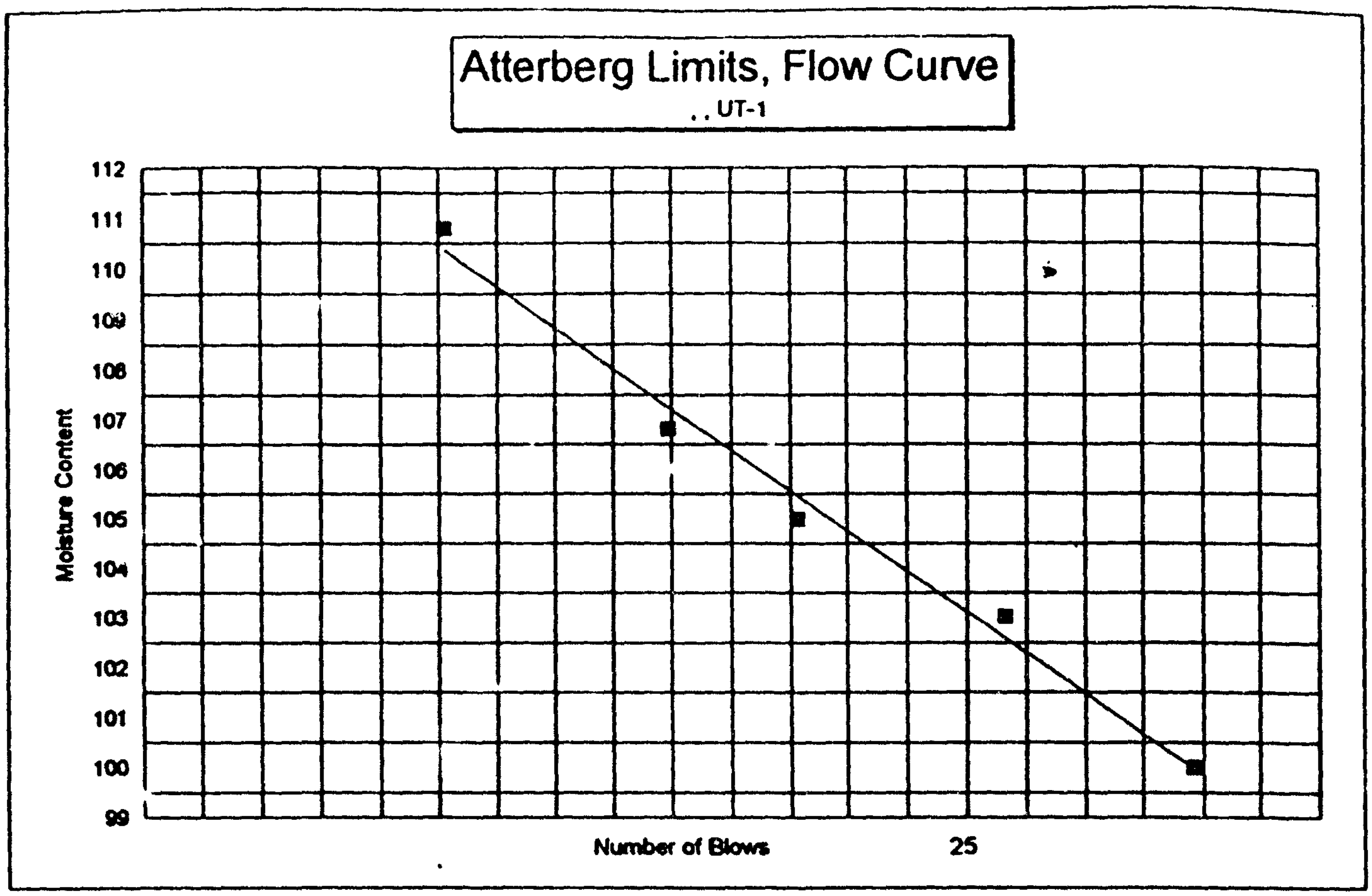
	1	2	3	4	5
Number of Blows	39	27	18	14	9
Wt Dish & Wet Soil	12.18	10.42	10.92	12.33	10.06
Wt Dish & Dry Soil	6.64	5.67	5.87	6.53	5.34
Wt of Moisture	5.54	4.75	5.05	5.80	4.72
Wt of Dish	1.10	1.06	1.06	1.10	1.08
Wt of Dry Soil	5.54	4.61	4.81	5.43	4.26
Moisture Content	100.00	103.04	104.99	106.81	110.80

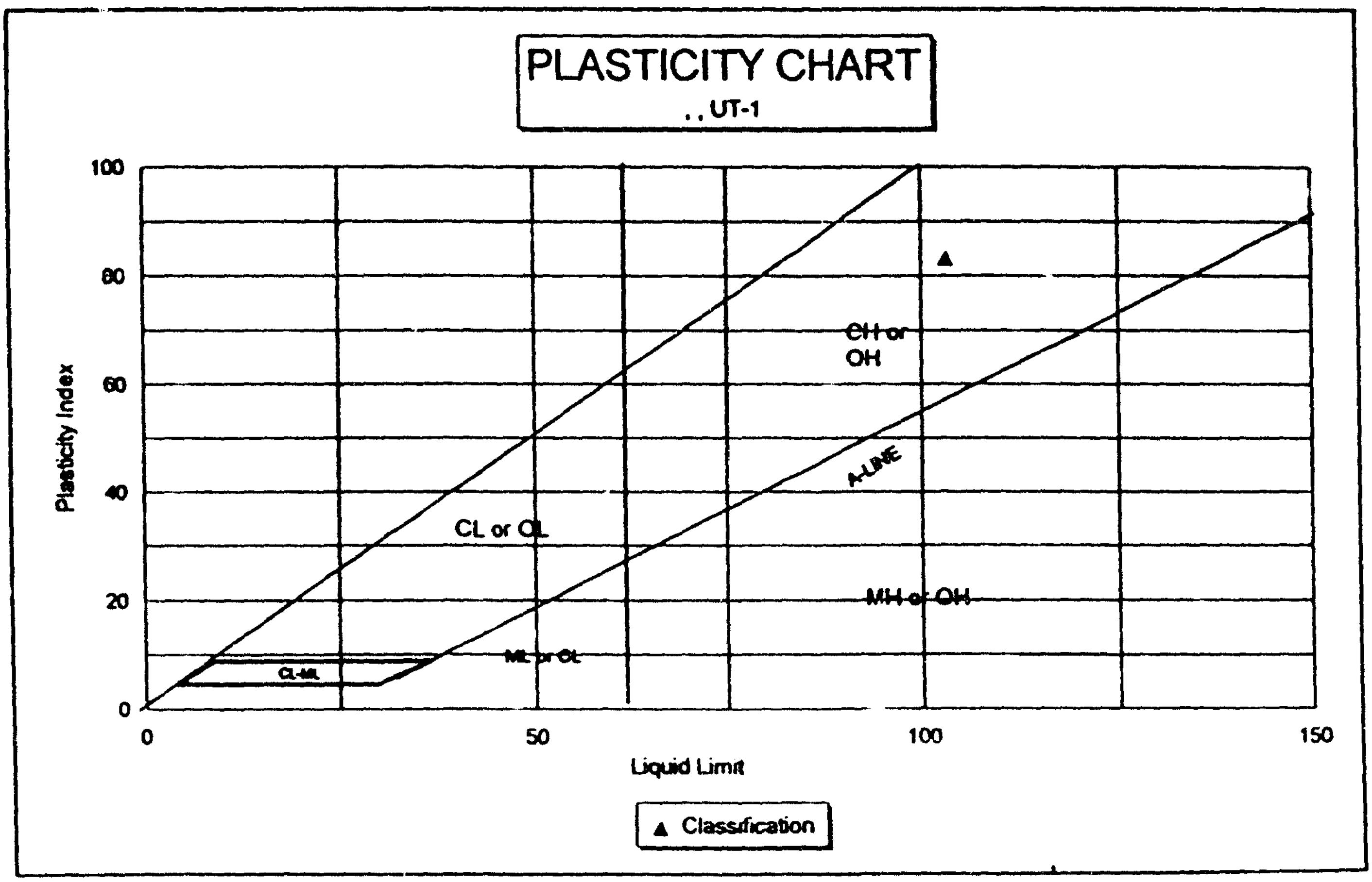
Liquid Limit 103.1
Plastic Limit 19.9
Plasticity Index 83.3

Atterberg Classification CH

Data entry by: NAA Date: 7-26-96
Checked by: [signature] Date: 7-26-96
FileName: TIGOUT1

ADVANCED TERRA TESTING, INC.


Atterberg Limits, Flow Curve
, , UT-1
112
111
110
109
108
107
106
105
104
103
102
101
100
99
Moisture Content
Number of Blows
25


PLASTICITY CHART
, , UT-1
100
80
60
40
20
0
Plasticity Index
CH or
OH
A-LINE
CL or OL
MH or OH
ML or OL
CL-ML
0
50
100
150
Liquid Limit
Classification

C .PACTION TEST
ASTM D 1557 A

CLIENT: Tltan Env.

JOB NO. 2234-04

25/32

BORING NO.
:PTH
.AMPLE NO. UT-1

SOIL DESCR.
DATE SAMPLED
DATE TESTED 7-25-96 RV

Moisture determination

	1	2	3	4	5
Wt of Moisture added (ml)	100.00	150.00	250.00	350.00	450.00
Wt. of soil & dish (g)	384.26	393.92	291.42	244.20	281.17
Dry wt. soil & dish (g)	350.6C	355.61	251.40	202.69	225.04
Net loss of moisture (g)	33.66	38.31	40.02	41.51	56.13
Wt. of dish (g)	8.01	8.34	8.31	8.29	8.43
Net wt. of dry soil (g)	342.59	347.27	243.09	194.40	216.61
Moisture Content (%)	9.83	11.03	16.46	21.35	25.91
Corrected Moisture Content					

Density determination

Wt of soil & mold (lb)	14.20	14.49	14.68	14.59	14.46
Wt. of mold (lb)	10.36	10.36	10.36	10.36	10.36
Net wt. of wet soil (lb)	3.84	4.13	4.32	4.23	4.10
'''t wt of dry soil (lb)	3.50	3.72	3.71	3.49	3.26
, Density, (pcf)	104.89	111.59	111.28	104.57	97.69
Corrected Dry Density (pcf)					
Volume Factor	30	30	30	30	30

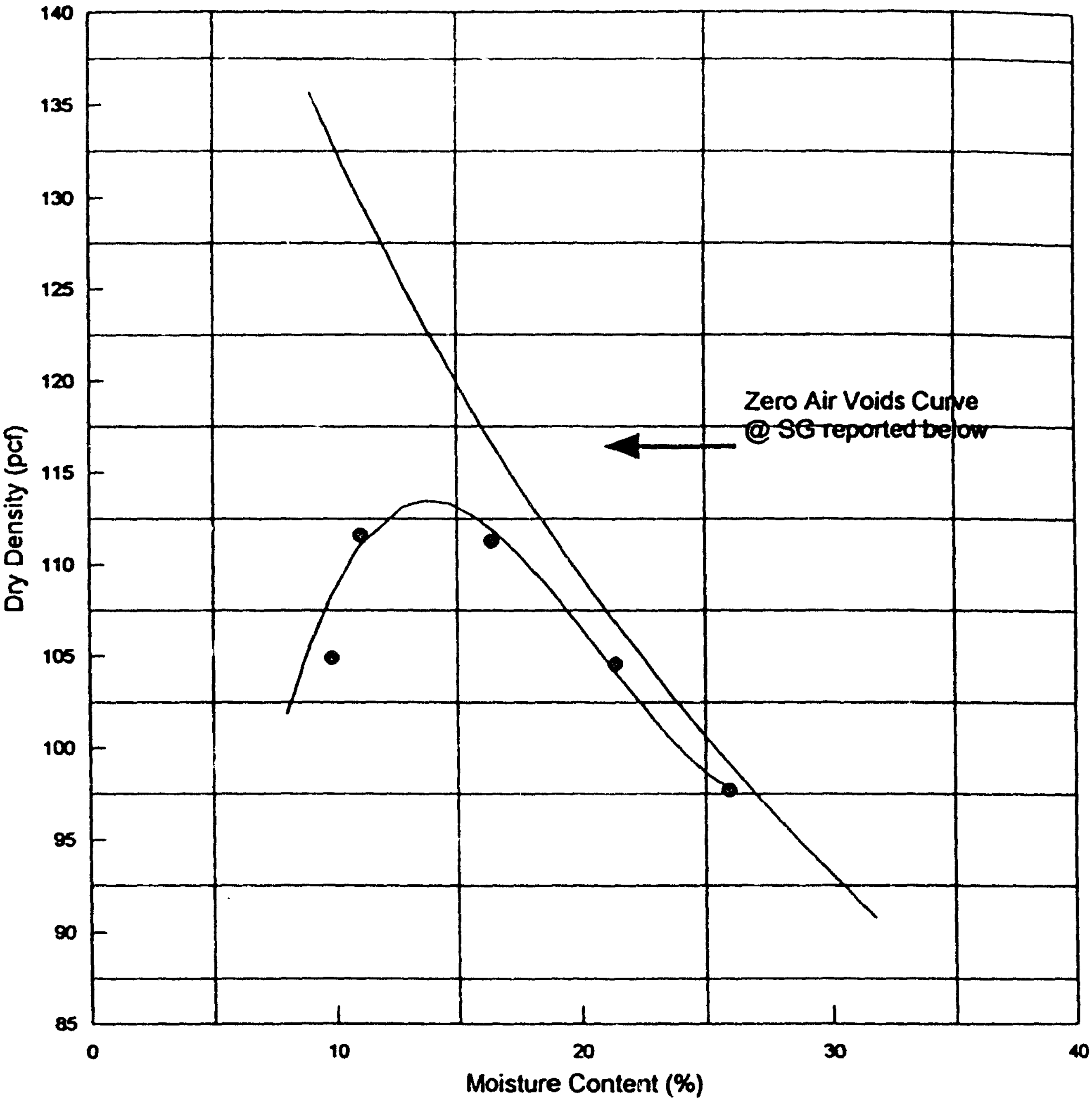
Data entered by: RV Date: 7-26-96
a checked by: [signature] Date: 7-26-96
FileName: TIPRUT-1

ADVANCED TERRA TESTING, INC

Proctor Compaction Test

, , UT-1

26/32



- Best Fit Curve
- Actual Data
- Zero Air VoidsCurve @ SG = 2.70

OPTIMUM MOISTURE CONTENT = 13.9 MAXIMUM DRY D[illegible]SITY = 113.5
ASTM D 1557 A, Rock correction applied? N

ADVANCED TERRA TESTING, INC.

PERMEABILITY DETERMINATION
FALLING HEAD
FIXED WALL

27/32

CLIENT	Titan Environmental	JOB NO.	2234-04	
BORING NO.				
DEPTH		SAMPLED		
SAMPLE NO.	UT-1	TEST STARTED	7-28-96	CAL
SOIL DESCR.	Remolded 95% Mod Pt. @ OMC	TEST FINISHED	8-7-96	CAL
SURCHARGE	200	SETUP NO.	1	

MOISTURE/DENSITY DATA		BEFORE TEST	AFTER TEST
Wt. Soil & Ring(s)	(g)	386.9	404.5
Wt. Ring(s)	(g)	93.0	93.0
Wt. Soil	(g)	293.9	311.4
Wet Density	PCF	122.3	120.5
Wt. Wet Soil & Pan	(g)	302.4	319.9
Wt. Dry Soil & Pan	(g)	266.2	266.2
Wt. Lost Moisture	(g)	36.2	53.8
Wt. of Pan Only	(g)	8.5	8.5
Wt. of Dry Soil	(g)	257.7	257.7
Moisture Content	%	14.1	20.9
Dry Density	PCF	107.2	99.7
Max. Dry Density	PCF	113.5	113.5
Percent Compaction		94.4	87.8

ELAPSED TIME (MIN)	BURETTE READING h1 (CC)	BURETTE READING h2 (CC)	PERCOLATION RATE FT/YEAR	PERCOLATION RATE CM/SEC
	0.2			
2599	10.8	10.8	0.14	1.4E-07
1427	14.2	14.2	0.09	8.4E-08
1440	16.8	16.8	0.07	6.5E-08
1440	18.6	18.6	0.05	4.6E-08
1440	20.2	20.2	0.04	4.1E-08
1440	21.6	21.6	0.04	3.7E-08
1469	23.0	23.0	0.04	3.6E-08
1440		24.4	0.04	3.7E-08

Data Entered By: NAA Date: 8-8-96
Date Checked By: [illegible] Date: 8-8-96
Filename:TIFHUT1

ADVANCED TERRA TESTING, INC.

Rogers & Associates Engineering Corporation

28/32

REPORT OF RADON DIFFUSION COEFFICIENT MEASUREMENTS
(TIME-DEPENDENT DIFFUSION TEST METHOD RAE-SQAP-3.6)

Report Date: 9/3/96
Contract: C960019
By: BCR
Date Received: 8/96

Sample Identification: Titan Environmental

Sample ID	Moisture (Dry Wt. %)	Density (g/cm^3)	Radon Diffusion Coefficient (cm^2/s)	Saturation (Mp/P)	Specific Gravity (g/cm^3)
UT-1	14.6%	1.72	9.1E-03	0.89	2.39

RAE

Post Office Box 330
Salt Lake City • Utah 84110
(801) 263-1600

Rogers & Associates Engineering Corporation

29/32

REPORT OF RADIUM CONTENT AND EMANATION COEFFICIENT MEASUREMENTS

(LAB PROCEDURE RAE-SQAP-3.1)

Report Date: 9/3/96
Contract: C9600/9
By: BCR
Date Received: 8/96

Sample Identification: Titan Environmental

Sample ID	Moisture (Dry Wt. %)	Radon Emanation Coefficient	Radium-226 (pCi/g)	Comments
UT-1	14.6%	0.22 ± 0.04	1.5 ± 0.3	

RAE

Post Office Box 330
Salt Lake City • Utah 84110
(801) 263-1600

Appendix C

31/32

...from the Professors who know it best...

PRINCIPLES & PRACTICE OF CIVIL ENGINEERING

—2nd Edition—

The most efficient and authoritative review book for the PE License Exam

Editor: MERLE C. POTTER, PhD, PE
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Authors:	Mackenzie L. Davis, PhD, PE	Water Quality
	Richard W. Furlong, PhD, PE	Structures
	David A. Hamilton, MS, PE	Hydrology
	Ronald Harichandran, PhD, PE	Structures
	Thomas L. Maleck, PhD, PE	Transportation
	George E. Mase, PhD	Mechanics
	Merle C. Potter, PhD, PE	Fluid Mechanics
	David C. Wiggert, PhD,PE	Hydraulics
	Thomas F. Wolff, PhD, PE	Soils

The authors are professors at Michigan State University, with the exception of R. W. Furlong, who teaches at the University of Texas at Austin and D. A. Hamilton who is employed by the Michigan Department of Natural Resources.

published by:

GREAT LAKES PRESS

P.O. Box 483

Okemos, MI 48805-0483

14.5 Other Useful Equations for Weight-Volume Problems

It is strongly recommended that weight-volume problems be solved using phase diagrams rather than only formulas, as completing a phase diagram clearly indicates whether sufficient information is known to complete the problem, whether information is insufficient and assumptions must be made, or whether too much information is present and the problem is overconstrained. For example, it may not be immediately apparent from the information given whether a soil is saturated until all quantities are calculated. Nevertheless, following are given additional useful equations that may be used to solve certain classes of weight-volume problems.

A very useful equation relating four different quantities is

$$Se = wG_s \tag{14.5.1}$$

For saturated soils (S = 100%) there results

$$e = wG_s \tag{14.5.2}$$

The relationships between the void ratio and porosity are

$$e = \frac{n}{1-n} \tag{14.5.3}$$

and

$$* \quad n = \frac{e}{1+e} \tag{14.5.4}$$

n = porosity
e = Volume of Voids / Volume of Solids

The total unit weight can be obtained as

$$\gamma = \frac{(G_s + Se)\gamma_w}{1+e} = \frac{(1+w)\gamma_w}{w/S + 1/G_s} \tag{14.5.5}$$

The dry unit weight can be obtained as

$$* \quad \gamma_d = \frac{G_s\gamma_w}{1+e} = \frac{G_s\gamma_w}{1+(wG_s/S)} \tag{14.5.6}$$

γ_d: Dry Bulk Density
G_s: Specific Gravity
γ_w: Density of Water

EXAMPLE 14.8

Rework example 14.6 using equations introduced in this section.

Solution.

$$Se = wG_s$$

$$S = wG_s/e = (.20)(2.65)/(0.800) = 0.6625 \text{ or } 66.3\%$$

$$n = \frac{e}{1+e} = \frac{0.800}{1+0.800} = 0.444$$

$$\gamma = \frac{(1+w)\gamma_w}{w/S + 1/G_s} = \frac{(1.20)(62.4)}{0.2/0.6625 + 1/2.65} = 110.2 \text{ lb/ft}^3$$

$$\gamma_d = \frac{G_s\gamma_w}{1+e} = \frac{(2.65)(62.4)}{1+0.800} = 91.9 \text{ lb/ft}^3$$

APPENDIX C

Radon Flux Measurments

1994 Results

Site Specific Sample Results (reference Figure 6-1)

(a) The mean radon flux for each region within each cell is as follows:

Cell 2 - Cover Area = 7.7 pCi/m^2-s (based on 225,882 m^2 area)
- Beach Areas = 23.3 pCi/m^2-s (based on 41,761 m^2 area)
- Standing Liquid Areas = 0 pCi/m^2-s (based on 2,982 m^2 area)

Cell 3 - Cover Area = 7.5 pCi/m^2-s (based on 82,762 m^2 area)
- Beach Areas = 39.7 pCi/m^2-s (based on 62,761 m^2 area)
- Standing Liquid Areas = 0 pCi/m^2-s (based on 143,335 m^2 area)

Note: Reference Appendix E of this report for entire summary for individual measurement results and specific sample region maps.

(b) Using the data presented above, we have calculated the total mean radon flux for each pile (cell) as follows:

Cell 2 = 10.0 pCi/m^2-s

$$\frac{(7.7)(225,882) + (23.3)(41,761) + (0)(2,982)}{270,625}$$

Cell 3 = 10.8 pCi/m^2-s

$$\frac{(7.5)(82,762) + (39.7)(62,761) + (0)(143,335)}{288,858}$$

1995 Results

6.0 SAMPLE RESULTS/CALCULATIONS

Referencing 40 CFR, Part 61, Subpart W, Appendix B, Method 115 - Monitoring for Radon-222 Emissions, Subsection 2.1.7 - Calculations, "the mean radon flux for each region of the pile and for the total pile shall be calculated and reported as follows:

(a) The individual radon flux calculations shall be made as provided in Appendix A EPA 86(1). The mean radon flux for each region of the pile shall be calculated by summing all individual flux measurements for the region and dividing by the total number of flux measurements for the region.

(b) The mean radon flux for the total uranium mill tailings pile shall be calculated as follows:

$$J_s = \frac{J_1A_1 + \ldots J_iA_i\ [+] \ldots J_iA_i}{A_t}$$

Where: J_s = Mean flux for the total pile (pCi/m^2-s)
J_i = Mean flux measured in region i (pCi/m^2-s)
A_i = Area of region i (m^2)
A_t = Total area of the pile (m^2)

2.1.8 Reporting. The results of individual flux measurements, the approximate locations on the pile, and the mean radon flux for each region and the mean radon flux for the total stack [pile] shall be included in the emission test report. Any condition or unusual event that occurred during the measurements that could significantly affect the results should be reported."

Site Specific Sample Results (reference Figure 6-1)

(a) The mean radon flux for each region within each cell is as follows:

Cell 2 - Cover Area = 6.1 pCi/m^2-s (based on 225,882 m^2 area)
- Beach Areas = 28.4 pCi/m^2-s (based on 41,761 m^2 area)
- Standing Liquid Areas = 0 pCi/m^2-s (based on 2,982 m^2 area)

Cell 3 - Cover Area = 11.1 pCi/m^2-s (based on 82,762 m^2 area)
- Beach Areas = 44.8 pCi/m^2-s (based on 62,761 m^2 area)
- Standing Liquid Areas = 0 pCi/m^2-s (based on 143,335 m^2 area)

Note: Reference Appendix B of this report for entire summary for individual measurement results and specific sample region maps.

(b) Using the data presented above, we have calculated the total mean radon flux for each pile (cell) as follows:

Cell 2 = 9.5 pCi/m²-s

$$\frac{(6.1)(225,882) + (28.4)(41,761) + (0)(2,982)}{270,625}$$

Cell 3 = 12.9 pCi/m²-s

$$\frac{(11.1)(82,762) + (44.8)(62,761) + (0)(143,335)}{288,858}$$

APPENDIX D

HELP Model

TITAN Environmental

By TAM Date 9/11/96 Subject EFN - White Mesa Page 1 of 34
Chkd By [initials] Date 9/11/96 Help Model Proj No 6111-001

Purpose: To determine the required soil cover thicknesses to minimize surface water infiltration through the White Mesa tailings impoundments so that precipitation will not fully penetrate the soil cover. The White Mesa Mill site is located in Blanding, Utah. The performance of the tailings cover was evaluated using the Hydrologic Evaluation of Landfill Performance (HELP) Model. The HELP model was developed to facilitate rapid, economical estimation of the amounts of surface runoff, subsurface drainage, and leachate that may be expected to result from the operation of a wide variety of possible cover designs.

Method: Determine the soil properties of the cover materials and climatic properties of Blanding, Utah based on existing database values previously collected, and acceptable default parameters. Input parameters into the computer modeling program "HELP" to determine the percolation through the cover materials. A variety of scenarios adjusting cover thicknesses were run to determine the optimum thicknesses of cover materials to eliminate percolation through the bottom cover layer. The modeled tailings cover consists of a compacted clay layer over the tailings, with a random fill soil layer covering the clay.

The model was developed for Cell 3 at the White Mesa Mill since it is the largest of the three cells to be covered (Cells 2, 3, and 4A). Figure 1 shows the location of the cells. The cover requirements determined for Cell 3 will be applied to the remaining cells as well. This is a conservative approach since the remaining cells are smaller in size and require less time and distance for precipitation runoff.

Results: A two-layer uranium mill tailings cover composed of a 2-foot layer of random fill over a 1-foot compacted clay layer will reduce percolation into the tailings material to a negligible quantity (see Appendix A for HELP results). As indicated by the model results, precipitation will either runoff the soil cover or be evaporated.

The cover thicknesses recommended above were also determined to be the minimum thickness requirements for White Mesa tailings covers based on results from radon flux calculations (see "Calculation of Radon Flux from the White Mesa Tailings Cover", 9/11/96). As indicated in the Radon Flux calculation, to restrict radon flux to 20 pCi/m2/sec, (Regulatory Guide 3.64), a cover consisting of 2-feet random fill and 1-foot compacted clay is required.

Parameters: The HELP model requires input of the following parameters for the cover materials:

- Weather Data:
  - Evapotranspiration
  - Precipitation
  - Temperature
  - Solar Radiation

- Soil and Design Data:
  - Landfill area (area of Cell 3)
  - Percent of area where runoff is possible
  - Moisture content initialization

- Cover Layer Data:
  - Layer type
  - Default soil/material texture number
  - Runoff curve number

Weather Data

Evapotranspiration and *solar radiation* data was input using the default parameters from Grand Junction, Colorado. Grand Junction is located north east of Blanding Utah in a similar climate and elevation. The elevation at Grand Junction is 4,600 feet and the elevation at Blanding Utah is 5,600 feet. Figure 1 in Appendix B shows the locations of Blanding and Grand Junction in relation to one another.

Precipitation data from 1988 to 1993 (skipping 1989) was obtained from Utah State University (see Appendix C). Daily precipitation values for the five years were input manually into the HELP model. *Temperature* data was obtained from the Dames & Moore (1978) and is also included in Appendix C. Daily temperature data was not available for manual entry therefore, the computer calculated mean monthly temperatures based on the default location (Grand Junction, Colorado). These values were then edited to match the actual mean monthly temperatures for Blanding, Utah.

Soil and Design Data

The surface area of Cell 3 at the White Mesa Mill, Blanding, Utah was used for the landfill area value. The surface area, as indicated on Figure 1, is 78.7 acres. It was assumed that runoff was possible over 100% of this area and that no rain would sit on the tailings cover.

Cover Layer Data

Layer Thickness:
A two-layer cover over approximately 28 feet of uranium mill tailings was used to run the HELP model. Actual cover thicknesses which would be constructed on site consist of 2-feet of random fill over a 1-foot compacted clay layer. This cover profile was adjusted for modeling purposes to account for freezing and thawing conditions. As indicated in the "Effects of Freezing on Uranium Mill Tailings Covers Calculation Brief" (6/17/96), 6.8 inches of the top random fill cover layer will be effected by freeze/thaw conditions at Blanding, Utah. This suggests that 6.8 inches of the top layer may not contribute to reductions of infiltration into the tailings piles. To conservatively compensate for effects from freezing and thawing, 6.8 inches were subtracted from the top random fill cover layer. Therefore, modeled layer thicknesses consisted of 17.2 inches of random fill over 12 inches of clay.

Layer Type:
The random fill soil layer was classified as a vertical percolation layer. Vertical percolation layers are composed of moderate to high permeability material that drains vertically, primarily as unsaturated flow. The clay layer was classified as a barrier soil liner. This material consists of low permeability soil designed to limit percolation/leakage and drains only vertically as a saturated flow.

Moisture Storage Parameters:
Required moisture storage parameters such as; porosity, field capacity, wilting point, initial soil water content, and permeability, are interrelated with the exception of permeability. The porosity must be greater than zero but less than 1. The field capacity must be between zero and 1 but must be smaller than the porosity. The wilting point must be greater than zero but less than the field capacity, and the initial moisture content must be greater than or equal to the wilting point and less than or equal to the porosity (U.S. EPA, 1994).

Based on these relations, actual measured porosity and permeability values were input for random fill (Chen and Associates, 1987) and clay (Advanced Terra Testing, 1996, sample UT-1). See Appendix D for physical property data. In addition, wilting point data for the layers was se*

equal to the long-term moisture content of the materials and the soil water content was adjusted to equal the optimum moisture content. Field capacity values just less than the porosity's were assumed to maintain the interrelationship of the parameters.

Runoff Curve Number
The runoff curve number was calculated by the HELP model based on a minimum surface slope of 0.2%, slope length of 1,200 feet, soil texture of the top layer, and vegetation. A slope length of 1,200 feet was assumed to be the maximum distance which precipitation would travel over the soil cover. The top layer on the tailings cover will be minimum 3" of rock riprap (sandstone) therefore, no vegetation will exist. This top layer, however, was not included in the model to determine percolation quantities.

References:

Advanced Terra Testing, 1996, Physical soil data, White Mesa Project, Blanding Utah, July 25, 1996.

Chen and Associates, 1987. Physical soil data, White Mesa Project, Blanding, Utah.

Dames & Moore, 1978. "Environmental Report, White Mesa Uranium Project, San Juan County Utah", January 20, 1978, revised May 15, 1978.

Principles & Practice of Civil Engineering, 2nd Edition, 1996.

U.S. Environmental Protection Agency (EPA), 1994. "The Hydrologic Evaluation of Landfill Performance (HELP) Model", September, 1994.

Utah Climate Center, Utah State University, Daily Precipitation Values, Station #42073807, Blanding, Utah, January 1988 through December 1993.

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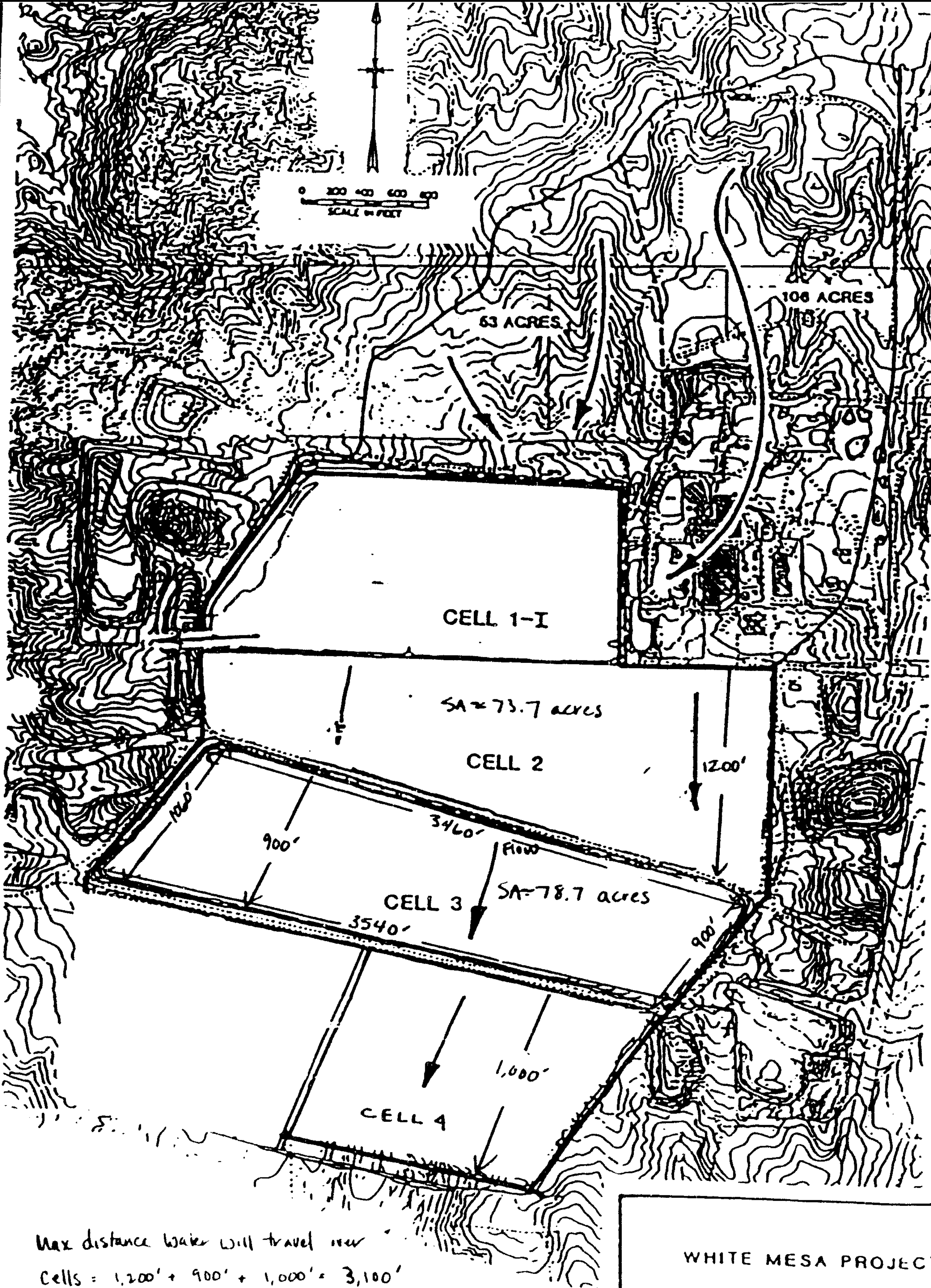

WHITE MESA PROJECT

SITE DRAINAGE

FIGURE: 1

Appendix A

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******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
 *          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                   **
**            HELP MODEL VERSION 3.01   (14 OCTOBER 1994)                   **
**               DEVELOPED BY ENVIRONMENTAL LABORATORY                      **
**                 USAE WATERWAYS EXPERIMENT STATION                        **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY                 **
**                                                                          **
**                                                                          **
******************************************************************************
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```
PRECIPITATION DATA FILE:     C:\HELP3\PRECIP.D4
TEMPERATURE DATA FILE:       C:\HELP3\TEMP2.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\SOLAR.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\EVAP.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\efn-fin2.D10
OUTPUT DATA FILE:            C:\HELP3\efn-fin2.OUT


TIME:  14: 9     DATE:   9/11/1996


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

     TITLE:  EFN - White Mesa

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


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                  LAYER  1
                                  --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  88
           THICKNESS                    =     17.20    INCHES
           POROSITY                     =      0.3150 VOL/VOL
           FIELD CAPACITY               =      0.3140 VOL/VOL
           WILTING POINT                =      0.0980 VOL/VOL
           INITIAL SOIL WATER CONTENT   =      0.1180 VOL/VOL
           EFFECTIVE SAT. HYD. COND.    =  0.886999999000E-06 CM/SEC


                                  LAYER  2
```

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TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 89

THICKNESS	=	12.00	INCHES
POROSITY	=	0.2800	VOL/VOL
FIELD CAPACITY	=	0.2799	VOL/VOL
WILTING POINT	=	0.1410	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2800	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.369999995000E-07	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #27 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 0.% AND A SLOPE LENGTH OF 1200. FEET.

SCS RUNOFF CURVE NUMBER	=	96.40	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	78.700	ACRES
EVAPORATIVE ZONE DEPTH	=	17.2	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.030	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	5.418	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.686	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	5.390	INCHES
TOTAL INITIAL WATER	=	5.390	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM GRAND JUNCTION COLORADO

MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	109	
END OF GROWING SEASON (JULIAN DATE)	=	293	
AVERAGE ANNUAL WIND SPEED	=	8.10	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	60.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	36.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	36.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	57.00	%

NOTE: PRECIPITATION DATA FOR BLANDING UTAH WAS ENTERED BY THE USER.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GRAND JUNCTION COLORADO

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

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JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
27.50	32.90	38.10	47.10	57.40	66.90
73.60	70.90	63.00	51.60	38.50	28.90

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GRAND JUNCTION COLORADO

STATION LATITUDE = 39.07 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1988 THROUGH 1993

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.10	1.32	0.92	0.46	1.31	0.60
	1.17	1.37	1.16	1.24	1.07	1.18
STD. DEVIATIONS	1.85	1.43	0.72	0.37	0.71	0.62
	0.92	0.43	0.35	0.66	0.51	0.71
RUNOFF						
TOTALS	1.455	0.999	0.542	0.265	0.871	0.389
	0.774	0.885	0.802	0.785	0.713	0.568
STD. DEVIATIONS	1.967	1.206	0.425	0.240	0.472	0.494
	0.691	0.350	0.220	0.495	0.432	0.441
EVAPOTRANSPIRATION						
TOTALS	0.700	0.411	0.331	0.224	0.413	0.231
	0.353	0.490	0.424	0.394	0.402	0.534
STD. DEVIATIONS	0.072	0.246	0.236	0.110	0.296	0.201
	0.243	0.211	0.223	0.235	0.141	0.191
PERCOLATION/LEAKAGE THROUGH LAYER 2						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 2

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1988 THROUGH 1993

	INCHES		CU. FEET	PERCENT
PRECIPITATION	13.90	(2.614)	3971537.7	100.00
RUNOFF	9.048	(2.4802)	2584718.25	65.081
EVAPOTRANSPIRATION	4.908	(0.7521)	1402180.62	35.306
.ERCOLATION/LEAKAGE THROUGH FROM LAYER 2	0.00000	(0.00000)	0.000	0.00000
AVERAGE HEAD ACROSS TOP OF LAYER 2	0.000	(0.000)		
CHANGE IN WATER STORAGE	-0.054	(0.1827)	-15362.23	-0.387

****

****

PEAK DAILY VALUES FOR YEARS 1988 THROUGH 1993

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	(INCHES)	(CU. FT.)
PRECIPITATION	1.33	379955.719
RUNOFF	1.684	481108.4370
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.000000	0.00000
AVERAGE HEAD ACROSS LAYER 2	0.000	
SNOW WATER	2.96	845040.4370

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.1182
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0962

****

****

FINAL WATER STORAGE AT END OF YEAR 1993 12/34

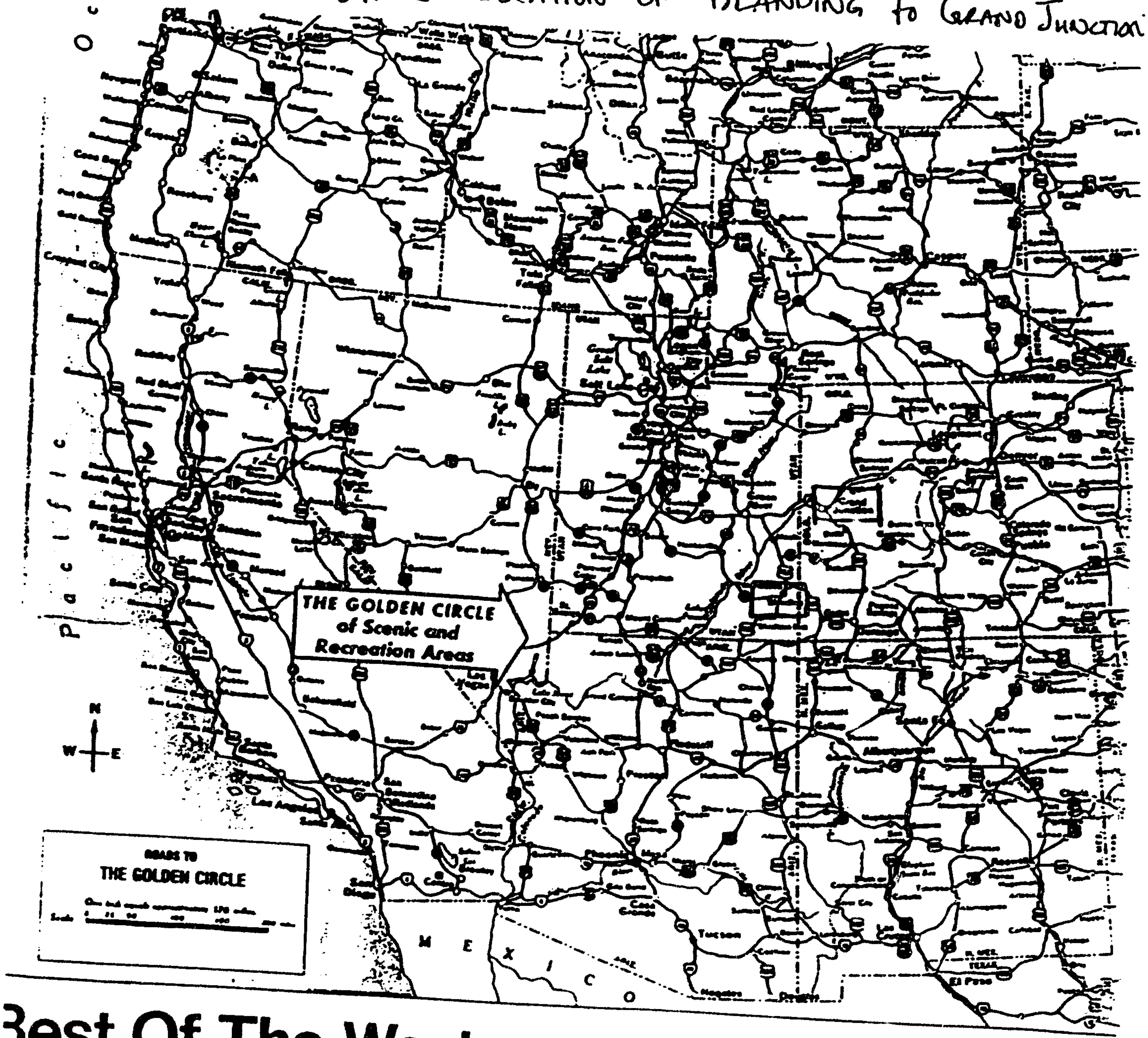
LAYER	(INCHES)	(VOL/VOL)
1	1.7607	0.1024
2	3.3600	0.2800
SNOW WATER	0.000	

****

****

Appendix B

Figure 1
Shows location of Blanding to Grand Junction



Best Of The West . . .

tah combines the best of the West ithin Utah's 85,000 square miles is a ncentrated collage of western folk- re scenery and history

eer into Utah and sample some of our e national parks, seven national mon- ents and two national recreation eas. Drive into our 43 state parks or ght national forests. Explore the untry on this map and you'll soon ho the statement first made by pio- er settlers to Utah: "This Is the Place"

IVE NATIONAL PARKS

Southeastern Utah is the place for the world's greatest—and most concen- trated—repertory of stone arches. Arches National Park's trademark is Delicate Arch, although Landscape Arch is a world record-holder with a span of 291 feet.

WHITE WATER CANYONS

The Colorado River glides past Arches and churns into Canyonlands National Park 40 miles southwest. *National Geo- graphic* labels Canyonlands "the realm of rock and far horizons." T...

Eighty percent of Utah's 1.2 million people live along the foothills of the Wasatch Mountains. Salt Lake City is not only the cultural and social hub of Utah, but also the international base for the Mormon Church.

The Utah Symphony, Ballet West, Utah Repertory Dance Theater and the Pio- neer Memorial Theater all lend a cos- mopolitan atmosphere to Salt Lake City. Professional sports are represented by the Golden Eagles hockey club and the Salt Lake Gulls baseball team.

Appendix C

Yearly Total (in) →

Daily Precipitation Values, Station #42073807, Blanding, Utah									
January, 1988 through February, 1994									
11.40		13.39		11.74		15.32		17.66	
Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)
1/1/88	0	1/1/90	0	1/1/91	0	1/1/92	0	1/1/93	0
1/2/88	0	1/2/90	0	1/2/91	0	1/2/92	0	1/2/93	0
1/3/88	0	1/3/90	0.2	1/3/91	0.15	1/3/92	0.04	1/3/93	0
1/4/88	0.06	1/4/90	0	1/4/91	0.96	1/4/92	0.31	1/4/93	0
1/5/88	0.19	1/5/90	0	1/5/91	0.08	1/5/92	0.02	1/5/93	0
1/6/88	0.17	1/6/90	0	1/6/91	0	1/6/92	0.42	1/6/93	0.34
1/7/88	0	1/7/90	0	1/7/91	0	1/7/92	0.03	1/7/93	0.36
1/8/88	0.01	1/8/90	0	1/8/91	0	1/8/92	0	1/8/93	1
1/9/88	0	1/9/90	0	1/9/91	0	1/9/92	0	1/9/93	0.01
1/10/88	0	1/10/90	0	1/10/91	0	1/10/92	0	1/10/93	0.51
1/11/88	0								
1/12/88	0	1/11/90	0	1/11/91	0	1/11/92	0	1/11/93	0.41
1/13/88	0	1/12/90	0	1/12/91	0	1/12/92	0	1/12/93	0
1/14/88	0	1/13/90	0.04	1/13/91	0.01	1/13/92	0	1/13/93	0.21
1/15/88	0	1/14/90	0	1/14/91	0	1/14/92	0	1/14/93	0.2
1/16/88	0	1/15/90	0.14	1/15/91	0.02	1/15/92	0	1/15/93	0
1/17/88	0.89	1/16/90	0.03	1/16/91	0	1/16/92	0	1/16/93	0.49
1/18/88	0.71	1/17/90	0.06	1/17/91	0	1/17/92	0	1/17/93	0.16
1/19/88	0	1/18/90	0.29	1/18/91	0	1/18/92	0	1/18/93	0.88
1/20/88	0	1/19/90	0.32	1/19/91	0	1/19/92	0	1/19/93	0.31
1/21/88	0	1/20/90	0	1/20/91	0	1/20/92	0	1/20/93	0
1/22/88	0	1/21/90	0	1/21/91	0	1/21/92	0	1/21/93	0
1/23/88	0	1/22/90	0	1/22/91	0	1/22/92	0	1/22/93	0
1/24/88	0	1/23/90	0	1/23/91	0	1/23/92	0	1/23/93	0
1/25/88	0	1/24/90	0	1/24/91	0	1/24/92	0	1/24/93	0
1/26/88	0	1/25/90	0	1/25/91	0	1/25/92	0	1/25/93	0
1/27/88	0	1/26/90	0	1/26/91	0	1/26/92	0	1/26/93	0
1/28/88	0	1/27/90	0	1/27/91	0	1/27/92	0	1/27/93	0
1/29/88	0	1/28/90	0	1/28/91	0	1/28/92	0	1/28/93	0
1/30/88	0	1/29/90	0	1/29/91	0	1/29/92	0	1/29/93	0
1/31/88	0	1/30/90	0	1/30/91	0	1/30/92	0	1/30/93	0.22
2/1/88	0	1/31/90	0.03	1/31/91	0	1/31/92	0	1/31/93	0.21
2/2/88	0.4	2/1/90	0.06	2/1/91	0	2/1/92	0	2/1/93	0.16
2/3/88	0.06	2/2/90	0.03	2/2/91	0	2/2/92	0	2/2/93	0
2/4/88	0	2/3/90	0	2/3/91	0	2/3/92	0	2/3/93	0
2/5/88	0	2/4/90	0	2/4/91	0	2/4/92	0.01	2/4/93	0
2/6/88	0	2/5/90	0	2/5/91	0	2/5/92	0	2/5/93	0
2/7/88	0	2/6/90	0	2/6/91	0	2/6/92	0	2/6/93	0
2/8/88	0	2/7/90	0	2/7/91	0	2/7/92	0	2/7/93	0
2/9/88	0	2/8/90	0	2/8/91	0	2/8/92	0.02	2/8/93	1.16
2/10/88	0	2/9/90	0	2/9/91	0	2/9/92	0	2/9/93	0.48
2/11/88	0	2/10/90	0	2/10/91	0	2/10/92	0.3	2/10/93	0.02
2/12/88	0	2/11/90	0	2/11/91	0	2/11/92	0.27	2/11/93	0
2/13/88	0	2/12/90	0	2/12/91	0	2/12/92	0.05	2/12/93	0
2/14/88	0	2/13/90	0	2/13/91	0	2/13/92	0.66	2/13/93	0
2/15/88	0	2/14/90	0.16	2/14/91	0	2/14/92	0	2/14/93	0.01
2/16/88	0	2/15/90	0.06	2/15/91	0	2/15/92	0	2/15/93	0.01
2/17/88	0	2/16/90	0	2/16/91	0.03	2/16/92	0.23	2/16/93	0.08
2/18/88	0	2/17/90	0	2/17/91	0.02	2/17/92	0	2/17/93	0
2/19/88	0	2/18/90	0.03	2/18/91	0	2/18/92	0	2/18/93	0.05
2/20/88	0	2/19/90	0.01	2/19/91	0	2/19/92	0	2/19/93	0.62
2/21/88	0	2/20/90	0.03	2/20/91	0	2/20/92	0	2/20/93	0.7
2/22/88	0	2/21/90	0	2/21/91	0	2/21/92	0	2/21/93	0
2/23/88	0	2/22/90	0	2/22/91	0	2/22/92	0	2/22/93	0
2/24/88	0	2/23/90	0	2/23/91	0	2/23/92	0	2/23/93	0
2/25/88	0	2/24/90	0	2/24/91	0	2/24/92	0	2/24/93	0.4
2/26/88	0	2/25/90	0	2/25/91	0	2/25/92	0	2/25/93	0.04
2/27/88	0.04	2/26/90	0	2/26/91	0	2/26/92	0	2/26/93	0
2/28/88	0	2/27/90	0	2/27/91	0	2/27/92	0	2/27/93	0
2/29/88	0	2/28/90	0	2/28/91	0.4	2/28/92	0	2/28/93	0
3/1/88	0	3/1/90	0.02	3/1/91	0.9	2/29/92	0	3/1/93	0
3/2/88	0	3/2/90	0	3/2/91	0	3/1/92	0	3/2/93	0
3/3/88	0	3/3/90	0	3/3/91	0	3/2/92	0	3/3/93	0
3/4/88	0	3/4/90	0	3/4/91	0	3/3/92	0.34	3/4/93	0

TABLE 1

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Daily Precipitation Values, Station #42073807, Blanding, Utah

January, 1988 through February, 1994

Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)
3/5/88	0	3/5/90	0	3/5/91	0	3/4/92	0	3/5/93	0
3/6/88	0.01	3/6/90	0.01	3/6/91	0	3/5/92	0	3/6/93	0
3/7/88	0	3/7/90	0	3/7/91	0	3/6/92	0	3/7/93	0
3/8/88	0	3/8/90	0	3/8/91	0	3/7/92	0	3/8/93	0
3/9/88	0	3/9/90	0	[illegible]	0	3/8/92	0.25	3/9/93	0
3/10/88	0.01	3/10/90	0.02	3/10/91	0	3/9/92	0.03	3/10/93	0
3/11/88	0	3/11/90	0.15	3/11/91	0	3/10/92	0	3/11/93	0
3/12/88	0	3/12/90	0.23	3/12/91	0	3/11/92	0	3/12/93	0
3/13/88	0	3/13/90	0.06	3/13/91	0	3/12/92	0	3/13/93	0
3/14/88	0	3/14/90	0	3/14/91	0.06	3/13/92	0	3/14/93	0
3/15/88	0	3/15/90	0	3/15/91	0.01	3/14/92	0	3/15/93	0
3/16/88	0.01	3/16/90	0	3/16/91	0	3/15/92	0	3/16/93	0
3/17/88	0	3/17/90	0	3/17/91	0	3/16/92	0	3/17/93	0
3/18/88	0	3/18/90	0	3/18/91	0	3/17/92	0	3/18/93	0.19
3/19/88	0	3/19/90	0	3/19/91	0.03	3/18/92	0	3/19/93	0
3/20/88	0	3/20/90	0	3/20/91	0	3/19/92	0	3/20/93	0
3/21/88	0	3/21/90	0	3/21/91	0.14	3/20/92	0	3/21/93	0
3/22/88	0	3/22/90	0	3/22/91	0	3/21/92	0.03	3/22/93	0
3/23/88	0	3/23/90	0	3/23/91	0	3/22/92	0.02	3/23/93	0
3/24/88	0	3/24/90	0	3/24/91	0	3/23/92	0.05	3/24/93	0
3/25/88	0	3/25/90	0	3/25/91	0	3/24/92	0.02	3/25/93	0
3/26/88	0	3/26/90	0	3/26/91	0.26	3/25/92	0	3/26/93	0.06
3/27/88	0	3/27/90	0	3/27/91	0	3/26/92	0	3/27/93	0.47
3/28/88	0	3/28/90	0	3/28/91	0	3/27/92	0.5	3/28/93	0
3/29/88	0	3/29/90	0	3/29/91	0	3/28/92	0.37	3/29/93	0.01
3/30/88	0	3/30/90	0.08	3/30/91	0	3/29/92	0	3/30/93	0
3/31/88	0	3/31/90	0	3/31/91	0	3/30/92	0.13	3/31/93	0
4/1/88	0	4/1/90	0	4/1/91	0	3/31/92	0.11	4/1/93	0
4/2/88	0	4/2/90	0	4/2/91	0	4/1/92	0.05	4/2/93	0
4/3/88	0	4/3/90	0	4/3/91	0	4/2/92	0	4/3/93	0
4/4/88	0.02	4/4/90	0	4/4/91	0	4/3/92	0	4/4/93	0.03
4/5/88	0	4/5/90	0	4/5/91	0	4/4/92	0	4/5/93	0.04
4/6/88	0	4/6/90	0	4/6/91	0	4/5/92	0	4/6/93	0.5
4/7/88	0	4/7/90	0.06	4/7/91	0	4/6/92	0	4/7/93	0
4/8/88	0	4/8/90	0.11	4/8/91	0	4/7/92	0	4/8/93	0
4/9/88	0	4/9/90	0	4/9/91	0	4/8/92	0	4/9/93	0
4/10/88	0	4/10/90	0	4/10/91	0	4/9/92	0	4/10/93	0
4/11/88	0	4/11/90	0	4/11/91	0	4/10/92	0	4/11/93	0
4/12/88	0	4/12/90	0	4/12/91	0	4/11/92	0	4/12/93	0
4/13/88	0	4/13/90	0	4/13/91	0	4/12/92	0	4/13/93	0
4/14/88	0.06	4/14/90	0	4/14/91	0	4/13/92	0	4/14/93	0
4/15/88	0.2	4/15/90	0	4/15/91	0	4/14/92	0	4/15/93	0
4/16/88	0.16	4/16/90	0	4/16/91	0	4/15/92	0.03	4/16/93	0.02
4/17/88	0.2	4/17/90	0	4/17/91	0	4/16/92	0.03	4/17/93	0
4/18/88	0.02	4/18/90	0	4/18/91	0	4/17/92	0	4/18/93	0
4/19/88	0	4/19/90	0	4/19/91	0	4/18/92	0	4/19/93	0
4/20/88	0	4/20/90	0	4/20/91	0	4/19/92	0	4/20/93	0
4/21/88	0.01	4/21/90	0	4/21/91	0	4/20/92	0	4/21/93	0
4/22/88	0.08	4/22/90	0	4/22/91	0	4/21/92	0	4/22/93	0
4/23/88	0.01	4/23/90	0	4/23/91	0.01	4/22/92	0	4/23/93	0
4/24/88	0.02	4/24/90	0.48	4/24/91	0	4/23/92	0	4/24/93	0
4/25/88	0	4/25/90	0	4/25/91	0	4/24/92	0	4/25/93	0
4/26/88	0	4/26/90	0	4/26/91	0	4/25/92	0	4/26/93	0
4/27/88	0	4/27/90	0	4/27/91	0	4/26/92	0	4/27/93	0
4/28/88	0	4/28/90	0	4/28/91	0	4/27/92	0	4/28/93	0
4/29/88	0	4/29/90	0.09	4/29/91	0	4/28/92	0	4/29/93	0
4/30/88	0	4/30/90	0.06	4/30/91	0	4/29/92	0	4/30/93	0
5/1/88	0	5/1/90	0.83	5/1/91	0	4/30/92	0	5/1/93	0
5/2/88	0	5/2/90	0	5/2/91	0	5/1/92	0	5/2/93	0
5/3/88	0	5/3/90	0	5/3/91	0	5/2/92	0	5/3/93	0
5/4/88	0	5/4/90	0	5/4/91	0	5/3/92	0	5/4/93	0.05
5/5/88	0	5/5/90	0	5/5/91	0	5/4/92	0.07	5/5/93	0.5
5/6/88	0	5/6/90	0	5/6/91	0	5/5/92	0	5/6/93	0
5/7/88	0	5/7/90	0	5/7/91	0	5/6/92	0	5/7/93	0.06

Table 1 (cont)

Daily Precipitation Values, Station #42073807, Blanding, Utah									
January, 1988 through February, 1994									
Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)
5/8/88	0	5/8/90	0	5/8/91	0	5/7/92	0.19	5/8/93	0.15
5/9/88	0	5/9/90	0	5/9/91	0	5/8/92	0	5/9/93	0
5/10/88	0	5/10/90	0	5/10/91	0	5/9/92	0.96	5/10/93	0
5/11/88	0	5/11/90	0	5/11/91	0	5/10/92	0	5/11/93	0
5/12/88	0	5/12/90	0	5/12/91	0	5/11/92	0	5/12/93	0
5/13/88	0	5/13/90	0	5/13/91	0	5/12/92	0	5/13/93	0
5/14/88	0	5/14/90	0	5/14/91	0	5/13/92	0	5/14/93	0
5/15/88	0	5/15/90	0	5/15/91	0.06	5/14/92	0	5/15/93	0.02
5/16/88	0	5/16/90	0	5/16/91	0	5/15/92	0	5/16/93	0.08
5/17/88	0.64	5/17/90	0	5/17/91	0	5/16/92	0	5/17/93	0.35
5/18/88	0.3	5/18/90	0	5/18/91	0	5/17/92	0	5/18/93	0
5/19/88	0.15	5/19/90	0	5/19/91	0	5/18/92	0	5/19/93	0
5/20/88	0	5/20/90	0	5/20/91	0	5/19/92	0.06	5/20/93	0.01
5/21/88	0	5/21/90	0	5/21/91	0	5/20/92	0.05	5/21/93	0
5/22/88	0	5/22/90	0	5/22/91	0	5/21/92	0.06	5/22/93	0
5/23/88	0	5/23/90	0	5/23/91	0	5/22/92	0.36	5/23/93	0
5/24/88	0	5/24/90	0	5/24/91	0	5/23/92	0.02	5/24/93	0
5/25/88	0	5/25/90	0	5/25/91	0	5/24/92	0.2	5/25/93	0.05
5/26/88	0	5/26/90	0	5/26/91	0	5/25/92	0.15	5/26/93	0.11
5/27/88	0	5/27/90	0	5/27/91	0	5/26/92	0.13	5/27/93	0.19
5/28/88	0	5/28/90	0	5/28/91	0	5/27/92	0.05	5/28/93	0.05
5/29/88	0.17	5/29/90	0.02	5/29/91	0	5/28/92	0	5/29/93	0
5/30/88	0.01	5/30/90	0	5/30/91	0	5/29/92	0.03	5/30/93	0
5/31/88	0	5/31/90	0	5/31/91	0.43	5/30/92	0	5/31/93	0
6/1/88	0	6/1/90	0	6/1/91	0	5/31/92	0	6/1/93	0
6/2/88	0	6/2/90	0	6/2/91	0	6/1/92	0	6/2/93	0
6/3/88	0	6/3/90	0	6/3/91	0	6/2/92	0	6/3/93	0
6/4/88	0	6/4/90	0	6/4/91	0	6/3/92	0	6/4/93	0
6/5/88	0	6/5/90	0	6/5/91	0	6/4/92	0.01	6/5/93	0
6/6/88	0	6/6/90	0	6/6/91	0	6/5/92	0.03	6/6/93	0.01
6/7/88	0	6/7/90	0	6/7/91	0	6/6/92	0	6/7/93	0.01
6/8/88	0	6/8/90	0	6/8/91	0	6/7/92	0	6/8/93	0.06
6/9/88	0	6/9/90	0.04	6/9/91	0	6/8/92	0.16	6/9/93	0
6/10/88	0	6/10/90	1.09	6/10/91	0	6/9/92	0	6/10/93	0
6/11/88	0	6/11/90	0	6/11/91	0	6/10/92	0	6/11/93	0
6/12/88	0	6/12/90	0	6/12/91	0	6/11/92	0	6/12/93	0
6/13/88	0	6/13/90	0	6/13/91	0	6/12/92	0	6/13/93	0
6/14/88	0	6/14/90	0	6/14/91	0.05	6/13/92	0	6/14/93	0
6/15/88	0	6/15/90	0	6/15/91	0	6/14/92	0	6/15/93	0
6/16/88	0	6/16/90	0	6/16/91	0	6/15/92	0	6/16/93	0
6/17/88	0	6/17/90	0	6/17/91	0	6/16/92	0	6/17/93	0.04
6/18/88	0	6/18/90	0	6/18/91	0	6/17/92	0	6/18/93	0
6/19/88	0	6/19/90	0	6/19/91	0	6/18/92	0	6/19/93	0
6/20/88	0	6/20/90	0	6/20/91	0	6/19/92	0	6/20/93	0
6/21/88	0	6/21/90	0	6/21/91	0	6/20/92	0	6/21/93	0
6/22/88	0.02	6/22/90	0	6/22/91	0	6/21/92	0	6/22/93	0
6/23/88	0.01	6/23/90	0	6/23/91	0	6/22/92	0	6/23/93	0
6/24/88	0.05	6/24/90	0	6/24/91	0	6/23/92	0	6/24/93	0
6/25/88	0.27	6/25/90	0	6/25/91	0	6/24/92	0	6/25/93	0
6/26/88	0.11	6/26/90	0	6/26/91	0	6/25/92	0.08	6/26/93	0
6/27/88	0.52	6/27/90	0	6/27/91	0	6/26/92	0	6/27/93	0
6/28/88	0.42	6/28/90	0	6/28/91	0	6/27/92	0	6/28/93	0
6/29/88	0	6/29/90	0	6/29/91	0	6/28/92	0.01	6/29/93	0
6/30/88	0	6/30/90	0	6/30/91	0	6/29/92	0	6/30/93	0
7/1/88	0	7/1/90	0	7/1/91	0	6/30/92	0	7/1/93	0
7/2/88	0	7/2/90	0	7/2/91	0	7/1/92	0	7/2/93	0
7/3/88	0	7/3/90	0	7/3/91	0	7/2/92	0	7/3/93	0
7/4/88	0	7/4/90	0	7/4/91	0	7/3/92	0	7/4/93	0
7/5/88	0	7/5/90	0	7/5/91	0	7/4/92	0	7/5/93	0
7/6/88	0	7/6/90	0	7/6/91	0	7/5/92	0	7/6/93	0
7/7/88	0	7/7/90	0.78	7/7/91	0	7/6/92	0	7/7/93	0
7/8/88	0	7/8/90	0.73	7/8/91	0.1	7/7/92	0	7/8/93	0
7/9/88	0	7/9/90	0.02	7/9/91	0.45	7/8/92	0.4	7/9/93	0
7/10/88	0	7/10/90	0	7/10/91	0.01	7/9/92	0	7/10/93	0

Table 1 (cont.)

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Daily Precipitation Values, Station #42073807, Blanding, Utah									
January, 1988 through February, 1994									
Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)
7/11/88	0	7/11/90	0	7/11/91	0	7/10/92	0	7/11/93	0
7/12/88	0	7/12/90	0	7/12/91	0	7/11/92	0	7/12/93	0
7/13/88	0	7/13/90	0	7/13/91	0	7/12/92	1.33	7/13/93	0
7/14/88	0	7/14/90	0.05	7/14/91	0	7/13/92	0.02	7/14/93	0
7/15/88	0	7/15/90	0	7/15/91	0	7/14/92	0	7/15/93	0
7/16/88	0	7/16/90	0	7/16/91	0	7/15/92	0	7/16/93	0
7/17/88	0.05	7/17/90	0	7/17/91	0	7/16/92	0	7/17/93	0
7/18/88	0	7/18/90	0.01	7/18/91	0	7/17/92	0	7/18/93	0
7/19/88	0	7/19/90	0	7/19/91	0	7/18/92	0.08	7/19/93	0
7/20/88	0	7/20/90	0	7/20/91	0.28	7/19/92	0	7/20/93	0
7/21/88	0	7/21/90	0.03	7/21/91	0	7/20/92	0	7/21/93	0
7/22/88	0	7/22/90	0	7/22/91	0	7/21/92	0	7/22/93	0
7/23/88	0	7/23/90	0.01	7/23/91	0.04	7/22/92	0.1	7/23/93	0
7/24/88	0	7/24/90	0.02	7/24/91	0.23	7/23/92	0.08	7/24/93	0.01
7/25/88	0	7/25/90	0.05	7/25/91	0.08	7/24/92	0	7/25/93	0
7/26/88	0.16	7/26/90	0	7/26/91	0.01	7/25/92	0.17	7/26/93	0
7/27/88	0	7/27/90	0	7/27/91	0	7/26/92	0	7/27/93	0
7/28/88	0	7/28/90	0.02	7/28/91	0	7/27/92	0	7/28/93	0
7/29/88	0.13	7/29/90	0	7/29/91	0	7/28/92	0.02	7/29/93	0
7/30/88	0.05	7/30/90	0.19	7/30/91	0	7/29/92	0	7/30/93	0
7/31/88	0.12	7/31/90	0	7/31/91	0	7/30/92	0	7/31/93	0
8/1/88	0.13	8/1/90	0	8/1/91	0.03	7/31/92	0	8/1/93	0
8/2/88	0	8/2/90	0.25	8/2/91	0.04	8/1/92	0	8/2/93	0
8/3/88	0	8/3/90	0	8/3/91	0.08	8/2/92	0	8/3/93	0
8/4/88	0	8/4/90	0	8/4/91	0	8/3/92	0	8/4/93	0.01
8/5/88	0.38	8/5/90	0	8/5/91	0.01	8/4/92	0	8/5/93	0
8/6/88	0.02	8/6/90	0	8/6/91	0.56	8/5/92	0.02	8/6/93	0.03
8/7/88	0	8/7/90	0	8/7/91	0	8/6/92	0.01	8/7/93	0.03
8/8/88	0	8/8/90	0	8/8/91	0	8/7/92	[illegible]	8/8/93	0.03
8/9/88	0	8/9/90	0	8/9/91	0	8/8/92	[illegible]	8/9/93	0.03
8/10/88	0	8/10/90	0	8/10/91	0	8/9/92	[illegible]	8/10/93	0.01
8/11/88	0.04	8/11/90	0.04	8/11/91	0	8/10/92	[illegible]	8/11/93	0
8/12/88	0.07	8/12/90	0	8/12/91	0.36	8/11/92	[illegible]	8/12/93	0
8/13/88	0	8/13/90	0.15	8/13/91	0	8/12/92	[illegible]	8/13/93	0
8/14/88	0	8/14/90	0.07	8/14/91	0	8/13/92	0	8/14/93	0
8/15/88	0.09	8/15/90	0.05	8/15/91	0.01	8/14/92	0	8/15/93	0
8/16/88	0.05	8/16/90	0.24	8/16/91	0	8/15/92	0	8/16/93	0
8/17/88	0	8/17/90	0	8/17/91	0	8/16/92	0	8/17/93	0
8/18/88	0	8/18/90	0	8/18/91	0.06	8/17/92	0.19	8/18/93	0
8/19/88	0	8/19/90	0	8/19/91	0	8/18/92	0	8/19/93	0.03
8/20/88	0.24	8/20/90	0	8/20/91	0	8/19/92	0	8/20/93	0
8/21/88	0.15	8/21/90	0	8/21/91	0	8/20/92	0	8/21/93	0.02
8/22/88	0	8/22/90	0	8/22/91	0	8/21/92	0	8/22/93	0
8/23/88	0	8/23/90	0	8/23/91	0	8/22/92	0.37	8/23/93	0
8/24/88	0	8/24/90	0	8/24/91	0	8/23/92	0.16	8/24/93	0
8/25/88	0	8/25/90	0	8/25/91	0	8/24/92	0	8/25/93	0.08
8/26/88	0	8/26/90	0	8/26/91	0	8/25/92	0	8/26/93	0.74
8/27/88	0	8/27/90	0	8/27/91	0.01	8/26/92	0	8/27/93	0
8/28/88	0	8/28/90	0	8/28/91	0	8/27/92	0	8/28/93	0.73
8/29/88	0	8/29/90	0	8/29/91	0	8/28/92	0	8/29/93	0
8/30/88	0.18	8/30/90	0	8/30/91	0	8/29/92	0	8/30/93	0
8/31/88	0.47	8/31/90	0	8/31/91	0.02	8/30/92	0.28	8/31/93	0.05
9/1/88	0.01	9/1/90	0.01	9/1/91	0	8/31/92	0.16	9/1/93	0
9/2/88	0	9/2/90	0.32	9/2/91	0	9/1/92	0	9/2/93	0
9/3/88	0	9/3/90	0.1	9/3/91	0	9/2/92	0	9/3/93	0
9/4/88	0	9/4/90	0	9/4/91	0	9/3/92	0	9/4/93	0
9/5/88	0	9/5/90	0.08	9/5/91	0	9/4/92	0	9/5/93	0
9/6/88	0	9/6/90	0.1	9/6/91	0.93	9/5/92	0	9/6/93	0
9/7/88	0	9/7/90	0	9/7/91	0.25	9/6/92	0	9/7/93	0
9/8/88	0	9/8/90	0	9/8/91	0	9/7/92	0	9/8/93	0
9/9/88	0	9/9/90	0	9/9/91	0	9/8/92	0	9/9/93	0
9/10/88	0.32	9/10/90	0	9/10/91	0	9/9/92	0	9/10/93	0
9/11/88	0.05	9/11/90	0	9/11/91	0.13	9/10/92	0	9/11/93	0
9/12/88	0.58	9/12/90	0	9/12/91	0	9/11/92	0	9/12/93	0.01

Table 1 (cont.)

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Daily Precipitation Values, Station #42073807, Blanding, Utah January, 1988 through February, 1994									
Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)
9/13/88	0	9/13/90	0	9/13/91	0.01	9/12/92	0	9/13/93	0.6
9/14/88	0	9/14/90	0	9/14/91	0	9/13/92	0	9/14/93	0
9/15/88	0	9/15/90	0	9/15/91	0	9/14/92	0	9/15/93	0
9/16/88	0	9/16/90	0	9/16/91	0	9/15/92	0.13	9/16/93	0
9/17/88	0	9/17/90	0	9/17/91	0	9/16/92	0	9/17/93	0
9/18/88	0	9/18/90	0.63	9/18/91	0	9/17/92	0	9/18/93	0.22
9/19/88	0	9/19/90	0	9/19/91	0	9/18/92	0.22	9/19/93	0
9/20/88	0	9/20/90	0.16	9/20/91	0	9/19/92	0.47	9/20/93	0
9/21/88	0.08	9/21/90	0	9/21/91	0	9/20/92	0.08	9/21/93	0
9/22/88	0	9/22/90	0	9/22/91	0	9/21/92	0	9/22/93	0
9/23/88	0	9/23/90	0.06	9/23/91	0	9/22/92	0	9/23/93	0
9/24/88	0	9/24/90	0	9/24/91	0	9/23/92	0	9/24/93	0
9/25/88	0	9/25/90	0	9/25/91	0	9/24/92	0	9/25/93	0
9/26/88	0	9/26/90	0	9/26/91	0	9/25/92	0	9/26/93	0
9/27/88	0.03	9/27/90	0	9/27/91	0	9/26/92	0	9/27/93	0
9/28/88	0	9/28/90	0.23	9/28/91	0	9/27/92	0	9/28/93	0
9/29/88	0	9/29/90	0	9/29/91	0	9/28/92	0	9/29/93	0
9/30/88	0	9/30/90	0	9/30/91	0	9/29/92	0	9/30/93	0
10/1/88	0	10/1/90	0.01	10/1/91	0	9/30/92	0	10/1/93	0
10/2/88	0	10/2/90	1.1	10/2/91	0	10/1/92	0	10/2/93	0
10/3/88	0	10/3/90	0.02	10/3/91	0	10/2/92	0	10/3/93	0
10/4/88	0	10/4/90	0	10/4/91	0	10/3/92	0	10/4/93	0
10/5/88	0	10/5/90	0	10/5/91	0	10/4/92	0	10/5/93	0
10/6/88	0.02	10/6/90	0	10/6/91	0	10/5/92	0	10/6/93	0.61
10/7/88	0.04	10/7/90	0.1	10/7/91	0	10/6/92	0	10/7/93	0.21
10/8/88	0.02	10/8/90	0	10/8/91	0	10/7/92	0	10/8/93	0.19
10/9/88	0	10/9/90	0	10/9/91	0	10/8/92	0	10/9/93	0
10/10/88	0	10/10/90	0	10/10/91	0	10/9/92	0	10/10/93	0.01
10/11/88	0	10/11/90	0	10/11/91	0	10/10/92	0	10/11/93	0.1
10/12/88	0	10/12/90	0	10/12/91	0	10/11/92	0	10/12/93	0
10/13/88	0	10/13/90	0	10/13/91	0	10/12/92	0	10/13/93	0
10/14/88	0	10/14/90	0	10/14/91	0	10/13/92	0	10/14/93	0
10/15/88	0	10/15/90	0	10/15/91	0	10/14/92	0	10/15/93	0
10/16/88	0	10/16/90	0	10/16/91	0	10/15/92	0	10/16/93	0.09
10/17/88	0	10/17/90	0	10/17/91	0	10/16/92	0	10/17/93	0.2
10/18/88	0	10/18/90	0.2	10/18/91	0	10/17/92	0	10/18/93	0.02
10/19/88	0	10/19/90	0.28	10/19/91	0	10/18/92	0	10/19/93	0
10/20/88	0	10/20/90	0.11	10/20/91	0	10/19/92	0	10/20/93	0
10/21/88	0	10/21/90	0	10/21/91	0	10/20/92	0	10/21/93	0
10/22/88	0	10/22/90	0	10/22/91	0.02	10/21/92	0.11	10/22/93	0
10/23/88	0	10/23/90	0	10/23/91	0	10/22/92	0	10/23/93	0
10/24/88	0	10/24/90	0	10/24/91	0.08	10/23/92	0	10/24/93	0
10/25/88	0	10/25/90	0	10/25/91	0	10/24/92	0.37	10/25/93	0
10/26/88	0	10/26/90	0	10/26/91	0	10/25/92	0.15	10/26/93	0
10/27/88	0	10/27/90	0	10/27/91	0.69	10/26/92	0	10/27/93	0
10/28/88	0	10/28/90	0	10/28/91	0.26	10/27/92	0.04	10/28/93	0
10/29/88	0	10/29/90	0	10/29/91	0.26	10/28/92	0.26	10/29/93	0
10/30/88	0.02	10/30/90	0	10/30/91	0.1	10/29/92	0.12	10/30/93	0
10/31/88	0	10/31/90	0	10/31/91	0	10/30/92	0.22	10/31/93	0
11/1/88	0	11/1/90	0	11/1/91	0	10/31/92	0.19	11/1/93	0
11/2/88	0	11/2/90	0.35	11/2/91	0	11/1/92	0	11/2/93	0
11/3/88	0	11/3/90	0.37	11/3/91	0	11/2/92	0	11/3/93	0
11/4/88	0	11/4/90	0	11/4/91	0	11/3/92	0	11/4/93	0
11/5/88	0	11/5/90	0	11/5/91	0	11/4/92	0	11/5/93	0
11/6/88	0	11/6/90	0.01	11/6/91	0	11/5/92	0	11/6/93	0
11/7/88	0	11/7/90	0.12	11/7/91	0	11/6/92	0	11/7/93	0
11/8/88	0	11/8/90	0	11/8/91	0	11/7/92	0	11/8/93	0
11/9/88	0	11/9/90	0	11/9/91	0	11/8/92	0	11/9/93	0
11/10/88	0	11/10/90	0	11/10/91	0.03	11/9/92	0	11/10/93	0
11/11/88	0.56	11/11/90	0	11/11/91	0	11/10/92	0.14	11/11/93	0.64
11/12/88	0	11/12/90	0	11/12/91	0	11/11/92	0	11/12/93	0.3
11/13/88	0	11/13/90	0	11/13/91	0	11/12/92	0	11/13/93	0.14
11/14/88	0	11/14/90	0	11/14/91	0.49	11/13/92	0	11/14/93	0
11/15/88	0.25	11/15/90	0	11/15/91	0.95	11/14/92	0	11/15/93	0

Table 1 (cont)

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Daily Precipitation Values, Station #42073807, Blanding, Utah									
January, 1988 through February, 1994									
Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)
11/16/88	0	11/16/90	0	11/16/91	0.03	11/15/92	0	11/16/93	0
11/17/88	0.02	11/17/90	0	11/17/91	0	11/16/92	0	11/17/93	0
11/18/88	0	11/18/90	0	11/18/91	0.07	11/17/92	0	11/18/93	0
11/19/88	0	11/19/90	0	11/19/91	0	11/18/92	0.01	11/19/93	0
11/20/88	0	11/20/90	0.09	11/20/91	0	11/19/92	0	11/20/93	0
11/21/88	0	11/21/90	0	11/21/91	0	11/20/92	0.12	11/21/93	0
11/22/88	0	11/22/90	0	11/22/91	0	11/21/92	0	11/22/93	0
11/23/88	0	11/23/90	0	11/23/91	0	11/22/92	0	11/23/93	0
11/24/88	0	11/24/90	0	11/24/91	0	11/23/92	0	11/24/93	0
11/25/88	0.07	11/25/90	0	11/25/91	0	11/24/92	0	11/25/93	0
11/26/88	0.11	11/26/90	0.48	11/26/91	0	11/25/92	0	11/26/93	0
11/27/88	0	11/27/90	0.01	11/27/91	0	11/26/92	0	11/27/93	0
11/28/88	0	11/28/90	0	11/28/91	0	11/27/92	0	11/28/93	0
11/29/88	0	11/29/90	0	11/29/91	0	11/28/92	0	11/29/93	0
11/30/88	0	11/30/90	0	11/30/91	0.01	11/29/92	0	11/30/93	0
12/1/88	0.03	12/1/90	0	12/1/91	0	11/30/92	0	12/1/93	0
12/2/88	0	12/2/90	0	12/2/91	0	12/1/92	0	12/2/93	0
12/3/88	0	12/3/90	0	12/3/91	0	12/2/92	0	12/3/93	0
12/4/88	0	12/4/90	0	12/4/91	0	12/3/92	0	12/4/93	0
12/5/88	0	12/5/90	0	12/5/91	0	12/4/92	0.13	12/5/93	0
12/6/88	0	12/6/90	0	12/6/91	0	12/5/92	0.81	12/6/93	0
12/7/88	0	12/7/90	0	12/7/91	0	12/6/92	0	12/7/93	0
12/8/88	0	12/8/90	0	12/8/91	0	12/7/92	-99999	12/8/93	0
12/9/88	0	12/9/90	0	12/9/91	0	12/8/92	0.28	12/9/93	0
12/10/88	0	12/10/90	0	12/10/91	0.02	12/9/92	0	12/10/93	0
12/11/88	0	12/11/90	0	12/11/91	0.26	12/10/92	0	12/11/93	0
12/12/88	0	12/12/90	0.27	12/12/91	0	12/11/92	0	12/12/93	0.07
12/13/88	0	12/13/90	0.04	12/13/91	0	12/12/92	0.5	12/13/93	0
12/14/88	0	12/14/90	0	12/14/91	0	12/13/92	0	12/14/93	0
12/15/88	0	12/15/90	0.06	12/15/91	0	12/14/92	0	12/15/93	0.07
12/16/88	0	12/16/90	0.11	12/16/91	0	12/15/92	0	12/16/93	0.18
12/17/88	0	12/17/90	0	12/17/91	0	12/16/92	0	12/17/93	0
12/18/88	0	12/18/90	0	12/18/91	0.54	12/17/92	0	12/18/93	0
12/19/88	0	12/19/90	0.06	12/19/91	0.43	12/18/92	0.2	12/19/93	0
12/20/88	0.05	12/20/90	0.36	12/20/91	0	12/19/92	0	12/20/93	0
12/21/88	0.38	12/21/90	0	12/21/91	0	12/20/92	0	12/21/93	0
12/22/88	0	12/22/90	0	12/22/91	0	12/21/92	0	12/22/93	0
12/23/88	0.2	12/23/90	0	12/23/91	0	12/22/92	0	12/23/93	0
12/24/88	0.13	12/24/90	0	12/24/91	0	12/23/92	0	12/24/93	0
12/25/88	0.09	12/25/90	0	12/25/91	0	12/24/92	0	12/25/93	0
12/26/88	0	12/26/30	0	12/26/91	0	12/25/92	0	12/26/93	0
12/27/88	0	12/27/90	0	12/27/91	0	12/26/92	0	12/27/93	0.1
12/28/88	0	12/28/90	0	12/28/91	0	12/27/92	0	12/28/93	0
12/29/88	0	12/29/90	0	12/29/91	0.05	12/28/92	0.3	12/29/93	0
12/30/88	0	12/30/90	0	12/30/91	0.11	12/29/92	0	12/30/93	0
12/31/88	0	12/31/90	0	12/31/91	0.02	12/30/92	0.07	12/31/93	0
						12/31/92	0		
Notes:	Source: Utah Climet Center, Utah State University, Logan, UT.								

Table 1 (cont.)

APPENDIX E

Freeze/Thaw Evaluation

Purpose: To determine if freeze/thaw conditions will impact the performance of the White Mesa uranium mill tailings cover. This calculation brief predicts the depth of frost which may be anticipated at the mill site. Only frost depth is evaluated since this would have the greatest impact on cover integrity (i.e. increasing permeability or damage by frost heave).

Method: A digital computer program of the modified Berggren equation for calculating the depth of freeze or thaw in a multi-layered soil system was used for purposes presented in this calculation. This method, used for determining the frost depth, is considered adequate for Uranium Mill Tailings Remedial Action (UMTRA) Projects by the U.S. Department of Energy for the following reasons:

- It calculates depth of frost based on a zero degrees Celsius isotherm, whereas the frozen front occurs some distance above this line.
- Extrapolation of current weather records beyond 200 years is not reliable.
- Extreme changes in temperatures for the 1,000 year design life are not anticipated based on geomorphic evidence.

Parameters for the cover materials based on accepted methods and existing database values previously collected, were input into the computer modeling program to determine the depth of frost penetration. A cover thickness of 2 feet random fill over 1 foot of compacted clay (as determined by HELP and RADON computer modeling) was used.

Assumptions: The model assumes:

- One-dimensional heat flow with the entire soil mass at its mean annual temperature prior to the start of the freezing season.
- At the start of the freezing season, the surface temperature changes suddenly from the mean annual temperature to a temperature below freezing and remains at this temperature throughout the entire freezing season.
- The effect of latent heat is considered as a heat sink at the moving frost line.
- Soil freezes at a temperature of 32 degrees Fahrenheit.

Results: The total frost penetration depth is less than 6.8 inches. Therefore, the 2-foot layer of random fill will provide adequate protection to the underlying 1-foot clay layer. See Appendix A for computer modeling results.

Parameters: The computer program requires input of the following parameters for the soil cover layers:

- freezing index (degree);
- length of season (days);
- mean annual temperature (degrees Fahrenheit);
- n-factor;
- layer thickness' (inches);
- water content (percent);
- dry unit weight (lbs/cubic foot);
- heat capacity (Btu/cubic foot-deg F);
- thermal conductivity (Btu/foot-hour-deg F), and;
- latent heat of fusion (Btu/cubic foot).

Freezing Index/Length of Season/Mean Annual Temperature

Default values from Grand Junction, Colorado were used for the freezing index and length of season. Grand Junction, Colorado was used for default parameters since it is similar in elevation and climate to Blanding Utah. An actual mean annual temperature for Blanding Utah from Dames & Moore (1978) was used for modeling purposes (see Appendix B).

N-factor

A default n-factor of 0.70 for sand and gravel surface type was used as per recommended in the freeze/thaw model guidelines (Aitken and Berg, 1968).

Soil type

Soil type was considered to be fine grained soil for both cover layers. Soil type number is 5.

Layer thickness'

The thickness of the cover materials were determined by infiltration and radon flux modeling programs to be 2 feet of random fill over 1 foot of clay. For this calculation, a single 36-inch layer was used. This was used because the random fill and clay soil have very similar properties.

Moisture Content

Optimum moisture content from Chen and Associates (1987) and Advanced Terra Testing (1996) was used for the random fill and the clay (UT-1) layer respectively. This data is included in Appendix B.

Optimum moisture content:

random fill	=11.8%
clay	=13.9%

A weighted averaged moisture content of 12.5 percent was used for this analysis.

Soil Density

Soil dry density was determined from Chen and Associates (1987) for random fill and Advanced Terra Testing (1996) for clay. The maximum dry density for the random fill was measured to be 120.2 pounds per cubic foot (pcf) and the maximum dry density for the clay was measured to be 113.5 pcf. Assuming the soil will be compacted to 95 percent of the maximum density, the weighted average bulk soil density would be 112 pcf.

Heat Capacity

Based on the nomographs presented in Aitken and Berg (1968) and included herein as Figure 1, using an average soil density of 112 pcf and an average moisture content of 12.5 percent yields a heat capacity of 30 Btu/ft^3 ° F.

Thermal Conductivity

Thermal conductivity of the soil cover was assumed to be similar to that for a dry sand. The thermal conductivity of a dry sand is reported to be 0.19 Btu/ hr. ft °F (Perry, Robert H. et al., 1984) (see Table 1).

Latent Heat

Based on the nomographs presented in Aitken and Berg (1968) and included herein as Figure 1, using an average soil density of 112 pcf and an average moisture content of 12.5 percent yields a Latent Heat of 2000 Btu/ ft^3 .

References:

Advanced Terra Testing, 1996. Physical soil data, White Mesa Project, Blanding Utah, July 25, 1996.

Aitken, George W. and Berg, Richard L., 1968, "Digital Solution of Modified Berggren Equation to Calculate Depths of Freeze or Thaw in Multilayered Systems", October, 1968.

Chen and Associates, 1987. Physical soil data, White Mesa Project Blanding Utah.

Dames & Moore, 1978. "Environmental Report, White Mesa Uranium Project, San Juan County, Utah, January 20, 1978, revised May 15, 1978.

Perry, Robert H. et al., 1984. "Perry's Chemical Engineers' Handbook, Sixth Edition", McGraw Hill Book Company, 1984.

U.S. Department of Energy, 1988, "Effect of Freezing and Thawing on UMTRA Covers" Albuquerque, New Mexico, October 1988.

TABLE 1

~~TABLE 3-???~~ **Thermal Conductivities of Some Building and Insulating Materials***

$k = Btu/(h \cdot ft^2)(°F/ft)$

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Material	Apparent density ρ, lb./cu. ft. at room temperature	t, °C.	k
Aerogel, silica, opacified	8.5	120	0.013
		290	.026
Asbestos-cement boards	120	20	.43
Asbestos sheets	55.5	51	.096
Asbestos slate	112	0	.087
	112	60	.114
Asbestos	29.3	−200	.043
	29.3	0	.090
	36	0	.087
	36	100	.111
	36	200	.120
	36	400	.129
	43.5	−200	.090
	43.5	0	.135
Aluminum foil (7 air spaces per 2.5 in.)	0.2	38	.025
		177	.038
Ashes, wood	......	0-100	.041
Asphalt	132	20	.43
Boiler scale (Note 1)			
Bricks:			
Alumina (92-99% Al_2O_3 by wt.) fused	......	427	1.8
Alumina (64-65% Al_2O_3 by wt.)	......	1315	2.7
(See also Bricks, fire clay)	115	800	0.62
	115	1100	.63
Building brick work	......	20	.4
Carbon	96.7	....	3.0
Chrome brick (32% Cr_2O_3 by wt.)	200	200	.67
	200	650	.85
	200	1315	1.0
Diatomaceous earth, natural, across strata (Note 2)	27.7	204	0.051
	27.7	871	.077
Diatomaceous, natural, parallel to strata (Note 2)	27.7	204	.081
	27.7	871	.106
Diatomaceous earth, molded and fired (Note 2)	38	204	.14
	38	871	.18
Diatomaceous earth and clay, molded and fired (Note 2)	42.3	204	.14
	42.3	871	.19
Diatomaceous earth, high burn, large pores (Note 3)	37	200	.13
	37	1000	.34
Fire clay (Missouri)	......	200	.58
		600	.85
		1000	.95
		1400	1.02
Kaolin insulating brick (Note 3)	27	500	0.15
	27	1150	.26
Kaolin insulating firebrick (Note 4)	19	200	.050
	19	760	.113
Magnesite (86.8% MgO, 6.3% Fe_2O_3, 3% CaO, 2.6% SiO_2 by wt.)	158	204	2.2
	158	650	1.6
	158	1200	1.1
Silicon carbide brick, recrystallized (Note 3)	129	600	10.7
	129	800	9.2
	129	1000	8.0
	129	1200	7.0
	129	1400	6.3
Calcium carbonate, natural	162	30	1.3
White marble	......	....	1.7
Chalk	96	....	0.4
Calcium sulfate ($4H_2O$), artificial	84.6	40	.22
plaster (artificial)	132	75	.43
(building)	77.9	25	.25
Cambric (varnished)	......	38	.091
Carbon, gas	......	0-100	2.0
Carbon stock	94	−184	0.55
	1	0	3.6
Cardboard, corrugated	......	....	0.037
Celluloid	87.3	30	.12
Charcoal flakes	11.9	80	.043
	15	80	.051
Clinker (granular)	......	0-700	.27
Coke, petroleum	......	100	3.4
		500	2.9
Coke, petroleum (20-100 mesh)	62	400	0.55
Coke (powdered)	......	0-100	.11
Concrete (cinder)	......	....	.20
(stone)	......	....	.54
(1:4 dry)	......	....	.44

Material	Apparent density ρ, lb./cu. ft. at room temperature	t, °C.	k
Cotton wool	5	30	0.024
Cork board	10	30	.025
Cork (regranulated)	8.1	30	.026
(ground)	9.4	30	.025
Diatomaceous earth powder, coarse (Note 2)	20.0	38	.036
	20.0	871	.082
fine (Note 2)	17.2	204	.040
	17.2	871	.074
molded pipe covering (Note 2)	26.0	204	.051
	26.0	871	.088
4 vol. calcined earth and 1 vol. cement, poured and fired (Note 2)	61.8	204	.16
	61.8	871	.23
Dolomite	167	50	1.0
Ebonite	......	....	0.10
Enamel, silicate	38	....	0.5-0.75
Felt, wool	20.6	30	0.03
Fiber insulating board	14.8	21	.028
Fiber, red	80.5	20	.27
(with binder, baked)	......	20-97	.097
Gas carbon	......	0-100	2.0
Glass	......		0.2-0.73
Borosilicate type	139	30-75	0.63
Window glass	......	....	0.3-0.61
Soda glass	......	....	0.3-0.44
Granite	......	....	1.0-2.3
Graphite, longitudinal	......	20	95.
powdered, through 100 mesh	30	40	0.104
Gypsum (molded and dry)	78	20	.25
Hair felt (perpendicular to fibers)	17	30	.021
Ice	57.5	0	1.3
Infusorial earth, see diatomaceous earth			
Kapok	0.88	20	0.020
Lampblack	10	40	.038
Lava	......	....	.49
Leather, sole	62.4	....	.092
Limestone (15.3 vol. % H_2O)	103	24	.54
Linen	......	30	.05
Magnesia (powdered)	49.7	47	.35
Magnesia (light carbonate)	13	21	0.034
Magnesium oxide (compressed)	49.9	20	.32
Marble	......	....	1.2-1.7
Mica (perpendicular to planes)	......	50	0.25
Mill shavings	......	....	0.033-0.05
Mineral wool	9.4	30	0.0225
	19.7	30	.024
Paper	......	....	.075
Paraffin wax	......	0	.14
Petroleum coke	......	100	3.4
	......	500	2.9
Porcelain	......	200	0.88
Portland cement, see concrete	......	90	.17
Pumice stone	......	21-66	.14
Pyroxylin plastics	......	....	.075
Rubber (hard)	74.8	0	.087
(para)	......	21	.109
(soft)	......	21	0.075-0.092
Sand (dry)	94.6	20	0.19
Sandstone	140	40	1.06
Sawdust	12	21	0.03
Scale (Note 1)	......		
Silk	6.3	....	.026
varnished	......	38	.096
Slag, blast furnace	......	24-127	.064
Slag wool	12	30	.022
Slate	......	94	.86
Snow	34.7	0	.27
Sulfur (monoclinic)	......	100	0.09-0.097
(rhombic)	......	21	0.16
Wall board, insulating type	14.8	21	.028
Wall board, stiff pasteboard	43	30	.04
Wood shavings	8.8	30	.034
Wood (across grain):			
Balsa	7-8	30	0.025-0.03
Oak	51.5	15	0.12
Maple	44.7	50	.11
Pine, white	34.0	15	.087
Teak	40.0	15	.10
White fir	28.1	60	.062
Wood (parallel to grain):			
Pine	34.4	21	.20
Wool, animal	6.9	30	.021

* Marks, "Mechanical Engineers' Handbook," 4th ed., McGraw-Hill, New York, 1941. "International Critical Tables," McGraw-Hill, 1929, and other sources. For additional data, see pp. 458–459.

Note 1: B. Kamp [*Z. tech. Physik*, 12, 30 (1931)] shows the effect of increased porosity in decreasing thermal conductivity of boiler scale. Partridge [University of Michigan *Eng. Research Bull.* 15, 1930] has published a 170-page treatise on Formation and Properties of Boiler Scale.

Note 2: Townshend and Williams, *Chem. & Met.*, 39, 219 (1932).

Note 3: Norton, "Refractories," 2d ed., McGraw-Hill, New York, 1942.

Note 4: Norton, private communication.

REF: PERRY'S CHEMICAL ENGINEERS' HANDBOOK, 1984, 6TH EDITION.

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FIGURE 1

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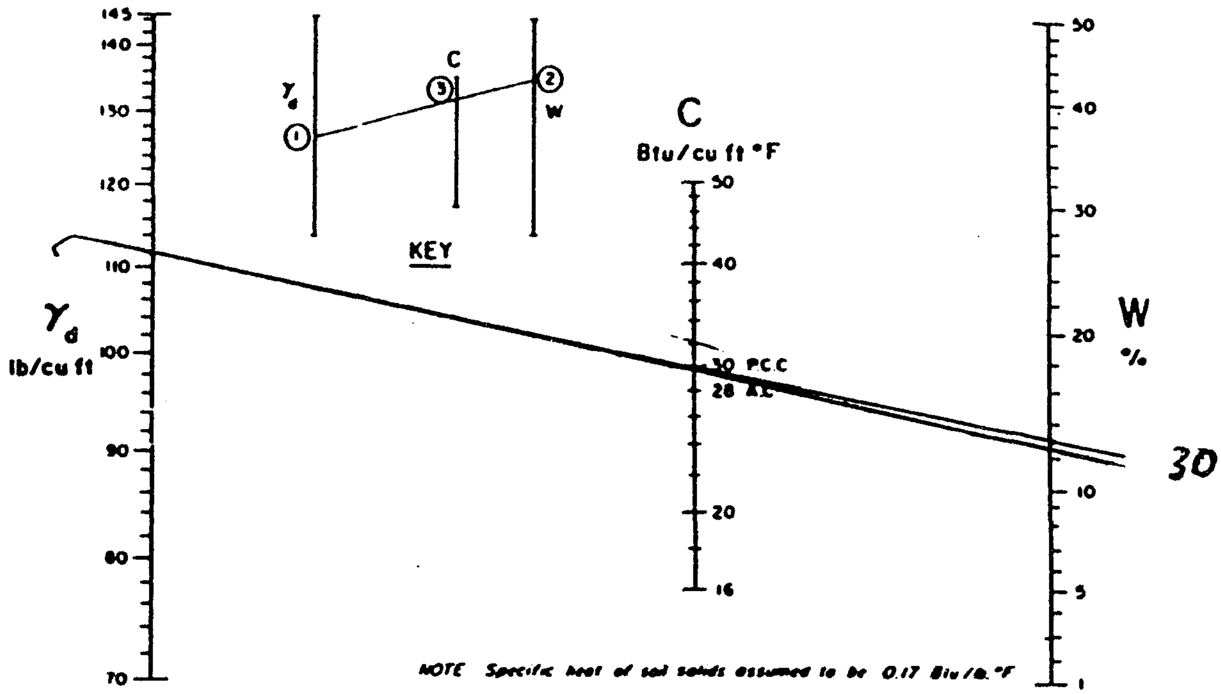

Figure 8. Average volumetric heat capacity for soils (after Aldrich and Paynter, 1953).

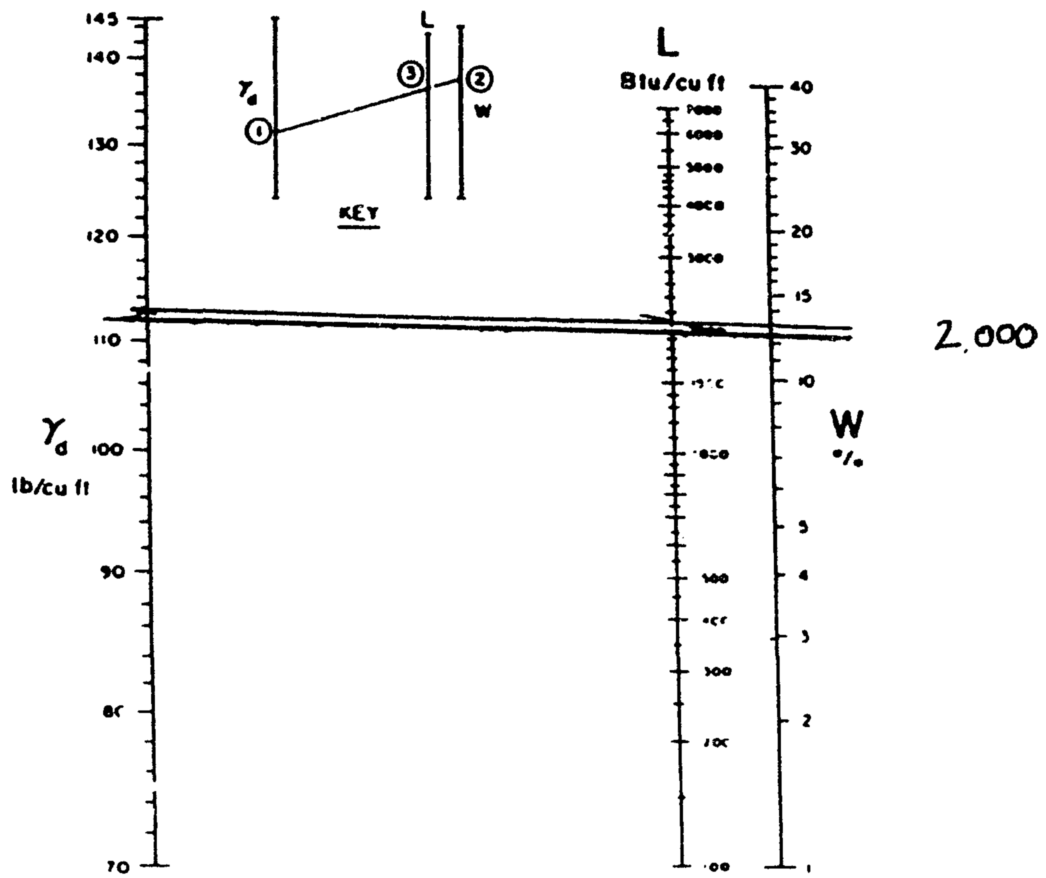

Figure 9. Volumetric latent heat for soils (after Aldrich and Paynter, 1953).

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Appendix A

WEATHER STATIONS in Colorado:

Station Location	Design Freezing Index (°F days)	Mean Annual Temp. (°F)	Length of Freezing Season (days)
1 = Alamosa	2274	41.3	159
2 = Buckley ANGB	577	50.3	88
3 = Colorado Springs	633	48.7	67
4 = Denver	629	50.3	71
5 = Grand Junction	1101	52.6	86
6 = Pueblo	676	52.3	65

Enter the number representing the data you want:
(0 to input your own data):

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LOCATION and WEATHER DATA

Input weather data for your location in Colorado:

DESIGN AIR FREEZING Index (F-Days): 1101

MEAN ANNUAL TEMPERATURE (F): 49.8

LENGTH of FREEZING SEASON (Days): 86

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CHOOSE an APPROPRIATE N-FACTOR

Surface Type	N-Factor * (Freezing)
1 = Portland Cement (snow-free)	0.75
2 = Asphalt (snow-free)	0.70
3 = Snow	1.00
4 = Sand and Gravel (snow-free)	0.70
5 = Turf (snow-free)	0.50

0 = To input your own N-Factor

Enter your option: 4

* N-Factor varies with lattitude, wind speed, cloud cover, and other climatic conditions.

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INFORMATION for LAYER 1:

Choose the appropriate soil type for this layer —

1 = Portland Cement stabilized layer
2 = Asphalt stabilized layer
3 = Snow
4 = Course-grained soil
5 = Fine-grained soil
6 = Insulating layer
7 = Organic soil

Enter your option: 5

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LAYER PARAMETERS

Parameters for LAYER 1, Fine-grained	Default Values	Values Used
Layer Thickness (inches)	12.0	36.0
Moisture Content (% dry weight)	17.0	12.5
Dry Unit Weight (lbs/cubic foot)	122.0	112.0
Heat Capacity (Btu/cubic foot °F)	* 29.5	30.0
Thermal Conductivity (Btu/foot hour °F)	* 0.90	0.19
Latent Heat of Fusion (Btu/cubic foot)	* 2016.0	2000

* recalculated based upon new MOISTURE CONTENT/WEIGHT value(s).

...<return> for Def...lt Values...

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Summary: MODIFIED BERGGREN SOLUTION

Design Freezing Index (AIR) = 1101 F-days
Design Freezing Index (SURFACE) = 771 F-days
Mean Annual Temperature = 49.8 °F
Length of Freezing Season = 86 Days

LAYER #: Type	LAYER THICKNESS (inches)	FREEZING INDEX DISTRIBUTION Each Layer	Accum	Berggren
1: Fine-grained	< 6.8	145	*	Calculations could not converge Surface DFI

End of Frost Penetration

TOTAL FROST PENETRATION = 6.8 inches

Do you want a hard copy of this data (Y or default N)?

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Appendix B

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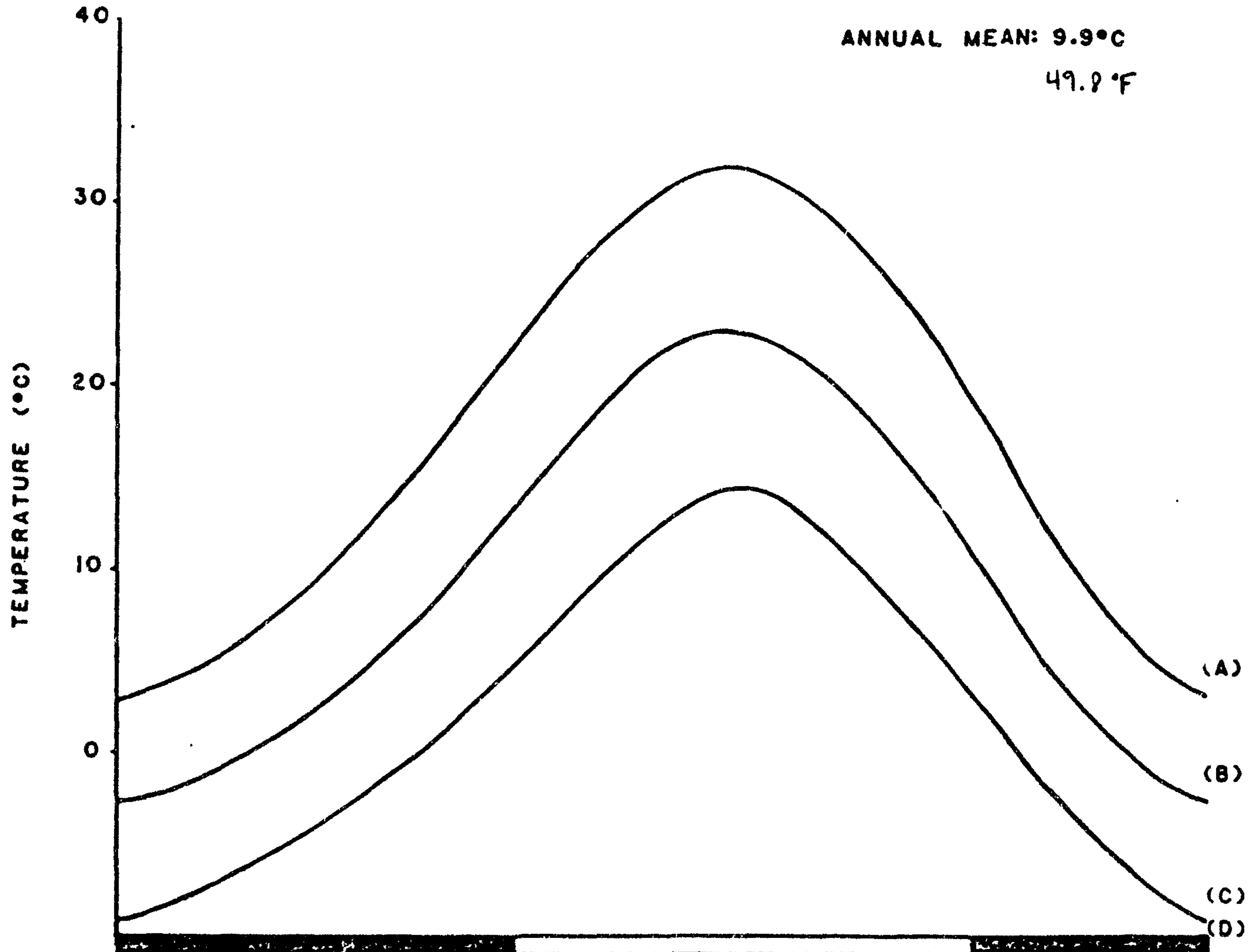
MONTHLY MEANS AND EXTREMES OF TEMPERATURES BLANDING, UTAH



MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
EXTREME MAX.	16	18	24	27	33	38	38	37	34	29	21	15
MEAN MAX.	3.8	6.9	10.9	16.3	22.8	28.7	31.9	30.2	26.0	18.8	10.2	4.5
MEAN	-2.5	0.5	3.4	8.4	14.1	19.4	23.1	21.6	17.2	10.9	3.6	-1.7
MEAN MIN.	-8.8	-5.9	-3.2	0.4	5.4	10.1	14.2	13.1	8.4	2.9	-3.2	-7.8
EXTREME MIN.	-29	-22	-15	-11	-6	-1	8	3	-5	-12	-19	-22

(A) MEAN DAILY MAXIMUM
(B) MEAN MONTHLY
(C) MEAN DAILY MINIMUM
(D) FREEZE DATES

DAMES & MOORE

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TAILINGS AND RANDOM FILL PROPERTIES

Table 3.4-1

Physical Properties of Tailings

and

Proposed Cover Materials

Material Type	Atterberg Limits LL	Atterberg Limits PI	Specific Gravity	% Passing No. 200 Sieve	Maximum Dry Density (pcf)	Optimum Moisture Content
Tailings	28	6	2.85	46	104	18.1
Random Fill	22	7	2.67	48	120.2	11.8
Clay	29	14	2.69	56	121.3	12.1
Clay	36	19	2.75	68	108.7	18.5

Note: Physical Soil Data from Chen and Associates (1987).

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ADVANCED TERRA TESTING inc

833 Parfet Street
Lakewood, Colorado 80215
(303) 232-8308

Proctor Compaction Test

, , UT-1

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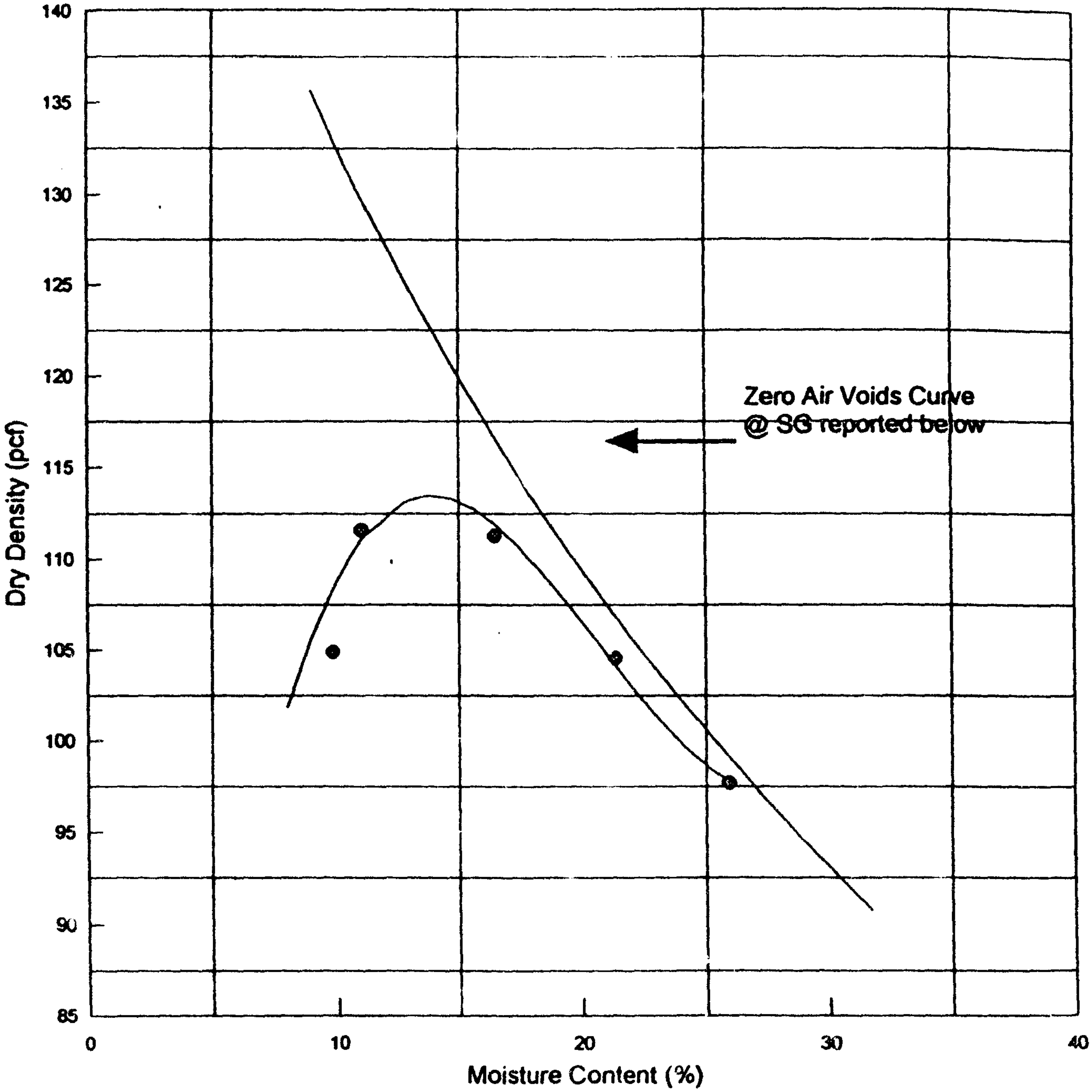

- Best Fit Curve
- Actual Data
- Zero Air VoidsCurve @ SG = 2.70

OPTIMUM MOISTURE CONTENT = 13.9 MAXIMUM DRY DENSITY = 113.5
ASTM D 1557 A, Rock correction applied? N

ADVANCED TERRA TESTING, INC.

APPENDIX F

Erosion Protection

PURPOSE:

Design of Erosion Protection layer of Riprap for the Cover of Uranium Tailings

An erosion protection layer of rock riprap is required to protect the soil cover for the uranium mill tailings at Blanding, Utah. The cover is supposed to have a design life of 1000 years according to requirements set by U.S. Nuclear Regulatory Commission [Ref: "Final Staff Technical Position - Design of Erosion Protection Covers for Stabilization of Uranium Mill Tailings Sites", 1990; U.S. Nuclear Regulatory Commission (U.S.N.R.C.)]. Hence the erosion protection layer should be designed accordingly. A design for the stone size and overall riprap thickness required for erosion protection is provided in this document.

METHODOLOGY:

The design for rock riprap for protection of top and side slopes of the cover is based on the guidelines provided by the following documents:

a) "Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments" (NUREG/CR-4620), 1986; U.S. Nuclear Regulatory Commission

b) "Final Staff Technical Position - Design of Erosion Protection Covers for Stabilization of Uranium Mill Tailings Sites", 1990; U.S. Nuclear Regulatory Commission (U.S.N.R.C.)

c) "Development of Riprap Design Criteria by Riprap Testing in Flumes"(NUREG/CR-4651), 1987; U.S. Nuclear Regulatory Commission

The top of the cover and the side slopes will be designed separately as the side slopes are much steeper than the top of the cover. Overland flow calculations will be determined based on the guidelines set by Nuclear Regulatory Commission and the site data. The size of the riprap placed on top of the tailings cover will be determined using the Safety Factor method (NUREG/CR-4651), while the Stephenson method (NUREG/CR-4651) will be applied for those placed along the side slopes.

A: Overland Flow Calculations

The methods for overland flow calculations are same for top and side slopes of the cover. The results have been tabulated under Table 1A and 2A respectively. The formulas, methodologies and equations used for overland flow calculations are discussed in this part of the document. The calculations are based on unit width of drainage area.

Average Slope 'S' and Length of drainage basin 'L': Figure 1 shows the direction of drainage for cells 2, 3 & 4. Table 1A calculates the flow parameters by varying slopes and slope lengths of cells 2, 3 & 4. Runoff and flow calculations have been provided for slopes ranging from 0.001 to 0.008 for cells 2 and 4 and from 0.001 to 0.005 for cell 3. As the slopes are very gentle, for each cell the drainage length varies negligibly and hence has been considered constant for calculation purpose. The drainage lengths have been measured from the site map. For erosion protection design of the side slopes, a side slope of 5H:1V and the maximum value of drainage lengths for cells 2, 3 & 4 have been considered (Table 2A).

Probable Maximum Precipitation (PMP): The 1-hour local storm PMP for White Mesa is 7.76 inches (data from NOAA, 1977).

Time of Concentration of Rainfall, T_c:

$$T_c = 0.00013\frac{L^{0.77}}{S^{0.385}}\text{ hours} = 0.00013\frac{L^{0.77}}{S^{0.385}} \times 60\text{ mins}$$ (Ref: Equation 4.44 in NUREG/CR-4620)

where, S = average slope of drainage basin and L = length of drainage basin in feet
The percentage of 1-hour precipitation is obtained by interpolating from Table 2.1 of NUREG/CR-4620. The minimum value of T_c used in this table is 2.5 minutes.

% PMP: The percentage for 1-hour precipitation (PMP) is obtained by interpolating from table 2.1 of NUREG/CR-4620.

Rainfall Depth:
Precipitation Amount (inches) = % PMP × PMP = % of 1-hour precipitation × PMP (Ref: Eqn. 2.1, NUREG/CR-4620).

Precipitation intensity, 'i':
Precipitation intensity in inches/hour can be computed as (Ref: Eqn. 2.2, NUREG/CR-4620):
i = rainfall depth (inches) × [60 / {rainfall duration T_c (minute)}]

Runoff Coefficient, C: Runoff coefficient depends on climatic conditions, the type of terrain, permeability, and storage potential of the basin. Runoff Coefficient has been assumed to be 0.8 for

the top of cover and the side slopes (Ref: Appendix D, section 2.4 (Example) in "Final Staff Technical Position", U.S.N.R.C.).

Unit Area, A: Area of 1-ft wide drainage basin
A = Length of drainage basin (ft.) × width (ft.) = L × 1 sq. ft. = [L×1/(43560)] Acres

Peak discharge per unit width for the drainage basin, q:
By Rational method, q = CiA, where C, i & A have their usual meanings [q in cu. ft./sec (cfs), i in inches/hour and A in acres] (Ref: Eqns. 4.42 and 4.43, NUREG/CR-4620).

Flow Concentration Factor:
From section 4.9 of NUREG/CR-4620, "...it is reasonable to assume that values between 2 and 3 are attainable with only a slight evolutionary change in cover." Thus, a flow concentration factor of 3 and 2 have been assumed for top and side slopes respectively (as the top of cover is flatter than the side slopes, it has been assumed that concentration of flow will be higher on the top than along the side slopes).

Concentrated discharge per unit width for the drainage basin, q_c:
q_c (cu. ft./sec) = q × flow concentration factor

Manning's Roughness coefficient, n:
Assumed n = 0.03 for graded loam to cobbles (Ref: table 4.2, NUREG/CR-4620)

Depth of water, D:

Depth of water in ft., $D = \left[\frac{q_c \times n}{1.486\sqrt{S}}\right]^{\frac{3}{5}}$ (Ref: Eqn. 4.46, NUREG/CR-4620), where q_c is in cu. ft./sec

Permissible Velocity:
The cover permissible velocity is between 5 to 6 ft./sec (Ref: section 4.11.3, NUREG/CR-4620)

Flow Velocity, V:
Using continuity equation,
discharge = velocity × cross-sectional area

$\therefore q_c = V \times (D \times \text{unit width}) = V \times D \times 1$

$\therefore V(\text{in ft./sec}) = \frac{q_c}{D \times 1}$

For all the calculations provided in Table 1A and 2A for top of cover and side slopes respectively, $V_{developed} < V_{permissible}$

B: Calculation for Preliminary Size (D_{50}) of Rock Riprap used for Erosion Protection

B.1 Preliminary Size (D_{50}) of Riprap along Top of Cover

According to recommendations by U.S.N.R.C. [Ref: Appendix D, section 2.2 (step 5), "Final Staff Technical Position"], recent studies have indicated that Safety Factor method is more applicable for designing rock for slopes less than 10%. The slopes along top of the cover for all the cells 2, 3 and 4 do not exceed 10%. Hence the Safety Factor method has been adopted to calculate the median diameter D_{50} of the rock particles used for riprap.

According to the Safety Factor method for determination of stone size, if the Safety Factor (S.F.) is greater than unity, the riprap is considered to be safe from failure (Ref: Section 3.4.1,"Development of Riprap Design Criteria by Riprap Testing in Flumes", NUREG/CR-4651). For calculations to determine the riprap size for top of cover, a safety factor of 1.1 has been assumed and the D_{50} corresponding to this safety factor has been computed. Table 1B tabulates the results for the safety factor method.

The equations 3.5 through 3.9 of NUREG/CR-4651 (see appendix) for Safety Factor method are provided below :

$$SF = \frac{\cos\theta \tan\phi}{\eta' \tan\phi + \sin\theta \cos\beta} \quad \text{.................eqn. } A_1 \text{ (eqn. 3.5 of NUREG/CR-4651)}$$

$$\eta' = \eta\left[\frac{1+\sin(\lambda+\beta)}{2}\right] \quad \text{.........................eqn. } B_1 \text{ (eqn. 3.6 of NUREG/CR-4651)}$$

$$\eta = \frac{21\tau_0}{(G_s - 1)\gamma_w \times D_{50}} \quad \text{..........................eqn. } C_1 \text{ (eqn. 3.7 of NUREG/CR-4651)}$$

$$\tau_0 = \gamma_w DS \quad \text{..eqn. } D_1 \text{ (eqn. 3.8 of NUREG/CR-4651)}$$

$$\beta = \tan^{-1}\left[\frac{\cos\lambda}{\frac{2\sin\theta}{\eta\tan\phi} + \sin\lambda}\right] \quad \text{..................eqn. } E_1 \text{ (eqn 3.9 of NUREG/CR-4651)}$$

where,

λ = angle between a horizontal line and the velocity vector compoment measured in the plane of side slope (refer to fig. 3.1of NUREG/CR-4651)

θ = side slope angle

S = side slope = $\tan\theta$

ϕ = angle of repose (friction angle) of rock

τ_0 = bed shear stress
D_{50} = representative stone size
G_s = Specific gravity or relative density of the rock
D = depth of flow
γ_w = specific weight of the liquid (in this case, water)
η & η' = stability numbers
β = angle between vector component of the weight, Ws, directed down the side slope and the direction of particle movement

For top of the cover, as slopes are very gentle, for all practical purposes, λ can be considered to be equal to zero (Ref: pg 22, NUREG/CR-4651)
Thus for $\lambda = 0$: $\cos\lambda = 1$, $\sin\lambda = 0$.
Hence, equation 3.9 of NUREG/CR-4651 can be reduced to

$$\beta = \tan^{-1}\left[\frac{\eta\tan\phi}{2\sin\theta}\right] \text{.......................................eqn } E_2 \text{ (eqn 3.10 of NUREG/CR-4651)}$$

Also, equation 3.6 of NUREG/CR-4651 can be reduced to

$$\eta' = \eta\left[\frac{1+\sin\beta}{2}\right] \text{..eqn. } B_2$$

ϕ = 40° (see Table 3)
G_s = 2.48 (see Table 3)
γ_w = 62.4 lb./ft^3

The values for depth of water 'D' have been computed in Table 1A. Table 1B provides the preliminary D_{50} size for each of cells 2, 3 & 4 by varying the slope and the length of the drainage basin.

D_{50} calculated by CSU method

According to CSU method (Ref: NUREG/CR-4651, Phase-II),
$D_{50} = 5.23 \times (\text{slope})^{0.43} \times (\text{discharge})^{0.56}$
The results of D_{50} computed by CSU method have been included in table 1B (values of discharge have been computed in table 1A to compare with those obtained by Safety Factor method.

B.2 Preliminary Size (D_{50}) of Riprap along Side Slopes

According to recommendations by U.S.N.R.C. (Ref: Appendix D, section 2.2 (step 5), "Final Staff Technical Position"), recent studies have indicated that Stephenson method is more applicable for designing rock for slopes less than 10%. As the side slopes (5H:1V) have a value of S = 1/5 = 0.2 = 20%(>10%), the Stephenson method (Ref: "Development of Riprap Design Criteria by Riprap Testing in Flumes", NUREG/ CR-4651) will be most appropriate.

By **Stephenson method**, the median size for rock, D_{50} is given by the following equation (Ref: eqn. 3.15, NUREG/CR-4651):

$$D_{50} = \left[\frac{q_c (\tan\theta)^{\frac{7}{6}} \times n_p^{\frac{1}{6}}}{C\sqrt{g} \times [(1-n_p)(G_s - 1)(\cos\theta)(\tan\phi - \tan\theta)]^{\frac{5}{3}}} \right]^{\frac{2}{3}}$$

where, q_c = Concentrated discharge in cu. ft./sec
θ = Slope angle = $\tan^{-1}$ (S) = $\tan^{-1}$ (0.2) = 11.31°
ϕ = Friction angle of the rock = 40° (see Table 3)
G_s = Relative Density of the rock = 2.48 (see Table 3)
g = Acceleration due to gravity = 32.2 ft./sec^2
n_p = Porosity of the rock = 0.30 (for sandstone) [Ref: (a) "Origin of Sedimentary Rocks" and (b) Table 3
C = Empirical factor [0.22 for gravel/pebble and 0.27 for crushed granite]
Also, K = Oliver's constant [1.2 for gravel and 1.8 for crushed rock]

The results for q_c from table 2A have been substituted into the above equation and the solution tabulated in table 2B. The value of D_{50} has been multiplied by the Oliver's constant K to insure stability.

<u>D_{50} calculated by CSU method</u>

According to CSU method (Ref: NUREG/CR-4651, Phase-II),
$D_{50} = 5.23 \times (\text{slope})^{0.43} \times (\text{discharge})^{0.56}$
The results of D_{50} computed by CSU method have been included in table 2B to compare with those obtained by Stephenson method.

C: Oversizing of Riprap based on durability and Overall Riprap Thickness

C.1 Modification of Size (D_{50}) of Riprap based on Durability

Tables 3 and 4 include the properties of the rock to be used as protective cover material. Based on these values and according to the scoring criteria set by U.S.N.R.C. (Ref: Appendix D, sections 6.2, 6.2.1,6.2.2 and table D-1 in "Final Staff Technical Position"), a rock rating analysis has been provided in Table 4. The results show a rock rating of 55.74%, which according to U.S.N.R.C. can be used for non critical areas like top slopes and side slopes.

Thus the oversizing required = 80-55.74 = 24.26%
[ref: (a) Appendix D, section 6.2.2B, "Final Staff Technical Position"; U.S.N.R.C. (oversizing required based on a 80-rating), (b) Appendix D, section 6.4 (example), "Final Staff Technical Position" and (c) Table 4.
However a oversizing factor of 25 % has been used. Thus the nominal diameter D_{50} obtained in tables 1B and 2B has been multiplied with 1.25 to obtain a modified rock size D_{50} (tables 1C and 2C).

C.2 Overall Riprap Thickness

According to the Safety Factor method, it is recommended that the riprap thickness be at least 1.5 times the D_{50} value whereas according to the Stephenson method the riprap thickness should be at least 2 times the D_{50} value. The results based on the above recommendations are shown in tables 1C and 2C respectively.

RESULTS:

Results of the calculations have been tabulated under tables 1A, 1B, 1C, 2A, 2B, 2C respectively.

REFERENCE:

a) "Final Staff Technical Position - Design of Erosion Protection Covers for Stabilization of Uranium Mill Tailings Sites", 1990; U.S. Nuclear Regulatory Commission (U.S.N.R.C.)

b) Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments" (NUREG/CR-4620), 1986; U.S. Nuclear Regulatory Commission

c) "Development of Riprap Design Criteria by Riprap Testing in Flumes" (NUREG/CR-4651), 1987; U.S. Nuclear Regulatory Commission

d) National Oceanic and Atmospheric Administration (NOAA), 1977. Probable Maximum Precipitation Estimates, Colorado River and Great Basin Drainages. Hydrometeorological Report (HMR) No. 49.

e) "Origin of Sedimentary Rocks", second edition; Harvey Blatt, Gerard Middleton and Raymond Murray

TABLES

TITAN ENVIRONMENTAL

Project #: 8111-001
Client: EFN, White Mesa
Location: Blanding, Utah

Date: June 1996
Prepared by: KG
Checked by:

Overland Flow Calculations for Top Portion of the Cover

Table 1A Calculation for Runoff and Flow parameters

Cell No	Maximum Length "L" of Drainage Basin (appx.)	Average Slope "S"	Drainage Area per ft. run A = L x 1 ft.		Manning's Roughness Coefficient n	1-hour precipitation amount	Design Storm	Time of Concentration, Tc: Calculated value (using Eqn. 4.44, NUREG 4620)	Time of Concentration, Tc: Minimum value, based on table 2.1, NUREG 4620	Time of Concentration, Tc: Value used	%PMP = % of 1-hour precipitation (Table 2.1, NUREG 4620)	Rainfall Depth	Precipitation Intensity "I"	Runoff Coefficient "C"	Flow Concentration Factor	Peak Discharge per unit ft. width q = CIA	Concentrated Discharge per unit ft. width q_c	Depth of water, "D" (eqn. 4.48, NUREG 4620)	Flow Velocity, V = Discharge / c.s. Area	Permissible Velocity
	ft.	ft./ft.	sq. ft.	Acres		inches		minutes	minutes	minutes		inches	inches/hr.			cu.ft./sec.	cu.ft./sec.	ft.	ft./sec	ft./sec
	1350	0.0080	1350	0.0310	0.03	7.76	PMP	12.86	2.5	12.86	68.90	5.35	24.92	0.8	3	0.62	1.86	0.583	3.13	
	1350	0.0072	1350	0.0310	0.03	7.76	PMP	13.41	2.5	13.41	70.18	5.45	24.37	0.8	3	0.60	1.81	0.604	3.00	
2	1350	0.0070	1350	0.0310	0.03	7.76	PMP	13.66	2.5	13.66	70.63	5.47	24.23	0.8	3	0.60	1.80	0.607	2.97	
	1350	0.0065	1350	0.0310	0.03	7.76	PMP	14.36	2.5	14.36	72.52	5.63	23.46	0.8	3	0.58	1.75	0.624	2.80	
	1350	0.0050	1350	0.0310	0.03	7.76	PMP	15.43	2.5	15.43	74.69	5.80	22.54	0.8	3	0.56	1.68	0.643	2.61	
	1350	0.0040	1350	0.0310	0.03	7.76	PMP	16.61	2.5	16.61	76.90	5.97	21.30	0.8	3	0.53	1.58	0.664	2.36	
	1350	0.0030	1350	0.0310	0.03	7.76	PMP	18.76	2.5	18.76	80.06	6.21	19.84	0.8	3	0.49	1.48	0.694	2.13	
	1350	0.0020	1350	0.0310	0.03	7.76	PMP	21.96	2.5	21.96	83.37	6.47	17.68	0.8	3	0.44	1.31	0.731	1.80	
	1350	0.0010	1350	0.0310	0.03	7.76	PMP	28.67	2.5	28.67	88.07	6.83	14.30	0.8	3	0.36	1.08	0.783	1.34	
	1100	0.0050	1100	0.0253	0.03	7.76	PMP	13.16	2.5	13.16	69.63	5.40	24.60	0.8	3	0.50	1.49	0.569	2.49	
	1100	0.0040	1100	0.0253	0.03	7.76	PMP	14.36	2.5	14.36	72.47	5.62	23.46	0.8	3	0.47	1.42	0.623	2.29	5 - 6
3	1100	0.0030	1100	0.0253	0.03	7.76	PMP	16.04	2.5	16.04	75.67	5.87	21.96	0.8	3	0.44	1.33	0.652	2.04	
	1100	0.0020	1100	0.0253	0.03	7.76	PMP	18.76	2.5	18.76	80.00	6.21	19.85	0.8	3	0.40	1.20	0.684	1.74	
	1100	0.0013	1100	0.0253	0.03	7.76	PMP	22.14	2.5	22.14	83.50	6.48	17.66	0.8	3	0.35	1.06	0.733	1.45	
	1100	0.0010	1100	0.0253	0.03	7.76	PMP	24.49	2.5	24.49	85.14	6.61	16.19	0.8	3	0.33	0.98	0.756	1.30	
	1250	0.0080	1250	0.0287	0.03	7.76	PMP	12.13	2.5	12.13	67.12	5.21	25.76	0.8	3	0.59	1.77	0.577	3.07	
	1250	0.0070	1250	0.0287	0.03	7.76	PMP	12.77	2.5	12.77	68.66	5.33	25.02	0.8	3	0.57	1.72	0.591	2.92	
4	1250	0.0060	1250	0.0287	0.03	7.76	PMP	13.06	2.5	13.06	70.53	5.47	24.23	0.8	3	0.56	1.67	0.607	2.75	
	1250	0.0057	1250	0.0287	0.03	7.76	PMP	13.63	2.5	13.63	71.18	5.52	23.97	0.8	3	0.55	1.65	0.612	2.70	
	1250	0.0050	1250	0.0287	0.03	7.76	PMP	14.54	2.5	14.54	72.90	5.66	23.34	0.8	3	0.54	1.61	0.627	2.57	
	1250	0.0040	1250	0.0287	0.03	7.76	PMP	15.85	2.5	15.85	75.35	5.85	22.14	0.8	3	0.51	1.52	0.649	2.35	
	1250	0.0030	1250	0.0287	0.03	7.76	PMP	17.70	2.5	17.70	78.32	6.08	20.60	0.8	3	0.47	1.42	0.678	2.08	
	1250	0.0020	1250	0.0287	0.03	7.76	PMP	20.69	2.5	20.69	82.49	6.40	18.66	0.8	3	0.43	1.28	0.719	1.78	
	1250	0.0010	1250	0.0287	0.03	7.76	PMP	27.02	2.5	27.02	86.92	6.74	14.96	0.8	3	0.34	1.03	0.778	1.33	

Rainfall Duration (min.)	% of 1-hr. precipitation
2.5	27.5
5	45
10	62
15	74
20	82
30	90
45	96
60	100

Table 2.1 of NUREG 4620

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BMA 1/96

TITAN ENVIRONMENTAL

Project #: 0111-001
Client: EFN, White Mesa
Location: Blanding, Utah

Date: June 1996
Prepared by: KG
Checked by:

Riprap Design for Top portion of the Cover

Table 1B: Calculation for preliminary sizing of riprap, D50

Cell No.	Slope of Channel S (ft/ft)	θ (degrees)	Depth of flow, D (ft)	Specific Weight of water γ_w (lb/cu ft)	Bed Shear Stress $\tau_0 = \gamma_w DS$ (lb/sq ft)	Rock Specific Gravity S_s	Angle of Motion φ (degrees)	λ (degrees)	cos θ	sin θ
2	0.0080	0.458	0.580	62.4	0.290	2.40	40	0	1.000	0.008
	0.0072	0.413	0.604	62.4	0.271	2.40	40	0	1.000	0.007
	0.0070	0.401	0.607	62.4	0.265	2.40	40	0	1.000	0.007
	0.0060	0.344	0.624	62.4	0.233	2.40	40	0	1.000	0.006
	0.0050	0.286	0.643	62.4	0.201	2.40	40	0	1.000	0.005
	0.0040	0.229	0.664	62.4	0.166	2.40	40	0	1.000	0.004
	0.0030	0.172	0.694	62.4	0.130	2.40	40	0	1.000	0.003
	0.0020	0.115	0.731	62.4	0.091	2.40	40	0	1.000	0.002
	0.0010	0.057	0.795	62.4	0.049	2.40	40	0	1.000	0.001
3	0.0050	0.286	0.598	62.4	0.187	2.40	40	0	1.000	0.005
	0.0040	0.229	0.623	62.4	0.156	2.40	40	0	1.000	0.004
	0.0030	0.172	0.653	62.4	0.122	2.40	40	0	1.000	0.003
	0.0020	0.115	0.694	62.4	0.087	2.40	40	0	1.000	0.002
	0.0013	0.074	0.733	62.4	0.060	2.40	40	0	1.000	0.001
	0.0010	0.057	0.796	62.4	0.047	2.40	40	0	1.000	0.001
4	0.0080	0.458	0.577	62.4	0.288	2.40	40	0	1.000	0.008
	0.0070	0.401	0.591	62.4	0.258	2.40	40	0	1.000	0.007
	0.0060	0.344	0.607	62.4	0.227	2.40	40	0	1.000	0.006
	0.0057	0.327	0.612	62.4	0.218	2.40	40	0	1.000	0.006
	0.0050	0.286	0.627	62.4	0.196	2.40	40	0	1.000	0.005
	0.0040	0.229	0.649	62.4	0.162	2.40	40	0	1.000	0.004
	0.0030	0.172	0.679	62.4	0.127	2.40	40	0	1.000	0.003
	0.0020	0.115	0.719	62.4	0.090	2.40	40	0	1.000	0.002
	0.0010	0.057	0.779	62.4	0.049	2.40	40	0	1.000	0.001

Cell No.	cos λ	sin λ	tan φ	D50 by Safety Factor method (inches)	D50 by Safety Factor method (ft)	η	tan β	β (degrees)	cos β	η'	Safety Factor	D50 by CSU method (inches)
2	1.000	0.000	0.839	0.89	0.074	0.007	47.882	89.798	0.021	0.007	1.10	0.93
	1.000	0.000	0.839	0.82	0.068	0.009	62.839	89.917	0.016	0.009	1.10	0.87
	1.000	0.000	0.839	0.80	0.066	0.010	64.839	89.840	0.016	0.010	1.10	0.86
	1.000	0.000	0.839	0.70	0.058	0.010	65.634	89.100	0.016	0.010	1.10	0.79
	1.000	0.000	0.839	0.60	0.050	0.012	76.610	89.251	0.013	0.012	1.10	0.72
	1.000	0.000	0.839	0.50	0.041	0.012	96.001	89.401	0.010	0.012	1.10	0.63
	1.000	0.000	0.839	0.39	0.033	0.009	127.130	89.549	0.008	0.009	1.10	0.53
	1.000	0.000	0.839	0.28	0.023	0.009	169.375	89.666	0.006	0.009	1.10	0.42
	1.000	0.000	0.839	0.16	0.012	0.012	262.475	89.800	0.003	0.012	1.10	0.29
3	1.000	0.000	0.839	0.54	0.047	0.011	76.416	89.[illegible]	0.013	0.011	1.10	0.67
	1.000	0.000	0.839	0.47	0.039	0.013	95.721	89.401	0.010	0.013	1.10	0.60
	1.000	0.000	0.839	0.37	0.030	0.013	127.001	89.551	0.008	0.013	1.10	0.66
	1.000	0.000	0.839	0.26	0.022	0.009	190.967	89.[illegible]	0.005	0.009	1.10	0.40
	1.000	0.000	0.839	0.19	0.016	0.012	304.186	89.[illegible]	0.003	0.012	1.10	0.31
	1.000	0.000	0.839	0.14	0.012	0.009	379.844	89.840	0.003	0.009	1.10	0.27
4	1.000	0.000	0.839	0.87	0.072	[illegible]	47.[illegible]	89.798	0.021	[illegible]	1.10	0.90
	1.000	0.000	0.839	0.70	0.066	0.009	64.460	89.840	0.016	0.009	1.10	0.84
	1.000	0.000	0.839	0.69	0.057	0.012	63.742	89.101	0.016	0.012	1.10	0.77
	1.000	0.000	0.839	0.66	0.055	0.007	66.770	89.142	0.016	0.007	1.10	0.76
	1.000	0.000	0.839	0.60	0.049	0.012	76.531	89.251	0.013	0.012	1.10	0.70
	1.000	0.000	0.839	0.49	0.040	0.012	96.024	89.401	0.010	0.012	1.10	0.62
	1.000	0.000	0.839	0.38	0.032	0.011	127.413	89.[illegible]	0.008	0.011	1.10	0.52
	1.000	0.000	0.839	0.27	0.023	0.007	190.227	89.[illegible]	0.005	0.007	1.10	0.41
	1.000	0.000	0.839	0.15	0.012	0.009	300.792	89.[illegible]	0.003	0.009	1.10	0.27

Table 1C: Diameter of Riprap modified based on durability, and Overall Riprap Thickness

Cell No.	Slope of channel S (ft/ft)	D50 based on Safety Factor Method (inches)	Oversizing Factor based on Rock Quality (from previous report)	Modified D50 after oversizing (inches)	Thickness of Riprap layer =1.5xD50 (inches)	Overall Riprap Thickness suggested (inches)
2	0.0080	0.89	1.25	1.11	1.67	3
	0.0072	0.82	1.25	1.02	1.53	
	0.0070	0.80	1.25	0.99	1.49	
	0.0060	0.70	1.25	0.88	1.31	
	0.0050	0.60	1.25	0.76	1.13	
	0.0040	0.50	1.25	0.62	0.93	
	0.0030	0.39	1.25	0.49	0.73	
	0.0020	0.28	1.25	0.34	0.52	
	0.0010	0.16	1.25	0.19	0.29	
3	0.0050	0.54	1.25	0.78	1.0[illegible]	
	0.0040	0.47	1.25	0.59	0.87	
	0.0030	0.37	1.25	0.46	0.69	
	0.0020	0.26	1.25	0.33	0.49	
	0.0013	0.19	1.25	0.22	0.33	
	0.0010	0.14	1.25	0.18	0.27	
4	0.0080	0.87	1.25	1.09	1.62	
	0.0070	0.70	1.25	0.97	1.46	
	0.0060	0.69	1.25	0.86	1.29	
	0.0057	0.66	1.25	0.82	1.23	
	0.0050	0.60	1.25	0.73	1.10	
	0.0040	0.49	1.25	0.61	0.91	
	0.0030	0.38	1.25	0.48	0.71	
	0.0020	0.27	1.25	0.34	0.51	
	0.0010	0.15	1.25	0.19	0.27	

WMARMOR2.XLS

RVA 7/96

TITAN ENVIRONMENTAL

Project : 6111-001
Client: EFN, White Mesa
Location: Blanding, Utah

Date: June 1996
Prepared by: KG
Checked by:

<u>Overland Flow Calculations for Side Slopes of the Cover</u>

<u>Table 2A. Calculation for Runoff and Flow parameters</u>

Maximum Length, "L" of Drainage Basin (appx)	Average Slope "S"	Drainage Area per ft. run A = L x 1 ft.		Manning's Roughness Coefficient n	1-hour precipitation amount	Design storm	Time of Concentration, Tc			% PMP % of 1-hour precipitation (Table 2.1, NUREG 4620	Precipitation Amount	Precipitation intensity "I"	Runoff Coefficient "C"	Flow Concentration Factor	Peak Discharge per unit ft. width q = CIA	Concentrated Discharge per unit ft. width q_f	Depth of water, "D" (eqn. 4.46, NUREG 4620)	Flow Velocity, V = Discharge / c.c. Area	Permissible Velocity (sec. 4.11.3 of (NUREG 4620)
							Calculated value (using Eqn.4.44, NUREG 4620)	Minimum value based on table 2.1, NUREG 4620	Value used										
ft.	ft./ft.	sq. ft.	Acres		inches		minutes	minutes	minutes		inches	inches/hr			cu.ft./sec.	cu.ft./sec.	ft.	ft./sec.	ft./sec.
275	0.2000	275	0.0063	0.03	7.76	PMP	1.10	2.5	2.5	27.5	2.13	51.22	0.8	2	0.28	0.52	0.105	4.93	5 - 6

Rainfall Duration (min.)	% of 1-hr. precipitation
2.5	27.5
5	45
10	62
15	74
20	82
30	89
45	95
60	100

WMARMOR2.XLS

RA 7/96

TITAN ENVIRONMENTAL

Project #: 6111-001
Client: EFN, White Mesa
Location: Blanding, Utah

Date: June 1996
Prepared by: KG
Checked by:

Riprap Design for Side Slopes of the Cover

Table 2B: Calculation for preliminary sizing of riprap, D_{50}

Slope of Channel		Angle of friction for rock	Concentrated discharge per unit ft. width, q_u	Relative density of Rock	Porosity	Type of Riprap	Stephenson Constant	tan θ	cos θ	tan φ	D_{50} by Stephenson Method		Oliver's Constant	Modified D_{50}	D_{50} based on CSU method
S	θ	φ		G_s	n_p		C				(Eqn. 4.28 of NUREG 4620)		K		
ft./ft.	degrees	degrees	cu. ft./sec								ft.	inches		inches	ft.
0.200	11.310	40	0.52	2.48	0.3	gravel/pebbles	0.22	0.200	0.981	0.839	0.22	2.70	1.2	3.235	1.81
0.200	11.310	40	0.52	2.46	0.3	crushed granite	0.27	0.200	0.981	0.839	0.20	2.35	1.8	4.234	1.81

Table 2C: Diameter of Riprap modified based on durability, and Overall Riprap Thickness

Slope of channel S	D_{50} based on Stephenson Method	Oversizing Factor based on Rock Quality (from previous report)	Modified D_{50} after oversizing	Thickness of Riprap layer = 2 x D_{50}	Overall Riprap Thickness suggested	Type of Riprap
ft./ft.	inches		inches	inches	inches	
0.200	3.235	1.25	4.04	8.09	12	gravel/pebbles
0.200	4.234	1.25	5.29	10.58	12	crushed granite

7/96 [illegible]

TABLE 3

WHITE MESA CHANNEL A ROCK APRON
RIPRAP SIZING – STEPHENSON'S METHOD

	ENTER		WITH 24% OVERSIZE
UNIT FLOW RATE "q"	4.27	CFS/FT	
ROCKFILL POROSITY – n	0.3		
SLOPE ANGLE	11.3	DEGREES	
FRICTION ANGLE	40	DEGREES	
SPECIFIC GRAVITY OF ROCK	2.48		
D–100 (BASED ON 1.25xD50)	12.00	INCHES	14.88"
D–50	9.60	INCHES	12.6"

WHITE MESA CHANNEL B ROCK APRON
RIPRAP SIZING – STEPHENSON'S METHOD

	ENTER		
UNIT FLOW RATE "q"	3.26	CFS/FT	
ROCKFILL POROSITY – n	0.3		
SLOPE ANGLE	11.3	DEGREES	
FRICTION ANGLE	40	DEGREES	
SPECIFIC GRAVITY OF ROCK	2.48		
D–100 (BASED ON 1.5xD50)	12.03	INCHES	14.9"
D–50	8.02	INCHES	9.94"

TABLE 4

NRC SCORING CRITERIA FOR DETERMINING ROCK QUALITY
WHITE MESA ROCK PROTECTION

ROCK TYPE: 2

Limestone = 1
Sandstone = 2
Igneous = 3

LABORATORY TEST	TEST RESULT	SCORE	WEIGHT	SCORE * WEIGHT	MAX. SCORE
Specific Gravity	2.48	4.60	6	27.60	60.00
Absorption, %	1.75	3.50	5	17.50	50.00
Sodium Sulfate, %	0.60	10.00	3	30.00	30.00
L/A Abrasion (100 revs), %	8.40	5.94	8	47.53	80.00
Schmidt Hammer	0.00	0.00	13	0.00	0.00
Tensile Strength, psi	0.00	0.00	4	0.00	0.00

ROCK RATING, %: 55.74

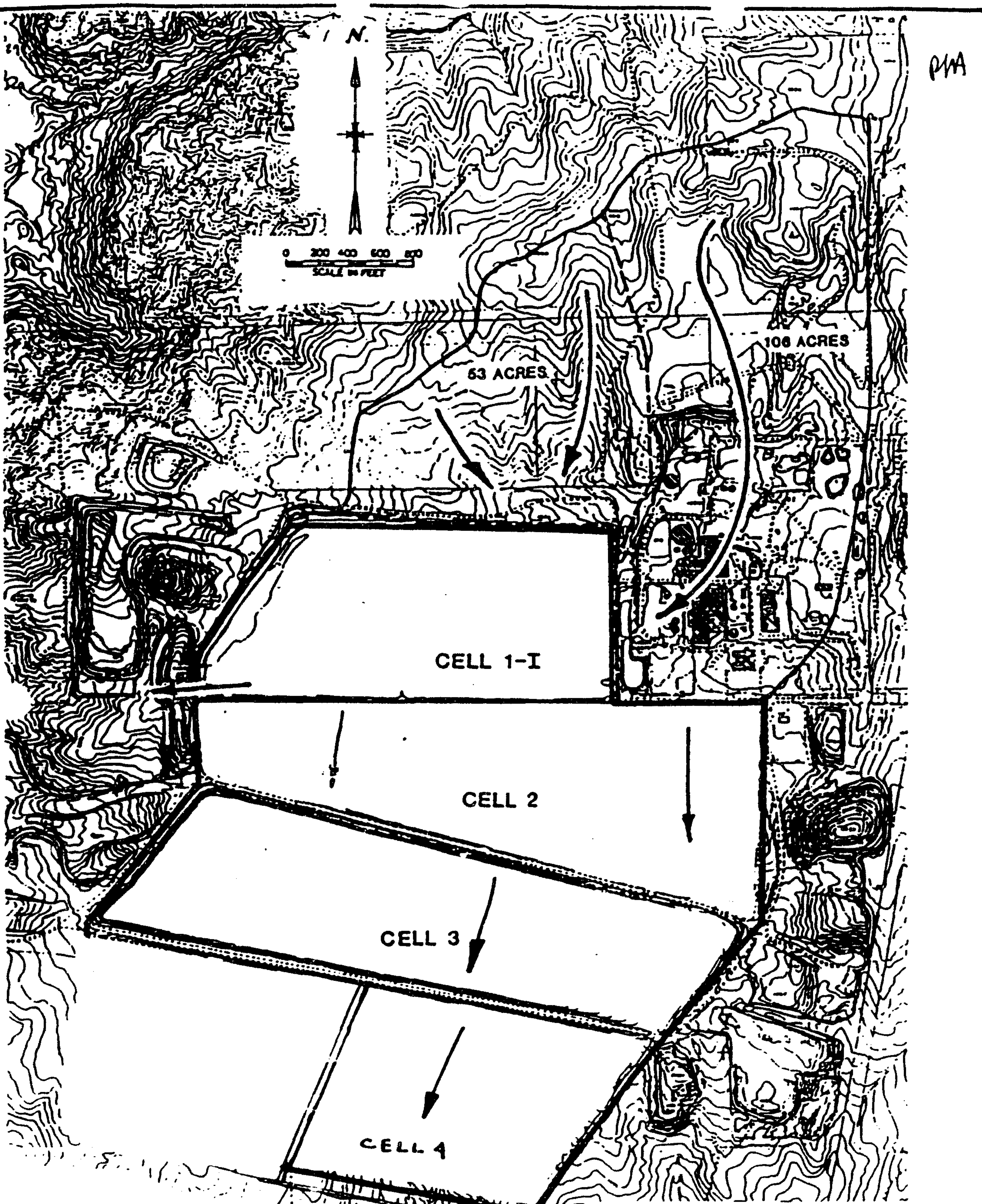
RATING ANALYSIS:

Critical Areas – REJECTED
Oversizing, % =

Non–Critical Areas – OVERSIZING REQUIRED
Oversizing, % = 24

FIGURE

PHA 7/96



WHITE MESA PROJECT

SITE DRAINAGE

FIGURE: 1

APPENDIX

FINAL

STAFF TECHNICAL POSITION
DESIGN OF EROSION PROTECTION COVERS FOR STABILIZATION OF URANIUM MILL TAILINGS SITES

U. S. Nuclear Regulatory Commission

August 1990

FINAL
STAFF TECHNICAL POSITION
DESIGN OF EROSION PROTECTION COVERS FOR
STABILIZATION OF URANIUM MILL TAILINGS SITES

1. INTRODUCTION

Criteria and standards for environmental protection may be found in the Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978 (PL 95-604) (see Ref. 1) and 10 CFR Section 20.106, "Radioactivity in Effluents to Unrestricted Areas." In 1983, the U. S. Environmental Protection Agency (EPA) established standards (40 CFR Part 192) for the final stabilization of uranium mill tailings for inactive (Title I) and active (Title II) sites. In 1980, the United States Nuclear Regulatory Commission (NRC) promulgated regulations (10 CFR Part 40, Appendix A) for active sites and later revised Appendix A to conform to the standards in 40 CFR Part 192. These standards and regulations establish the criteria to be met in providing long-term stabilization.

These regulations also prescribe criteria for control of tailings. For the purpose of this staff technical position (STP), control of tailings is defined as providing an adequate cover to protect against exposure or erosion of the tailings. To help licensees and applicants meet Federal guidelines, this STP describes design practices the NRC staff has found acceptable for providing such protection for 200 to 1000 years and focuses principally on the design of tailings covers to provide that protection.

Presently, very little information exists on designing covers to remain effective for 1000 years. Numerous examples can be cited where covers for protection of tailings embankments and other applications have experienced significant erosion over relatively short periods (less than 50 years). Experience with reclamation of coal-mining projects, for example, indicates that it is usually necessary to provide relatively flat slopes to maintain overall site stability (Wells and Jercinovic, 1983, see Ref. 2).

Because of the basic lack of design experience and technical information in this area, this position attempts to adapt standard hydraulic design methods and empirical data to the design of erosion protection covers. The design methods discussed here are based either on: (1) the use of documented hydraulic procedures that are generally applicable in any area of hydraulic design; or (2) the use of procedures developed by technical assistance contractors specifically for long-term stability applications.

It should be emphasized that a standard industry practice for stabilizing tailings for 1000 years does not currently exist. However, standard practice does exist for providing stable channel sections. This practice is widely used to design drainage channels that do not erode when subjected to design flood flows. Since an embankment slope can be treated as a wide channel, the staff concludes that the hydraulic design principles and practice associated with

2.1.2 Long-Term Stability

As required by 40 CFR 192.02 and 10 CFR Part 40, Appendix A, Criterion 6, stabilization designs must provide reasonable assurance of control of radiological hazards for a 1000-year period, to the extent practicable, but in any case, for a minimum 200-year period. The NRC staff has concluded that the risks from tailings could be accommodated by a design standard that requires that there be reasonable assurance that the tailings remain stable for a period of 1000 (or at least 200) years, preferably with reliance placed on passive controls (such as earth and rock covers), rather than routine maintenance.

2.1.3 Design for Minimal Maintenance

Criteria for tailings stabilization, with minimal reliance placed on active maintenance, are established in 40 CFR Part 192 and 10 CFR Part 40, Appendix A, Criteria 1 and 12. Criterion 1 of 10 CFR Part 40, Appendix A specifically states that: "Tailings should be disposed of in a manner [such] that no active maintenance is required to preserve conditions of the site." Criterion 12 states that: "The final disposition of tailings or wastes at milling sites should be such that ongoing active maintenance is not necessary to preserve isolation."

It is evident that remedial action designs are intended to last for a long time, without the need for active maintenance. Therefore, in accordance with regulatory requirements, the NRC staff has concluded that the goal of any design for long-term stabilization to meet applicable design criteria should be to provide overall site stability for very long time periods, with no reliance placed on active maintenance.

For the purposes of this STP, active maintenance is defined as any maintenance that is <u>needed</u> to assure that the design will meet specified longevity requirements. Such maintenance includes even minor maintenance, such as the addition of soil to small rills and gullies. The question that must be answered is whether longevity is dependent on the maintenance. If it is necessary to repair gullies, for example, to prevent their growth and ultimate erosion into tailings, then that maintenance is considered to be active maintenance.

2.1.4 Radon Release Limits

Titles 40 CFR 192.02 and 10 CFR Part 40, Appendix A require that earthen covers be placed over tailings at the end of milling operations to limit releases of radon-222 to not more than an average of 20 picocuries per square meter per second (pCi/m^2s), when averaged over the entire surface of the disposal site and over at least a one-year period, for the control period of 200 to 1000 years. Before placement of the cover, radon release rates are calculated in designing the protective covers and barriers for uranium mill tailings. Additionally, recent regulations promulgated under the Clean Air Act

design follows the procedure for a soil cover, because the layer is predominantly soil, rather than rock.

2.2 Design Procedures

A step-by-step procedure for designing riprap for the top and side slopes of a reclaimed pile is presented below:

Step 1. Determine the drainage areas for both the top slope and the side slope. These drainage areas are normally computed on a unit-width basis.

Step 2. Determine time of concentration (tc).

The tc is usually a difficult parameter to estimate in the design of a rock layer. Based on a review of the various methods for calculating tc, the NRC staff concludes that a method such as the Kirpich method, as discussed by Nelson, et al. (1986, see Ref. D2), should be used. The tc may be calculated using the formula:

$$tc = (11.9L^3/H)^{.385}, \quad \text{where } L = \text{drainage length (in miles)}$$

$$H = \text{elevation difference (in feet)}$$

Step 3. Determine Probable Maximum Flood (PMF) and Probable Maximum Precipitation (PMP).

Techniques for PMP determinations have been developed for the entire United States, primarily by the National Oceanographic and Atmospheric Administration, in the form of hydrometeorological reports for specific regions. These techniques are commonly accepted and provide straightforward procedures for assessing rainfall potential, with minimal variability. Acceptable methods for

determining the total magnitude of the PMP and various PMP intensities for specific times of concentration are given by Nelson, et al. (1986, see Ref. D2, Section 2.1).

Step 4. Calculate peak flow rate.

The Rational Formula, as discussed by Nelson et al. (1986, see Ref. D2), may be used to calculate peak flow rates for these small drainage areas. Other methods that are more precise are also acceptable; the Rational Formula was chosen for its simplicity and ease of computation.

Step 5. Determine rock size.

Using the peak flow rate calculated in Step 4, the required D_{50} may be determined. Recent studies performed for the NRC staff (Abt, et al., 1988, see Ref. D3) have indicated that the Safety Factors Method is more applicable for designing rock for slopes less than 10 percent and that the Stephenson Method is more applicable for slopes greater than 10 percent. Other methods may also be used, if properly justified.

2.3 Recommendations

Since it is unlikely that clogging of the riprap voids will not occur over a long period of time, it is suggested that no credit be taken for flow through the riprap voids. Even if the voids become clogged, it is unlikely that stability will be affected, as indicated by tests performed for the NRC staff by Abt, et al. (1987, see Ref. D4).

If rounded rather than angular rock is used, some increase in the average rock size may be necessary, since the rock will not be as stable. Computational models, such as the Safety Factors Method, provide stability

coefficients for different angles of repose of the material. The need for oversizing of rounded rock is further discussed by Abt, et al. (1987, see Ref. D4).

2.4 Example of Procedure Application

Determine the riprap requirements for a tailings pile top slope with a length of 1000 feet and a slope of 0.02 and for the side slope with an additional length of 250 feet and a slope of 0.2 (20 percent).

Step 1. The drainage areas for the top slope (A1) and the side slope (A2) on a unit-width basis are computed as follows:

$$A1 = (1000)\ (1)\ /\ 43560 = 0.023 \text{ acres}$$

$$A2 = (1000 + 250)\ (1)\ /\ 43560 = 0.029 \text{ acres.}$$

Step 2. The tcs are individually computed for the top and side slopes, using the Kirpich Method, as discussed by Nelson, et al. (1986, see Ref. D2).

$$tc = [(11.9)(L)^3/H]^{.385}$$

For L = 1000 feet and H = 20 feet,

tc = 0.12 hours = 7.2 minutes for the top slope

For L = 250 feet and H = 50 feet,

tc = 1.0 minute for the side slope.

Therefore, the total tc for the side slope is equal to 7.2 + 1.0, or 8.2 minutes.

Step 3. The rainfall intensity is determined using procedures discussed by Nelson, et al. (1986, see Ref. 02), based on a 7.2-minute PMP of 4.2 inches for the top slope and an 8.2-minute PMP of approximately 4.5 inches for the side slope. These incremental PMPs are based on a one-hour PMP of 8.0 inches for northwestern New Mexico and were derived using procedures discussed by Nelson, et al. (1986, see Ref. 02).

Rainfall intensities, for use in the Rational Formula, are computed as follows:

i_1 = (60)(4.2)/7.2 = 35 inches/hr for the top slope

i_2 = (60)(4.5)/8.2 = 33 inches/hr for the side slope.

Step 4. Assuming a runoff coefficient (C) of 0.8, the peak flow rates are calculated using the Rational Formula, as follows:

Q1 = (0.8) (35) (0.023) = 0.64 cfs/ft, for the top slope, and

Q2 = (0.8) (33) (0.029) = 0.77 cfs/ft, for the side slope.

Step 5. Using the Safety Factors Method, the required rock size for the pile top slope is calculated to be:

D_{50} = 0.6 inches.

Using the Stephenson Method, the required rock size for the side slopes is calculated to be:

D_{50} = 3.1 inches.

2.5 Limitations

The use of the aforementioned procedures is widely applicable. The Stephenson Method is an empirical approach and is not applicable to gentle slopes. The Safety Factors Method is conservative for steep slopes. Other methods may also be used, if properly justified.

3. RIPRAP DESIGN FOR DIVERSION CHANNELS

3.1 Technical Basis

The Safety Factors Method or other shear stress methods are generally accepted as reliable methods for determining riprap requirements for channels. These methods are based on a comparison of the stresses exerted by the flood flows with the allowable stress permitted by the rock. Documented methods are readily available for determining flow depths and Manning "n" values.

3.2 Design Procedures

3.2.1 Normal Channel Designs

In designing the riprap for a diversion channel where there are no particularly difficult erosion considerations, the design of the erosion protection is relatively straightforward.

1. The Safety Factors Method or other shear stress methods may be used to determine the riprap requirements.

2. The peak shear stress should be used for design purposes and can be determined ty substituting the value of the depth of flow (y) in the shear

6. OVERSIZING OF MARGINAL-QUALITY EROSION ROTECTION

6.1 Technical Basis

The ability of some rock to survive without significant degradation for long time periods is well-documented by archaeological and historic evidence (Lindsey, et al., 1982, see Ref. D13). However, very little information is available to quantitatively assess the quality of rock needed to survive for long periods, based on its physical properties.

In assessing the long-term durability of erosion protection materials, the NRC staff has relied principally on the results of durability tests at several sites and on information, analyses, and methodology presented in NUREG/CR-4620 (Nelson, et al., see Ref. D2). This document provides a quantitative method for determining the oversizing requirements for a particular rock type to be placed at specific locations on or near a remediated uranium mill tailings pile.

Staff review of actual field data from several tailings sites has indicated that the methodology may not be sufficiently flexible to allow the use of "borderline" quality rock, where a particular type of rock fails to meet minimum qualifications for placement in a specific zone, but fails to qualify by only a small amount. This may be very important, since the selection of a particular rock type and rock size depends on its quality and where it will be placed on the embankment.

Based on NRC staff review of the actual field data, the methodology previously derived has been modified to incorporate additional flexibility. These revisions include modifications to the quality ratings required for use in a particular placement zone, re-classification of the placement zones, reassessment of weighting factors based on the rock type, and more detailed procedures for computing rock quality and the amount of oversizing required.

Based on an examination of the actual field performance of various types and quality of rock (Esmiol, 1967, see Ref. D14), the NRC staff considers it important to determine rock properties with a petrographic examination. The case history data indicated that the singlemost important factor in rock deterioration was the presence of smectites and expanding lattice clay minerals. Therefore, if a petrographic examination indicates the presence of such minerals, the rock will not be suitable for long-term applications.

6.2 Design Procedures

Design procedures and criteria have been developed by the NRC staff for use in selecting and evaluating rock for use as riprap to survive long time periods. The methods are considered to be flexible enough to accommodate a wide range of rock types and a wide range of rock quality for use in various long-term stability applications.

The first step in the design process is to determine the quality of the rock, based on its physical properties. The second step is to determine the amount of oversizing needed, if the rock is not of good quality. Various combinations of good-quality rock and oversized marginal-quality rock may also be considered in the design, if necessary.

6.2.1 Procedures for Assessing Rock Quality

The suitability of rock to be used as a protective cover should be assessed by laboratory tests to determine the physical characteristics of the rocks. Several durability tests should be performed to classify the rock as being of poor, fair (intermediate), or good quality. For each rock source under consideration, the quality ratings should be based on the results of about three to four different durability test methods for initial screening and about six test methods for final sizing of the rock(s) selected for inclusion in the design. Procedures for determining the rock quality and determining a rock quality "score" are developed in Table D1.

6.2.2 Oversizing Criteria

Oversizing criteria vary, depending on the location where the rock will be placed. Areas that are frequently saturated are generally more vulnerable to weathering than occasionally-saturated areas where freeze/thaw and wet/dry cycles occur less frequently. The amount of oversizing to be applied will also depend on where the rock will be placed and its importance to the overall performance of the reclamation design. For the purposes of rock oversizing, the following criteria have been developed:

A. Critical Areas. These areas include, as a minimum, frequently-saturated areas, all channels, poorly-drained toes and aprons, control structures, and energy dissipation areas.

Rating

80-100 - No Oversizing Needed

65-80 - Oversize using factor of (80-Rating), expressed as the percent increase in rock diameter. For example, a rock with a rating of 70 will require oversizing of 10 percent. (See example of procedure application, given in Section 6.4, p. D-28)

Less than 65 - Reject

B. Non-Critical Areas. These areas include occasionally-saturated areas, top slopes, side slopes, and well-drained toes and aprons.

Rating

80-100	-	No Oversizing Needed
50-80	-	Oversize using factor of (80-Rating), expressed as the percent increase in rock diameter

Less than 50 - Reject

TABLE D1

Scoring Criteria for Determining Rock Quality

Laboratory Test	Weighting Factor			Score										
	Limestone	Sandstone	Igneous	10	9	8	7	6	5	4	3	2	1	0
					Good			Fair			Poor			
Sp. Gravity	12	6	9	2.75	2.70	2.65	2.60	2.55	2.50	2.45	2.40	2.35	2.40	2.25
Absorption, %	13	5	2	.1	.3	.5	.67	.83	1.0	1.5	2.0	2.5	3.0	3..
Sodium Sulfate, %	4	3	11	1.0	3.0	5.0	6.7	8.3	10.0	12.5	15.0	20.0	25.0	30.0
L/A Abrasion (100 revs), %	1	8	1	1.0	3.0	5.0	6.7	8.3	10.0	12.5	15.0	20.0	25.0	30.0
Schmidt Hammer	11	13	[illegible]	70.0	65.0	60.0	54.0	47.0	40.0	32.0	24.0	16.0	8.0	0.0
Tensile Strength, psi	6	4	10	1400	1200	1000	833	666	500	400	300	200	100	0

1. Scores were derived from Tables 6.2, 6.5, and 6.7 of NUREG/CR-2642 - "Long-Term Survivability of Riprap for Armoring Uranium Mill Tailings and Covers: A Literature Review," 1982 (see Ref. D13).

2. Weighting Factors are derived from Table 7 of "Petrographic Investigations of Rock Durability and Comparisons of Various Test Procedures," by G. W. DuPuy, Engineering Geology, July, 1965 (see Ref. D15). Weighting factors are based on inverse of ranking of test methods for each rock type. Other tests may be used; weighting factors for these tests may be derived using Table 7, by counting upward from the bottom of the table.

3. Test methods should be standardized, if a standard test is available and should be those used in NUREG/CR-2642 (see Ref. D13), so that proper correlations can be made. This is particularly important for the tensile strength test, where several methods may be used; the method discussed by Nilsson (1962, see Ref. D16) for tensile strength was used in the scoring procedure.

6.3 Recommendations

Based on the performance histories of various rock types and the overall intent of achieving long-term stability, the following recommendations should be considered in assessing rock quality and determining riprap requirements for a particular design.

1. The rock that is to be used should first be qualitatively rated at least "fair" in a petrographic examination conducted by a geologist or engineer experienced in petrographic analysis. See NUREG/CR-4620, Table 6.4 (see Ref. D2), for general guidance on qualitative petrographic ratings. In addition, if a rock contains smectites or expanding lattice clay minerals, it will not be acceptable.

2. An occasionally-saturated area is defined as an area with underlying filter blankets and slopes that provide good drainage and are steep enough to preclude ponding, considering differential settlement, and are located well above normal groundwater levels; otherwise, the area is classified as frequently-saturated. Natural channels and relatively flat man-made diversion channels should be classified as frequently-saturated. Generally, any toe or apron located below grade should be classified as frequently-saturated; such toes and aprons are considered to be poorly-drained in most cases.

3. Using the scoring criteria given in Table D1, the results of a durability test determines the score; this score is then multiplied by the weighting factor for the particular rock type. The final rating should be calculated as the percentage of the maximum possible score for all durability tests that were performed. See example of procedure application for additional guidance on determining final rating.

4. For final selection and oversizing, the rating may be based on the durability tests indicated in the scoring criteria. Other tests may also

be substituted or added, as appropriate, depending on rock type and site-specific factors. The durability tests given in Table D1 are not intended to be all-inclusive. They represent some of the more commonly-used tests or tests where data may be published or readily-available. Designers may wish to use other tests than those presented; such an approach is acceptable. Scoring criteria may be developed for other tests, using procedures and references recommended in Table D1. Further, if a rock type barely fails to meet minimum criteria for placement in a particular area, with proper justification and documentation, it may be feasible to throw out the results of a test that may not be particularly applicable and substitute one or more tests with higher weighting factors, depending on the rock type or site location. In such cases, consideration should be given to performing several additional tests. The additional tests should be those that are among the most applicable tests for a specific rock type, as indicated by the highest weighting factors given in the scoring criteria for that rock type.

5. The percentage increase of oversizing should be applied to the diameter of the rock.

6. The oversizing calculations represent minimum increases. Rock sizes as large as practicable should be provided. (It is assumed, for example, that a 12-inch layer of 4-inch rock costs the same as a 12-inch layer of 6-inch rock.) The thickness of the rock layer should be based on the constructability of the layer, but should be at least 1.5 x D_{50}. Thicknesses of less than 6 inches may be difficult to construct, unless the rock size is relatively small.

6.4 Example of Procedure Application

It is proposed that a sandstone rock source will be used. The rock has been rated "fair" in a petrographic examination. Representative test results are given. Compute the amount of oversizing necessary.

Using the scoring criteria in Table D1, the following ratings are computed:

Lab Test	Result	Score	Weight	Score x Weight	Max. Score
Sp. Gr.	2.61	7	6	42	60
Absorp., %	1.22	4	5	20	50
Sod. Sulf., %	6.90	6	3	18	30
L.A. Abr., %	8.70	5	8	40	80
Sch. Ham.	51	6	13	78	130
Tens. Str., psi	670	6	4	24	40
Totals				222	390

The final rating is computed to be 222/390 or 57 percent. As discussed in Section 6.2, the rock is not suitable for use in frequently-saturated areas, but is suitable for use in occasionally-saturated areas, if oversized. The oversizing needed is equal to (80 - 57), or a 23 percent increase in rock diameter.

6.5 Limitations

The procedure previously presented is intended to provide an approximate quantitative method of assessing rock quality and rock durability. Although the procedure should provide rock of reasonable quality, additional data and studies are needed to establish performance histories of rock types that have a score of a specific magnitude. It should be emphasized that the procedure is only a more quantitative estimate of rock quality, based on USBR classification standards.

It should also be recognized that durability tests are not generally intended to determine if rock will actually deteriorate enough to adversely affect the stability of a reclaimed tailings pile for a design life of 200 to 1000 years. These tests are primarily intended to determine acceptability of rock for various construction purposes for design lifetimes much shorter than 1000 years. Therefore, although higher scores give a higher degree of confidence that significant deterioration will not occur, there is not complete assurance that deterioration will not occur. Further, typical construction projects rely on planned maintenance to correct deficiencies. It follows, then, that there is also less assurance that the oversizing methodology will actually result in rock that will only deteriorate a given amount in a specified time period. The amount of oversizing resulting from these calculations is based on the engineering judgment of the NRC staff, with the assistance of contractors. However, in keeping with the Management Position (USNRC, 1989, see Ref. D17), the staff considers that this methodology will provide reasonable assurance of the effectiveness of the rock over the design lifetime of the project.

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NUREG/CR-4620
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Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments

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The rainfall depth for a specific site is estimated by determining the rainfall duration and/or appropriate time of concentration. The resulting rainfall depth in inches, is

$$\text{PMP rainfall depth} = (\%\ \text{PMP}) \times (\text{PMP}) \tag{2.1}$$

where the percent PMP is obtained from Table 2.1 and the PMP is obtained from the appropriate PMP design storm presented in Section 2.1.1.

The rainfall intensity, i, in inches per hour can be computed as

$$i = \text{rainfall depth (inches)} \times \frac{60}{\text{rainfall duration (minutes)}} \tag{2.2}$$

The rainfall intensity determined from Equation 2.2 is generally a conservative value and represents the peak rainfall intensity of the design storm.

To compute the rainfall intensity for any rainfall duration, it is recommended that a rainfall intensity versus rainfall duration curve be plotted on semilogarithmic paper. Because of the extremely conservative rainfall intensity values obtained for short durations, it is recommended that the minimum rainfall duration be 2.5 minutes. Rainfall depths should be extracted from the appropriate Hydrometeorological Report.

2.2 PMP COMPARISON STORMS

A comparison of estimates of the PMP with greatest observed rainfall and estimates of the 100-year events for areas both east and west of the 105° meridian was prepared (NWS, 1980). Information from 6500 precipitation reporting stations in the eastern U.S. and about 2100 stations in the west was used. Including storm durations of 6 to 72 hours, the study indicated that 177 separate storm events have been recorded in which the rainfall was greater than or equal to 50 percent of the PMP for stations east of the 105° meridian. Only 66 separate storm events were recorded west of the 105° meridian where rainfalls were greater than or equal to 50 percent of the PMP.

The National Weather Service also reported the number of storm events which met or exceeded the 100-year rainfall values and compared them with the regional PMP values (NWS, 1980). Table 2.2 summarizes these rainfall events for 6 and 24-hour storms occurring over a 10 square mile area. It is interesting to note that a storm has not been officially recorded west of the Continental Divide that exceeds 90% of the PMP value. However, it is evident that a number of storms approach the PMP values, thereby substantiating that the prescribed PMP values are not extremely conservative.

4.1.5.6 Gully Width

The width of the gully across the top of the gully at the point of maximum depth can be estimated from Figure 4.5. Having computed the maximum depth, D_{max}, and knowing the uniformity coefficient, C_u, the top width is estimated to be approximately 5.6 feet. However, the gully width will widen over time to where the gully side wall stands at an angle less than the angle of repose of the cover material.

4.2 EMBANKMENT AND SLOPE STABILIZATION USING RIPRAP

Rock riprap is one of the most economical materials that is commonly used to provide for cover and slope protection. Factors to consider when designing rock riprap are: (1) rock durability, density, size, shape, angularity, and angle of repose; (2) water velocity, depth, shear stress, and flow direction near the riprap; and (3) the slope of the embankment or cover to be protected. Through the proper sizing and placement of riprap on any impoundment cover, rill and gully erosion can be minimized to ensure long term stabilization.

The primary failure mechanism of concern is the removal of material from the impoundment due to shear forces developed by water flowing parallel and/or adjacent to the cover as described by Nelson et al. (1983). One purpose of the cover is to expedite the removal of precipitation and tributary waters away from the cover to minimize seepage and percolation. However, when surface waters are not properly managed, extreme erosion may result and endanger the impoundment stability. For example, slopes are often designed and constructed to develop sheet flow conditions. After many years of exposure, sheet and rill erosion, and localized settlement, the hydraulic conditions have significantly altered causing flows to merge or concentrate into drainage channels. The greater the concentration of flow into the drainage channels, the greater the erosion potential.

4.2.1 Zone Protection

The design requirements for placing riprap rock on a cover vary depending upon cover location. It is suggested that four areas exist on the cover in which different failure mechanisms can result from tributary drainage. The four areas or zones of concern are presented in Figure 4.6 and include:

1. Zone I: This zone is considered the toe-of-the-slope of the reclaimed impoundment. The riprap protecting the slope toe must be sized to stabilize the slope due to flooding in the major watersheds and dissipate energy as the flow transitions from the impoundment slope into the natural terrain. Zone I is considered a zone of frequent saturation.

2. Zone II: This is the area along the side slope which remains in the major watershed flood plain (PMF). The rock protection must resist not only the flow off the cover, but also floods. The

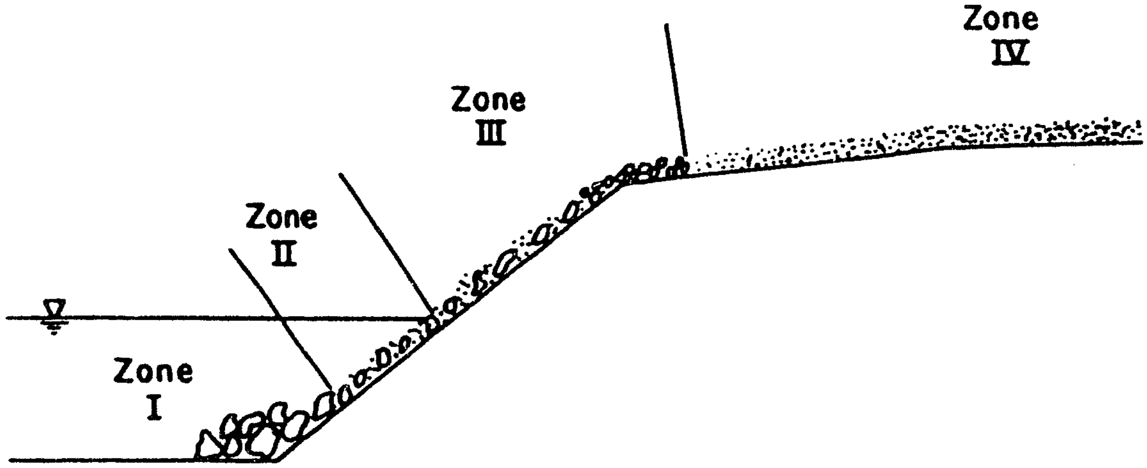

Fig. 4.6. Zones of a reclaimed impoundment requiring riprap protection.

riprap must serve as embankment protection similar to river and canal banks. Zone II is considered a zone of occasional saturation.

3. Zone III: Riprap should be designed to protect steep slopes and embankments from potential high overtopping velocities and excessive erosion. Flows in Zone III are derived from tributary drainage and direct runoff from the reclaimed site. Zone III is considered a seldom saturated zone.

4. Zone IV: Rock protection for Zone IV is generally designed for flows from mild slopes. Zone IV will usually be characterized by sheet flow with low flow velocities. Zone IV is considered a zone of seldom saturation.

Since the rock protection requirements are significantly different on various locations on the cover, it should be apparent that each riprap design procedure available was formulated to address a specific application. Since a single riprap design procedure does not necessarily meet all of the cover protection requirements, recommendations will be made indicating which zone(s) each riprap design procedure best addresses.

Because the frequency of wetting or saturation varies by zone, the durability requirements of the riprap may vary by zone. The concept of durability and oversizing will be addressed in Chapter 6 of this report.

4.2.2 Design Procedures

Presently, several methods are available to assist the designer in determining the appropriate rock size for protection of impoundment covers, embankments and unprotected slopes from the impact of drainage waters. Alternative riprap design methods summarized herein are

1. Safety Factors Method
2. The Stephenson Method
3. Corps of Engineers Method
4. The U.S. Bureau of Reclamation Method

These riprap design procedures are but examples of the many methods available.

4.2.2.1 Safety Factors Method

The Safety Factors Method (Richardson et al., 1975) for sizing rock riprap is quite versatile in that it allows the designer to evaluate rock stability from flow parallel to the cover and adjacent to the cover. The Safety Factors Method can be used by assuming a rock size and then calculating the safety factor (S.F.) or allowing the designer to determine a S.F. and then computing the corresponding rock size. If the S.F. is greater than unity, the riprap is considered safe from failure; if the S.F. is unity, the rock is at the condition of incipient motion; and if S.F. is less than unity, the riprap will fail.

where d_{50} is the mean rock size in feet. A graphical representation for determining n is presented in Figures 4.12 and 4.13. However, these values were developed for uniform flow condition over submerged riprap. When overtopping flows on steep slopes begin to cascade, n values will increase and may range from 0.07 to 0.09 or higher. (Abt and Ruff, 1985 and COE, 1970).

Table 4.2. Manning Coefficient, n.

Channel Material	Manning Coefficient, n
Fine sand, colloidal	0.020
Sandy loam, non-colloidal	0.020
Silt loam, non-colloidal	0.020
Alluvial silts, non-colloidal	0.020
Ordinary firm loam	0.020
Volcanic ash	0.020
Stiff clay, very colloidal	0.025
Alluvial silts, colloidal	0.025
Shales and hardpans	0.025
Fine gravel	0.020
Graded loam to cobbles, non-colloidal	0.030
Graded silts to cobbles, colloidal	0.030
Coarse gravel, non-colloidal	0.025
Cobbles and shingles	0.035

Source: Morris and Wiggert, 1972.

4.8 COVER EROSION RESISTANCE EVALUATION

The cover design should be evaluated to determine if the unprotected slopes(s) can withstand overland or sheet flow with a minimum of erosion. Based upon the site-specific cover and precipitation parameters, the design sheet flow velocity should be estimated. A comparison of the design flow velocity with the cover permissible flow velocity can be performed. Furthermore, the design velocity can be used to determine the sediment discharge using the Universal Soil Loss Equation (Chapter 5) and for sizing stone protection (Section 4.2).

The design velocity will usually be determined from the peak discharge generated from the Probable Maximum Flood (PMF). The PMF can be estimated by

(a) Using computer models, i.e., HEC-1 (COE, 1974), that are widely accepted by the engineering profession.

(b) Applying the Rational Method for tributary areas that are less than approximately one square mile in area.

The Rational formula is commonly expressed as

$$Q = CiA \tag{4.42}$$

where Q is the maximum or design discharge in cfs, C is a runoff coefficient dependent upon the characterization of the drainage basin, i is the rainfall intensity expressed in inches per hour and A is the tributary area expressed in acres. When a unit width approach is taken, the area A_w is the slope(s) length times the unit width. Therefore, Equation 4.42 would be presented as

$$q = CiA_w \tag{4.43}$$

for a unit width analysis.

4.8.1 Runoff Coefficient

The runoff coefficient, C, is related to the climatic conditions and type of terrain characteristic of the watershed including soil materials, permeability and storage potential. Values of the coefficient C are presented in Table 4.4 (Lindsley et al., 1958), Table 4.5 (Chow, 1964), and Table 4.6 (ASCE, 1970 and Seelye, 1960).

Table 4.4. Values of Coefficient C.

Type Area	Value of C
Flat cultivated land, open sandy soil	0.20
Rolli cultivated land, clay-loam soil	0.50
Hill land, forested, clay loam soil	0.50
Steep, impervious slope	0.95

Source: Lindsley, et al, 1958.

The selection of a coefficient value requires considerable judgment as it is a tangible aspect of using the rational formula. It is recommended

that a conservative value of C be applied for PMF estimation since infiltration and storage comprise a low percentage of the runoff. Furthermore, the C values presented were derived for storms of 5-100 year frequencies. Therefore, less frequent, higher intensity storms will require the use of a higher C value (Chow, 1964). It is recommended that a runoff coefficient of 1.0 be used for PMF applications in very small watersheds since the effects of localized storage and infiltration will be small.

Table 4.5. Values of C for Use in Rational Formula.

Soil Type	Watershed Cover		
	Cultivated	Pasture	Woodlands
With above-average infiltration rates; usually sandy or gravelly	0.20	0.15	0.10
With average infiltration rates; no clay pans; loams and similar soils	0.40	0.35	0.30
With below-average infiltration rates; heavy clay soils or soils with a clay pan near the surface; shallow soils above impervious rock	0.50	0.45	0.40

Source: Chow, 1964.

4.8.2 Rainfall Intensity

In order to determine the rainfall intensity, i, the time of concentration, t_c must be estimated. The time of concentration can be approximated by:

(a) Applying one of the many accepted empirical formulae such as

$$t_c = 0.00013 \frac{L^{0.77}}{S^{0.385}} \qquad (4.44)$$

where L is the length of the basin in feet measured along the watercourse from the upper end of the watercourse to the drainage basin outlet and S is the average slope of the basin. Time of concentration is expressed in hours. This procedure is not applicable to rock covered slopes. This expression was

Table 4.6. Values of runoff coefficient C.

Character of Surface	Runoff Coefficients	
	Range	Recommended
Pavement--asphalt or concrete	0.70-0.95	0.90
Gravel, from clean and loose to clayey and compact	0.25-0.70	0.50
Roofs	0.70-0.95	0.90
Lawns (irrigated) sandy soil		
Flat, 2 percent	0.05-0.15	0.10
Average, 2 to 7 percent	0.15-0.20	0.17
Steep, 7 percent or more	0.20-0.30	0.25
Lawns (irrigated) heavy soil		
Flat, 2 percent	0.13-0.17	0.15
Average, 2 to 7 percent	0.18-0.22	0.20
Steep, 7 percent	0.25-0.35	0.30
Pasture and non-irrigated lawns		
Sand		
Bare	0.15-0.50	0.30
Light vegetation	0.10-0.40	0.25
Loam		
Bare	0.20-0.60	0.40
Light vegetation	0.10-0.45	0.30
Clay		
Bare	0.30-0.75	0.50
Light vegetation	0.20-0.60	0.40
Composite areas		
Urban		
Single-family, 4-6 units/acre	0.25-0.50	0.40
Multi-family, >6 units/acre	0.50-0.75	0.60
Rural (mostly non-irrigated lawn area)		
<1/2 acre - 1 acre	0.20-0.50	0.35
1 acre - 3 acres	0.15-0.50	0.30
Industrial		
Light	0.50-0.80	0.65
Heavy	0.60-0.90	0.75
Business		
Downtown	0.70-0.95	0.85
Neighborhood	0.50-0.70	0.60
Parks	0.10-0.40	0.20

Source: ASCE, 1970 and Seelye, 1960.

designed for and applicable to small drainage basins (Kirpich, 1940).

(b) Using the Soil Conservation Service (SCS) Triangular Hydrograph Theory (DOI, 1977), the time of concentration is

$$t_c = \left(\frac{11.9\ L^3}{H}\right)^{0.385} \qquad (4.45)$$

See USNRC (pg D-3) "Final Staff Technical Position Design of Erosion Protection Covers for Stabilization of Uranium Mill Tailings Sites" (1990)

where L is the length (miles) of the longest watercourse from the point of interest to the tributary divide, H is the difference in elevation (feet) between the point of interest and the tributary divide. The time of concentration will be expressed in hours. The SCS procedure is most applicable to drainage basins of at least 10 square miles.

Once the rainfall duration or time of concentration is determined, the rainfall depth can be computed based on the PMP intensity values estimated in Section 2.1.2.

4.8.3 Tributary Area

The tributary area may be expressed in a unit width format for design of rock protection on an embankment. Therefore, the area is the length of the longest expected or measured water course multiplied by the unit width. This procedure is primarily applicable to Zones I, II, and III and is not applicable for drainage ditch design. It should be noted that a unit width approach to drainage and diversion ditch design is not effective. Ditch design requires an entire basin analysis in which a composite inflow hydrograph is determined and is routed along the channel. From the inflow hydrograph, water surface profiles (i.e., HEC-2) can be estimated to determine flow depth and velocities for riprap design (COE, 1982).

4.8.4 Sheet Flow Velocity

The design velocity for sheet flow on an embankment slope can be estimated by solving the Manning formula presented in Equation 4.39. It is assumed that the hydraulic radius, R, is approximately equal to the flow depth, y, and that the design discharge is equal to that estimated by the Rational Method. Therefore, the depth of flow is

$$y = \left[\frac{Qn}{1.486\ S^{1/2}}\right]^{3/5} \qquad (4.46)$$

where Q is the discharge, S is the slope, and n is the Manning coefficient.

Therefore, the design velocity can be estimated as

$$V_{Design} = Q/A \text{ (feet/sec)} \tag{4.47}$$

where A is the cross-sectional area of flow.

4.9 FLOW CONCENTRATIONS

Despite the extensive efforts of the impoundment reclamation designer, reviewer, contractor and inspector, the topographic features of the cover will alter over time without continual maintenance (Powledge and Dodge, 1985). Cover modifications will result from differential settlement, collapsing soils, marginal quality control in cover placement, erosion, major hydrologic events and monitoring disturbance. Because of these unpredictable and generally uncontrollable events, tributary drainage areas evolve that were not originally designed or constructed. The result is that the peak discharge and volume of runoff exceed design levels and increase the erosion potential.

Abt and Ruff (1985) conducted a series of flume experiments on a 1V:5H prototype embankment protected by riprap with median rock sizes of 2 inches to 6 inches in diameter. It was observd that 2-4 inch diameter riprap were highly susceptible to sheet flows converging along the face of the embankment into channels. The discharge in the channel(s) was compared to the total discharge over the embankment by

$$CF = \frac{1}{1 - (Q_c - Q)} \tag{4.48}$$

where CF is the concentration factor, Q_c is the discharge in the channel and Q is the total discharge over the embankment. The concentration factors ranged from 1.1 to 3.2 where flows were less than the failure discharge. These preliminary results indicate that riprap designed for sheet flow conditions may be subjected to flow channelizations that concentrate 3 times the discharge in a single location.

The peak discharge along a crest or at a design point is a function of the amount of precipitation, the tributary drainage area, the slope of the drainage basin, the basin contouring, the cover material and cover protection. Any modification in one or more of these parameters can impact the outlet peak discharge. The cover design must account for these potential changes in the form of a concentration or safety factor. Therefore, a flow concentration factor may be incorporated into the design process to adequately evaluate the soil resistance to erosion, to adequately select and evaluate alternative protective measures and to size riprap when warranted.

It is difficult to accurately predict the value of the flow concentration factor since limited information is currently available to substantiate design limits. However, it is reasonable to assume that values between 2 and 3 are attainable with only a slight evolutionary change in cover. Unless it can be shown that design procedures such as overbuilding can compensate for differential settlement, it is recommended that a conservative concentration factor be used until additional research can justify a more reasonable range of values.

To incorporate the flow concentration factor into the stone sizing procedure of any riprap design method, multiply the design peak discharge by the flow concentration factor. All subsequent computations, i.e., velocity and depth estimate, stone size determination, etc., will reflect the influence of the flow concentration.

4.10 PERMISSIBLE VELOCITIES

Evaluation of proposed reclamation alternatives should include an analysis of the critical erosion potential of the cover material. Erosion potential can be determined based upon the properties of the reclamation materials as well as the degree of compaction in which the material is placed. The permissible velocity approach consists of specifying a velocity criterion that will not erode the cover or channel and will prevent scour. A comparison of the actual or design flow velocities to the permissible velocities associated with overland flows, sheetflows or channel flows determines the erosion potential. When the design flow velocity meets or exceeds the permissible velocity, cover protection should be considered.

The permissible velocity values presented were developed from experiments performed primarily in canals and stream beds. Therefore, the following permissible velocities should provide a conservative estimate for evaluating the erosion resistance of the reclaimed covers over long term periods. In cases where a range of permissible velocities are presented, it is recommended that the lower velocity be used for determining erosion potential.

A series of permissible maximum canal velocities was developed by Fortier and Scobey (1926) and adapted by Lane (1955). The maximum permissible velocities presented in Table 4.7 are applicable to colloidal silts. These velocity values were developed for channels without sinuosity. Lane recommended a reduction of the velocities in Table 4.7 by 13 percent if the canal/channel is moderately sinuous. The maximum allowable velocities for sandy-based materials are given in Table 4.8. Table 4.9 provides limiting velocities for cohesive materials according to compactness for materials with less than 50 percent sand content. The Soil Conservation Service maximum permissible velocities (SCS, 1984) for well maintained grass covers are presented in Table 4.10.

It is important to recognize that limited information is available pertaining to permissible velocities on covers under sheet flow conditions.

Table 4.7. Maximum permissible velocities in erodible channels.

Channel Material	Water Transporting Colloidal Silts v (ft/sec)
Fine sand, colloidal	2.50
Sandy loam, non-colloidal	2.50
Silty loam, non-colloidal	3.00
Alluvial silts, non-colloidal	3.50
Firm loam	3.50
Volcanic ash	3.50
Stiff clay, colloidal	5.00
Alluvial silts, colloidal	5.00
Shales and hardpans	6.00
Fine gravel	5.00
Graded loam to cobbles, non-colloidal	5.00
Graded silts to cobble, colloidal	5.50
Coarse gravel, non-colloidal	6.00
Cobbles and shingles	5.50

Source: Lane 1955.

Table 4.8. Maximum allowable velocities in sand-based material.

Material	Velocity (ft/sec)
Very light sand of quicksand character	0.75 to 1.00
Very light loose sand	1.00 to 1.50
Coarse sand to light sandy soil	1.50 to 2.00
Sandy soil	2.00 to 2.50
Sandy loam	2.50 to 2.75
Average loam, alluvial soil, volcanic ash	2.75 to 3.00
Firm loam, clay loam	3.00 to 3.75
Stiff clay soil, gravel soil	4.00 to 5.00
Coarse gravel, cobbles and shingles	5.00 to 6.00
Conglomerate, cemented gravel, soft slate, tough hardpan, soft sedimentary rock	6.00 to 8.00

Source: Lane, 1955.

Therefore, the permissible velocities developed for channels is usually extended to overland flow situations. When design velocities reach or exceed those indicated in Tables 4.7 through 4.10, protection is warranted.

Table 4.9. Limiting Velocities in Cohesive Materials.

	Compactness of Bed			
	Loose	Fairly Compact	Compact	Very Compact
Principle Cohesive Material	Velocity (ft/sec)	Velocity (ft/sec)	Velocity (ft/sec)	Velocity (ft/sec)
Sandy clay	1.48	2.95	4.26	5.90
Heavy clayey soils	1.31	2.79	4.10	5.58
Clays	1.15	2.62	3.94	5.41
Lean clayey soils	1.05	2.30	3.44	4.43

Source: Lane, 1955.

The materials presented in Tables 4.7 through 4.9 can be referenced to the Unified Soil Classification System as presented by Wagner (1957). An engineering analysis of the cover material can provide an approximation of the permissible velocities that the alternative cover materials may withstand without supplemental protection.

4.11 PERMISSIBLE VELOCITY EXAMPLE

A tailings disposal site located in the northwest corner of New Mexico has prepared a reclamation plan for review. The reclamation plan indicates that a 10 foot thick cap will be placed atop the tailings at a slope of 2.4% with a compaction of 95% of optimum. The cap will be graded as shown in Figure 4.14 and shall transition into side slopes of 1V:10H. It is proposed that the cap will be composed of a sandy clay with a coarse gravel cover. Along the crest, a 12 inch thick layer of riprap will be placed for at least 8 feet upslope and downslope of the crest to stabilize the transition. The riprap will have a median stone size of 6 inches. The gravel cover will have a median rock size of 1.5 inches. The design reviewer must verify that the gravel cover will resist the potential velocities that may result on the cap.

In order to assess the stabilization of the cap against erosion due to overland flow, information provided in Sections 4.6 through 4.10 of this report must be utilized. One alternative means of reviewing the design is presented in the following analysis.

4.11.1 Estimation of Peak Runoff

The peak runoff can be estimated using the Rational formula presented in Equation 4.43. The three components of the Rational formula that require consideration are: the runoff coefficient, C; the rainfall intensity, i; and the tributary area, A.

The runoff coefficient can be estimated by examining Tables 4.4 through 4.6. Since the cap will be composed of a compacted clay, the infiltration and localized storage will be low. The peak runoff is a direct function of the estimated localized PMF. Therefore, a reasonable C value is 1.0.

The rainfall intensity can be estimated by determining the 1-hr, 1-mi^2 local storm PMP value and adjusting the rainfall depth in accordance with the percentages presented in Table 2.1. For northwest New Mexico, the 1-hr, 1-mi^2 PMP is estimated to be 9.5 inches after the appropriate elevation and area adjustments are performed.

The time of concentration, t_c, should be estimated. Using Equation 4.44, the t_c can be estimated where the longest flow path is approximately 450 feet as

$$t_c = 0.00013 \frac{(450)^{0.77}}{(0.024)^{0.385}} \qquad (4.49)$$

and

$$t_c = 0.06 \text{ hrs} = 3.62 \text{ minutes} \qquad (4.50)$$

The rainfall depth for variable rainfall durations can be estimated using the values presented in Table 2.1 which are applicable to northwest New Mexico. Since the time of concentration is 3.6 minutes, the percent of the 1-hr PMP can be interpolated to be approximately 35 percent. The rainfall depth is computed using Equation 2.1 to be

$$\text{Rainfall depth} = (0.35) \times 9.5 \text{ inch} = 3.33 \text{ inches} \qquad (4.51)$$

A conservative estimate of the rainfall intensity is determined by applying Equation 2.2.

$$i = 3.33 \text{ inches} \times \frac{60}{3.6} = 55.5 \text{ inches/hr} \qquad (4.52)$$

The tributary area, A, can be estimated using a unit width approach presented in Section 4.8. Since the longest flow path is 450 feet with a unit width of one foot, the tributary area is 450 square feet. The tributary area can be converted to acres by dividing by 43,560 square feet/acre resulting in an area of 0.0103 acres.

The peak sheet flow unit discharge at the transition can be computed by using the Rational formula presented in Equation 4.43.

$$q = (1.0)\ (55.5)\ (0.0103) = 0.57 \text{ cfs} \qquad (4.53)$$

4.11.2 Sheet Flow Velocity

The sheet flow design velocity can be estimated by first determining the depth of flow. The depth of flow, y, can be calculated using Equation 4.46. However, the Manning surface roughness coefficient, n, must be determined. From Equation 4.41, the Manning n value can be calculated as

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

$$n = 0.0395\ (0.125)^{1/6} = 0.028 \qquad (4.54)$$

The depth of flow is then computed to be

$$y = \left[\frac{(0.57)\ 0.028}{1.486\ (0.024)^{1/2}}\right]^{3/5} = 0.202 \text{ feet} \qquad (4.55)$$

or

$$y = (0.202 \text{ ft})\ (12 \text{ in/ft}) = 2.42 \text{ inches} \qquad (4.56)$$

The design sheet flow velocity is calculated using Equation 4.47.

$$V = \frac{0.57}{(1.0)(0.20)} = 2.82 \text{ feet/sec} \qquad (4.57)$$

where 0.57 is the unit discharge, 1.0 is the width of flow in feet and 0.20 is the depth of flow in feet. It should be noted that the flow concentration factor was not incorporated into this computation.

4.11.3 Cover Permissible Velocity

The permissible velocity for the clay cap covered with gravel has been determined to be 5.0-6.0 feet/sec as presented in Table 4.8. Since the design sheet flow velocity was calculated to be 2.9 feet/sec, the cover should be able to withstand the design flow.

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Development of Riprap Design Criteria by Riprap Testing in Flumes: Phase I

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embankments, channel and unprotected slopes from the impact of flowing waters. Four riprap design procedures which will be referenced are:

1. Safety Factors Method (SF)
2. The Stephenson Method (STEPH)
3. The U.S. Army Corps of Engineers Method (COE)
4. The U.S. Bureau of Reclamation Method (USBR)

A summary of each method will be presented.

3.4.1 Safety Factors Method

The Safety Factors Method (Richardson et al., 1975) for sizing riprap allows the designer to evaluate rock stability from flow parallel to the cover and adjacent to the cover. The Safety Factors Method can be used by assuming a stone size and then calculating the safety factor (SF) or allowing the designer to determine a SF and then computing the corresponding stone size. If the SF is greater than unity, the riprap is considered safe from failure; if the SF is unity, the rock is at the condition of incipient motion; and if SF is less than unity, the riprap will fail.

The following equations are provided for riprap placed on a side slope or embankment where the flow has a non-horizontal (downslope) velocity vector. The safety factor, SF, is:

$$SF = \frac{\cos\theta \tan\phi}{\eta' \tan\phi + \sin\theta \cos\beta} \quad (3.5)$$

where

$$\eta' = \eta \left[\frac{[1 + \sin(\lambda + \beta)]}{2} \right] \qquad (3.6)$$

$$\eta = \frac{21\ \tau_0}{(G_s - 1)\,\gamma\,D_{50}} \qquad (3.7)$$

$$\tau_0 = \gamma\,DS \qquad (3.8)$$

and

$$\beta = \tan^{-1}\left[\frac{\cos\lambda}{(2\sin\theta)/(\eta\tan\phi) + \sin\lambda} \right] \qquad (3.9)$$

The angle, λ, is shown in Figure 3.1 and is the angle between a horizontal line and the velocity vector component measured in the plane of the side slope. The angle, θ, is the side slope angle shown in Figure 3.1 and β is the angle between the vector component of the weight, W_s, directed down the side slope and the direction of particle movement. The angle, ϕ, is the angle of repose of the riprap, τ_0 is the bed shear stress (Simons and Senturk, 1977), D_{50} is the representative stone size, G_s is the specific gravity of the rock, D is the depth of flow, γ is the specific weight of the liquid, S is the slope of the channel, and η' and η are stability numbers. In Figure 3.1, the forces F_l and F_d are the lift and drag forces, and the moment arms of the various forces are indicated by the value e_i as i = 1 through 4. Figure 3.2 illustrates the angle of repose for riprap material sizes.

Riprap is often placed along side slopes where the flow direction is close to horizontal or the angularity of the velocity component with the

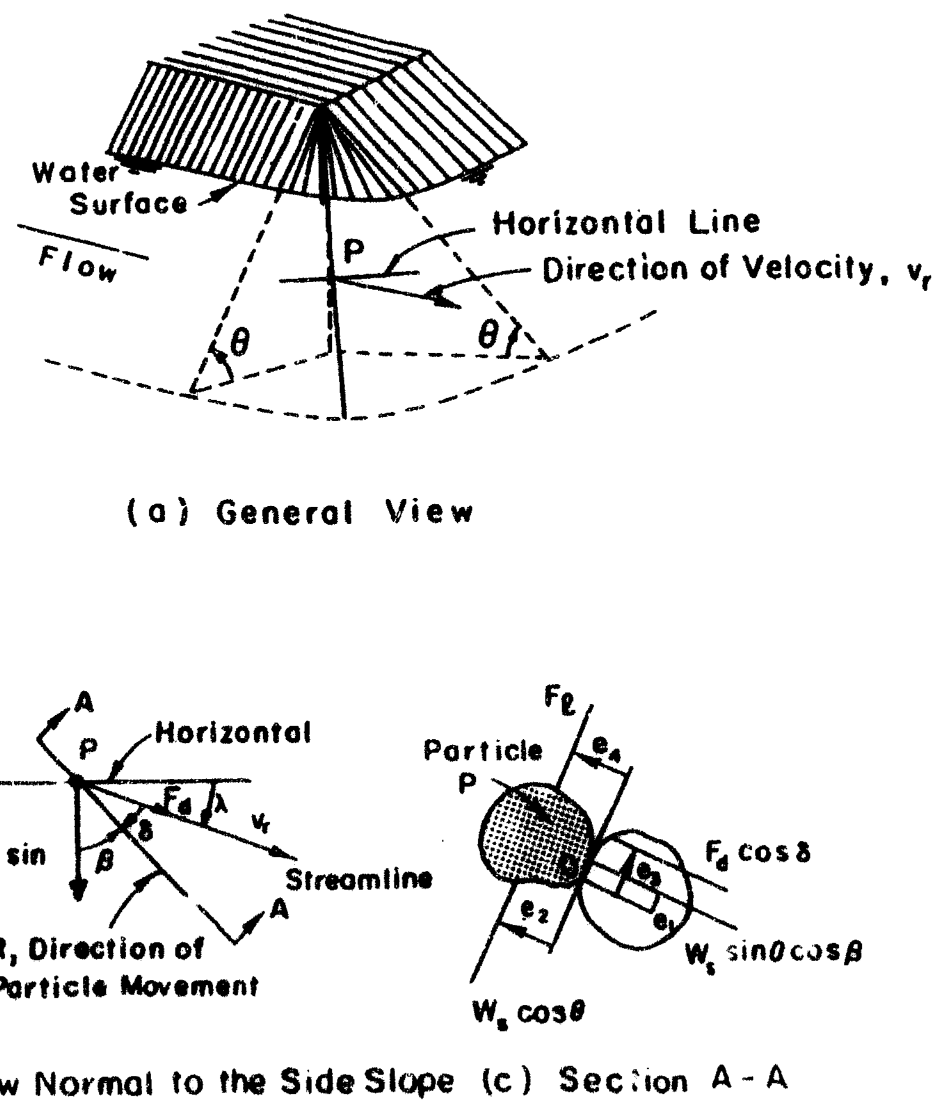


Fig. 3.1. Riprap stability conditions as described in the Safety Factors Method.

horizontal is small (i.e., $\lambda = 0$). For this case, the above equations reduce to:

$$\tan \beta = \frac{\eta \tan \phi}{2 \sin \theta} \tag{3.10}$$

and

$$\eta = \left[\frac{S_m^2 - (SF)^2}{(SF)\,(S_m^2)} \right] \cos \theta \tag{3.11}$$

where

$$S_m = \frac{\tan \phi}{\tan \theta} \tag{3.12}$$

The term S_m is the safety factor of the rock particles against rolling down the slope with no flow. The safety factor, SF, for horizontal flow may be expressed as:

$$SF = \frac{S_m}{2} [S_m^2 \eta^2 \sec^2 \theta + 4)^{0.5} - S_m \eta \sec \theta] \tag{3.13}$$

Riprap may also be placed on the cover or side slope. For a cover sloping in the downstream direction at an angle, α, with the horizontal, the equations reduce to:

$$SF = \frac{\cos \alpha \tan \phi}{\eta \tan \phi \sin \alpha} \tag{3.14}$$

Historic use of the Safety Factors Method has indicated that a minimum SF of 1.5 for non-PMF applications (i.e. 100-year events) provides a side slope with reliable stability and protection (Simons and Senturk, 1977). However, a SF of slightly greater than 1.0 is recommended for PMF or maximum credible flood circumstances. It is recommended that the riprap thickness be a minimum of 1.5 times the D_{50}. Also, a bedding or filter layer should underlay the rock riprap. The filter layer should minimally range from 6 inches to 12 inches in thickness. In cases where the Safety Factors Method is used to design riprap along embankments or slopes steeper than 4H:1V, it is recommended that the toe be firmly stabilized.

3.4.2 Stephenson Method

The Stephenson Method for sizing rockfill to stabilize slopes and embankments is an empirically derived procedure developed for emerging flows (Stephenson, 1979). The procedure is applicable to a relatively even layer of rockfill acting as a resistance to through and surface flow. It is ideally suited for the design and/or evaluation of embankment gradients and rockfill protection for flows parallel to the embankments, cover or slope.

The sizing of the stable stone or rock requires the designer to determine the maximum flow rate per unit width (q), the rockfill porosity (n_p), the acceleration of gravity (g), the relative density of the rock (G_s), the angle of the slope measured from the horizontal (θ), the angle of friction (ϕ), and the empirical factor (C).

The stone or rock size, D_{50}, is expressed by Stephenson as

$$D_{50} = \left[\frac{q(\tan \theta)^{7/6} n_p^{1/6}}{C\ g^{1/2}\ [1-n_p)(G_s-1)\cos\theta\ (\tan\phi - \tan\theta)]^{5/3}} \right]^{2/3} \qquad (3.15)$$

where the factor C varies from 0.22 for gravel and pebbles to 0.27 for crushed granite. The stone size calculated in Equation 3.15 is the representative diameter, D_{50}, at which rock movement is expected for unit discharge, q. The representative median stone diameter $(D_{50})_l$, is then multiplied by Oliviers' constant, K, to insure stability. Oliviers' constants are 1.2 for gravel and 1.8 for crushed rock. The rockfill layer should be well graded and at least two times the D_{50} in thickness. A bedding layer or filter should be placed under the rockfill.

The Stephenson Method does not account for uplift of the stones due to emerging flow. This procedure was developed for flow over and through rockfill on steep slopes. Therefore, it is recommended that the Stephenson Method be applied as an embankment stabilization for overflow or sheetflow conditions. Alternative riprap rockfill design procedures should be considered for toe and stream bank stabilization.

3.4.3 U.S. Army Corps of Engineers Method

The U.S. Army Corps of Engineers has developed perhaps the most comprehensive methods and procedures for sizing riprap revetment. Their criteria are based on extensive field experience and practice (COE, 1970 and

SECOND EDITION

ORIGIN OF SEDIMENTARY ROCKS

HARVEY BLATT

University of Oklahoma

GERARD MIDDLETON

McMaster University

RAYMOND MURRAY

University of Montana

Prentice-Hall, Inc., Englewood Cliffs, New Jersey 07632

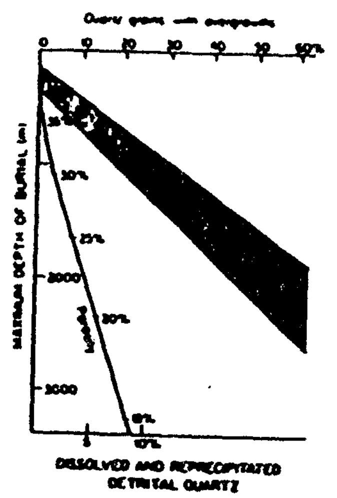


Fig. 12-6 Porosity, burial depth, and abundance of quartz overgrowths in quartz sandstones from the "Dogger beta" (Jurassic), West Germany. For example, at a depth of 1000 m the porosity is 31%, quartz overgrowths form 1% of the rock, and between 10% and 20% of the detrital quartz grains have overgrowths. (From Hans Füchtbauer, 1967, Proc. 7th World Pet. Cong., Mexico City, 2, 354. Used by permission of the Elsevier Scientific Pub. Co.)

by retarding pressure solution and the formation of quartz overgrowths. Fluid flow through sandstones may also enhance porosity by dissolving earlier-formed cements or detrital mineral grains.

12.4 PERMEABILITY

Permeability is a measure of the ease with which a fluid flows through a rock. It is defined by an empirical relationship first recognized by the French hydrologist Henri Darcy in 1856 and may be written

$$V = \frac{Q}{A} = k\frac{\Delta p}{\mu l}$$

where V = apparent velocity (cm/s)
Q = discharge (cm^3/s)
A = cross-sectional area (cm^2)
k = permeability (darcies = $cm^2 \times 10^{-8}$)
μ = fluid viscosity (centipoises, gm/cm s $\times 10^{-2}$)
l = distance of flow (cm)
p = pressure (dynes/cm^2); this term consists of both a fluid pressure term and a gravitational acceleration term.

Permeabilities to water of more than 500 darcies have been measured in modern river sands; in ancient rocks permeabilities to air range from a high of several darcies in coarser sandstones to a measured low of 10^{-11} darcy in a shale. The median permeability of petroleum reservoirs is on the order of 0.1 darcy (100 md).

Permeability is normally determined in the laboratory by sealing the side of the cylindrical rock core, removing any oil in the core with a solvent, and forcing air longitudinally through the core. Thus permeabilities ordinarily reported in core analysis refer to the permeability to dry air at atmospheric pressure. The permeability to freshwater, brine, or petroleum may be much less, depending on the mineral composition of the rock, particularly the amount and type of clay minerals it contains (see below). Unfortunately, the accuracy of core analysis for determining permeability is somewhat illusory. When a core is removed from the subsurface, all confining forces are removed and the rock matrix expands in all directions, partially changing the pore radii and fluid flow paths inside the core. Increases in permeability of more than 100% have been documented (Fatt and Davis, 1952). Presumably the percentage increase depends largely on the depth at which the core was taken and on the mineral composition of the core, particularly its content of clay and mica.

Subsurface measurements of permeability can be made by using semiempirical electric logging techniques, but errors of 100% are possible. A better method in use in petroliferous rocks is to determine the output of a well under a known pressure drawdown or to interpret pressure buildup data during a drill-stem test. The drill-stem test has the advantage that it represents the effective permeability of a large volume of rock under *in situ* conditions.

Depositional permeability is greatest in a direction either parallel to the bedding or at a small angle to it because of grain orientations, micaceous foliations produced during deposition of the sediment, and vertical changes in grain size within the rock unit. Johnson and Hughes (1948) examined 33 Devonian oil sands in New York and Pennsylvania and found variations in permeability averaging 30% in the plane of the bedding, with differences being less pronounced in sands of higher permeabilities. Griffiths (1949) observed that sand grains are normally imbricated at a low angle to the bedding and, therefore, planes parallel to the bedding are projections of sections through the individual grains on a plane that lies at varying angles to varying imbrications. Small variations in grain shape would result in large differences on the projection plane. He found greatest permeabilities in those cores at a low angle to the bedding and attributed the result to the existence of grain imbrication in the sandstones. Mast and Potter (1963) studied permeabilities in the bedding plane of 13 Carboniferous sandstones and concluded that variations in permeability as a result of fabric "are extremely small." Clearly it is difficult to generalize about directional permeability beyond the statement that it is least in a direction approximately normal to bedding.

In some units, however, jointing or microfaulting can increase permeability perpendicular to bedding by orders of magnitude (Nelson and Handin, 1977).

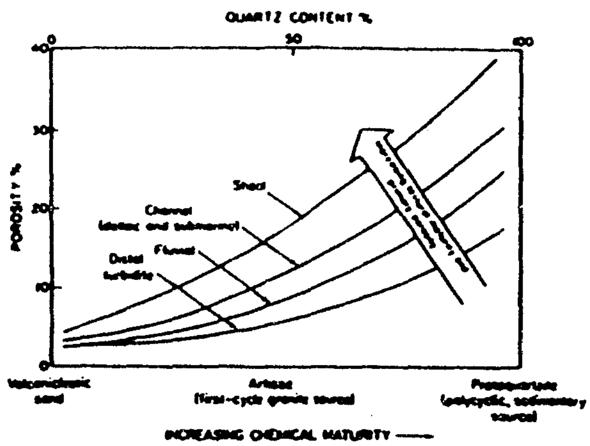


Fig. 12-6 Interrelationships among porosity, mineral composition, and environment of deposition of Jurassic sandstones in the North Sea area. (From R. C. Selley, 1978, *Jour. Geol. Soc.*, 135, 128. Used by permission of the Geological Society.)

in the sand and undercompaction of the mud (Sec. 5.12). The effect of clay mineralogy on compaction of muds can be traced primarily to the presence of smectites or interlayered smectite-illite clays. Smectitic clays contain more water than illitic or kaolinitic clays and resist compaction of the mud.

Burst (1969) has suggested that the compaction of clays proceeds in three main stages. In the first, pore-water and water interlayers beyond two are removed by the action of overburden pressure. At the time of deposition muds may have water contents on the order of 70 to 90%. After a few thousand feet of burial the mud retains only about 30% water by volume, of which 20 to 25% is interlayer water and 5 to 10% is residual pore water. In the second stage, pressure is relatively ineffective as a dehydrating agent. Dehydration proceeds by heating, which removes another 10 to 15% of the water. The second stage begins at temperatures close to 80°C and may be accompanied by diagenetic changes in clay mineralogy. Since this is also the temperature at which organic matter matures to petroleum (Sec. 9.2), it is possible that expulsion of water during the third stage of clay recrystallization is also the cause of the "primary" migration of petroleum from source to reservoir rocks. The third stage of dehydration is also controlled by temperature but apparently is also very slow, requiring tens to hundreds of years to reach completion.

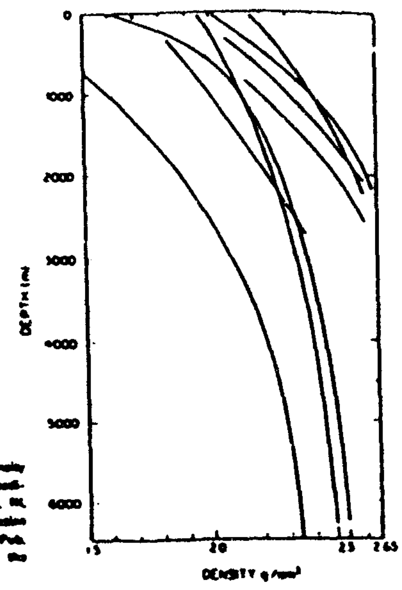


Fig. 12-7 Variation of the bulk density of mudrocks with depth in several sedimentary basins. (From H. H. Rieke, III, and G. V. Chilingar, 1974, *Compaction of Argillaceous Sediments*. Elsevier Pub. Co., p. 34. Used by permission of the Elsevier Scientific Pub. Co.)

Interlayer water is removed completely, leaving only a few percent of pore water in the mudrock.

Authigenesis

Authigenic minerals in sandstones are dominantly calcite and quartz cements but may also be clay minerals (Chap. 9). Authigenesis in both sands and muds is favored by increasing compaction, temperature, and salinity, all of which accompany increased depth of burial. The relationship between burial depth and the formation of secondary growths on detrital quartz grains is illustrated for some Mesozoic sandstones by Füchtbauer (1967) (Fig. 12-8). In some rocks, however, authigenesis may preserve rather than destroy porosity. Lumsden et al. (1971) found that authigenic chlorite coatings on detrital quartz grains in the Spiro and Foster Sands (Pennsylvanian, Oklahoma) preserve the bulk of depositional porosity

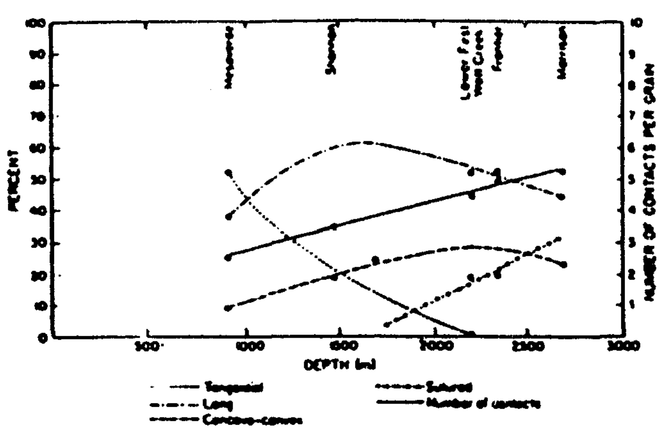


Fig. 12-4 Relationship between depth and type of grain-to-grain contact in thin sections of cores of Mesozoic sandstones in Wyoming. (From J. M. Taylor, 1950, *Amer. Assoc. Pet. Geol. Bull.*, 34, 715. Used by permission of the American Assoc. Petroleum Geologists.)

may have resulted simply from either an increase in percentage of elongate rock fragments with depth or an increase in clay content of the sandstones.

The presence of detrital clay in a sandstone has the same effect as the presence of ductile fragments but increases the rate of compaction. Mud has a very low bearing strength and noticeable compaction of clayey sandstones can occur at depths of only a few meters.

Increased compaction causes a decrease in primary porosity, a feature observed in several field studies. Data relating porosity to burial depth have been collected from large numbers of subsurface cores in different sedimentary basins (Fig. 12-5), and it was found that porosity can decrease either linearly or nonlinearly with depth and at greatly differing rates. Petrographic studies are needed to determine the causes of these differences. The interrelationships among porosity, textural maturity, and mineralogic composition are well illustrated by Selley (1978) in a study of the occurrence of oil in Jurassic sandstones in the North Sea area (Fig. 12-6). Volcaniclastic sands are easily altered chemically during diagenesis to produce fine-grained matrix. Nearly pure quartz sandstones suffer least from diagenetic effects. Arkoses occupy an intermediate position with respect to diagenetic effects. With respect to texture, the situation in the Jurassic rocks is equally clear, with shallow environments being most texturally mature, distal turbidites the least.

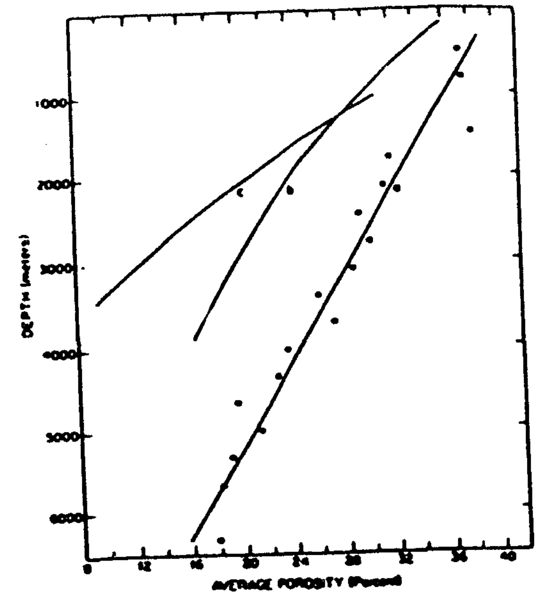


Fig. 12-5 Porosity vs. depth. (a) South Louisiana Tertiary sands: 17,367 samples. (From G. I. Atwater and E. E. Miller, 1965, unpub. ms.; data averaged for each 1000 ft. interval); (b) Great Valley Cretaceous and Tertiary sands: 166 reservoirs. (From D. L. Zieglar, and J. H. Spotts, 1978, *Amer. Assoc. Pet. Geol. Bull.*, 62, 814; (c) Cis-Caucasus, U.S.S.R.; 93 samples. (From B. K. Proshlyakov, 1960, trans. by Assoc. Tech. Serv., Inc., N.J., 1966, p. 3.)

The compaction of muds is considerably more complex than that of sandstones, as Meade (1966) has described. In the early stages, compaction may depend strongly on several factors in addition to depth of burial: grain size, rate of deposition, clay mineralogy, content of organic matter, and geochemical factors (Chapter 11). Variations in these parameters cause wide variations in the amount of compaction suffered by different muds at the same burial depth (Fig. 12-7). Coarser grain size correlates with increased quartz/clay ratio and hence reduced compaction. High rates of deposition can result in the formation of clay "seals" above sand units, which destroy vertical permeability and cause the formation of excess pore pressure

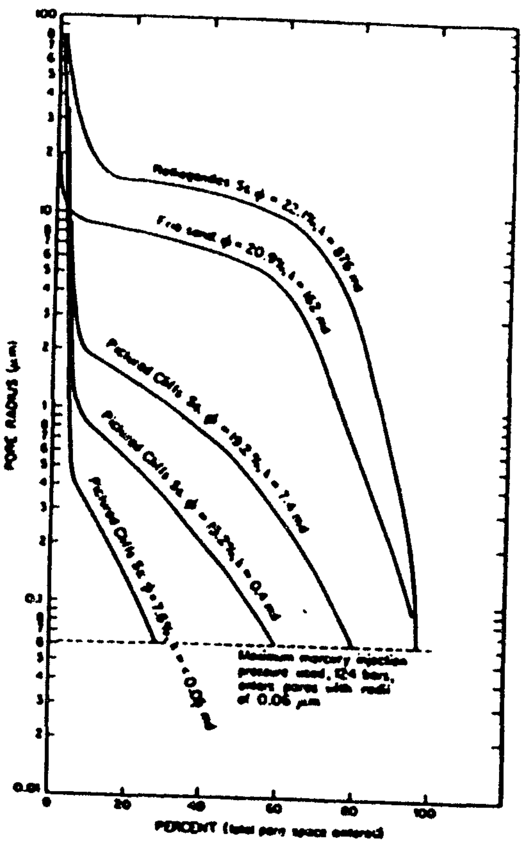


Fig. 12-3 Relationships among total porosity (φ), permeability (k), and pore radii of five sandstone cores (courtesy of Amoco Production Company). Total porosity determined by gas expansion. For the three relatively impermeable sandstones, the majority of the pore throat radii are less than 0.5 μm.

to 0.01 μm or less at a depth of 3000 m. These values are an order of magnitude smaller than those typical of sandstones (see Fig. 12-3).

The quantitative significance of the sorting of sand grains on porosity of a sandstone was studied experimentally by Beard and Weyl (1973) for gaussian distributions. Porosity was essentially independent of grain size but decreased sequentially as sorting decreased from 42.4% porosity in extremely well-sorted sands to 27.9% in very poorly sorted sands with no clay matrix. This result seems quite reasonable because smaller grains will lodge between the larger ones. Pryor (1973) found no significant change in the porosity of river, beach, and dune sands with change in standard deviation from 0.3φ to 1.6φ, but his core samples, unlike those in the Beard and Weyl study, were not homogeneous. Pryor's cores consisted of many thin, individually well-sorted laminae so that although porosity would be excellent, the sediment sorting determined in the laboratory might be good or poor for the core as a unit.

The porosity of a sandstone depends on postdepositional factors as well as those present at the time and site of deposition. As noted, the most important factors during deposition are clay content and the sorting of the sand fraction of the sediment. Of lesser importance are initial grain packing, sand mineralogy, mean grain size (assuming constant sorting), and grain angularity. Important postdepositional or diagenetic factors are degree of compaction and the formation of authigenic minerals.

Compaction

Upon burial, sands compact much less than mudrocks. The lesser compaction of sands results from two factors. First, the average sandstone is composed largely of quartz grains, and these grains are undeformable under most sedimentary conditions. Secondly, the finer particles that predominate in mudrocks are deposited with initially higher water contents and this water is quickly expelled. Many investigators have compacted quartz sands in the laboratory with the result that the thickness of the aggregate has decreased only 10 to 15% due to rearrangement of grains and chipping of grain corners.

The amount of compaction increases significantly with the proportion of ductile rock fragments in the detrital fraction of the sand. Such particles as shale, slate, phyllite, and schist deform easily at shallow depth, decreasing porosity (see below) and thinning the stratigraphic section. This decrease in porosity is noticeable in well logs and was first studied in thin sections of subsurface cores by Taylor (1950). She found that the proportions of the four different types of intergranular contacts changed with depth of burial (Fig. 12-4). Tangential contacts decreased rapidly in abundance with depth, whereas the other three types showed marked increases. Grains were being pushed close together as burial depth increased. Unfortunately, Taylor did not keep a close check on changes in mineral composition with depth; so we cannot be certain how much of the increased closeness of grains was due to plastic deformation of elongate ductile fragments and how much

tance. Tortuosity in a sandstone is usually between 2 and 3; in loose sediment it is approximately one-half as large. The greater the tortuosity, the slower the flow of fluid through the pore system.

The physical principle on which the mercury injection method is based is that liquids forming contact angles on solid surfaces of more than 90° (i.e., nonwetting fluids) cannot penetrate into small pores unless the injection pressure exceeds the capillary pressure. The higher the injection pressure, the smaller the pores that can be penetrated by the liquid. In circular pores with radius r the surface tension σ acts along the perimeter of the circle with the force $-2\pi r\sigma$. The force counteracting the intrusion of the liquid parallel to the axis of the pore is $-2\pi r\sigma \cos \lambda$, where λ is the angle of contact. The force caused by the injection pressure p is $\pi r^2 p$. For equilibrium, we obtain

$$-2\pi r\sigma \cos \lambda = \pi r^2 p$$

or

$$r = -\frac{2\sigma \cos \lambda}{p}$$

The surface tension of mercury is 484.2 dynes/cm at 25°C, and the angle of contact of mercury on silicate mineral surfaces has been determined experimentally to approximate 141.3°. Using these values,

$$r = \frac{7.6}{p}$$

when pressure is measured in bars and pore radii in micrometers (Fig. 12-2). Using this relationship, mercury injection of a core yields the volume percentage of pore throats of any given size in the rock sample (Fig. 12-3).

The porosity of mudrocks varies over essentially the same range as in sandstones, from zero to about 40%, but the definition of porosity in a mudrock is not as clear-cut as in the coarser-grained rocks. Indeed, the definition and measurement of porosity in mudrocks present problems not encountered in sandstones. In a sandstone composed primarily of quartz and similar minerals, the boundary between pore space and grain is reasonably well defined. For example, if the pore space is filled with water, then this free or movable water represents the porosity. The proportion of adsorbed or bound water is usually negligible because the specific surface of such minerals as quartz is only 1 to 2 m^2/g of sediment. (Compare with clay minerals below.) In subsurface studies, logging methods that measure total hydrogen concentration, such as neutron logging, effectively measure the porosity. But mudrocks present a more complex problem. Many of the clay minerals contain water as part of their structure, and this water certainly should be considered part of the solid rather than part of the pore space. In addition, water adsorbed on the surface of the clay flakes normally is not free to move, and water may form a large percentage of the total water between clay flakes in mudrock. This situation occurs because the specific surface of clay minerals very large, on the order of tens of square meters per gram. Within the space between the grains and their adsorbed water, however, there exists free water

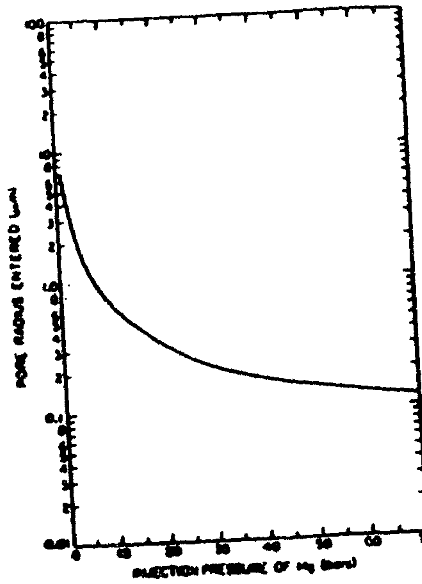


Fig. 12-2 Relationship between injection pressure of mercury into a core and the radii of pore throats that are penetrated.

capable of moving or being easily removed by compaction. Thus when we speak of mudrock porosity, we usually mean the percentage of the total volume of the rock that contains free or easily movable water. It is usually measured by mechanically compacting the rock and measuring the amount of fluid removed or the percentage of volume reduction. These methods are, at best, an approximation of the true pore volume because of the possibility of altering the water content of the clay flakes or the amount of adsorbed water during the analysis.

The critical differences in pore characteristics between sandstones and mudrocks are the sizes and shapes of the pores. Particularly in fissile mudrocks (shales), the clay mineral flakes that form 60% of the mineral grains are oriented in parallel and hence pore spaces are dominantly tabular. Furthermore, because flat flakes can be very closely packed, pore sizes are much smaller. Heling (1970) studied the fabric of Tertiary shales from the Rhinegraben that were buried to depths up to 3400 m. Pore radii decreased from an average of 0.04 μm at a depth of 100 m

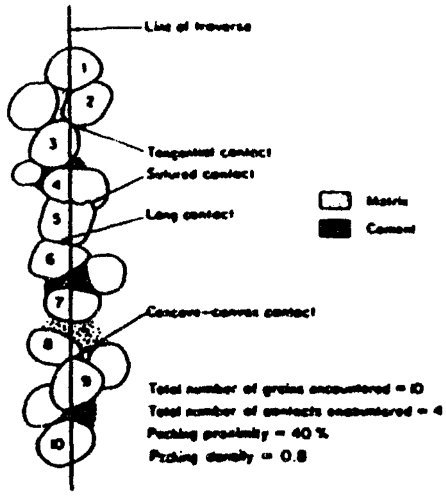


Fig. 12-1 Definition of grain contact types and packing proximity. (After J. M. Taylor, 1950, *Amer. Assoc. Pet. Geol. Bull.*, 34, p. 711, 712, and J. S. Kahn, 1956, *Jour. Geol.*, 64, p. 392).

grain volume; and effective porosity, the ratio of interconnected void volume to total rock volume. In detrital silicate rocks, effective porosity is usually only slightly less than total porosity.

Methods of Measurement

Cores of rocks used for porosity determination are normally cylinders one inch long and one inch in diameter. The porosity can be easily determined by gas expansion, using Boyle's law. Alternatively, the grain density can be assumed (2.65) and the porosity determined by weighing a sample saturated with a fluid of known density. These experimental methods are suitably accurate and are the standards for calibration of all other porosity-determining methods, such as point counts in rock thin sections or subsurface logging techniques. An important point to keep in mind, however, is that the porosity of 13 cm³ of rock may not be representative of a rock unit millions of times larger in volume, particularly because field observations reveal that porosities can vary greatly over small distances with such factors as clay mineral or rock fragment content.

The use of subsurface logging techniques (sonic, density, neutron) can sometimes produce porosity values within 1% of the value obtained on the same rock in a core sample. The advantages of logging methods over core analysis for porosity determination lie in the much larger volume of rock "sampled," perhaps 100 times larger than the laboratory core, and in the fact that the measurement is made *in situ*, before overburden pressure is removed. In addition, there is the matter of cost. Electric logs are made of all wells, but cores are taken in relatively few.

In most sandstones the bulk of pore space has diameters less than the 30 μm thickness of a standard thin section and so is difficult or impossible to detect during examination of the slide unless special techniques are used. The usual technique is to vacuum-impregnate the rock slice with a colored epoxy before thin sectioning so that even extremely narrow pores that intersect the plane of the thin section become visible in uncrossed nicols. This technique, now standard in industry laboratories, also makes it possible to distinguish between pores produced by diagenetic dissolution of detrital grains and pseudopores produced by grain plucking during grinding of the thin section.

Pore Sizes, Geometry, and Measurement

Pores are irregularly shaped cavities in a rock; therefore any definition of their "size" is an approximation based on the measurement technique used to determine it. In some cases, it is possible to vacuum-impregnate a porous rock with either a molten plastic or metal and then dissolve the rock by using suitable reagents to produce a "negative image" of the rock—that is, its three-dimensional pore network (Swanson, 1979). This technique, although useful for some research purposes, is impractical as a standard method.

The distribution of pore sizes in a rock sample is determined generally by injection of mercury into the rock. The sizes of pores determined in this way are actually the sizes of the pore "throats" or narrow connections between large pores. It is the sizes of the throats that control the flow of fluid through rocks, whether the flow is of mercury during measurement of porosity or is water, petroleum, or natural gas in the subsurface. One deficiency of the mercury injection technique is that if a large pore, such as a vug, is entered by fluid through a narrow throat, the large vug will be included within the volume of pore space represented by the throat size. A second deficiency is that not all pores can be invaded by the mercury because they may be shielded by other smaller pores whose displacement pressure is not exceeded.

The individual pore may be tubular like a capillary tube; or it may be nodular and feather out into the bounding constrictions between nodules; or it may be a thin, intercrystalline tabular opening that is 30 to 100 times as wide as it is thick. The wall of the pore may be clean quartz, feldspar, or calcite; or it may be coated with clay mineral particles, platey accessory minerals, or rock fragments. The crookedness of the pore pattern, called the *tortuosity*, is the ratio between the distance between two points by way of the connected pores and the straight-line dis-

CHAPTER 12

POROSITY AND PERMEABILITY OF DETRITAL ROCKS

12.1 INTRODUCTION

The porosity and permeability of sandstones and mudrocks have been generally neglected by academic geologists. Most of our knowledge in this area comes from the petroleum industry as part of its effort to locate reserves of oil and gas. It is strange that few geologists outside of industry have investigated the porosities and permeabilities of detrital rocks, for these variables control most diagenetic processes in rocks. Without adequate permeability to water there can be little cementation of sandstones, diagenetic alteration of heavy minerals, conversion of smectite to illite, or the myriad of other processes that affect rock after burial. Pore space and permeability are basic aspects of rock fabric and should be studied as a normal part of a petrologic investigation.

12.2 FABRIC

The term *fabric* is reserved for "the manner of mutual arrangement in space of the components of a rock body and of the boundaries between these components" (*International Tectonics Dictionary*). It thus includes both the packing

and orientation of grains. Grain packing strongly affects both porosity and permeability and grain orientation affects the permeability (Sec. 12.4).

The least-studied aspect of fabric is *packing*, "the spacing or density pattern of mineral grains in a rock" (AGI Glossary). The meaning of packing and its distinction from other aspects of fabric, such as orientation, is most clearly seen for the case of a sediment composed of perfect spheres uniform in size. Even in this highly idealized case it has been shown that there are six different systematic ways of arranging the spheres so that each sphere is in contact with four or more adjacent spheres and there are no vacant positions. The arrangements vary from the "loosest" cubic packing with a porosity of 47.6% to the "tightest" rhombohedral packing with a porosity of 26.0%. The six regular packings do not exhaust the number of ways that spheres may, in fact, be packed because in nature an infinite number of combinations of the six and of "random" packings may also be developed.

Kahn (1956) devised two numerical measures for use in thin section studies.

1. The *packing density* is the ratio of the sum of the lengths of grain intercepts to the total length of the traverse across the thin section. It is a measure of the porosity of a cement-and matrix-free sand or of the "matrix-cement-free porosity" of a sandstone that has some matrix and cement.
2. The *packing proximity* is the ratio of the number of grain-to-grain contacts (encountered in a traverse across the thin section) to the total number of contacts of all kinds encountered in the same traverse (Fig. 12-1). If the grains have only small areas of contact with each other, most of the contacts observed in a thin section will be contacts between a grain and matrix or cement; so the packing proximity will be small. In a rock in which there has been compaction without the introduction of much cement, most of the grain contacts observed will be grain-to-grain contacts and the packing proximity will be large.

The type of contact between grains can also be studied in thin section. In the ideal case of packed spheres, the only observed contacts between grains would be tangential ones. But in the case of nonspherical grains or where compaction has taken place, three other types of contacts can be observed (Taylor, 1950). The four possible types of contacts are (*a*) tangential, (*b*) long—that is, a contact that appears as a straight line in the plane of section, (*c*) concavoconvex, and (*d*) sutured. The frequency of concavoconvex and sutured contacts relative to that of other types of contacts has been used as a measure of the intensity of compaction of sands.

12.3 POROSITY

Several terms are widely used to indicate the amount of pore space in a rock. The most common are porosity, the ratio of void volume to total rock volume (multiplied by 100 to form a percentage); void ratio, the ratio of pore volume to

APPENDIX G

Slope Stability

PURPOSE:

Stability Analysis of the Side Slopes of the Cover

The purpose of this calculation brief is to evaluate stability of the side slopes of the cover for the uranium tailings impoundments. The sides of the covers are sloped at 5H:1V. From the old drawings as published by UMETCO (section B-B), the side slope for Cell 4 is the tallest. Also, along the southern section of Cell 4, the ground elevation drops rapidly. Hence the side slopes of the cover located along the southern side of Cell 4 are assumed to be critical and considered for stability analysis.

METHODOLOGY:

Static and pseudostatic slope stability analyses have been performed for the slope geometry as shown in Figure 1. The limit equilibrium slope stability code GSLOPE, developed by MITRE Software Corporation has been used for these analyes. The Bishop's method of slices has been applied.

Geometry and Material Properties

Along the southern end of Cell 4, the topography drops at a rate of approximately 5.5% (Figure 2). The material properties as provided by Dames and Moore, 1978, have been used for these analyses. The material properties have been listed in Table 1, below.

Material No.	Type of Material	Unit weight, γ (pcf)	Cohesion, c (psf)	Angle of friction, ϕ (degrees)
1	Earthfill	123	0	30
2	Tailings	62.4	0	0
3	Dike	123	0	30
4	Foundation	120	0	28
5	Bedrock	130	10,000	45

Table 1: Material Properties

The surface of the bedrock has been determined from the bore-logs as supplied by Chen and Associates, 1978. But as this bedrock surface almost coincides with that of the foundation, assuming the bedrock layer to be about 10 ft. below the lowest point of the foundation surface, will

give conservative results. Thus, for the stability analysis, the surface of competent bedrock has been assumed to be at an elevation of +5540 ft. above mean sea level (MSL).

Factor of Safety and Horizontal Acceleration required for analysis:
A factor of safety of 1.5 and 1.0 are respectively acceptable for static and pseudostatic analyses. Pseudostatic slope stability analysis has been performed for a maximum seismic coefficient of 0.1g.

RESULTS:

Results of the stability analyses have been presented in this calculation document.
Results for Static case: For static analysis, the maximum Factor of Safety calculated is 2.91 (>1.5).
Results for Pseudostatic case: For pseudostatic analysis, the maximum Factor of Safety calculated is 1.903 (>1.0) for a ground acceleration of 0.1g.

Hence the side slopes are stable.

REFERENCE:

a) Chen and Associates, Inc., 1978. Soil Property Study, Earth Lined Tailings Retention Cells, White Mesa Uranium Project, Blanding, Utah.

b) Dames and Moore, 1978. Site Selection and Design Study - Tailing Retention and Mill Facilities, White Mesa Uranium Project, January 17, 1978.

c) "GSLOPE Limit Equilibrium Slope Stability Analysis", Mitre Software Corporation, Alberta, Canada

RESULTS OF RUN BY "GSLOPE" ANALYSIS

Material	Unit Wt pcf	C psf	Phi deg	Piezo Surf.	Ru
Earthfill	123	0	30	0	0
Tailings	62.4	0	0	0	0
Dike	123	0	30	0	0
Foundation	120	0	28	0	0
Bedrock	130	10000	45	0	0

Titan Environmental - Bozeman MT

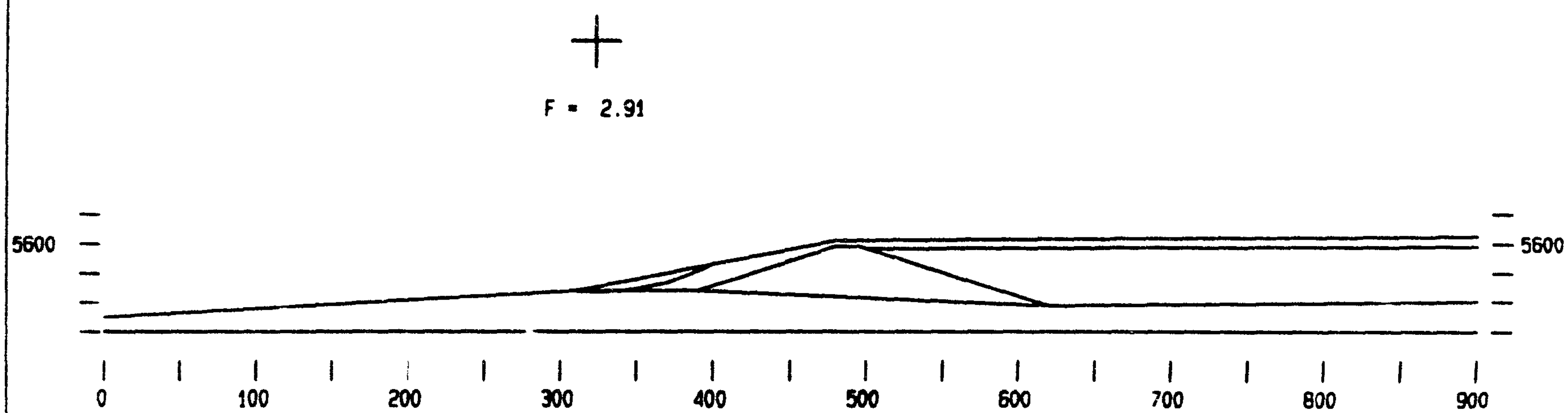
6111.001

EFN White Mesa Slope Stability

7/1996

Static Analysis

WHTMESA1.GSL



DATA FILE NAME..... C:\STABLITY\GSLOPE\WHTMESA1.GSL

Job No.	6111.001
itle	EFN White Mesa Slope Stability
Date	7/1996
Label A	Static Analysis
Label B	

Max Slice Width	10
Set Neg. Normals to zero	Y
No. of Materials	5
Seismic Acceleration	0
External Forces	0
Piezometric Surfaces	0
Unit Wt. of Pore Fluid	62.4

Material	Unit Wt	Cohesion	Friction Angle	Piezo Surface	Ru Value
# 1 -Earthfill	123	0	30	0	0
# 2 -Tailings	62.4	0	0	0	0
# 3 -Dike	123	0	30	0	0
# 4 -Foundation	120	0	28	0	0
# 5 -Bedrock	130	10000	45	0	0

Upper Surface of Material # 1 (Earthfill)

X-Coord	Y-Coord
0	5550.5
310	5568
480	5602
900	5605

Upper Surface of Material # 2 (Tailings)

X-Coord	Y-Coord
0	5550.5
310	5568
390	5568
480	5598
495	5598
500	5596.5
[illegible]0	5598

Upper Surface of Material # 3 (Dike)

X-Coord	Y-Coord
0	5550.5
[illegible]	5568
3[illegible]	5568
480	5598
495	5598

500	5596.5
620	5557.5
900	5560

Upper Surface of Material # 4 (Foundation)

X-Coord	Y-Coord
0	5550.5
310	5568
390	5568
620	5557.5
900	5560

Upper Surface of Material # 5 (Bedrock)

X-Coord	Y-Coord
0	5540
900	5540

There are no explicit external forces in the data set.

GSLOPE 3.26a

LIMIT EQUILIBRIUM SLOPE STABILITY ANALYSIS

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Titan Environmental - Bozeman MT

Results are for Bishop's Modified Method unless otherwise noted.

File C:\STABLITY\GSLOPE\WHTMESA1.GSL   Output dated 07-03-1996 at 11:55:05

Material	Unit Wt	Cohesion	Friction Angle	Piezo Surface	Ru Value
# 1 -Earthfill	123	0	30	0	0
# 2 -Tailings	62.4	0	0	0	0
# 3 -Dike	123	0	30	0	0
# 4 -Foundation	120	0	28	0	0
# 5 -Bedrock	130	10000	45	0	0

X-centre	Y-centre	Radius	Factor of Safety	Iterations	Slices	M Alpha Warnings
322.60	5732.50	165.50	2.9103	4	11	0
322.91	5732.50	165.50	2.9101	4	11	0
323.23	5732.50	165.50	2.9164	4	12	0
322.60	5733.13	166.13	2.9101	4	11	0
322.91	5733.13	166.13	2.9159	4	12	0
323.23	5733.13	166.13	2.9164	4	12	0
322.60	5733.75	166.75	2.9099	4	11	0
322.91	5733.75	166.75	2.9160	4	12	0
323.23	5733.75	166.75	2.9164	4	12	0
Minimum Bishop Factor of Safety this run:						
322.60	5733.75	166.75	2.9099	4	11	0

Material	Unit Wt pcf	C psf	Phi deg	Piezo Surf.	Ru
Earthfill	123	0	30	0	0
Tailings	62.4	0	0	0	0
Dike	123	0	30	0	0
Foundation	120	0	28	0	0
Bedrock	130	10000	45	0	0

Seismic coefficient = .1

Titan Environmental - Bozeman MT

6111.001

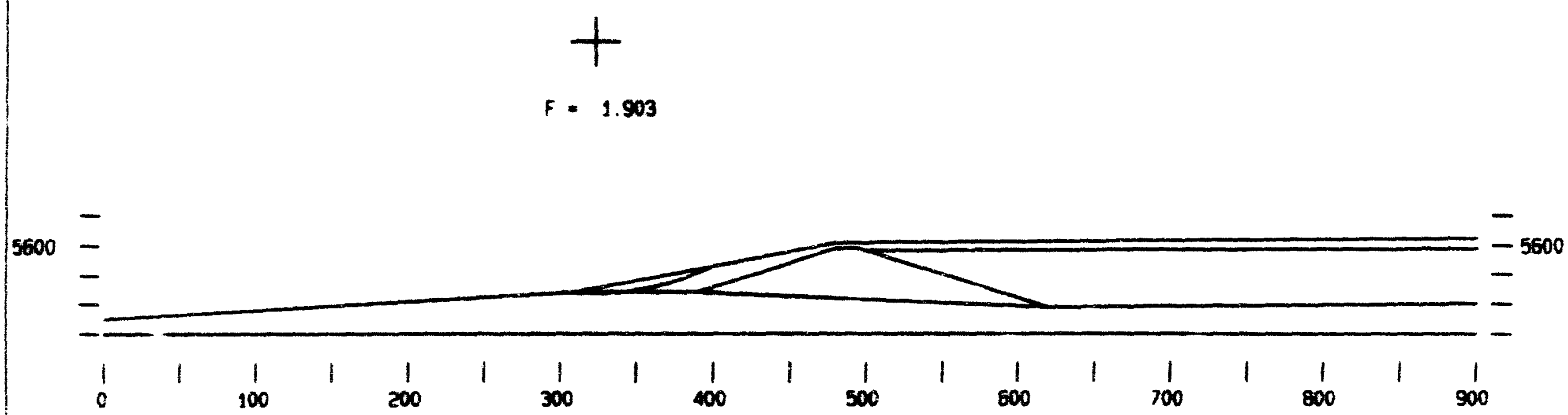
EFN White Mesa Slope Stability

7/1996

Pseudostatic Analysis

ground accln. = 0.1g

WHTMESA2.GSL



DATA FILE NAME..... C:\STABLITY\GSLOPE\WHTMESA2.GSL

Job No.	6111.001
tle	EFN White Mesa Slope Stability
uate	7/1996
Label A	Pseudostatic Analysis
Label B	ground accln. = 0.1g

Max Slice Width	10
Set Neg. Normals to zero	Y
No. of Materials	5
Seismic Acceleration	.1
External Forces	0
Piezometric Surfaces	0
Unit Wt. of Pore Fluid	62.4

Material	Unit Wt	Cohesion	Friction Angle	Piezo Surface	Ru Value
# 1 -Earthfill	123	0	30	0	0
# 2 -Tailings	62.4	0	0	0	0
# 3 -Dike	123	0	30	0	0
# 4 -Foundation	120	0	28	0	0
# 5 -Bedrock	130	10000	4[illegible]	0	0

Upper Surface of Material # 1 (Earthfill)

X-Coord	Y-Coord
0	5550.5
310	5568
480	5602
900	5605

Upper Surface of Material # 2 (Tailings)

X-Coord	Y-Coord
0	5550.5
310	5568
390	5568
480	5598
495	5598
500	5596.5
900	5598

Upper Surface of Material # 3 (Dike)

X-Coord	Y-Coord
0	5550.5
[illegible]	5568
390	5568
480	5598
495	5598

500	5596.5
620	5557.5
900	5560

Upper Surface of Material # 4 (Foundation)

X-Coord	Y-Coord
0	5550.5
310	5568
390	5568
620	5557.5
900	5560

Upper Surface of Material # 5 (Bedrock)

X-Coord	Y-Coord
0	5540
900	5540

There are no explicit external forces in the data set.

GSLOPE 3.26a

LIMIT EQUILIBRIUM SLOPE STABILITY ANALYSIS

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Titan Environmental - Bozeman MT

Results are for Bishop's Modified Method unless otherwise noted.

File C:\STABLITY\GSLOPE\WWTMSA2.GSL   Output dated 07-03-1996 at 12:14:06

Material	Unit Wt	Cohesion	Friction Angle	Piezo Surface	Ru Value
# 1 - Earthfill	123	0	30	0	0
# 2 - Tailings	62.4	0	0	0	0
# 3 - Dike	123	0	30	0	0
# 4 - Foundation	120	0	28	0	0
# 5 - Bedrock	130	10000	45	0	0

X-centre	Y-centre	Radius	Factor of Safety	Iterations	Slices	M Alpha Warnings
322.60	5732.50	165.50	1.9036	4	11	0
322.60	5732.50	166.13	1.9067	4	12	0
322.60	5732.50	164.88	1.9160	4	11	0
		MIN THIS CENTRE	1.903			
322.91	5732.50	165.50	1.9037	4	11	0
322.91	5732.50	166.13	1.9067	4	12	0
322.91	5732.50	164.88	1.9163	4	11	0
		MIN THIS CENTRE	1.903			
323.23	5732.50	165.50	1.9066	4	12	0
323.23	5732.50	166.13	1.9068	4	12	0
323.23	5732.50	164.88	1.9165	4	11	0
		MIN THIS CENTRE	1.906			
322.60	5733.13	166.13	1.9035	4	11	0
322.60	5733.13	166.75	1.9067	4	12	0
322.60	5733.13	165.50	1.9160	4	11	0
		MIN THIS CENTRE	1.903			
322.91	5733.13	166.13	1.9062	4	12	0
322.91	5733.13	166.75	1.9067	4	12	0
22.91	5733.13	165.50	1.9162	4	11	0
		MIN THIS CENTRE	1.906			

323.23	5733.13	166.13	1.9066	4	12	0
323.23	5733.13	166.75	1.9067	4	12	0
323.23	5733.13	165.50	1.9164	4	11	0
		MIN THIS CENTRE		1.906		
322.60	5733.75	166.75	1.9034	4	11	0
322.60	5733.75	167.38	1.9067	4	12	0
322.60	5733.75	166.13	1.9159	4	11	0
		MIN THIS CENTRE		1.903		
322.91	5733.75	166.75	1.9062	4	12	0
322.91	5733.75	167.38	1.9067	4	12	0
322.91	5733.75	166.13	1.9161	4	11	0
		MIN THIS CENTRE		1.906		
323.23	5733.75	166.75	1.9066	4	12	0
323.23	5733.75	167.38	1.9066	4	12	0
323.23	5733.75	166.13	1.9163	4	11	0
		MIN THIS CENTRE		1.906		

Minimum Bishop Factor of Safety this run:

322.60	5733.75	166.75	1.9034	4	11	0

PURPOSE:

Pseudostatic Slope Stability Analysis of the Side Slopes of the Cover for horizontal acceleration of 0.12g

The purpose of this calculation brief is to evaluate pseudostatic stability of the side slopes of the cover for the uranium tailings impoundments for a horizontal ground acceleration of 0.12g. The sides of the covers are sloped at 5H:1V. From the old drawings as published by UMETCO (section B-B), the side slope for Cell 4 is the tallest. Also, along the southern section of Cell 4, the ground elevation drops rapidly. Hence the side slopes of the cover loca' d along the southern side of Cell 4 are assumed to be critical and considered for stability analysis.

METHODOLOGY:

Pseudostatic slope stability analyses have been performed for the slope geometry as shown in Figure 1. The limit equilibrium slope stability code GSLOPE, developed by MITRE Software Corporation has been used for these analyes. The Bishop's method of slices has been applied.

Geometry and Material Properties
Along the southern end of Cell 4, the topography drops at a rate of approximately 5.5% (Figure 2). The material properties as provided by Dames and Moore, 1978, have been used for these analyses. The material properties have been listed in Table 1, below.

Material No.	Type of Material	Unit weight, γ (pcf)	Cohesion, c (psf)	Angle of friction, ϕ (degrees)
1	Earthfill	123	0	30
2	Tailings	62.4	0	0
3	Dike	123	0	30
4	Foundation	120	0	28
5	Bedrock	130	10,000	45

Table 1: Material Properties

The surface of the bedrock has been determined from the bore-logs as supplied by Chen and Associates, 1978. But as this bedrock surface almost coincides with that of the foundation, assuming the bedrock layer to be about 10 ft. below the lowest point of the foundation surface, will

give conservative results. Thus, for the stability analysis, the surfac of competent bedrock has been assumed to be at an elevation of +5540 ft. above mean sea level (MSL).

Factor of Safety and Horizontal Acceleration required for analysis:

A factor of safety of 1.0 is acceptable for pseudostatic. Pseudostatic slope stability analysis has been performed for a maximum seismic coefficient of 0.12g as recommended by the Lawrence Livermore National Laboratory.

RESULTS:

Results for Pseudostatic case: For pseudostatic analysis, the maximum Factor of Safety calculated is 1.778 (>1.0) for a ground acceleration of 0.12g.

Hence the side slopes are stable.

REFERENCE:

a) Chen and Associates, Inc., 1978. Soil Property Study, Earth Lined Tailings Retention Cells, White Mesa Uranium Project, Blanding, Utah.

b) Dames and Moore, 1978. Site Selection and Design Study - Tailing Retention and Mill Facilities, White Mesa Uranium Project, January 17, 19 8.

c) Report by "Lawrence Livermore Natioal Laboratory"

d) "GSLOPE Limit Equilibrium Slope Stability Analysis", Mitre Software Corporation, Alberta, Canada

AA 9/96

Material	Unit Wt	C	Phi	Piezo	Ru
	pcf	psf	deg	Surf.	
Earthfill	123	0	30	0	0
Tailings	61.4	0	0	0	0
Dike	123	0	30	0	0
Foundation	120	0	28	0	0
Bedrock	139	10000	45	0	0

Seismic coefficient = .12

Titan Environmental - Bozeman MT

6111.001

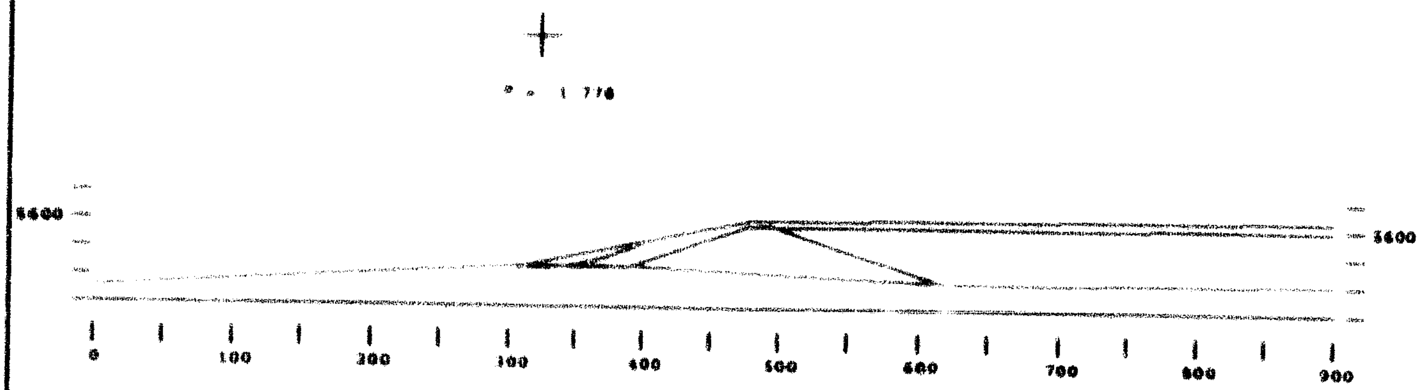
EFN White Mesa Slope Stability

7/1996

Pseudostatic Analysis

ground accln. = 0.12g

WHTMESA4.GSL



DATA FILE NAME..... C:\STABLITY\GSLOPE\....MESA4.GSL

PA 9/96

Job No.	6111.001
Title	EFN White Mesa Slope Stability
Date	7/1996
1 A	Pseudostatic Analysis
1 B	ground accln. = 0.12g

Max Slice Width	10
Set Neg. Normals to zero	Y
No. of Materials	5
Seismic Acceleration	.12
External Forces	0
Piezometric Surfaces	0
Unit Wt. of Pore Fluid	62.4

Material	Unit Wt	Cohesion	Friction Angle	Piezo Surface	Ru Value
# 1 -Earthfill	123	0	30	0	0
# 2 -Tailings	62.4	0	0	0	0
# 3 -Dike	123	0	30	0	0
# 4 -Foundation	120	0	28	0	0
# 5 -Bedrock	130	10000	45	0	0

Surface of Material # 1 (Earthfill)

X-Coord	Y-Coord
0	5550.5
310	5568
480	5602
900	5605

Upper Surface of Material # 2 (Tailings)

X-Coord	Y-Coord
0	5550.5
310	5568
390	5568
480	5598
495	5598
500	5595.5
900	5598

Upper Surface of Material # 3 (Dike)

X-Coord	Y-Coord
0	5550.5
310	5568
390	5568
	5598
	5598
500	5596.5
620	5557.5
900	5560

Upper Surface of Material # 4 (Foundation)

X-Coord	Y-Coord
0	5550.5
310	5568
390	5568
[illegible]	5557.5
[illegible]	5560

Upper Surface of Material # 5 (Bedrock)

X-Coord	Y-Coord
0	5540
900	5540

There are no explicit external forces in the data set.

[illegible]

BA 9/96

GSLOPE 3.26a

LIMIT EQUILIBRIUM SLOPE STABILITY ANALYSIS

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Titan Environmental - Bozeman MT

Results are for Bishop's Modified Method unless otherwise noted.

File C:\STABLITY\GSLOPE\WHTMESA4.GSL Output dated 08-28-1996 at 13:09:05

Material	Unit Wt	Cohesion	Friction Angle	Piezo Surface	Ru Value
# 1 -Earthfill	123	0	30	0	0
# 2 -Tailings	62.4	0	0	0	0
# 3 -Dike	123	0	30	0	0
# 4 -Foundation	120	0	28	0	0
# 5 -Bedrock	130	10000	45	0	0

X-centre	Y-centre	Radius	Factor of Safety	Iterations	Slices	M Alpha Warnings
322.60	5732.50	165.50	1.7777	4	11	0
22.91	5732.50	165.50	1.7778	4	11	0
323.23	5732.50	165.50	1.7804	4	12	0
322.60	5733.13	166.13	1.7777	4	11	0
322.91	5733.13	166.13	1.7801	4	12	0
323.23	5733.13	166.13	1.7804	4	12	0
322.60	5733.75	166.75	1.7776	4	11	0
322.91	5733.75	166.75	1.7801	4	12	0
323.23	5733.75	166.75	1.7804	4	12	0
Minimum Bishop Factor of Safety this run:						
322.60	5733.75	166.75	1.7776	4	11	0

FIGURES

SLOPE STABILITY ANALYSIS ALON CELL-4 DIKE
(SECTION BB BY UMETCO)

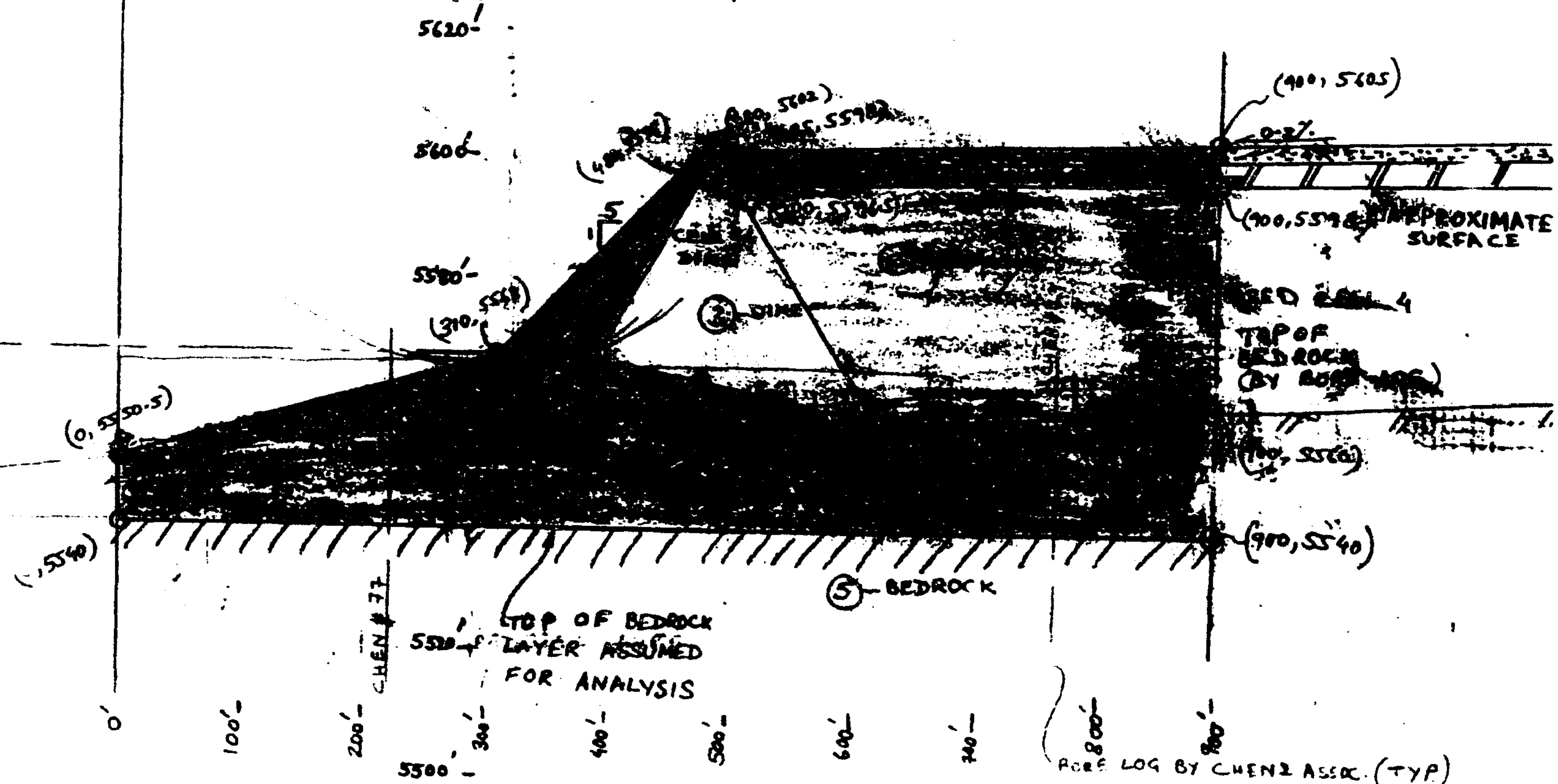
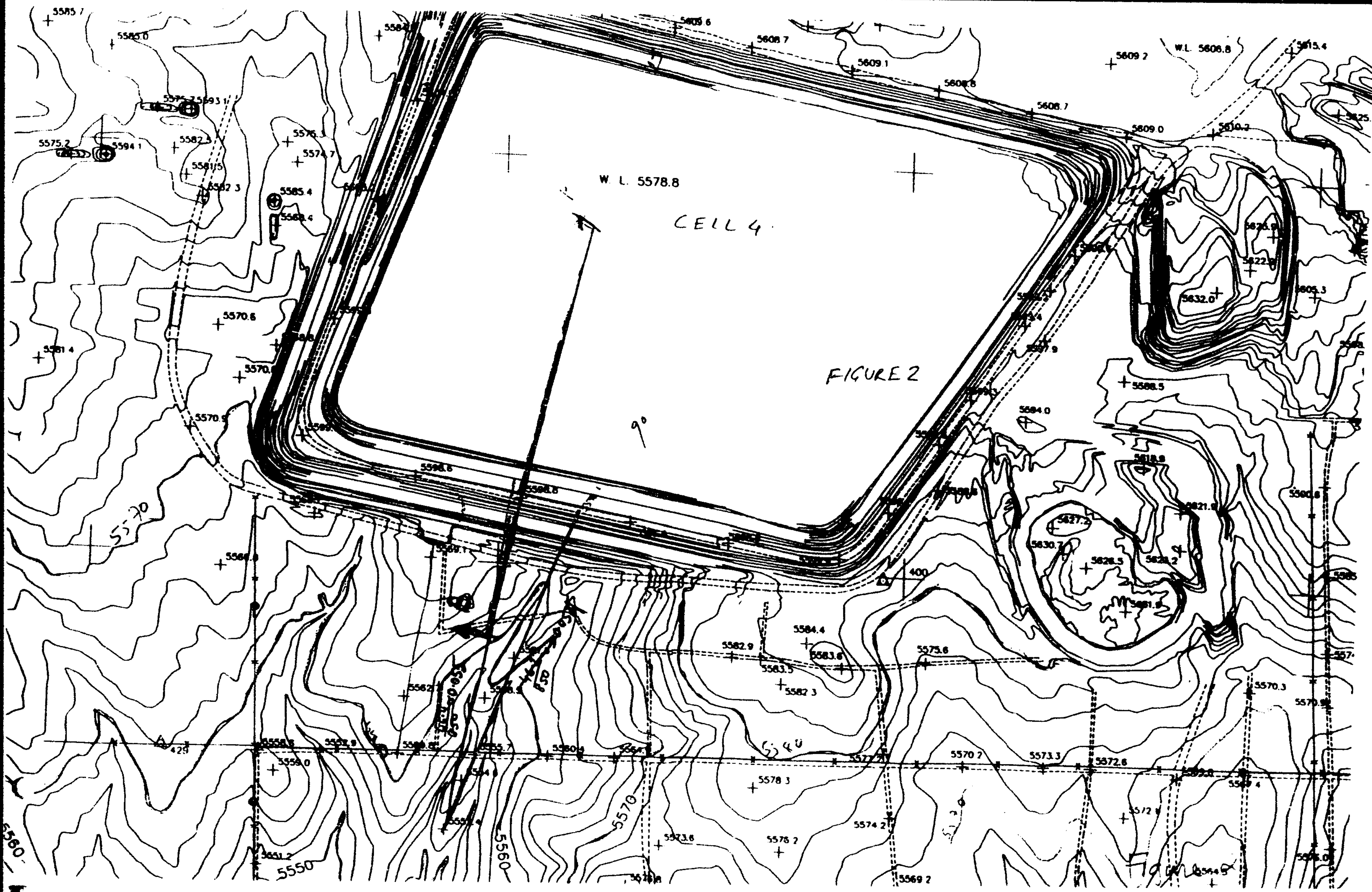
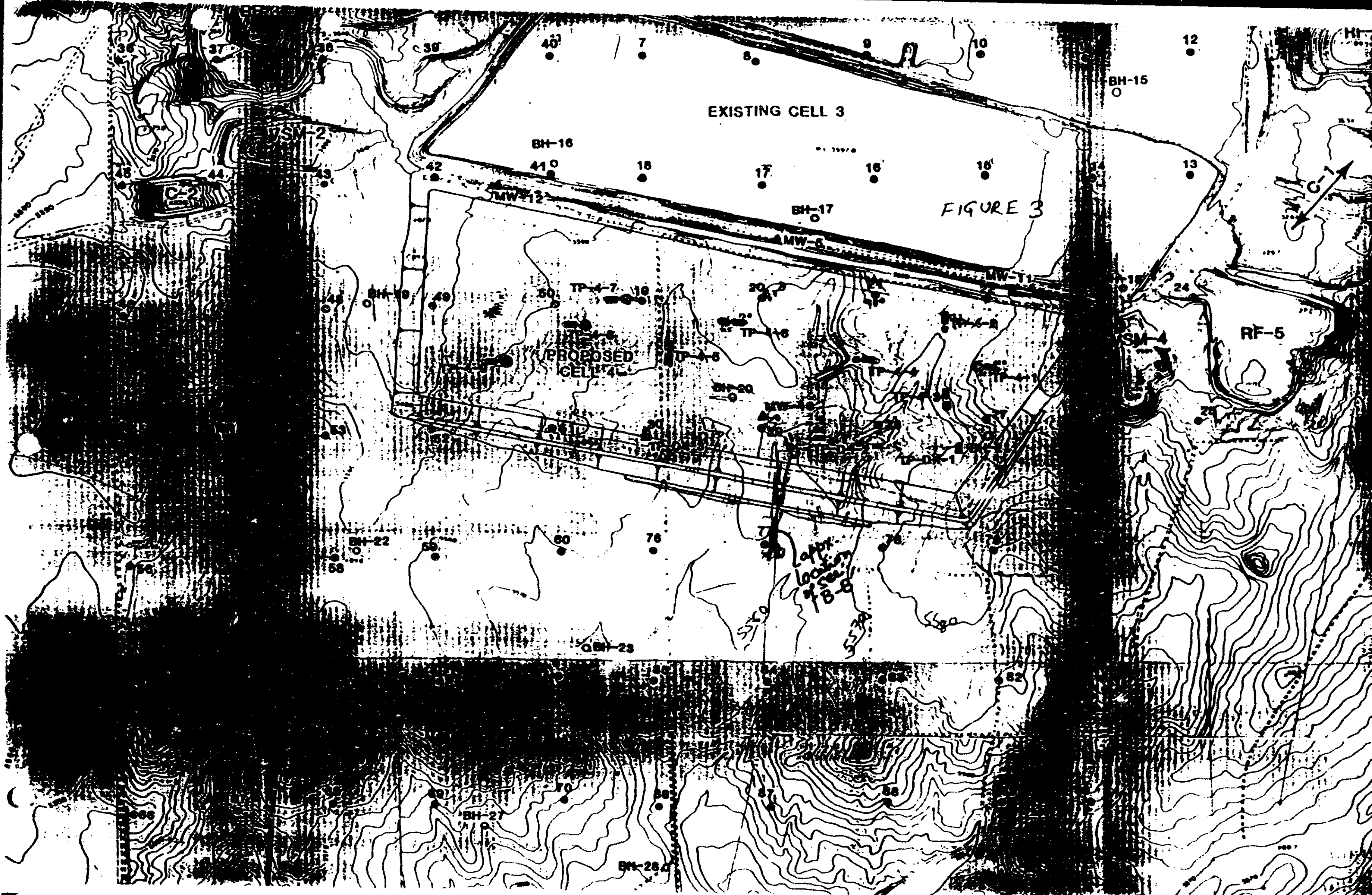


FIGURE 1


W. L. 5578.8
CELL 4
FIGURE 2
W.L. 5606.8
5550
5560
5570
400
429



EXISTING CELL 3
FIGURE 3
PROPOSED CELL 4
BH-15
BH-16
BH-17
BH-20
BH-22
BH-23
BH-27
BH-28
MW-12
AMW-5
MW-11
SM-2
SM-4
C-2
C-1
RF-5
TP-4-7
TP-4-6
TP-4-5
TP-4-4
TP-4-3

APPENDIX

chen and associates, inc.
CONSULTING ENGINEERS

SOIL & FOUNDATION ENGINEERING
96 S. ZUNI • DENVER, COLORADO 80223 • 303/744-7105
1924 EAST FIRST STREET • CASPER, WYOMING 82601 • 307/234-2126

SECTION 2

Extracted Data From

SOIL PROPERTY STUDY
EARTH LINED TAILINGS RETENTION CELLS
WHITE MESA URANIUM PROJECT
BLANDING, UTAH

Prepared for:

ENERGY FUELS NUCLEAR, INC.

PARK CENTRAL
1515 ARAPAHOE STREET
DENVER, COLORADO 80202

Job No. 16,406

July 18, 1978

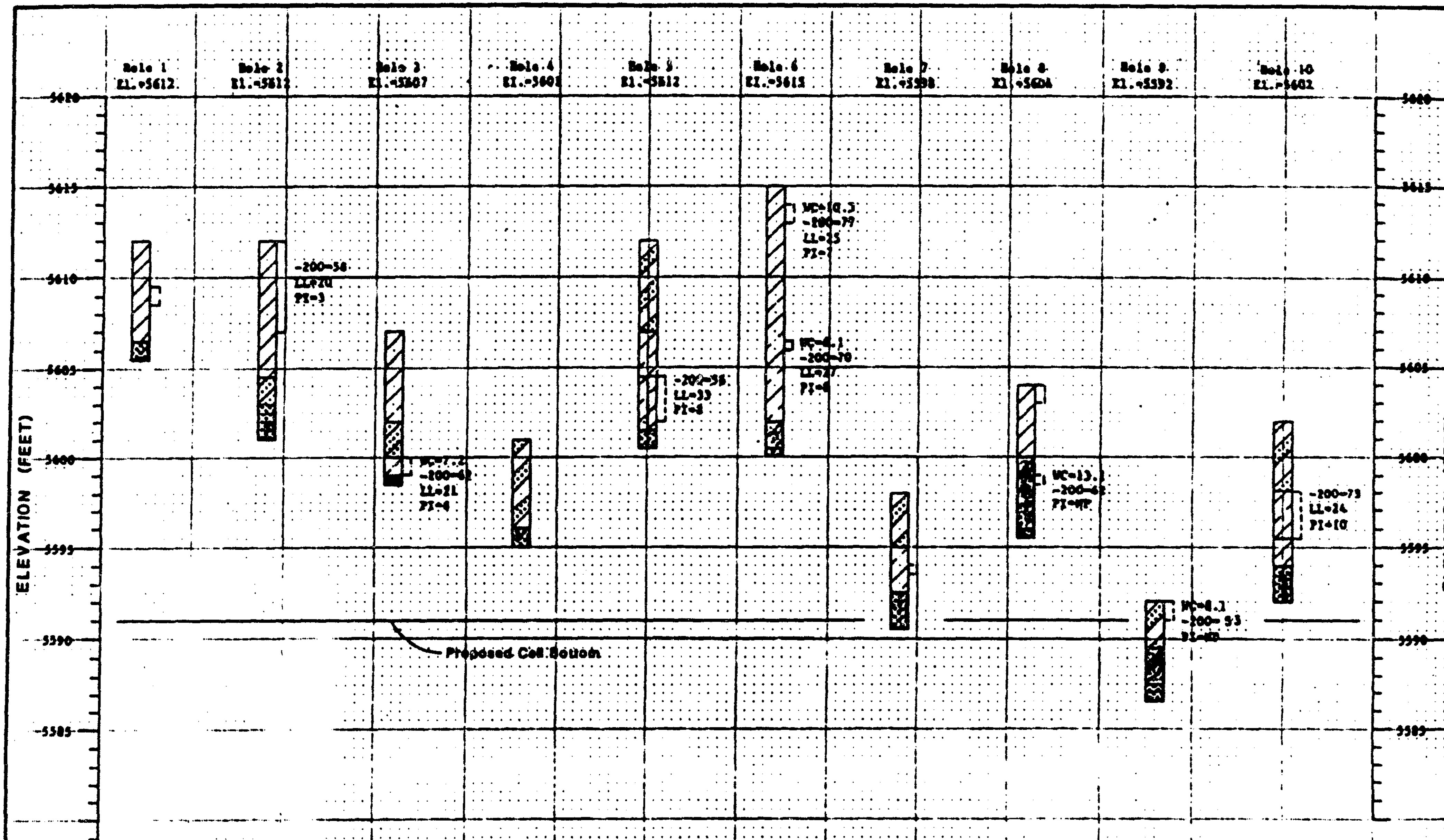


FIGURE 2
LOGS OF EXPLORATORY BORINGS
(CHEN & ASSOCIATES)
WHITE MESA PROJECT

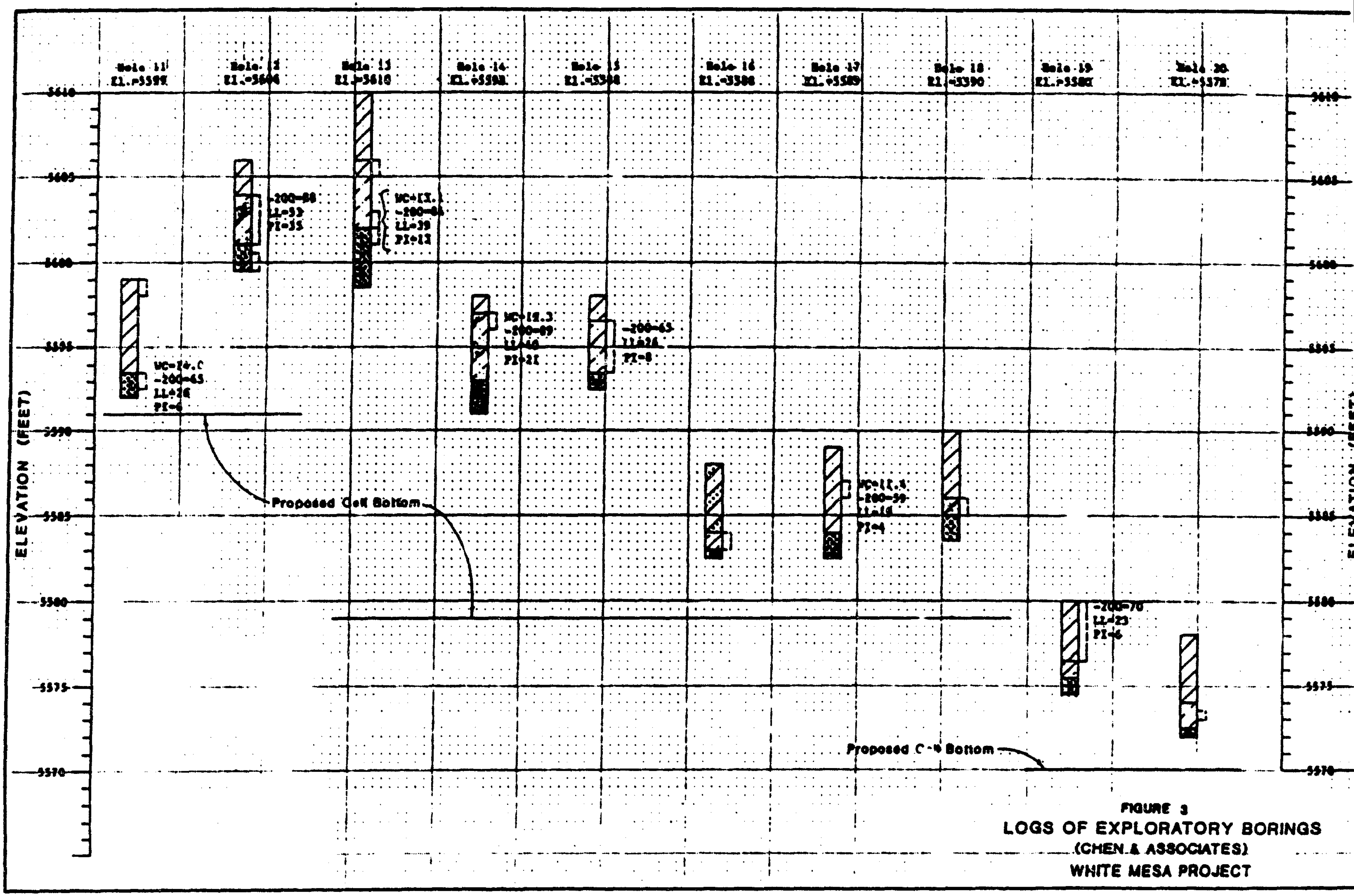


FIGURE 3
LOGS OF EXPLORATORY BORINGS
(CHEN & ASSOCIATES)
WHITE MESA PROJECT

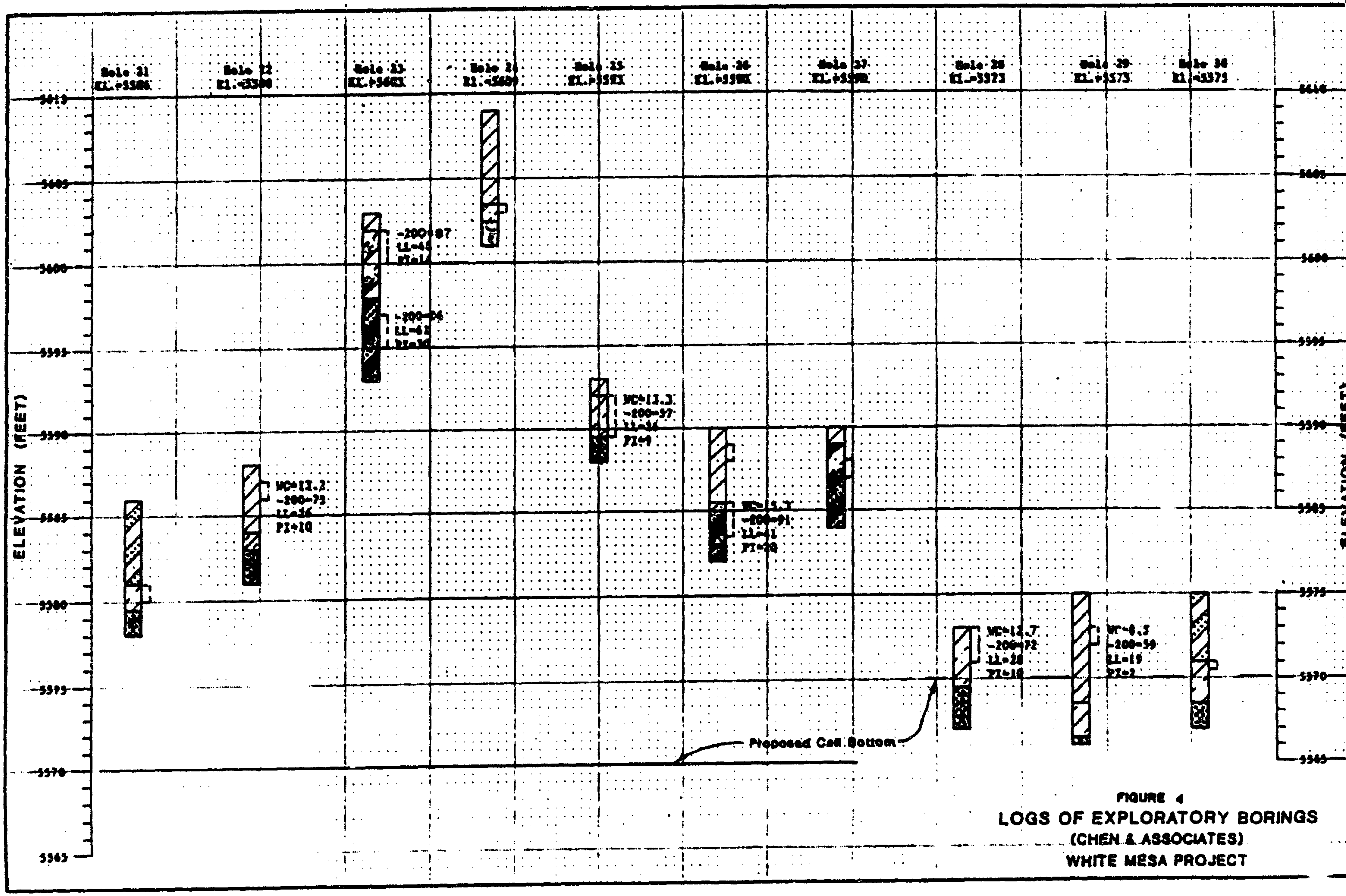


FIGURE 4
LOGS OF EXPLORATORY BORINGS
(CHEN & ASSOCIATES)
WHITE MESA PROJECT

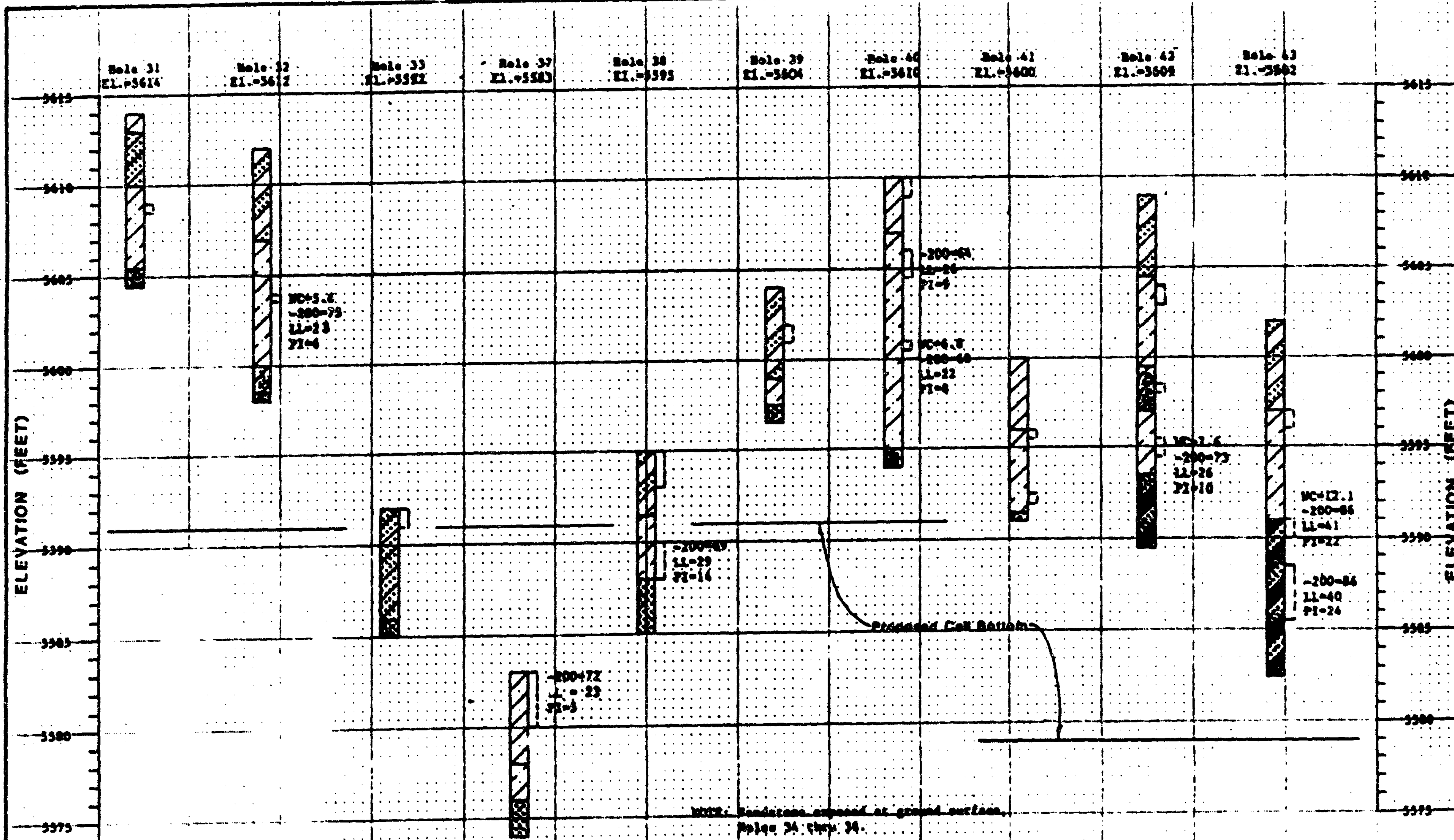


FIGURE 6

LOGS OF EXPLORATORY BORINGS

(CHEN & ASSOCIATES)

WHITE MESA PROJECT

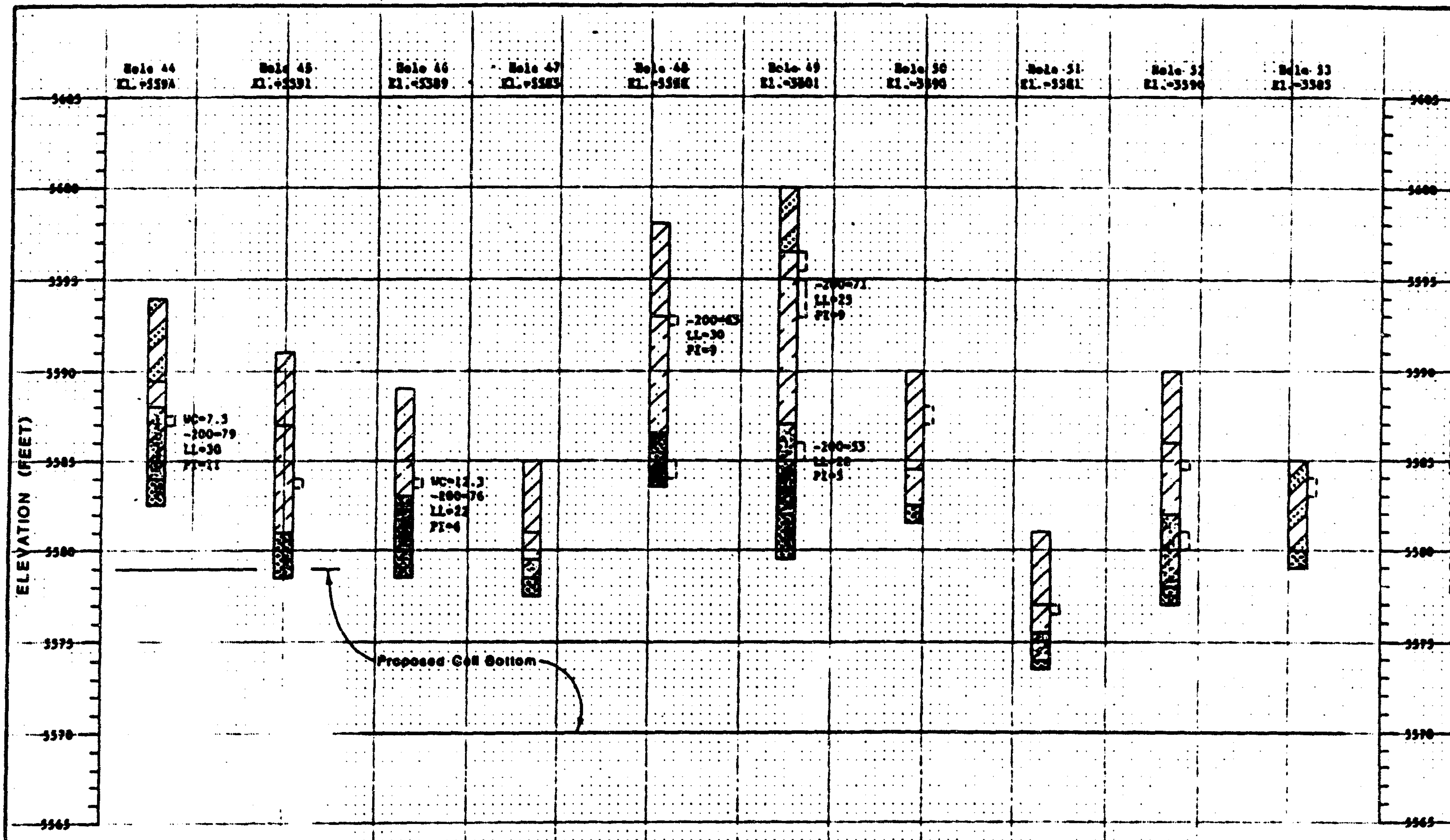


FIGURE 6
LOGS OF EXPLORATORY BORINGS
(CHEN & ASSOCIATES)
WHITE MESA PROJECT

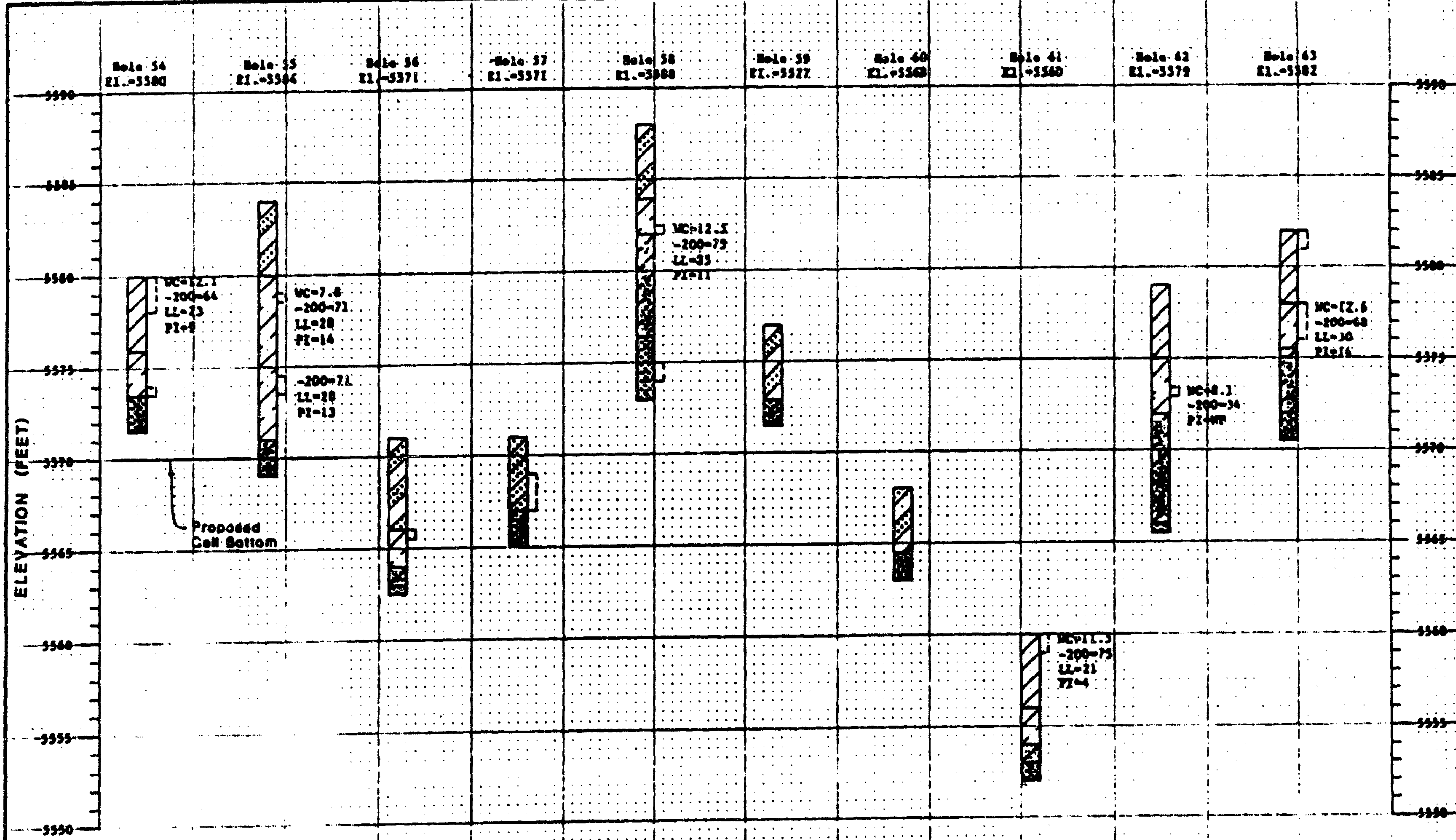


FIGURE 7

LOGS OF EXPLORATORY BORINGS

(CHEN & ASSOCIATES)

WHITE MESA PROJECT

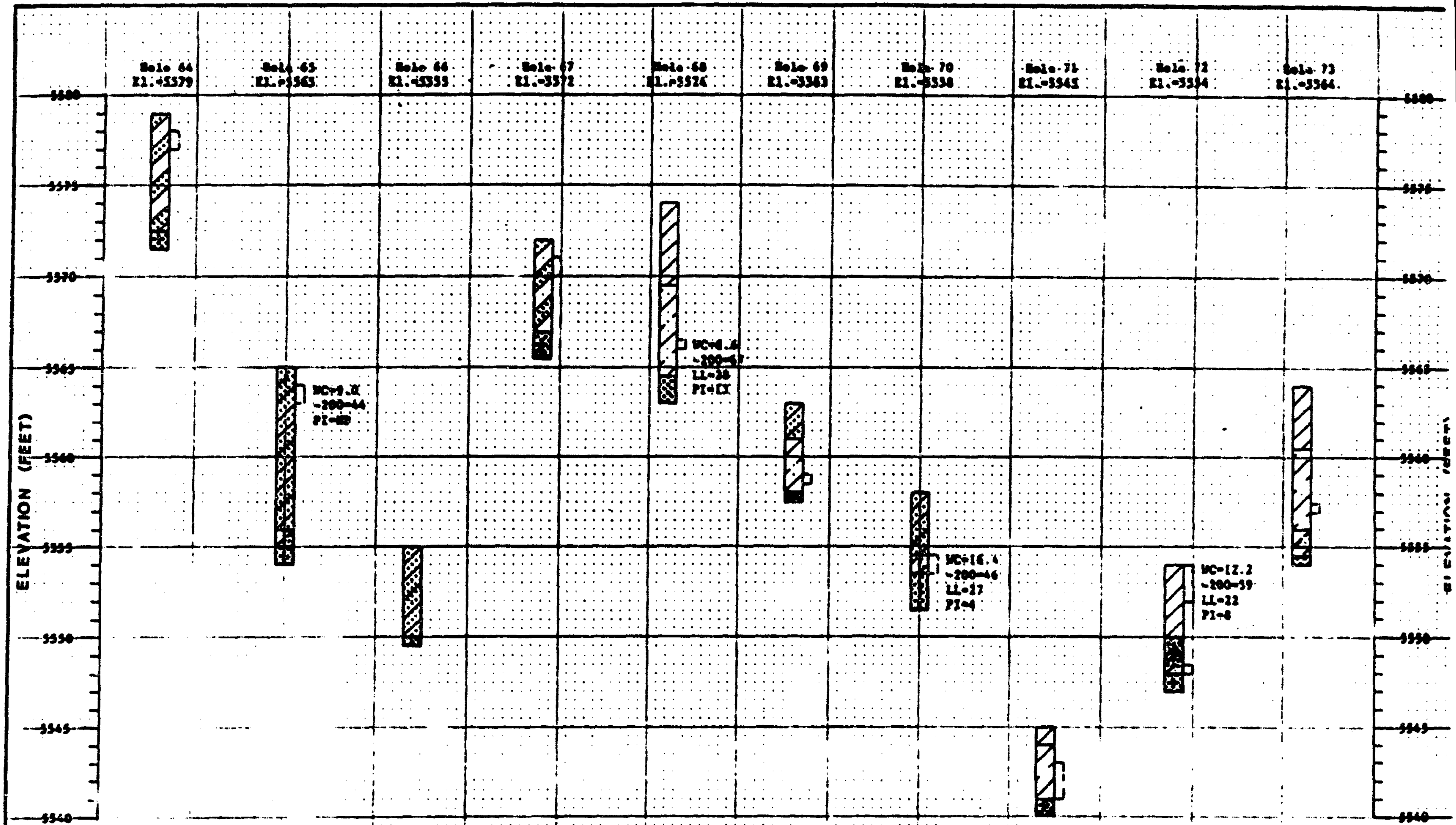
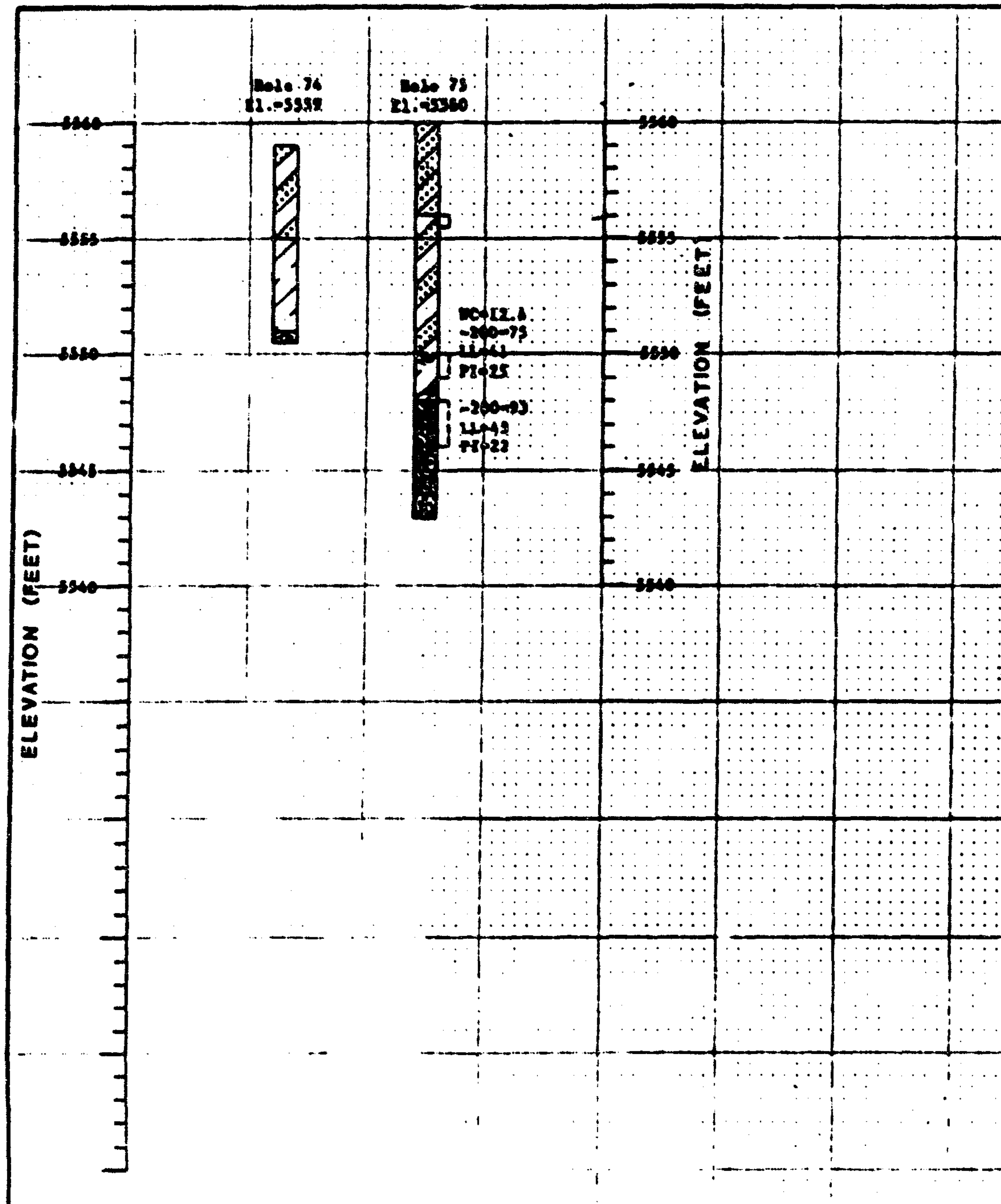


FIGURE 6

LOGS OF EXPLORATORY BORINGS

(CHEN & ASSOCIATES)

WHITE MESA PROJECT



Legend:

Sand (SM), silty, fine to medium grained, approximately 40-50% silt, slightly moist to moist, reddish brown.

Sand, silty to sandy silt (SM-ML), fine to medium grained, approximately 50-60% silt, slightly moist to moist, reddish brown.

Silt (ML), sandy, approximately 60-70% silt, fine to medium sand size, slightly calcareous with depth, slightly moist to moist, reddish brown to light brown.

Clay, silty to sandy silt (CL-ML), approximately 60-75% low to non-plastic fines, fine to medium sand size, slightly to moderately calcareous with depth, slightly moist, light brown.

Clay (CL), highly calcareous, sandy to silty, approximately 50-75% low plasticity fines, scattered very hard lenses/layer, dry to slightly moist, light tan to white.

Weathered claystone (CL-CH), approximately 90% medium to high plasticity fines, moist, gray-brown.

Claystone, bedrock, slightly moist, greenish grey.

Claystone-sandstone bedrock, lightly cemented, roughly stratified, fine to medium grained, greenish grey.

Sandstone bedrock, well cemented with depth, fine to medium grained, tan to grey.

Disturbed auger sample.

NOTES:

(1) Test holes were drilling on May 17 and 18, 1978 with a 12-inch, single-flight, power auger.
(2) Elevations are approximate and taken from contours shown on Fig. 1.
(3) No free water was found in test holes at the time of drilling.
(4) WC = Water Content (%);
-200 = Percent Passing No. 200 Sieve;
LL = Liquid Limit (%);
PI = Plasticity Index (%)
NP = Non-Plastic.

FIGURE 8
LOGS OF EXPLORATORY BORINGS
(CHEN & ASSOCIATES)
WHITE MESA PROJECT

SECTION 4

Extracted Data From

REPORT
SITE SELECTION AND DESIGN STUDY
TAILING RETENTION AND MILL FACILITIES
WHITE MESA URANIUM PROJECT
BLANDING, UTAH
FOR ENERGY FUELS NUCLEAR, INC.

Dames and Moore

January 17, 1978

09973-015-14

3.8 Stability

3.8.1 Slope Stability

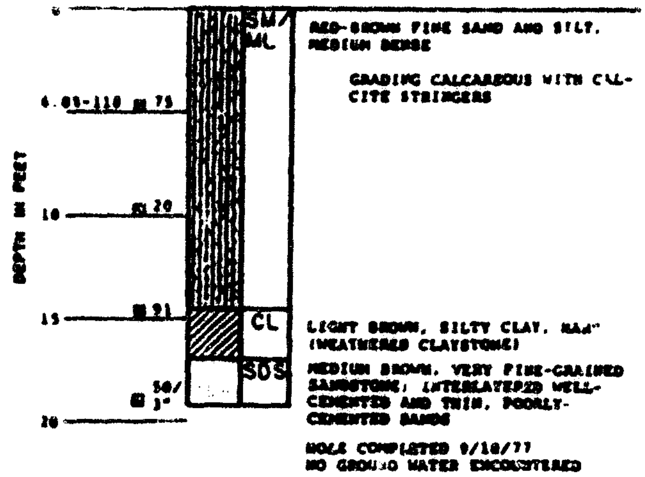
The external dikes formed by cover placement on Cell 2 will be extended to a reclaimed slope of 5(H) to 1(V) but may exist on an interim basis as 3(H) to 1(V) slopes until final reclamation. A stability analysis was performed using the 3(H) to 1(V) slopes. The maximum section of the dike will have a 15-foot wide berm at its base. The soil strength parameters used in the analysis are those developed by Dames & Moore (1978a) and are as follows:

Soil Parameters
for
Slope Stability Analysis

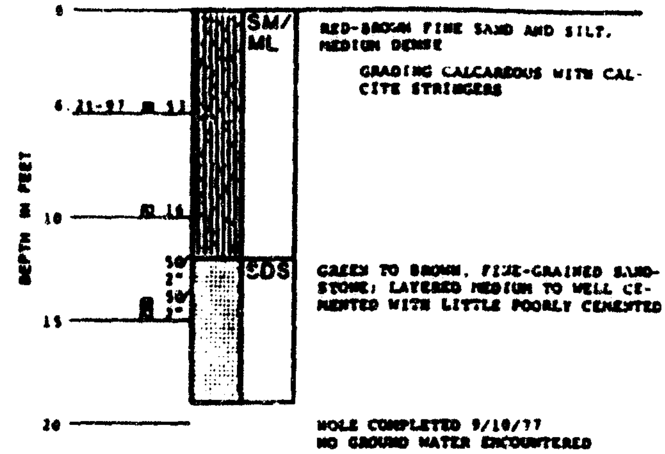
Section	Density (Pcf)	(Degrees)	C (psf)
Embankment	123	30	0
Tailings	62.4	0	0
Foundation Soils	120	28	0
Bedrock	130	45	10,000

From UMETCO, 1988

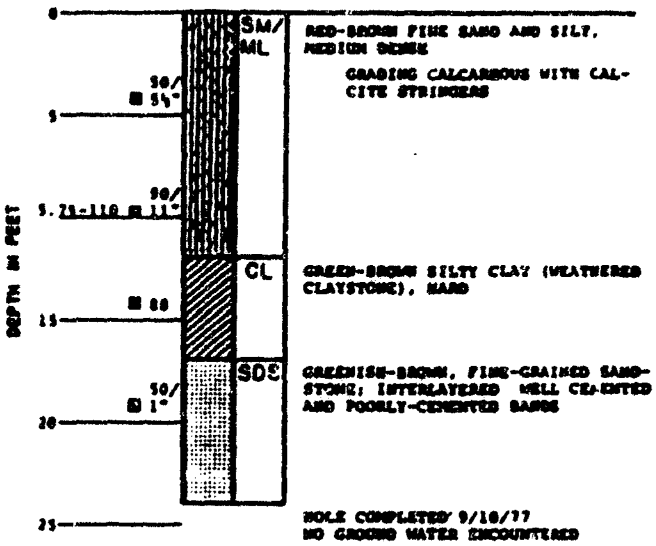
BORING NO. 1
EL. 5629.0 FT.



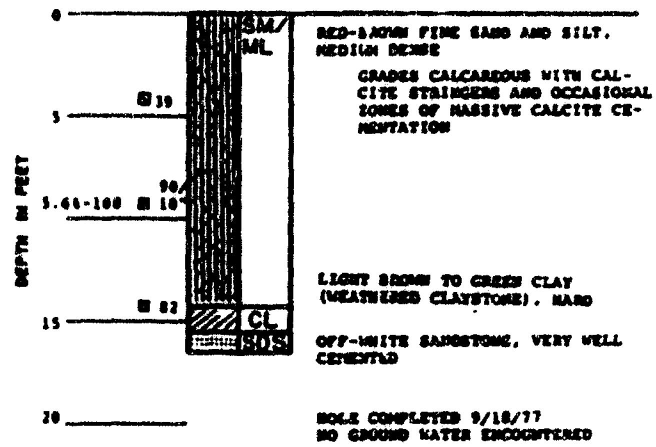
BORING NO. 5
EL. 5632.9 FT.



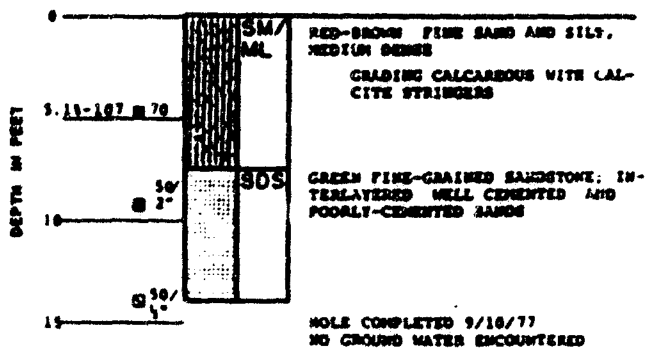
BORING NO. 2
EL. 5634.3 FT.



BORING NO. 6
EL. 5633.5 FT.



BORING NO. 4
EL. 5623.2 FT.



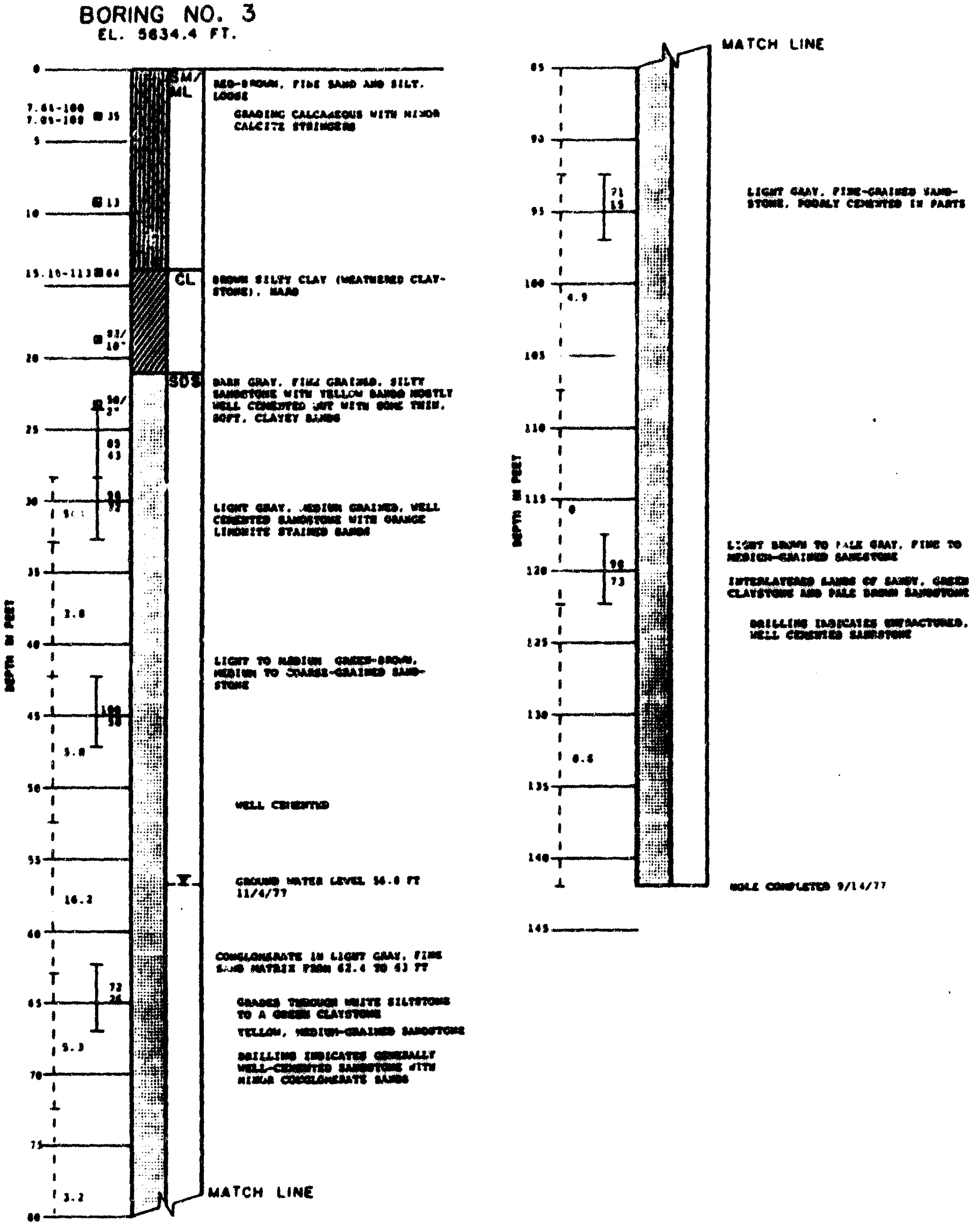
KEY

A-B ▪ C	INDICATES DEPTH AT WHICH UNDISTURBED SAMPLE WAS EXTRACTED USING DAMES & MOORE SAMPLER
▪ C	INDICATES DEPTH AT WHICH DISTURBED SAMPLE WAS EXTRACTED USING DAMES & MOORE SAMPLER
□ C	INDICATES SAMPLE ATTEMPT WITH NO RECOVERY
▪ C	INDICATES DEPTH AT WHICH DISTURBED SAMPLE WAS EXTRACTED USING STANDARD PENETRATION TEST SAMPLER
A	FIELD MOISTURE EXPRESSED AS A PERCENTAGE OF THE DRY WEIGHT OF SOIL
B	DRY DENSITY EXPRESSED IN LBS/CU FT
C	BLOWS/FT OF PENETRATION USING A 140-LB HAMMER DROPPING 30 INCHES
D E	INDICATES NC CORE RUN
D	PERCENT OF CORE RECOVERY
E	RQD*
F	INDICATES PACKER TEST SECTION
F	PERMEABILITY MEASURED BY SINGLE PACKER TEST IN FT/YR
NA	NOT APPLICABLE (USED FOR RQD IN CLAYS OR MECHANICALLY FRACTURED ZONES)
NOTE:	ELEVATIONS PROVIDED BY ENERGY FUELS NUCLEAR, INC.

* ROCK QUALITY DESIGNATION -- PERCENTAGE OF CORE RECOVERED IN LENGTHS GREATER THAN 4 INCHES

LOG OF BORINGS

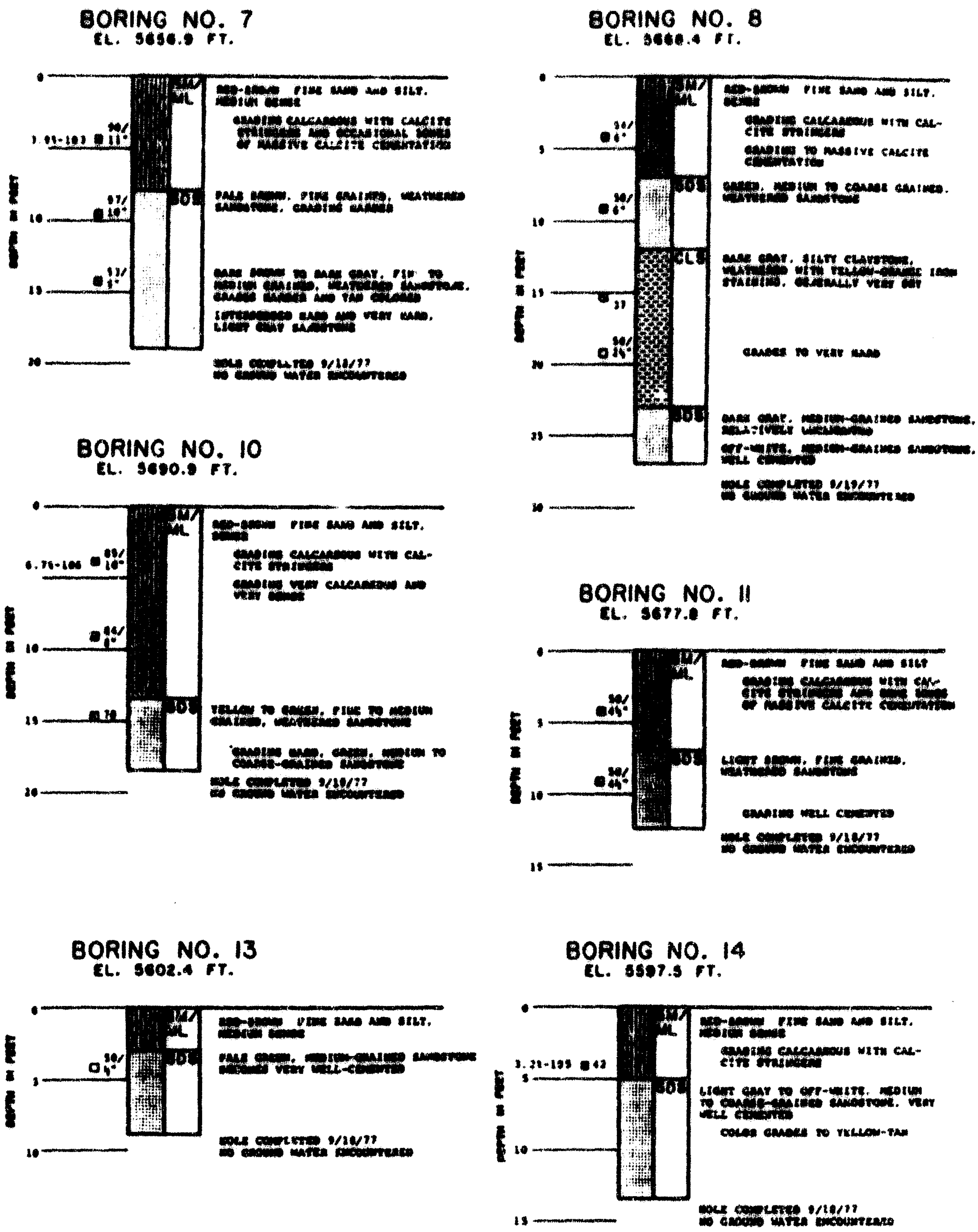
DAMES & MOORE



LOG OF BORINGS

DAMES & MOORE

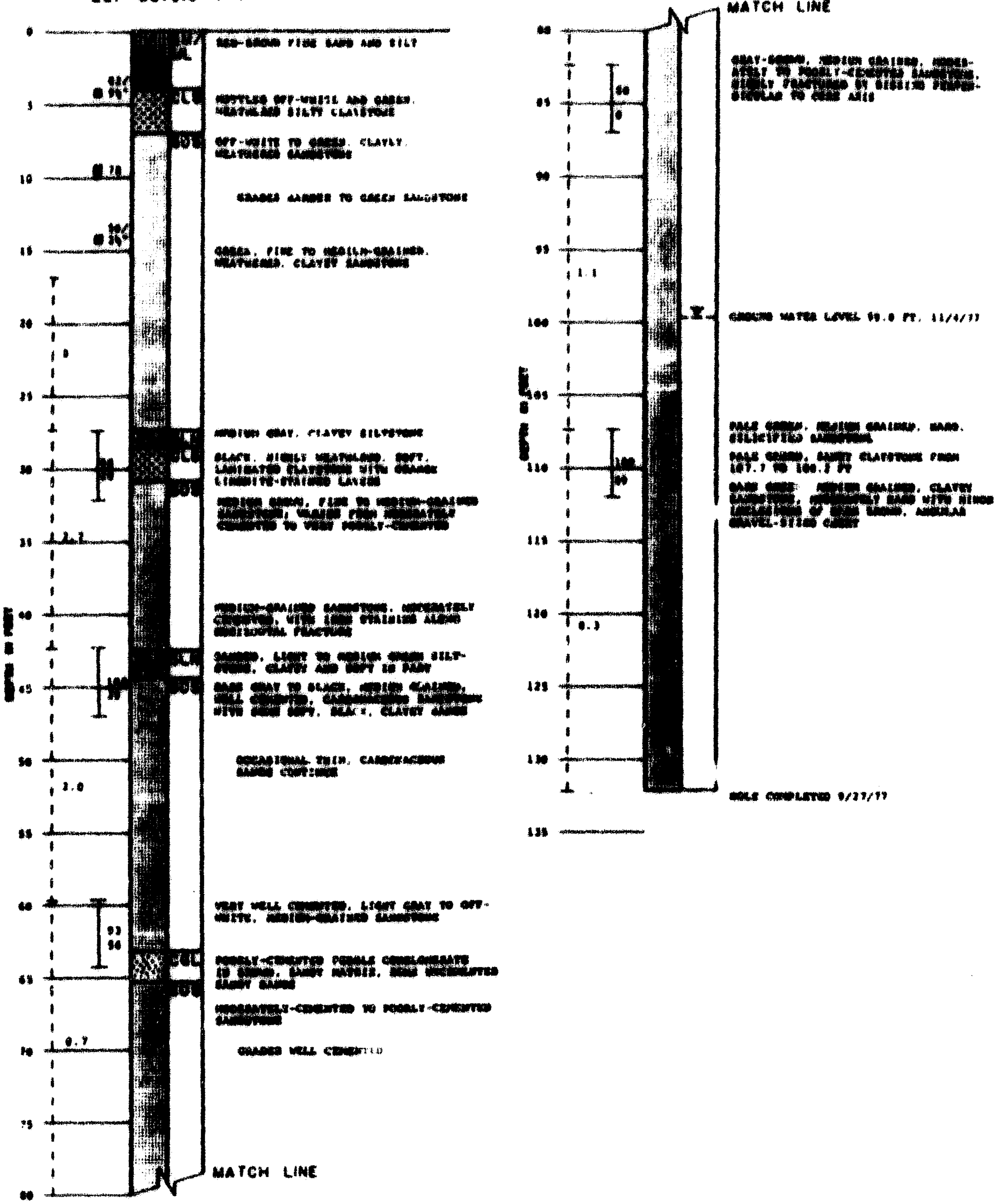
PLATE A-4



LOG OF BORINGS

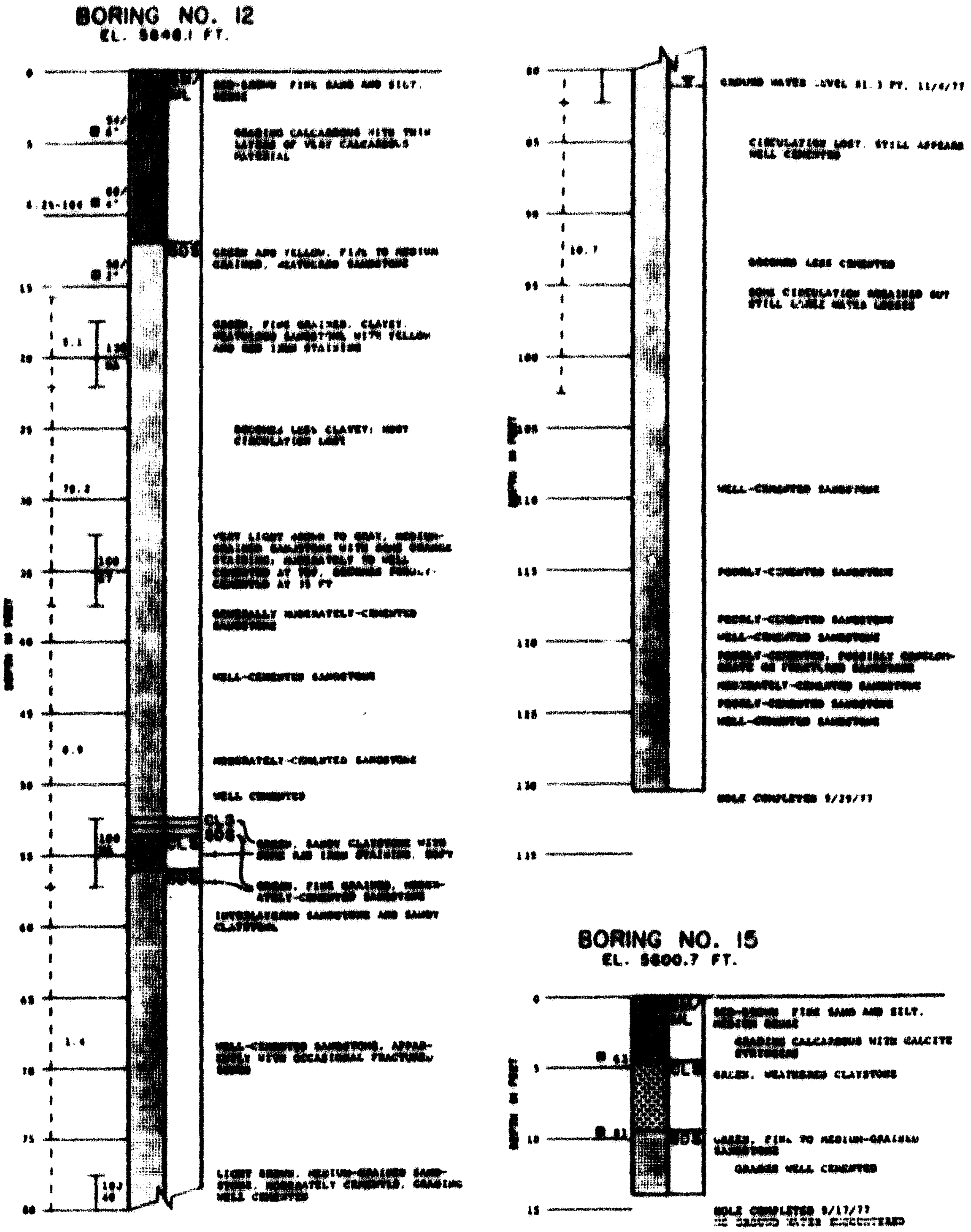
DAMES & MOORE

BORING NO. 9
EL. 5670.3 FT.



LOG OF BORINGS

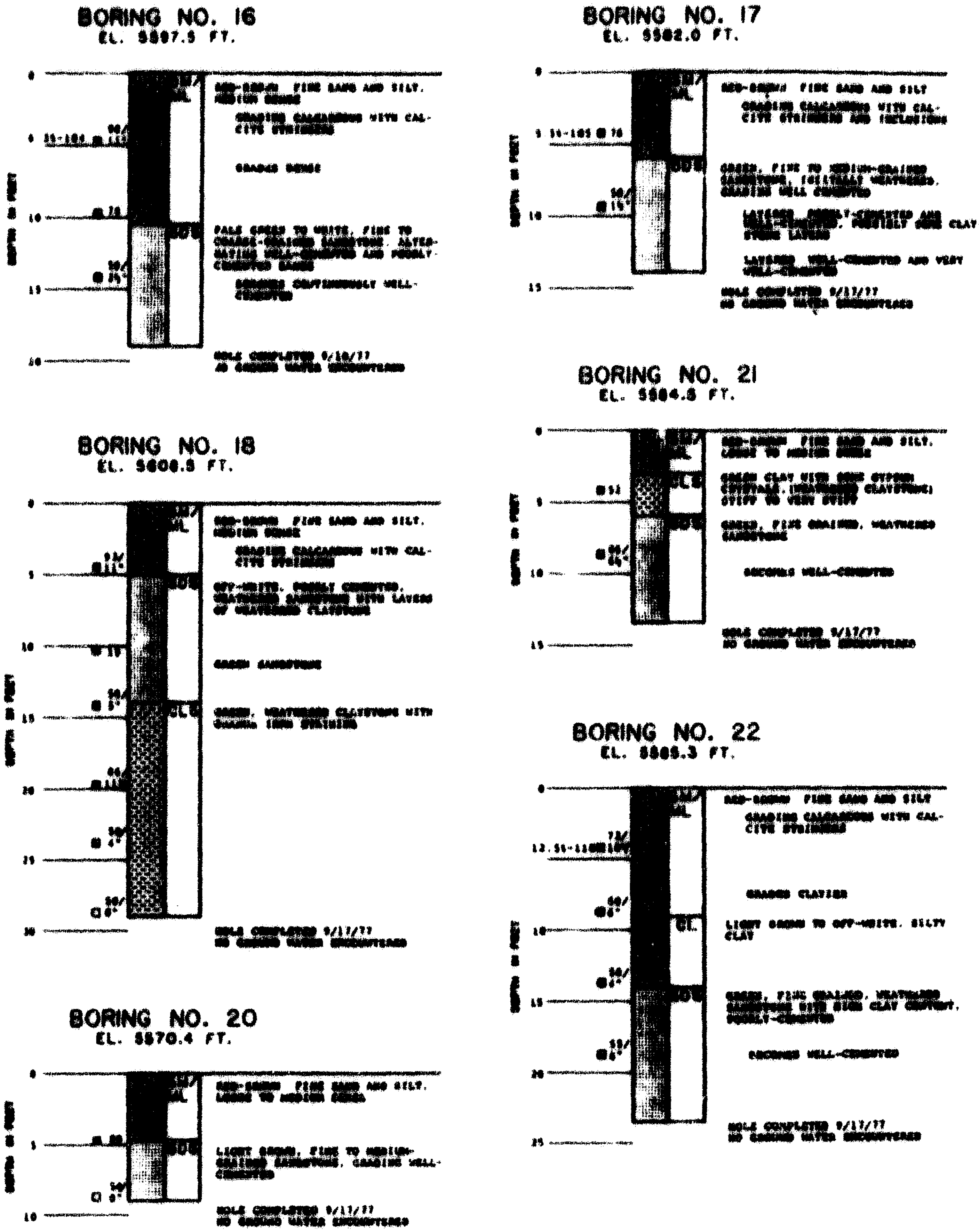
DAMES & MOORE



LOG OF BORINGS

DAMES & MOORE

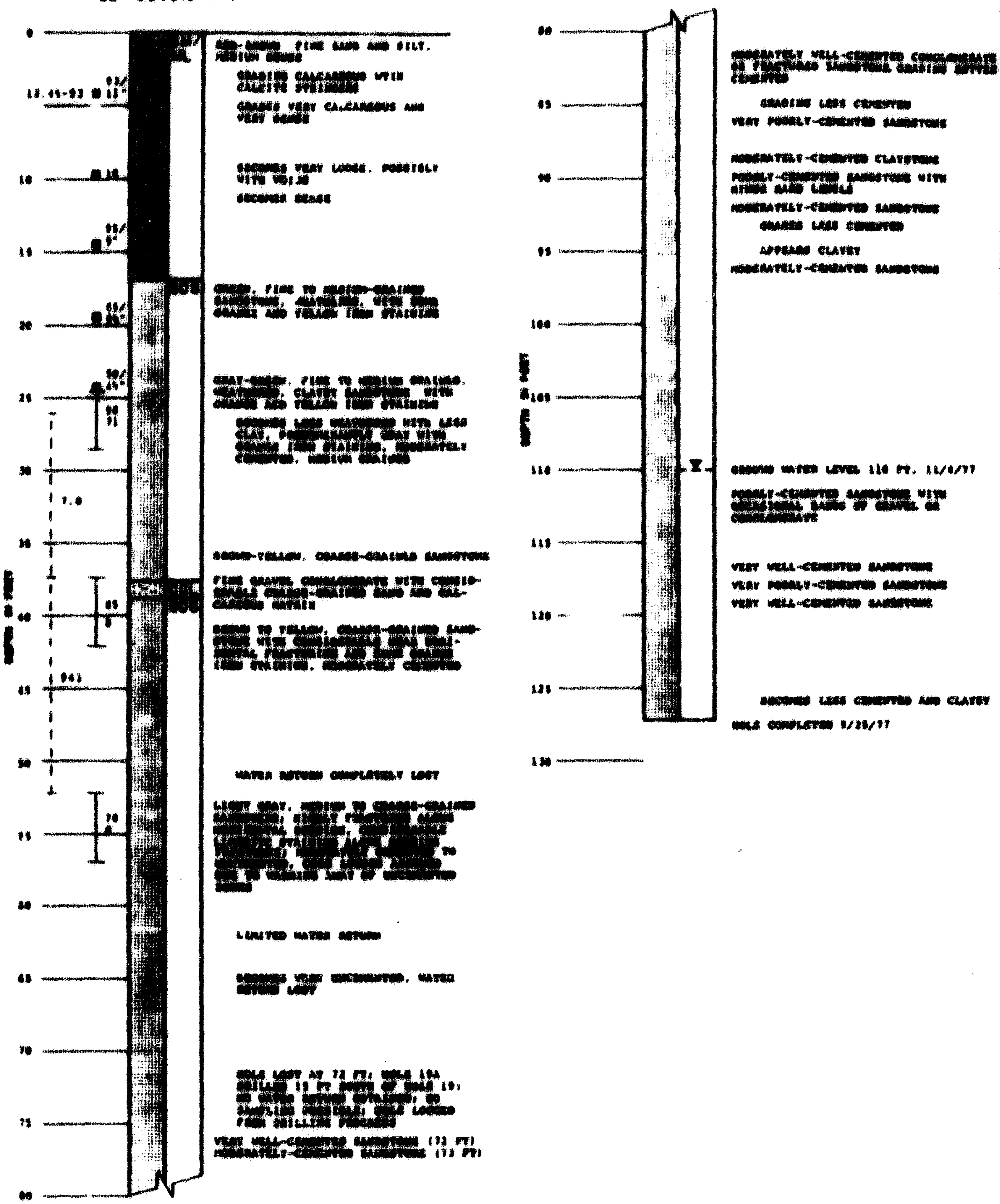
PLATE A-7



LOG OF BORINGS

DAMES & MOORE

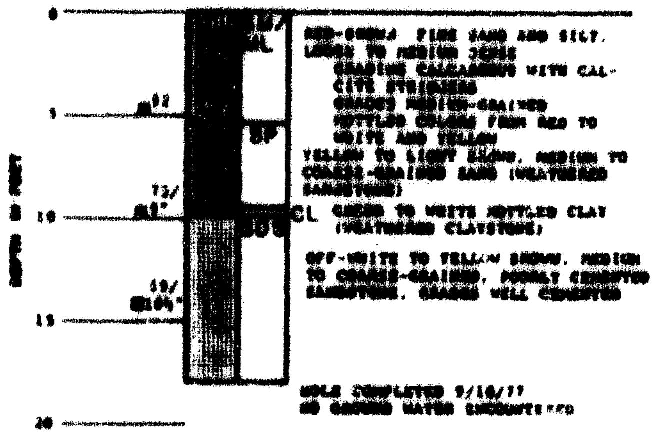
BORING NO. 19
EL. 5600.3 FT.



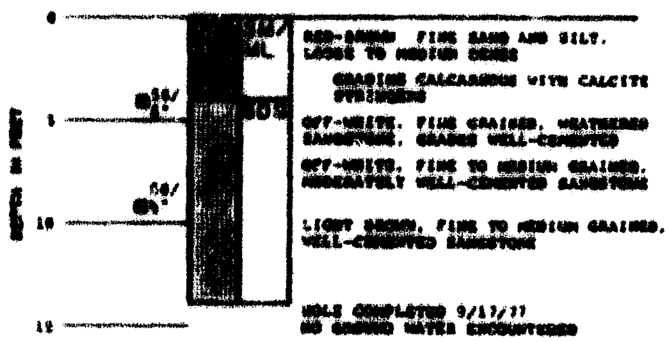
LOG OF BORINGS

DAMES & MOORE

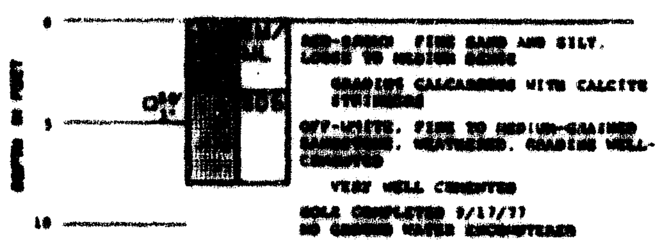
BORING NO. 23
EL. 5555.9 FT.



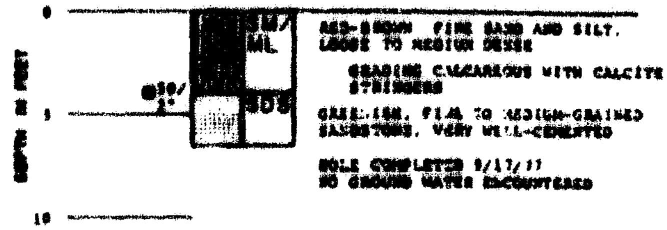
BORING NO. 24
EL. 5573.4 FT



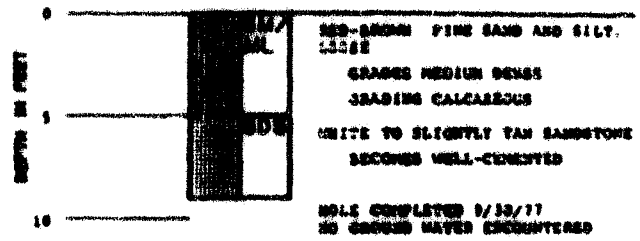
BORING NO. 26
EL. 5578.3 FT.



BORING NO. 27
EL. 5555.0 FT.



BORING NO. 29
EL. 565[illegible].0 FT. (APPROX)

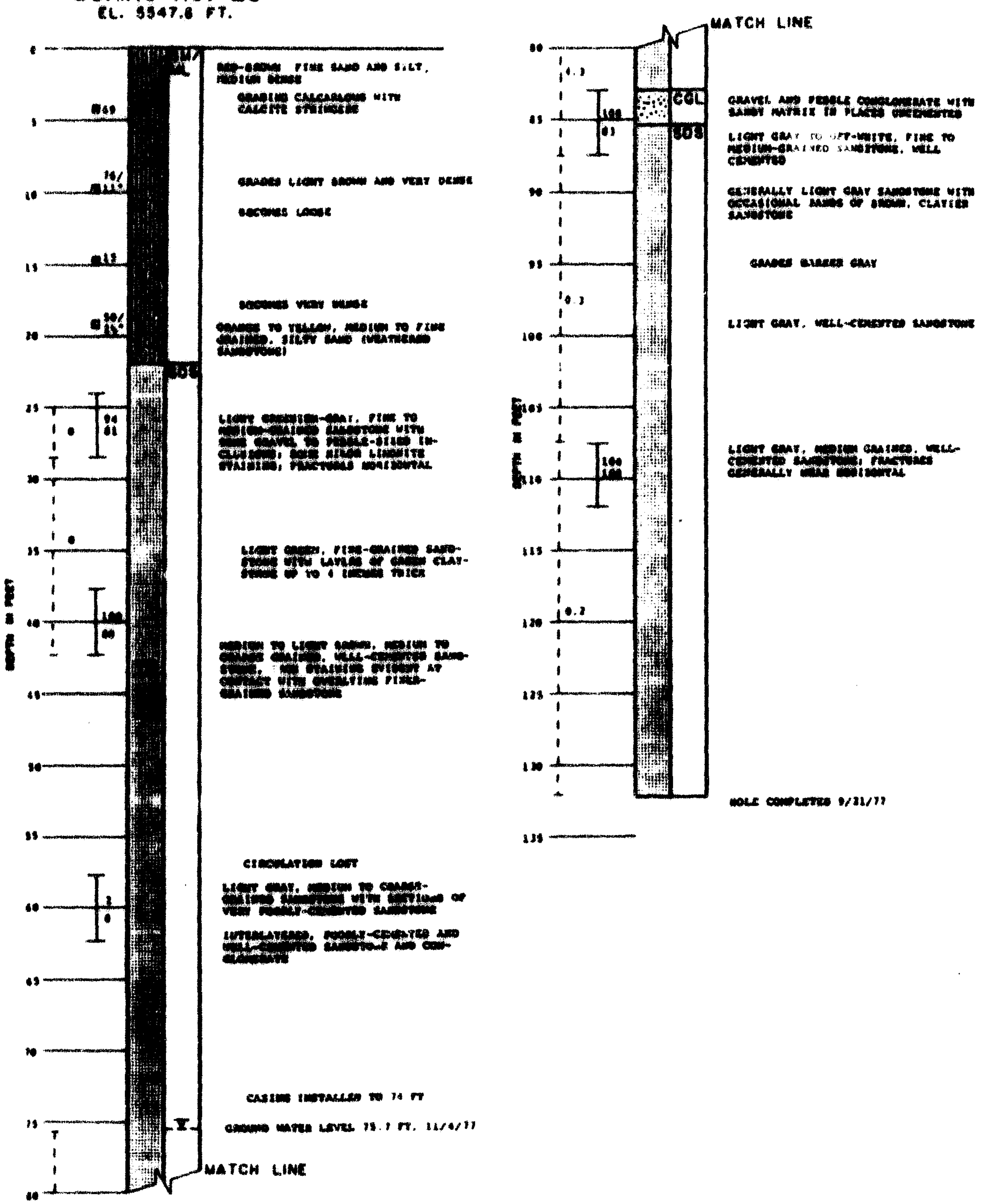


LOG OF BORINGS

DAMES & MOORE

BORING NO. 28

EL. 5547.6 FT.

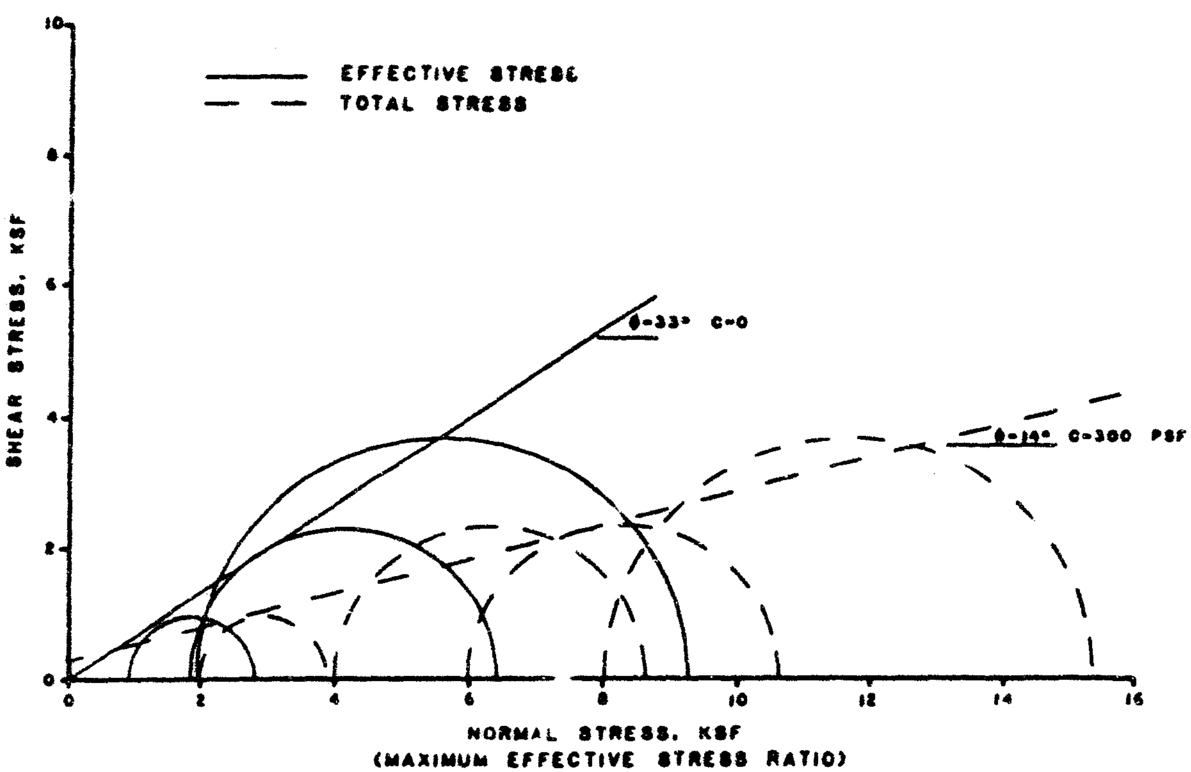


LOG OF BORINGS

DAMES & MOORE

PLATE A-11

TRIAXIAL COMPRESSION TESTS ON SILTY FINE SAND COMPACTED TO 95% OF AASHTO T-99 MAXIMUM DRY DENSITY



KEY		①		②		③		④	
BORING		19A		19A		19A		19A	
SAMPLE		1		2		3		4	
DEPTH (FEET)		Bulk		Bulk		Bulk		Bulk	
INITIAL	w, %	13.3		13.2		13.3		13.1	
	γ_d, PCF	111.1		111.2		111.1		111.3	
	e	0.529		0.537		0.526		0.526	
	% S	68 %		68 %		68 %		67 %	
FINAL	w, %	18.2		17.4		16.7		16.1	
	γ_d, PCF	114.7		117.1		117.0		120.5	
	e	0.481		0.450		0.451		0.409	
	% S	100 %		100 %		100 %		100 %	
BACK PRESSURE (PSI)		86.1		72.2		165		165	
STRAIN RATE (INCHES/MINUTE)		.002833		.000833		.000833		.000500	
STRESS CONDITION		PEAK $\sigma_1 - \sigma_3$	MAX σ_1/σ_3	PEAK $\sigma_1 - \sigma_3$	MAX σ_1/σ_3	PEAK $\sigma_1 - \sigma_3$	MAX σ_1/σ_3	PEAK $\sigma_1 - \sigma_3$	MAX σ_1/σ_3
TOTAL STRESS	ε, %	18.99	5.56	20.00	[illegible]	17.69	[illegible]	20.00	[illegible]
	TIME TO FAIL. (MIN.)	760	[illegible]	1021	760	1261	[illegible]	1026	[illegible]
	σ_3, KSF	2.00	2.00	4.00	4.00	6.00	[illegible]	8.00	[illegible]
	$\sigma_1 - \sigma_3$	3.98	1.88	5.68	4.59	5.12	[illegible]	11.68	[illegible]
	σ_1, KSF	4.98	3.88	9.68	8.59	11.12	[illegible]	19.68	[illegible]
	$\frac{1}{2}(\sigma_1 - \sigma_3)$	1.99	0.94	2.84	2.30	2.56	[illegible]	5.84	[illegible]
	$\frac{1}{2}(\sigma_1 + \sigma_3)$	3.99	2.94	6.84	6.30	8.57	[illegible]	13.84	11.64
	u, KSF	0.72	1.07	1.61	2.19	3.58	[illegible]	4.88	[illegible]
	$A = u/(\sigma_1 - \sigma_3)$	0.29	0.57	0.28	0.48	0.70	[illegible]	0.37	[illegible]
EFFECTIVE STRESS	ε, %	18.99	5.56	20.00	10.98	17.69	[illegible]	20.00	[illegible]
	TIME TO FAIL. (MIN.)	760	376	1421	780	1261	[illegible]	1026	498
	$\bar{\sigma}_3$, KSF	1.28	0.98	2.39	1.81	2.46	1.55	3.67	[illegible]
	$\sigma_1 - \sigma_3$	3.98	1.88	5.68	4.59	5.12	[illegible]	11.68	[illegible]
	$\bar{\sigma}_1$, KSF	5.26	2.81	8.07	6.40	7.58	[illegible]	15.35	[illegible]
	$\frac{1}{2}(\sigma_1 - \sigma_3)$	1.99	0.94	2.84	2.30	2.56	2.29	5.84	[illegible]
	$\frac{1}{2}(\bar{\sigma}_1 + \bar{\sigma}_3)$	3.27	1.89	5.23	4.11	4.98	[illegible]	9.51	[illegible]
	u, KSF	0.72	1.07	1.61	2.19	3.58	[illegible]	4.88	[illegible]
	$A = u/(\sigma_1 - \sigma_3)$	0.39	[illegible]	0.28	[illegible]	0.70	[illegible]	0.37	[illegible]
	$\bar{\sigma}_1/\bar{\sigma}_3$	2.94	3.01	3.38	[illegible]	3.08	[illegible]	4.19	[illegible]

TRIAXIAL COMPRESSION TEST REPORT

TYPE OF TEST: CONSOLIDATED - UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE MEASUREMENT

TYPE MATERIAL: COMPACTED CORE

SAMPLE DESCRIPTION

CLASSIFICATION: REDDISH - BROWN, CLAYEY SILT

LIQUID LIMIT: - PLASTIC LIMIT: - SPECIFIC GRAVITY, G_s: 2.70 (est.)

PROJECT: ENERGY FUELS

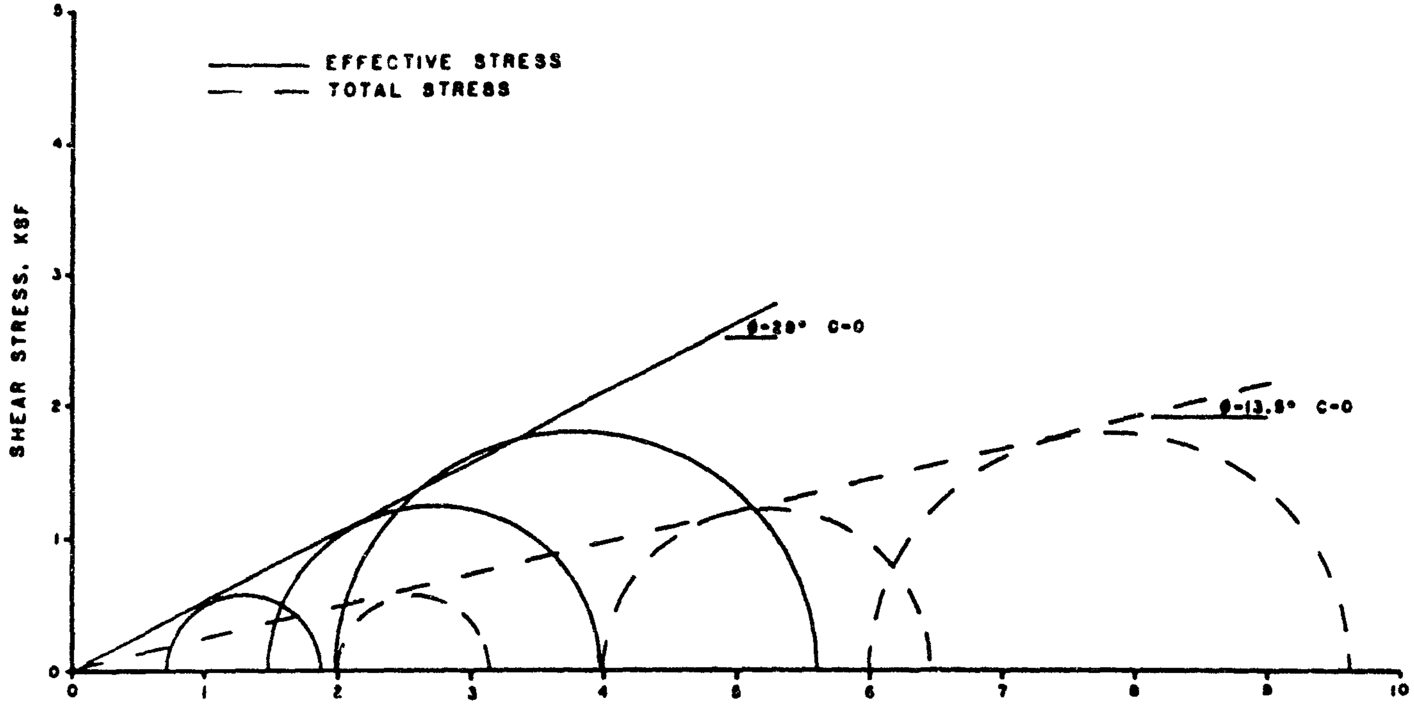
LOCATION: DENVER

JOB NO. 7973-016-14 PREPARED BY: RH, 10/27/77

CHECKED BY: RH, 10/27/77

PLATE B-11

MULTI PHASE TRIAXIAL COMPRESSION TESTS ON SILTY FINE SAND AT NATURAL DENSITY



		①		②		③	
KEY		①		②		③	
BORING		14		14		14	
SAMPLE		1		1		1	
DEPTH (FEET)		4'		4'		4'	
INITIAL	w, %	8.2		19.7		17.7	
	γ_d, PCF	104.7		108.6		112.6	
	e_o	.5903		.5227		.4693	
	S	.15		1.0		1.0	
FINAL	w, %	19.7		17.7		17.6	
	γ_d, PCF	108.6		112.6		113.7	
	e_f	.5227		.4693		.4542	
	S	1.0		1.0		1.0	
BACK PRESSURE (PSI)							
STRAIN RATE (INCHES / MINUTE)							
STRESS CONDITION		MAX $\sigma_1-\sigma_3$	MAX $\bar{\sigma}_1/\bar{\sigma}_3$	MAX $\sigma_1-\sigma_3$	MAX $\bar{\sigma}_1/\bar{\sigma}_3$	MAX $\sigma_1-\sigma_3$	MAX $\bar{\sigma}_1/\bar{\sigma}_3$
TOTAL STRESS	ε, %	1.5	2.5	1.0	1.5	1.0	2.0
	TIME TO FAIL (MIN)	15	25	10	15	10	19
	σ_3, PSF	2000	2000	4000	4000	6000	6000
	$\sigma_1-\sigma_3$	1171	1160	2484	2467	3764	3628
	σ_1, PSF	3171	3160	6484	6467	9764	9628
	$\frac{1}{2}(\sigma_1-\sigma_3)$	585	580	1242	1234	1882	1814
	$\frac{1}{2}(\sigma_1+\sigma_3)$	2585	2580	5242	5234	7882	7812
	u, PSF	1166	1282	2318	2506	3442	4018
	A, $u/(\sigma_1-\sigma_3)$	.996	1.11	.933	1.02	.914	1.11
EFFECTIVE STRESS	ε, %	1.5	2.5	1.0	1.5	1.0	2.0
	TIME TO FAIL (MIN)	15	25	10	1500	10	19
	$\bar{\sigma}_3$, PSF	834	718	682	1494	2558	1982
	$\bar{\sigma}_1-\bar{\sigma}_3$	1171	1160	2484	2467	3764	3628
	$\bar{\sigma}_1$, PSF	2005	1878	4166	3961	6322	5610
	$\frac{1}{2}(\bar{\sigma}_1-\bar{\sigma}_3)$	585	580	1242	1234	1882	1814
	$\frac{1}{2}(\bar{\sigma}_1+\bar{\sigma}_3)$	1420	1298	2924	2728	4440	3796
	u, PSF	1166	1282	2318	2506	3442	4018
	A, $u/(\bar{\sigma}_1-\bar{\sigma}_3)$	.996	1.11	.933	1.02	.914	1.11
	$\bar{\sigma}_1/\bar{\sigma}_3$	2.40	2.62	2.48	2.65	2.47	2.83

TRIAXIAL COMPRESSION TEST REPORT

TYPE OF TEST Tx-CU-PP

TYPE MATERIAL Brn Silt & F. Sand

SAMPLE DESCRIPTION

CLASSIFICATION SM/ML

LIQUID LIMIT N/A PLASTIC LIMIT N/A SPECIFIC GRAVITY, G_s 2.65 assumed

PROJECT Energy Fuels

LOCATION Blanding UT.

JOB NO. 15973-015-14 PREPARED BY LWK 11/4/77

CHECKED BY ____ / /

APPENDIX H

Material Quantities

3 of 8

TABLE 1
Volume of materials for top of cover:

Cell #	surface area ft^2				Th (riprap) inches	Th (fill) feet	Th (clay) feet					V (riprap)[1] ft.^3	V(fill)[1] ft.^3	V(clay)[1] ft.^3
2	3237500				3	2	1					809375	6475000	3237500
3	3780750				3	2	1					945188	7561500	3780750
4A	1920000				3	2	1					480000	3840000	1920000
Option 1 Total (Cells 2,3,and 4A):												2234563	17876500	8938250
Option 2 Total (Cells 2 and 3):												1754563	14036500	7018250

TABLE 2
Volume of materials for side slopes:

Slope #	total h ft.	h (riprap) ft.	h (fill) ft.	h (clay) ft.	L' (riprap) ft.	L' (fill) ft.	L' (clay) ft.	Length ft.	Th (riprap) feet	Th (fill) feet	Th (clay) feet	V(riprap)[2] ft.^3	V(fill)[2] ft.^3	V(clay)[2] ft.^3
1	16	15.5	14.0	12.5	79.0	71.4	63.7	3500	1	2	1	278622	499704	223082
2	6	5.5	4.0	2.5	28.0	20.4	12.7	500	1	2	1	14022	20398	6374
3	6	5.5	4.0	2.5	28.0	20.4	12.7	1180	1	2	1	33083	48135	15042
4	20	19.5	18.0	16.5	99.4	91.8	84.1	1900	1	2	1	188919	348773	159854
5	43	42.5	41.0	39.5	216.7	209.1	201.4	1750	1	2	1	379240	731709	352470
6	10	9.5	8.0	6.5	48.4	40.8	33.1	950	1	2	1	46019	77506	31486
7	5	4.5	3.0	1.5	22.9	15.3	7.6	1350	1	2	1	30977	41302	10326
8	27	26.5	25.0	23.5	135.1	127.5	119.8	1200	1	2	1	162149	305941	143792
9	35	34.5	33.0	31.5	175.9	168.3	160.6	1450	1	2	1	255078	487976	232898
10	18	17.5	16.0	14.5	89.2	81.6	73.9	1300	1	2	1	116003	212119	96117
Option 1 Total (Slopes 1, 2, 3, 4, 6, 7, 8, 9, and 10):												1122881	2041861	918971
Option 2 Total (Slopes 1, 2, 3, 4, 5, 6, and 7):												968890	1767524	798634

TABLE 3
Total Material Volumes for the Cover

Option 1:			
	riprap (top of cover)	2234563 ft^3	82762 yd^3
	riprap (side slopes)	1122881 ft^3	41588 yd^3
	random fill	19918361 ft^3	737717 yd^3
	clay	9857221 ft^3	365082 yd^3
Option 2:			
	riprap (top of cover)	1754563 ft^3	64984 yd^3
	riprap (side slopes)	968890 ft^3	35885 yd^3
	random fill	15804024 ft^3	585334 yd^3
	clay	7816884 ft^3	289514 yd^3

Notes.
Riprap on top and sides of cover are of different dimensions, and are therefore calucualted separately.
Total h = the average height along the slope length.
Th = Thickness of the layer of material.
V = Total volume of the material
L' = Length of the layer down the side slope. Calculated as (h(material)) / (cos 78.7). The slope is 5H:1V.
Length = Horizontal length of the side slope.

(1) Volume calculated as (surface area) x (layer thickness).
(2) Volume calculated as (L' x Th x Length)

Purpose: To determine the volume of riprap, clay, and random fill materials required to construct the uranium mill tailings cover at White Mesa Mill in Blanding, Utah.

Material volumes were calculated for two construction options:

- An integrated soil cover over Disposal Cells 2, 3, and 4A, and
- A cover over Cells 2 and 3, where Cell 4A tailings are excavated and placed in Cell 3.

Method: Standard geometric equations, as shown below, were used to determine the required material volumes.

Volume of a rectangle	= base * height * length
Volume of a trapezoid	= 1/2 * height *($base_1$ + $base_2$)

Surface area calculations for the tops of Cells 2, 3, and 4A are shown in Figure 1, and material volumes are calculated in Table 1.

The method for calculating material volumes on the side slopes is shown in Figure 2. The 5H:1V slopes have been divided into several zones which are indicated on Figure 1. The slopes have been categorized based on the average height they attain over a certain length. The height of the cover above the ground surface, along each side, was estimated using the cross sections in Figures 3 - 5. Calculations are presented in Table 2.

Assumptions:

- Random fill will be used to fill the existing freeboard space between the tailings and clay layer of the cover and bring the tailings pile elevations up to the berm elevations. This will create a smooth surface with a slope matching that of the cover. The random fill thickness between the clay and tailings surface will be a minimum of three feet. This random fill volume was not calculated due to the lack of information of the current topography in the tailings piles.

- The 0.2 percent slope on the tailings piles will be created using random fill materials beneath the clay layer of the cover. Cover materials will consist of one foot of clay under two feet of random fill . The top, riprap layer will consist of a minimum three inches on the top of the cover, and one foot on the side slopes.

TITANEnvironmental

By TAM Date 7/5/96 Subject EFN - White Mesa Page 2 of 8
Chkd By [handwritten initials] Date 8/14/96 Tailings Cover Material Volume Calc. Proj No 6111-001

Results:

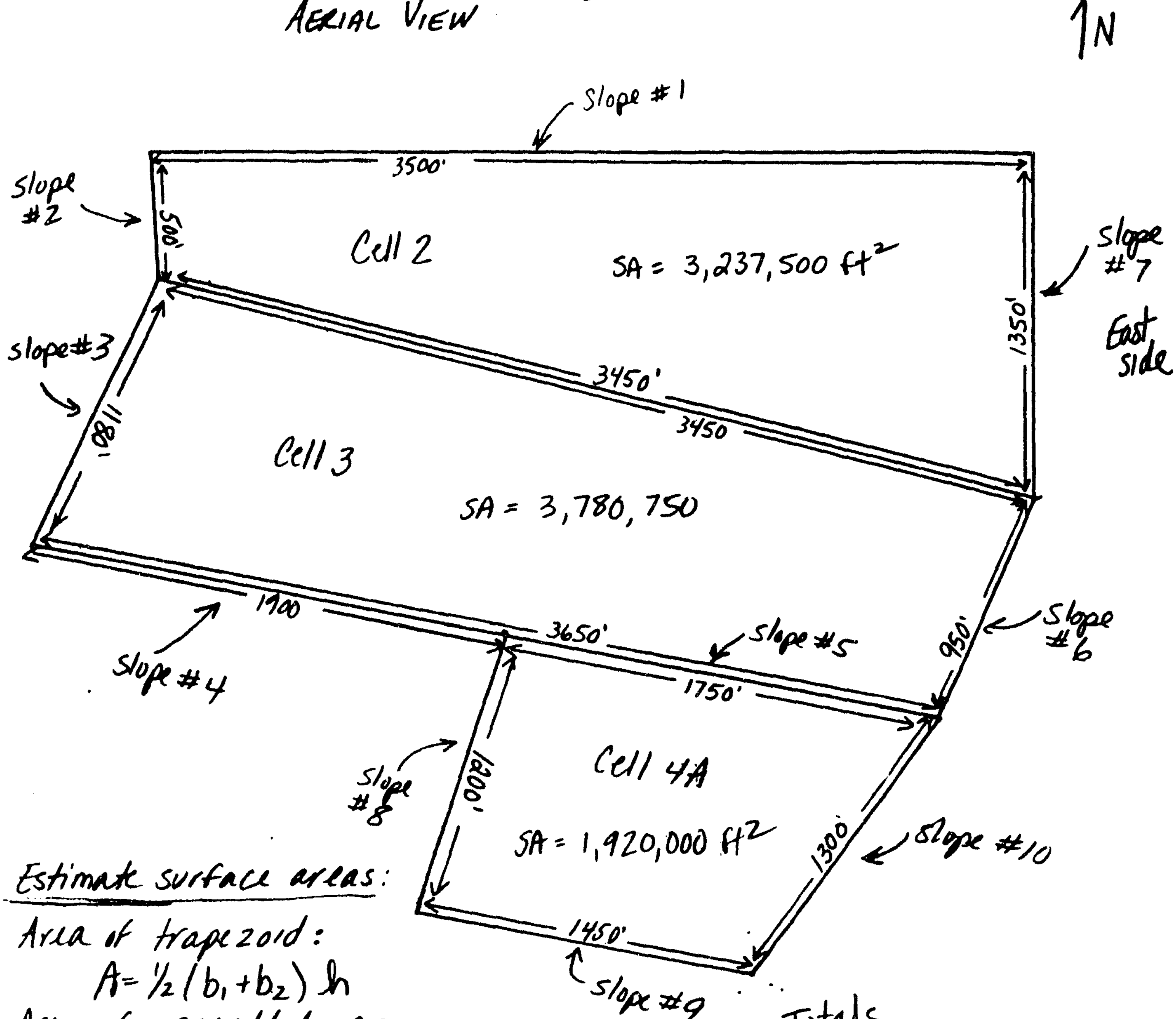
Option 1: (Cover on Cells 2, 3, and 4A):

Total volume (Clay):	=9,857,221 ft3	=365,082 yd3
Total volume (Random fill):	=19,918,351 ft3	=737,717 yd3
Total volume (Riprap - top cover):	=2,234,563 ft3	=82,762 yd3
Total volume (Riprap - side slopes):	=1,122,881 ft3	=41,588 yd3

Option 2: (Cover on Cells 2 and 3):

Total volume (Clay):	=7,816,884 ft3	=289,514 yd3
Total volume (Random fill):	=15,804,024 ft3	=585,334 yd3
Total volume (Riprap - top cover):	=1,754,563 ft3	=64,984 yd3
Total volume (Riprap - side slopes):	=968,890 ft3	=35,885 yd3

Surface Areas of Cells
AERIAL VIEW



Estimate surface areas:

Area of trapezoid:

$A = \frac{1}{2}(b_1 + b_2)\,h$

Area of parallelogram:

$A = bh$

Cell #2

$A = \frac{1}{2}(1350' + 500') \times 3500' = 3,237,500 \text{ ft}^2$

Cell #3

$A = (3550 \times 1065) = 3,780,750 \text{ ft}^2$

Cell #4A

$A = \frac{1}{2}(1450 + 1750) \times 1200 = 1,920,000 \text{ ft}^2$

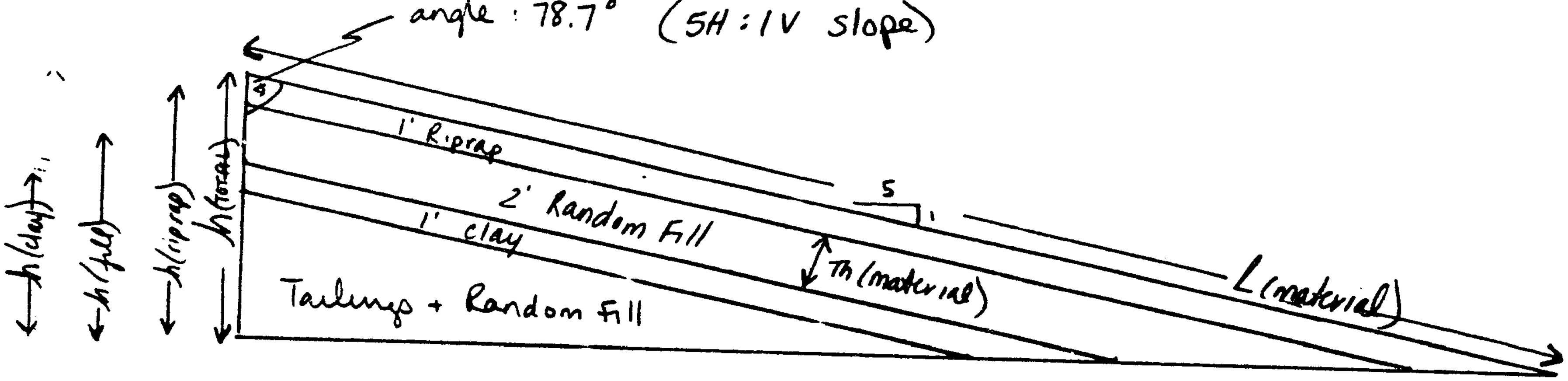
Totals

1) Option #1
Cells 2, 3, 4A:
8,938,250

2) Option #2
Cells 2, 3:
7,018,250 ft²

Figure 1

Volumes of Materials along side slopes



L = length of material layer down side slope

$$\cos \measuredangle = \frac{h\,(\text{material})}{L\,(\text{material})}$$

$$L(\text{material}) = \frac{h(\text{material})}{\cos 78.7}$$

$$V(\text{material}) = L(\text{material}) \times Th\,(\text{material}) \times \text{Length (from aerial view)}$$

Example: For $h_{TOTAL} = 16$ ft. (slope #1)

$h_{riprap} = 16\text{ ft.} - 0.5\text{ ft.} = 15.5\text{ ft.}$

$$L_{riprap} = \frac{15.5\text{ ft}}{\cos 78.7} = 79.0\text{ ft.}$$

$$V_{riprap} = (79.0')(1.0')(3500') = \underline{\underline{276{,}500\text{ ft}^3}}$$

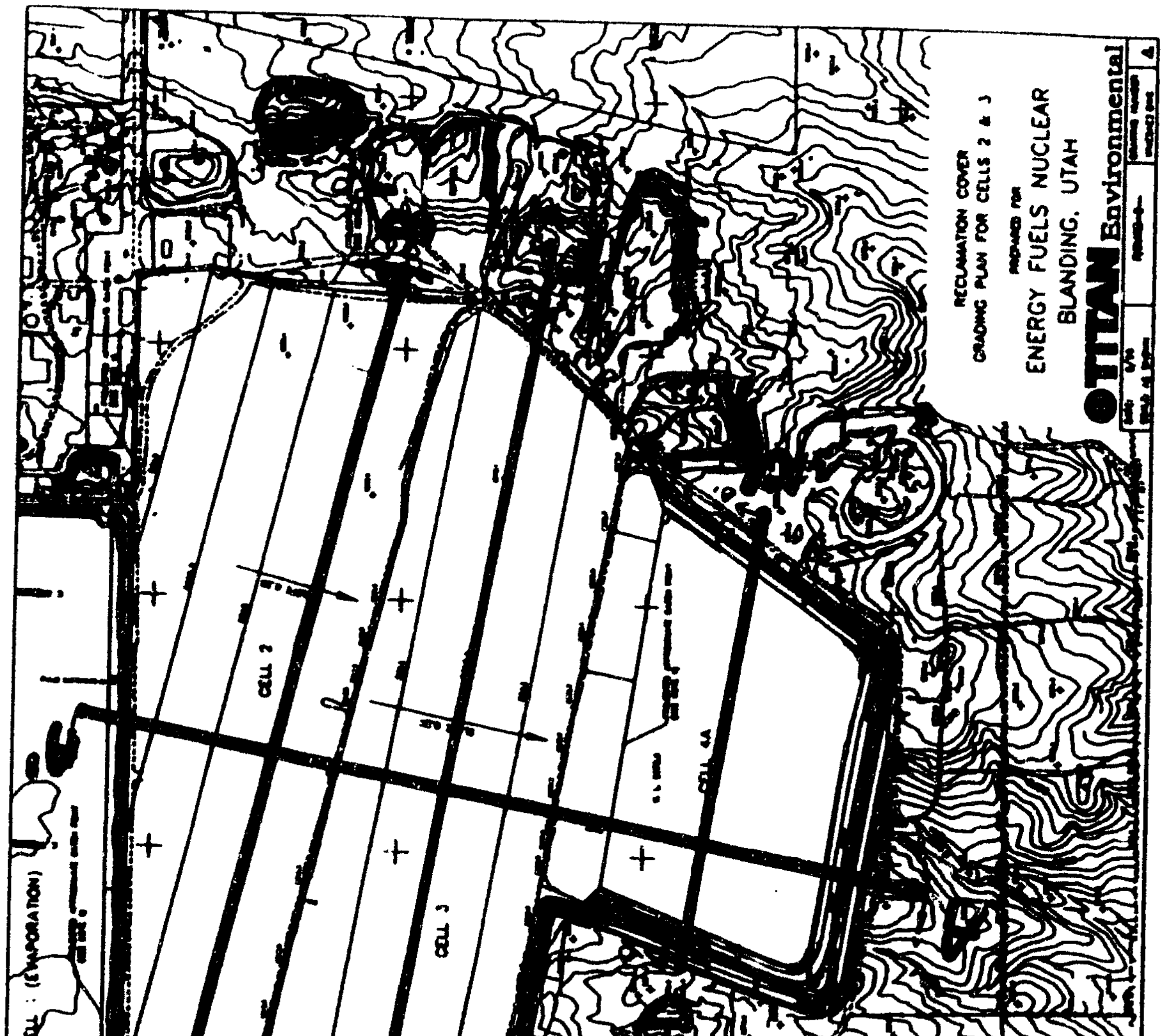
Figure 2

Figure 2

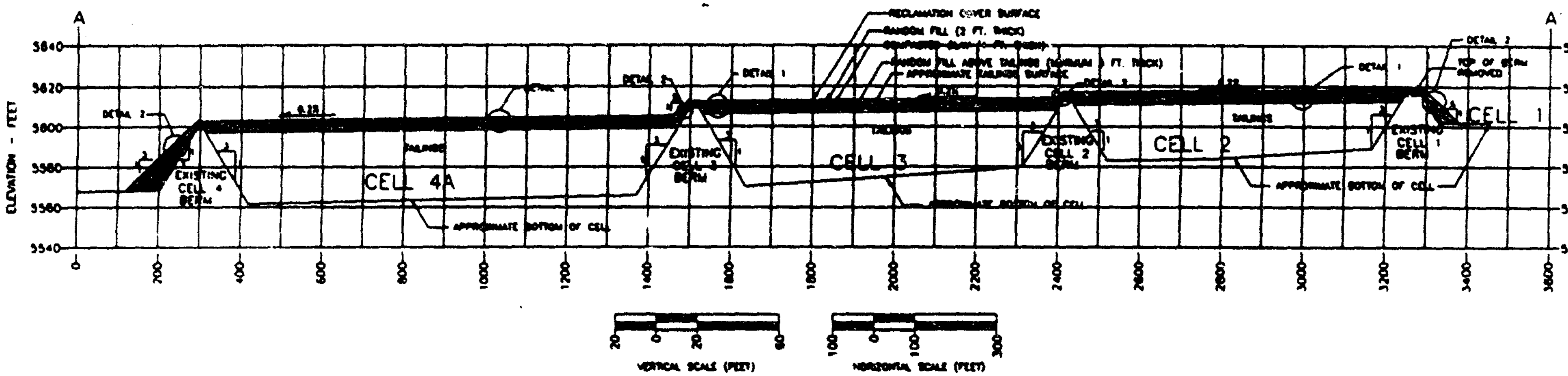
6 of 8

Key a/14

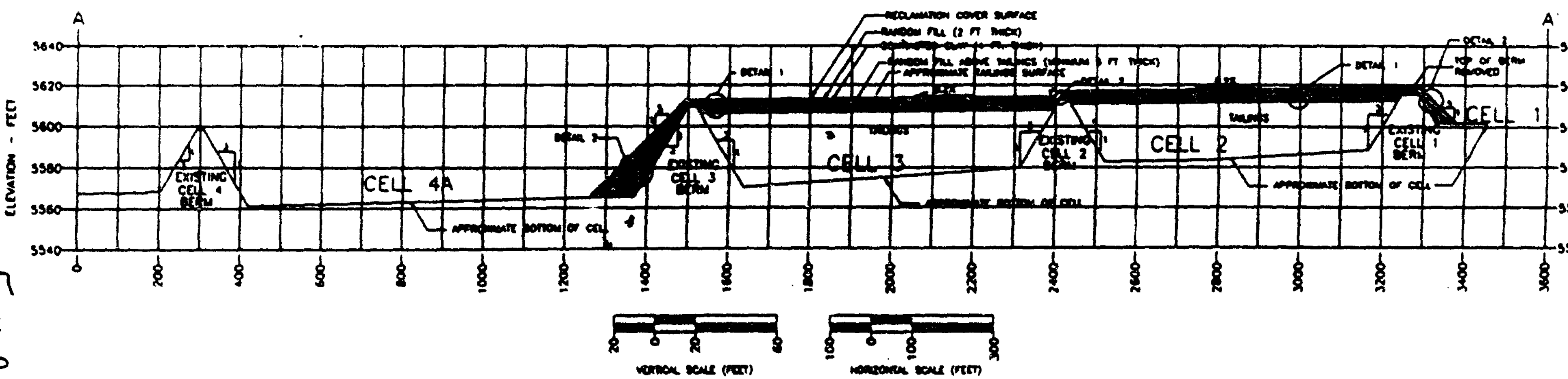
Fig 3



Frame 3



SECTION A-A' (WITH COVER ON CELLS 2, 3 & 4A)



SECTION A-A' (WITH COVER ON CELLS 2 & 3)

Figure 4

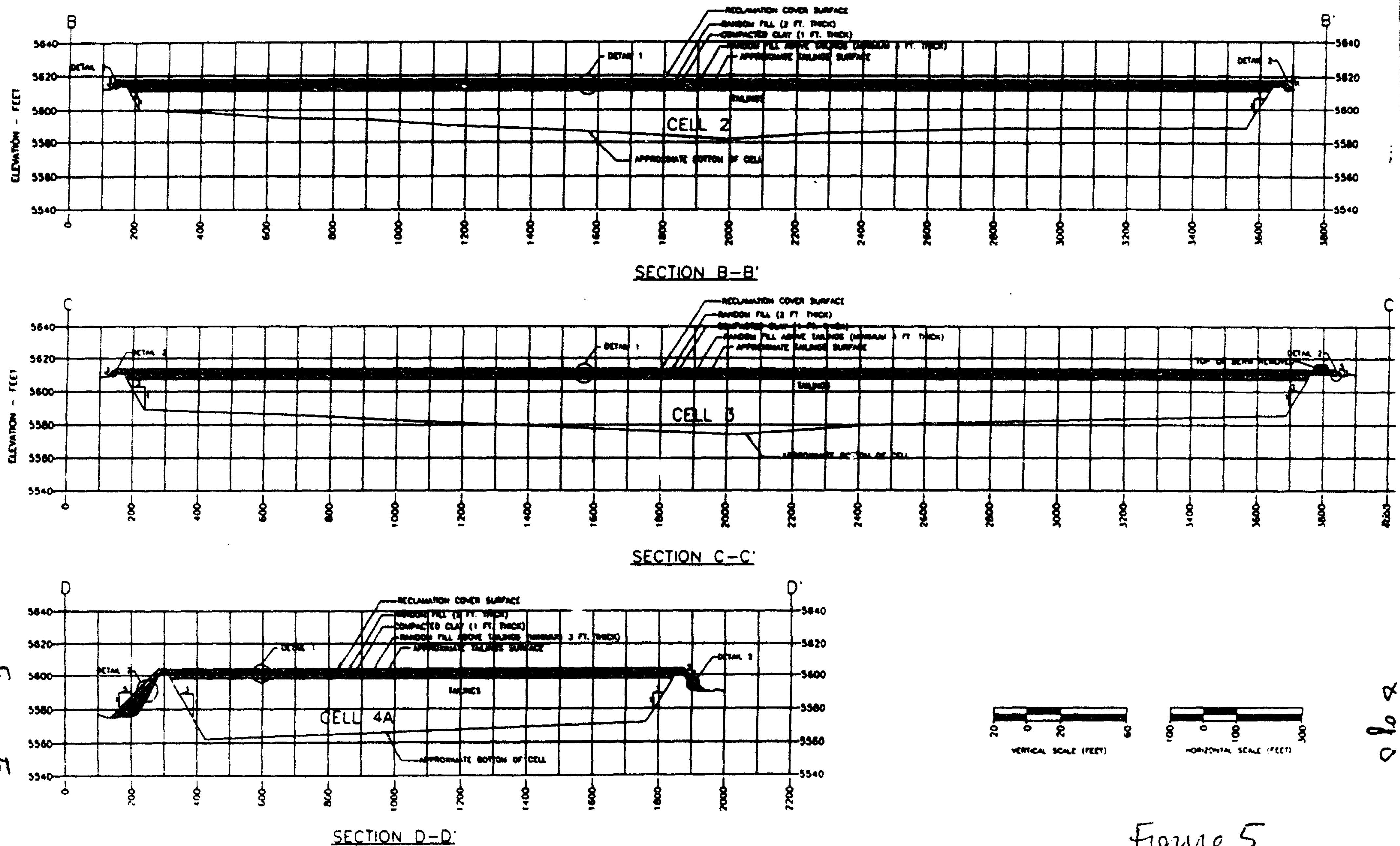


Figure 5

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NESHAPS RADON FLUX MEASUREMENT PROGRAM

WHITE MESA MILL, OCTOBER 1995

FOR

RECLAMATION

OF

WHITE MESA FACILITIES

BLANDING, UTAH

PREPARED BY

TELLCO ENVIRONMENTAL

1231 N. 23 ST., STE. 206

GRAND JUNCTION, COLORADO 81506

9602040022

NESHAPS RADON FLUX MEASUREMENT PROGRAM

White Mesa Mill, 1995

Prepared for:

Energy Fuels Nuclear, Inc.
P. O. Box 789
Blanding, Utah 84511

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October 1995

NESHAPS RADON FLUX MEASUREMENT PROGRAM

Energy Fuels Nuclear, Inc.
White Mesa Mill
P. O. Box 789
Blanding, Utah 84511

1.0 INTRODUCTION

During July and August 1995, Tellco Environmental (Tellco) provided support to Energy Fuels Nuclear, Inc. (Energy Fuels) regarding their required National Emission Standards for Hazardous Air Pollutants (NESHAPs) Radon Flux Measurement effort on Tailings Cells 2 and 3 at the White Mesa Mill uranium processing facility in Blanding, Utah. These measurements are required of Energy Fuels to show compliance with 40 Code of Federal Regulations, Part 61, Subpart W, National Emission Standards for Radon Emissions from Operating Mill Tailings. At present, there are no Subpart T uranium mill tailings at this site. As required by the regulations, the NESHAPs monitoring for existing mill tailings piles is a flux standard that limits the emission of radon from piles. The standard limits the amount of radon that can be emitted per unit area (m^2) per unit of time (s). This standard is not an average per facility, but is an average per radon source. According to subsection 61.252 Standard, (a) radon-222 emissions to ambient air from an existing uranium mill tailings pile shall not exceed 20 pCi/m^2-s of radon-222. Subsection 61.253 Determining Compliance, states that: "Compliance with the emission standard in this subpart shall be determined annually through the use of Method 115 of Appendix B."

Tellco was contracted to provide radon collectors, field placement/retrieval of said collectors, and analysis for calendar year 1995. This report addresses the procedures employed by Tellco to obtain the results presented in Section 6.0 of this report.

Environmental Scientist, Mr. Bryce Bird with the State of Utah, Division of Radiation Control, was present on July 25 & 26, 1995 during the placement and retrieval of collectors for Cell 2 and placement of collectors for Cell 3 tailings beach region.

2.0 SITE DESCRIPTION

The White Mesa Mill is located south of Blanding, Utah on Highway 191. The mill began operations in 1980 for the purpose of extracting uranium and vanadium from feed stocks. Processing effluents from the operation are deposited in four "lined" cells which vary in depth. Cells 1-I and 4A are used solely for "liquor" storage, and Cells 2 and 3 are used for sand tailings/liquor deposition.

Cell 2 has a total area of 270,625 square meters (m^2). This cell was comprised of two source regions that required NESHAPs radon monitoring: approximately 225,882 m^2 of the cell had a soil cover of varying thickness, with approximately 41,761 m^2 of exposed tailings "beaches". The remaining approximately 2,982 m^2 was covered by standing liquid in "low" elevation areas.

Cell 3 has a total area of 288,858 m^2. This cell was comprised of two source regions that required NESHAPs radon monitoring: approximately 82,762 m^2 of the cell had a soil cover of varying thickness, with approximately 62,761 m^2 of exposed tailings "beaches". The remaining approximately 143,335 m^2 was covered by standing liquid in "low" elevation areas.

Due to worker health and safety concerns expressed by both Energy Fuels site personnel and Tellco monitoring staff, some of the areas of the wet beaches of Cell 2 and Cell 3 were not investigated due to the extreme instability of wet tailings beaches.

3.0 SAMPLER DESCRIPTION

The Large Area Activated Charcoal Canisters (LAACC) used by Tellco personnel to perform the required radon measurements were fabricated in conformance with "Radon Flux Measurements on Gardinier and Royster Phosphogypsum Piles near Tampa and Mulberry, Florida" (NTIS Document #PB86-161874) as referenced in 40 CFR, Part 61, Method 115, Appendix B. This method of performing radon flux measurements involves the adsorption of radon on activated charcoal in a large-area collector. The charged collector is placed directly on the material surface to be measured and is allowed to collect radon for a given time period (24 hours). The radon collected on the activated charcoal is then measured by means of gamma spectroscopy.

Each LAACC was constructed using a 10-inch diameter PVC end cap, spacer pads, charcoal distribution grid, retainer screens, pads, and a steel retainer ring (see Figure 3-1).

Prior to deployment, each collector was charged with 180 grams of baked charcoal from sealed individual sample containers (reference Section 5.0 below for laboratory procedures). After the 24 hour measurement period, the exposed charcoal was transferred to the plastic sample containers, sealed air-tight (with tape), labeled as to sample identification along with exposure times/dates, and transferred to the Tellco laboratory (Grand Junction, Colorado) facility for analysis.

4.0 FIELD OPERATIONS

4.1 General Site Specific Information

Tellco personnel laid out baselines along the sides of Cells 2 and 3, and a grid coordinate location system was developed to accommodate locating the samplers in the field.

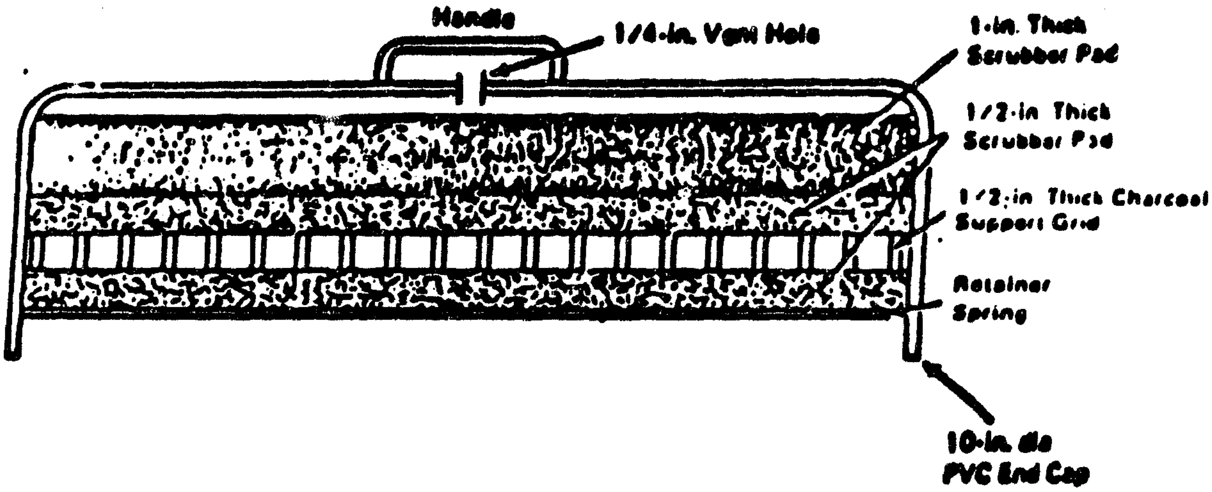
The sampling effort commenced on the morning of July 24, 1995. After site specific health and safety training provided by Energy Fuels Health and Safety personnel, Tellco field technicians laid out the grid system on Cell 2 and Cell 3 using a measuring tape, pacing, and line-of-sight markings. Boundary distinctions between the three source regions were established by visual inspection and so noted on the field maps. Tellco personnel placed a minimum/maximum thermometer between the two cells during sampling, measuring ambient air temperatures at the site, to monitor compliance with the 35°F measurement criterion.

4.2 Sampler Placement

Radon measurements were made in conformance with methods described in NTIS Document #PB86-161874 for each 100 sample measurement set for each source region. In addition to the 100 samples, each sample set consisted of 5% field blanks. The spacing distribution for each set of 100 measurements was determined by visual means and a "best fit" distribution pattern for each

FIGURE 3-1

Large Area Radon Collector (LAACC)



From Appendix A, page A.i, "Radon Flux Measurements on Gardinier and Royster Phosphogypsum Piles near Tampa and Mulberry, Florida" (NTIS Document #PB86-161874).

source region. Field personnel safety was paramount in the distribution of samplers over "wet beach" regions due to the loose, unconsolidated condition of the saturated tailings, which are similar in consistency to "quicksand." Placement of collectors was accomplished using an all-terrain vehicle where possible and by foot travel during placement on some tailings "beaches", due to access.

A collector was chosen and the retaining ring, screen and foam pad removed to expose the charcoal support grid. A pre-measured charcoal charge was selected from a batch, opened and distributed evenly across the area of the support grid. The collector was then re-assembled and gently placed face down on the surface to be measured. Care was exercised not to "push" the device into the soil surface. The collector rim was "sealed" to the surface using a berm of local borrow material (either tailings or soil) to reduce dilution due to air or wind currents within the collector.

A sample identification number was then assigned to the collector. Sample numbers utilized an alpha-numeric system composed of the charcoal batch letter (i.e., A, B, C . . .) followed by a sequential number indicating the placement (i.e., 01, 02, . . .). This sample identification number was recorded on an adhesive label and placed on the top of the collector. The sample ID, date, and time of placement were recorded on a master data sheet for each set of measurements.

During placement of charcoal flux collectors, five field blanks were collected. The procedure for field blanks was to charge a collector with charcoal, and place it inside an air-tight container. The blank remained in the sealed collector for the 24-hour sample time period.

4.3 Sampler Retrieval

Retrieval of the collectors followed the same pattern as placement. The collectors were disassembled and the charged charcoal removed by pouring from the collector into a large funnel suspended above a sample charge container. The sample ID number was transferred to the charge container which was sealed and placed in a box for transport. The date and time of retrieval were recorded on the same data sheet as the sample placement information.

Each charged collector was retrieved upon completion of the measurement time period (approximately 24 hours). Upon retrieval of the collectors, the field blanks were retrieved and the charged charcoal returned to a container, sealed, and labeled as such, and returned for analysis along with the measurement set. Sample data sheets accompanied the shipment to the laboratory. Tellco personnel maintained custody and assured timely delivery of the samples to the Tellco Grand Junction laboratory for prompt analysis of the charcoal samples.

4.4 Site Exit

Tellco field personnel and equipment we.e alpha scanned for possible contamination resu'ting from field work activities. All equipment and field personnel were surveyed and released for unrestricted use by Energy Fuels Health and Safety personnel.

4.5 Environmental Conditions during Measurement Periods

Referencing 40 CFR, Part 61, Subpart W, Appendix B, Method 115 - Monitoring for Radon-222 Emissions, Subsection 2.1.4 - Restrictions to Radon Flux Measurements, "the following restrictions are placed on making radon flux measurements:

(a) Measurements shall not be initiated within 24 hours of a rainfall.

(b) If a rainfall occurs during the 24 hours measurement period, the measurement is invalid if the seal around the lip of the collector has washed away or if the collector is surrounded by water.

(c) Measurements shall not be performed if the ambient temperature is below 35°F or if the ground is frozen."

Site Specific Discussion

(a) Prior to commencement of any sampler placement, rainfall amounts (if any) were ascertained at the Energy Fuels weather station rain gauge. No measureable rainfall occurred during the 24 hour period preceeding placement of the LAACC samplers at the site.

(b) During all 24-hour sample set placements, the minimum ambient air temperature recorded by Tellco at the site was 50°F.

5.0 LABORATORY OPERATIONS

5.1 Introduction

Activated charcoal gas adsorption collectors are passive sampling devices used to determine the flux rate of radon-222 gas from a surface area. The charcoal canister used consists of a 10-inch PVC cap containing a bed of 180 grams of activated, granular charcoal placed in a distribution grid on top of a 1½ inch thick layer of foam and secured under a ½ inch foam layer and a galvanized steel screen by a retaining ring.

Sample collection is initiated by placing 180 grams of unexposed charcoal from a sealed container into the above described canister and, after securing the retaining ring, placing the canister (open face down) onto the surface to be tested. Radon gas is adsorbed on the contained charcoal and subsequent radioactive decay of the entrained radon results in the occurrence of radioactive lead-214 and bismuth-214 in the canister.

These radon progeny isotopes emit characteristic gamma photons which can be detected. The original total activity of the adsorbed radon can be calculated from these gamma ray measurements using empirical calibration factors derived from cross-calibration of source standards containing a known total activity of radium-226 in a geometry identical to the samples to be counted.

5.2 Apparatus

- Single- or multi-channel pulse height analysis system, Ludlum Model 2200 with a Teledyne 3" x 3" NaI(Tl) detector.
- Lead shielded counting well approximately 40 cm deep with 5 cm thick lead walls and a 7 cm thick base and 5 cm thick top.
- NIST traceable aqueous solution radium-226 absorbed onto 180 grams of activated charcoal check source and Eberline Model CS-7A cesium-137 check source.
- Ohaus Model C501 balance with 0.1 gram sensitivity.

5.3 Analysis Procedure

Inspection of the Charcoal Container

Charcoal was received at the analytical laboratory in the sealed sample containers. Upon receipt, the integrity of the container was verified by visual inspection of the plastic container.

Sample Identification Numbers

Each sample container had a unique sample identification number which was determined in the field, and written onto a label attached to the sample container.

Drying and Recycling

All charcoal was dried before use in the field for radon flux measurements. Procedures were the same for newly prepared charcoal and for charcoal recycled after field use. Charcoal was dried at 110°C. Drying procedures were as follows:

- Oven temperature set to 110°C.
- Charcoal placed in the oven in a metal baking tray.
- Dried for 24 hours.
- Immediately after the tray was removed, approximately 180 grams of charcoal were transferred into clean sample containers and sealed with plastic tape.

5.4 Weighing and Background Counting

Proper balance operation was verified daily by checking with a standard weight. The balance readout should agree with the known standard weight to within ± 0.1%. If a discrepant readout was obtained, the balance was re-zeroed, the check weight wiped with a soft, lint-free cloth, and re-weighed. If the discrepancy persisted, the balance would have been removed from service and tagged "Out of Service." For this project, the scale conformed for each day of use (See Appendix A, Balance Operation Daily Check form).

After acceptable balance checkout, each empty container was individually placed on the balance and the tare weight of the container was documented to the nearest 0.1 grams on the label. The scale was re-zeroed with the container on

the balance. Charcoal was carefully added to the container until the readout registered approximately 180 grams. The lid was immediately placed on the container and sealed with plastic tape. The tape was stretched slightly while wrapping around the container. The end of the tape was folded to form a tab for easy tape removal. The balance was checked for readout drift between each container weighing step.

Gamma ray counting system checkout was performed as described in Section 5.6. A five-minute background count was acquired for five containers selected at random to represent the "batch." Each sealed container was placed individually in the shielded counting well, with the bottom of the container centered on the detector. Observed container background counts must fall within the average range of 154 ± 30 cpm using the existing Ludlum/Teledyne counting system, shielded well, and 4-inch high by 3-inch diameter containers. The background count rate was documented for the five containers on the respective "Radon Flux Field Data Sheet" for that batch. If the background counts were higher than the count range above, the entire batch was labeled non-conforming and recycled through the drying process.

5.5 Receipt and Weighing of Exposed Charcoal

Containers of exposed charcoal were delivered to the laboratory for analysis by Tellco personnel. The Tellco laboratory staff was responsible for weighing and inspection of the exposed canisters; inspection of the documentation forms; and entry of the required documentation to data base spreadsheets.

When the containers were received, the following items were inspected:

- Container was closed and sealed with tape.
- Container was not damaged.
- Data sheet was complete.
- Discrepancies found during the receipt inspection were documented on the data sheet.

ıtainers received open or damaged resulting in seal failure were considered void and were not analyzed. A total of four containers were not analyzed; two containers were spilled at the site during retrieval and two containers were damaged during shipment to the Tellco laboratory.

After receipt inspections, conforming containers were weighed on a balance to the nearest 0.1 gram and the gross weight was logged on the "Radon Flux Field Data Sheet" under the appropriate column.

5.6 Gamma Ray Counting

Source/Background Checks

The charcoal gamma ray counting system was subjected to performance checks daily when used. These checks included background, cesium-137, and radium check source measurements. (Appendix A of this report contains daily counter system performance check records.)

Sample Analysis

- The length of count time was determined by the activity of the sample being analyzed. A data quality objective establishing a minimum accruement of 1000 counts for any given sample was followed during sample anlyses.
- The sample container was placed in the counting well with the lid side up and the center on the NaI detector and the shielded well door was set into place.
- One sample count was accrued and the mid-sample count time and date was documented on the field data sheet.
- The sample counts were documented on the field data sheet for data reduction.
- The above steps were repeated for each exposed sample collector.
- Approximately 10% of the containers counted on a given date were selected for recounting. These containers were recounted no sooner than 1 day and no longer than 10 days following the original count.

5.7 Quality Control Samples

Charcoal flux measurement QC samples included the following intra-laboratory analytical objectives as required in 40 CFR, Part 61, Subpart W, Appendix B, Method 115, 4.0 - Quality Assurance Procedures for Measuring Ra-222 Flux, D.:

- recounts, 10%, and
- equipment blanks, 5%.

5.8 Data Validation - Recounts/Blanks

All sample canister data were subjected to validation protocols. The following presents data validation results:

Forty recount measurements were performed by conducting replicate analyses of individual field samples. These recount measurements comprised approximately 10% of the total number of samples analyzed. The precision of all recount measurements ranged from less than 1% to 14.9% with an overall average precision of approximately 5.6%. This recount precision is well within the expected variability of the analytical method.

Twenty equipment blanks were analyzed by measuring the radon progeny activity in samples subjected to all aspects of the measurement process, excepting exposure to the source region. These blank sample measurements comprised approximately 5% of the field measurements. The results of the blank sample analyses measured radon flux rates which less than or equal to 0.1 pCi/m^2-s, which corresponds to approximately 0.5% of the regulatory limit of 20 pCi/m^2-s.

The objective is 100 samples to be collected from each region, as specified by the regulations. The following is the actual completeness attained during Tellco's sampling program (EPA rules and regulations specify an 85% completeness objective):

- Cell 2, Cover - 99 samples = 99% completeness
- Cell 2, Beach - 99 samples = 99% completeness
- Cell 3, Cover - 99 samples = 99% completeness
- Cell 3, Beach - 100 samples = 100% completeness

As presented above, actual QC validation met the objective parameter requirements.

5.9 Calculations

Radon flux rates were calculated for charcoal collection samples using empirical c. ibration factors derived from cross-calibration of sources with known total activity witn identical geometry as the charcoal containers. A yield efficiency factor was used to calculate the total activity of the sample charcoal containers.

In practice, radon flux rates were calculated by a data base computer program. The algorithms utilized by the data base pro.ram were as follows:

Equation 5.1:

$$\text{pCi Rn-222/m}^2\text{sec} = \frac{N}{[Ts*A*b*0.5^{(d/91.75)}]}$$

where: N = net sample count rate, cpm under 220-662 keV peak
Ts = sample duration, seconds
b = instrument calibration factor, cpm per pCi; current value: 0.1827
d = decay time, elapsed hours between sample mid-time and count mid-time
A = area of the collector, m^2

Equation 5.2:
2σ error = 2 x

$$\frac{\sqrt{\frac{\text{Gross sample, cpm}}{\text{Sample count, t, min}} + \frac{\text{Bkgd, cpm}}{\text{Bkgd count t, min}}}}{\text{Net cpm}} \times \text{(sample concentration)}$$

Equation 5.3:

$$LLD = \frac{(CF)\ (S_b)}{[Ts*A*b*0.5^{(d/91.75)}]}$$

where: CF = confidence factor of the background standard dev.ation
S_b = standard deviation of the background count rate
Ts = sample duration, seconds
b = instrument calibration factor, cpm per pCi; current value: 0.1827
d = decay time, elapsed hours between sample mid-time and count mid-time
A = area of the collector, m^2

6.0 SAMPLE RESULTS/CALCULATIONS

Referencing 40 CFR, Part 61, Subpart W, Appendix B, Method 115 - Monitoring for Radon-222 Emissions, Subsection 2.1.7 - Calculations, "the mean radon flux for each region of the pile and for the total pile shall be calculated and reported as follows:

(a) The individual radon flux calculations shall be made as provided in Appendix A EPA 86(1). The mean radon flux for each region of the pile shall be calculated by summing all individual flux measurements for the region and dividing by the total number of flux measurements for the region.

(b) The mean radon flux for the total uranium mill tailings pile shall be calculated as follows:

$$J_s = \frac{J_1A_1 + \ldots J_2A_2 [+] \ldots J_iA_i}{A_t}$$

Where: J_s = Mean flux for the total pile (pCi/m^2-s)
J_i = Mean flux measured in region i (pCi/m^2-s)
A_i = Area of region i (m^2)
A_t = Total area of the pile (m^2)

2.1.8 Reporting. The results of individual flux measurements, the approximate locations on the pile, and the mean radon flux for each region and the mean radon flux for the total stack [pile] shall be included in the emission test report. Any condition or unusual event that occurred during the measurements that could significantly affect the results should be reported."

Site Specific Sample Results (reference Figure 6-1)

(a) The mean radon flux for each region within each cell is as follows:

Cell 2 - Cover Area = 6.1 pCi/m^2-s (based on 225,882 m^2 area)
- Beach Areas = 28.4 pCi/m^2-s (based on 41,761 m^2 area)
- Standing Liquid Areas = 0 pCi/m^2-s (based on 2,982 m^2 area)

Cell 3 - Cover Area = 11.1 pCi/m^2-s (based on 82,762 m^2 area)
- Beach Areas = 44.8 pCi/m^2-s (based on 62,761 m^2 area)
- Standing Liquid Areas = 0 pCi/m^2-s (based on 143,335 m^2 area)

Note: Reference Appendix B of this report for entire summary for individual measurement results and specific sample region maps.

(b) Using the data presented above, we have calculated the total mean radon flux for each pile (cell) as follows:

Cell 2 = 9.5 pCi/m^2-s

$$\frac{(6.1)(225,882) + (28.4)(41,761) + (0)(2,982)}{270,625}$$

Cell 3 = 12.9 pCi/m^2-s

$$\frac{(11.1)(82,762) + (44.8)(62,761) + (0)(143,335)}{288,858}$$

A P P E N D I X   A

Support Documents

BALANCE OPERATION DAILY CHECK

Balance Model: Ohaus Port-o-gram, C501

Standard Weight (g): 300.0

Date	Pre-check (g)	Post-check (g)	O.K. ± 0.1%	By
6/17/95	300.0	300.0	Yes	DK
6/24/95	300.0	300.0	yes	DK
7/8/95	300.0	300.0	yes	DK
7/29/95	300.0	300.0	yes	DK
7/30/95	300.0	300.0	yes	DK

NESHAPS GEOMETRY
Radium-226

CHARCOAL CANISTER ANALYSIS SYSTEM

Calibration Check Log

System ID: M01/D21 Calibration Due Date: 6/17/96

Scaler S/N: M01 High Voltage: 950 Window: 4.42 Threshold: 2.20

Detector S/N: D21 Source ID: 6504/6505 Source Activity: 59.3 KpCi

Empty Shield Bkgd. Range, cpm: 2σ = 117 to 161 3σ = 106 to 172

Net Source Range, cpm: 2σ = 9820 to 10946 3σ = 9538 to 11228

Technician DK

Date	By	BKG count (1 min. each) 1	2	3	Avg.	Source count (1 min. each) 1	2	3	Avg. Net	* Y/N	
6/17/95	DK	146	135	154	145	10313	10273	10498	10361	Y	
6/24/95	DK	156	137	146	146	9801	10108	9828	9912	Y	
[illegible]	DK	143	124	145	137	10062	10205	10119	10129	Y	
[illegible]	DK	152	129	127	136	10528	10551	10584	10554	Y	Pre
[illegible]	DK	157	145	150	151	10629	10437	10514	10527	Y	Post
7/31/95	DK	140	157	148	148	10525	10593	10553	10557	Y	Pre
7/31/95	DK	143	129	142	138	10554	10680	10731	10655	Y	Post

* Y/N: Y = daily average net CPM falls within the calibration range.
N = daily average net CPM does not fall within the calibration range.

.e acceptable ranges were determined on the calibration date as shown above and are based on a minimum of 10 counting periods of 10 minutes each.

NESHAPS GEOMETRY

Cesium 137

CHARCOAL CANISTER ANALYSIS SYSTEM

Calibration Check Log

System ID: M01/D21 Due Calibration Date: 6/17/96

Scaler S/N: M01 High Voltage: 950 Window: 4.42 Threshold: 2.20

Detector S/N: D21 Source ID: Cs-137 Source Activity: 1.503 µCi

Blank Canister Bkgd. Range, cpm: 2σ = 117 to 161 3σ = 106 to 172

Net Source Range, cpm: 2σ = 297325 to 306781 3σ = 294961 to 312145

Technician DLC

		BKG count (1 min. each)				Source count (1 min. each)				*	
Date	By	1	2	3	Avg.	1	2	3	Avg. Net	Y/N	
6/17/95	DLC	146	135	154	145	295895	295736	296032	295888	Y	
6/24/95	DLC	156	137	146	146	296328	295456	295646	DLC ~~295[illegible]~~ 295810	Y	
7/8/95	DLC	143	124	145	137	295537	295647	294884	295355	Y	
7/29/95	DLC	152	129	130	137	295250	294628	295172	295017	Y	P1
7/29/95	DLC	157	145	150	151	295517	294692	295313	295174	Y	P0
7/30/95	DLC	140	157	148	148	294852	295618	294993	295154	Y	P1
7/31/95	DLC	143	129	142	138	294959	295542	295482	295328	Y	Pct

* Y/N: Y= daily average background and net source CPM falls within the control limits.
N= daily average background and source CPM does not fall within the control limits.

The acceptable ranges were determined from the prior month's background and source check data.

NESHAPS GEOMETRY

Radium-226

CHARCOAL CANISTER ANALYSIS SYSTEM

Calibration Check Log

System ID: M02/D20 Calibration Due Date: 6/17/96

Scaler S/N: M02 High Voltage: 650 Window: 4.42 Threshold: 2.20

Detector S/N: D20 Source ID: 6504/6505 Source Activity: 593K pCi

Empty Shield Bkgd. Range, cpm: 2σ = 124 to 168 3σ = 113 to 179

Net Source Range, cpm: 2σ = 10317 to 11437 3σ = 10037 to 11717

Technician DLC

Date	By	BKG count (1 min. each) 1	2	3	Avg.	Source count (1 min. each) 1	2	3	Avg. Net	* Y/N	
6/17/95	DLC	143	155	138	145	10744	10956	10897	10866	Y	
6/24/95	DLC	160	143	133	145	10828	10837	10795	10820	Y	
7/8/95	DLC	133	159	139	144	10774	10673	10713	10720	Y	
7/[illegible]/95	DLC	141	141	135	137	10635	10797	10614	10683	Y	Pre
7/29/95	DLC	165	151	158	158	10791	10644	10765	10733	Y	Post
7/30/95	DLC	168	150	140	153	10828	10714	10929	10823	Y	Pre
7/30/95	DLC	151	155	160	155	10832	10906	10700	10813	Y	Post

* Y/N: Y = daily average net CPM falls within the calibration range.
N = daily average net CPM does not fall within the calibration range.

[Th]e acceptable ranges were determined on the calibration date as shown above and are based on a minimum of 10 counting periods of 10 minutes each.

Cesium 137

NESHAPS Geometry

CHARCOAL CANISTER ANALYSIS SYSTEM

Calibration Check Log

System ID: M02/D20 Calibration Due Date: 6/17/96

Scaler S/N: M02 High Voltage: 650 Window: 4.42 Threshold: 220

Detector S/N: D20 Source ID: Cs-137 Source Activity: 1.50 3uCi

Blank Canister Bkgd. Range, cpm: 2σ = 124 to 168 3σ = 113 to 179

Net Source Range, cpm: 2σ = 312206 to 316944 3σ = 311021 to 31817

Technician DLC

		BKG count (1 min. each)				Source count (1 min. each)				*	
Date	By	1	2	3	Avg.	1	2	3	Avg. Net	Y/N	
6/17/95	DLC	143	155	138	145	311357 ~~10744~~	311206 ~~10756~~	312342 ~~10647~~	311636 ~~10866~~	Y	
6/24/95	DLC	160	143	133	145	311996	312245	309766	311569	Y	
7/00/95	DLC	133	159	139	144	310454	313024	310884	311454	Y	
7/29/95	DLC	141	141	135	137	311140	311094	311063	311099	Y	Pre
7/29/95	DLC	165	151	158	158	310650	311343	312199	311347	Y	Pos
7/30/95	DLC	168	150	140	153	310951	312104	310974	311344	Y	Pre
7/30/95	DLC	151	155	160	155	310125	312288	310966	311124	Y	Pos

* Y/N: Y= daily average background and net source CPM falls within the control limits.
N= daily average background and source CPM does not fall within the control limits.

The acceptable ranges were determined from the prior month's background and source check data.

A P P E N D I X   B

Recount Data

CLIENT: ENERGY FUELS PROJECT: RADON FLUX MEASUREMENTS PROJECT NO.: 95004.00

PILE: #3 BATCH: H SURFACE: SOIL AIR TEMP MIN: 55°F WEATHER: CLEAR, WARM, NO RAIN
AREA: COVER DEPLOYMENT: 7 26 95 RETRIEVAL: 7 27 95 CHARCOAL BKG CPM: 154 NET WT OUT: 180.0 g.
FIELD TECHNICIANS: DLC, JD, SS, JM, SC COUNTED BY: DLC DATA ENTRY BY: DLC, SC TARE WEIGHT: 29.2 g.
COUNTING SYSTEM I.D.: M01/D21, M02/D20 CALIBRATION DUE: 6/17/96

RECOUNT ANALYSES RESULTS:

GRID LOCATION	SAMPLE I. D.	DEPLOY HR	DEPLOY MIN	RETRIV HR	RETRIV MIN	ANALYSIS MO	ANALYSIS DA	ANALYSIS YR	MID-TIME HR	MID-TIME MIN	CNT (MIN)	GROSS COUNTS	GROSS WT IN	RADON pCi/m2s	± pCi/m2s	LLD pCi/m2s	PRECISION (RPD) [DIFF]/MEAN
	H04	12	58	14	31	7	30	95	18	23	3	1314	214.7	0.6	0.1	0.04	
RECOUNT	H04	12	58	14	31	7	29	95	19	40	2	1029	214.7	0.7	0.1	0.03	6.7%
	H05	12	59	14	32	7	30	95	18	26	3	1293	193.2	0.6	0.1	0.04	
RECOUNT	H05	12	59	14	32	7	29	95	19	40	2	1005	193.2	0.6	0.1	0.03	5.8%
	H16	13	18	14	38	7	30	95	18	38	4	1932	204.9	0.7	0.1	0.04	
RECOUNT	H16	13	18	14	38	7	29	95	19	43	3	1745	204.9	0.8	0.1	0.03	8.9%
	H17	13	20	14	38	7	30	95	18	42	4	1420	211.8	0.4	0.0	0.04	
RECOUNT	H17	13	20	14	38	7	29	95	19	44	4	1561	211.7	0.4	0.0	0.03	1.2%
	H29	13	47	14	48	7	30	95	18	48	4	1540	217.2	0.5	0.1	0.04	
RECOUNT	H29	13	47	14	48	7	29	95	19	45	3	1362	217.2	0.6	0.1	0.03	8.7%
	H40	14	11	14	54	7	30	95	18	54	1	2722	214.9	5.9	0.6	0.04	
RECOUNT	H40	14	11	14	54	7	29	95	19	45	1	3015	214.9	5.5	0.5	0.04	6.7%
	H41	14	13	14	55	7	30	95	18	57	3	1119	217.1	0.5	0.0	0.04	
RECOUNT	H41	14	13	14	55	7	29	95	19	48	3	1332	217.1	0.6	0.1	0.04	10.6%
	H53	14	45	15	2	7	30	95	19	13	3	1086	215.5	0.5	0.0	0.04	
RECOUNT	H53	14	45	15	2	7	29	95	19	48	3	1260	215.5	0.5	0.1	0.04	6.9%
	H64	15	18	15	17	7	30	95	19	26	4	1276	217.0	0.4	0.0	0.04	
RECOUNT	H64	15	18	15	17	7	29	95	19	51	4	1307	217.0	0.3	0.0	0.04	13.2%
	H65	15	20	15	18	7	30	95	19	30	4	1700	201.9	0.6	0.1	0.04	
RECOUNT	H65	15	20	15	18	7	29	95	19	51	4	1812	201.8	0.6	0.1	0.04	0.0%
	H88	16	53	17	48	7	30	95	19	52	1	3828	213.6	8.2	0.8	0.04	
RECOUNT	H88	16	53	17	48	7	29	95	19	53	1	4065	213.5	7.3	0.7	0.03	11.9%

AVERAGE RELATIVE PERCENT PRECISION: 8.0%

CLIENT: ENERGY FUELS PROJECT: RADON FLUX MEASUREMENTS PROJECT NO.: 95004.00

PILE: #3 BATCH: J SURFACE: SAND/CRUST AIR TEMP MIN: 58°F WEATHER: CLEAR, WARM, NO RAIN
AREA: TAILS DEPLOYMENT: 7 25 95 RETRIEVAL: 7 26 95 CHARCOAL BKG CPM: 154 NET WT OUT: 180.0 g.
FIELD TECHNICIANS: DLC, JD, SS, JM, SC COUNTED BY: DLC DATA ENTRY BY: DLC TARE WEIGHT: 29.2 g.
COUNTING SYSTEM I.D.: M01/D21, M02/D20 CALIBRATION DUE: 6/17/96

RECOUNT ANALYSES RESULTS:

GRID LOCATION	SAMPLE I. D.	DEPLOY HR	DEPLOY MIN	RETRIV HR	RETRIV MIN	ANALYSIS MO	ANALYSIS DA	ANALYSIS YR	MID-TIME HR	MID-TIME MIN	CNT (MIN)	GROSS COUNTS	GROSS WT IN	RADON pCi/m2s	± pCi/m2s	LLD pCi/m2s	PRECISION (RPD) [DIFF]/MEAN
	J16	11	28	12	25	7	30	95	20	21	1	35246	200.2	98.0	9.8	0.05	
RECOUNT	J16	11	28	12	25	7	29	95	19	54	1	38121	200.2	88.1	8.8	0.04	10.6%
	J40	13	15	14	6	7	30	95	21	11	1	10248	195.5	28.1	2.8	0.05	
RECOUNT	J40	13	15	14	6	7	29	95	19	54	1	11839	195.5	26.9	2.7	0.04	4.5%
	J41	13	18	14	7	7	30	95	21	12	1	7786	218.2	21.3	2.1	0.05	
RECOUNT	J41	13	18	14	7	7	29	95	19	55	1	8718	218.2	19.7	2.0	0.04	7.6%
	J52	13	47	14	16	7	30	95	21	20	1	6277	203.1	17.3	1.7	0.05	
RECOUNT	J52	13	47	14	16	7	29	95	19	55	1	7169	203.0	16.3	1.6	0.04	5.6%
	J53	13	49	14	17	7	30	95	21	22	1	1997	209.3	5.2	0.5	0.05	
RECOUNT	J53	13	49	14	17	7	29	95	19	56	1	2288	209.3	5.0	0.5	0.04	4.6%
	J65	14	18	16	37	7	30	95	21	33	1	1133	219.4	2.5	0.3	0.05	
RECOUNT	J65	14	18	16	37	7	29	95	19	56	1	1325	219.5	2.5	0.3	0.04	1.4%
	J76	14	44	16	55	7	30	95	21	46	1	11776	219.9	30.3	3.0	0.05	
RECOUNT	J76	14	44	16	55	7	29	95	19	57	1	13012	220.0	27.6	2.8	0.04	9.4%
	J77	14	46	16	23	7	30	95	22	0	1	18449	192.7	49.0	4.9	0.05	
RECOUNT	J77	14	46	16	23	7	29	95	19	57	1	22017	192.7	48.1	4.8	0.04	1.9%
	J88	15	7	16	20	7	30	95	22	12	1	34939	204.5	94.7	9.5	0.05	
RECOUNT	J88	15	7	16	20	7	29	95	19	58	1	38145	204.5	84.8	8.5	0.04	11.0%
	J89	15	9	15	4	7	30	95	21	15	1	11165	194.7	31.5	3.2	0.05	
RECOUNT	J89	15	9	15	4	7	29	95	19	58	1	13259	194.7	31.0	3.1	0.04	1.7%
	J100	15	0	14	16	7	30	95	21	21	1	9450	230.9	27.5	2.7	0.05	
RECOUNT	J100	15	0	14	16	7	29	95	19	59	1	10901	230.9	26.2	2.6	0.04	4.7%

AVERAGE RELATIVE PERCENT PRECISION: 5.7%

CLIENT: ENERGY FUELS PROJECT: RADON FLUX MEASUREMENTS PRO.ECT NO.: 95004.00

PILE: #2 BATCH: K SURFACE: WET/DRY SAND AIR TEMP MIN: 52°F WEATHER: CLEAR, WARM, NO RAIN
AREA: TAILS DEPLOYMENT: 7 24 95 RETRIEVAL: 7 25 95 CHARCOAL BKG CPM: 154 NET WT OUT: 180.0 g.
FIELD TECHNICIANS: DLC, JD, SS, JM, SC COUNTED BY: DLC DATA ENTRY BY: SMC TARE WEIGHT: 29.2 g.
COUNTING SYSTEM I.D.: M01/D21, M02/D20 CAL. DUE: 06/17/96

RECOUNT ANALYSES RESULTS:

GRID LOCATION	SAMPLE I. D.	DEPLOY HR	DEPLOY MIN	RETRIV HR	RETRIV MIN	ANALYSIS MO	ANALYSIS DA	ANALYSIS YR	MID-TIME HR	MID-TIME MIN	CNT (MIN)	GROSS COUNTS	GROSS WT IN	RADON pCi/m2s	± pCi/m2s	LLD pCi/m2s	PRECISION (RPD) [DIFF]/MEAN
	K03	9	48	9	51	7	29	95	17	21	1	6684	241.1	18.8	1.9	0.05	
RECOUNT	K03	9	48	9	51	7	30	95	16	15	1	6123	241.2	20.4	2.0	0.06	8.3%
	K12	10	5	10	0	7	29	95	17	25	1	4758	248.8	13.3	1.3	0.05	
RECOUNT	K12	10	5	10	0	7	30	95	16	15	1	4355	248.8	14.4	1.4	0.06	8.1%
	K16	10	3	10	4	7	29	95	17	27	1	36250	222.6	103.9	10.4	0.05	
RECOUNT	K16	10	3	10	4	7	30	95	16	16	1	31697	222.6	107.9	10.8	0.06	3.8%
	K28	10	42	10	42	7	29	95	17	35	1	8785	248.8	24.8	2.5	0.05	
RECOUNT	K28	10	42	10	42	7	30	95	16	16	1	8002	248.8	26.7	2.7	0.06	7.6%
	K32	10	54	11	38	7	29	95	17	38	1	1679	224.0	4.2	0.4	0.05	
RECOUNT	K32	10	54	11	38	7	30	95	16	18	1	1401	224.1	4.1	0.4	0.06	3.0%
	K40	11	9	11	43	7	29	95	17	46	1	1161	240.5	2.8	0.3	0.05	
RECOUNT	K40	11	9	11	43	7	30	95	16	18	1	1055	240.6	3.0	0.3	0.06	5.9%
	K56	11	42	12	27	7	29	95	18	9	2	1002	235.9	1.0	0.1	0.05	
RECOUNT	Κ56	11	42	12	27	7	30	95	16	21	3	1377	236.1	1.0	0.1	0.06	3.9%
	K68	11	58	12	45	7	29	95	18	19	1	13145	242.4	35.8	3.6	0.05	
RECOUNT	K68	11	58	12	45	7	30	95	16	21	1	11855	242.8	38.1	3.8	0.06	6.2%
	K72	12	6	12	46	7	29	95	18	21	1	3130	220.9	8.2	0.8	0.05	
RECOUNT	K72	12	6	12	46	7	30	95	16	24	1	2755	221.1	8.5	0.9	0.06	3.2%
	K84	12	16	13	19	7	29	95	18	28	1	3086	229.9	8.0	0.8	0.05	
RECOUNT	K84	12	16	13	19	7	30	95	16	24	1	2656	227.5	8.0	0.8	0.06	0.7%
	K90	12	23	12	48	7	29	95	18	31	1	2701	232.9	7.1	0.7	0.05	
RECOUNT	K90	12	23	13	33	7	30	95	16	26	1	2349	233.0	7.0	0.7	0.06	1.6%

AVERAGE RELATIVE PERCENT PRECISION: 4.8%

CLIENT: ENERGY FUELS PROJECT: RADON FLUX MEASUREMENTS PROJECT NO.: 95004.00

PILE: #2 BATCH: L SURFACE: SOIL AIR TEMP MIN: 55°F WEATHER: CLEAR, WARM, NO RAIN
AREA: COVER DEPLOYMENT: 7 27 95 RETRIEVAL: 7 28 95 CHARCOAL BKG CPM: 154 NET WT OUT: 180.0 g.
FIELD TECHNICIANS: DLC, JD, SS, JM, SC COUNTED BY: DLC DATA ENTRY BY: DLC TARE WEIGHT: 29.2 g.
COUNTING SYSTEM I.D.: M01/D21, M02/D20 CALIBRATION DUE: 6/17/96

RECOUNT ANALYSES RESULTS:

GRID LOCATION	SAMPLE I. D.	DEPLOY HR	DEPLOY MIN	RETRIV HR	RETRIV MIN	ANALYSIS MO	ANALYSIS DA	ANALYSIS YR	MID-TIME HR	MID-TIME MIN	CNT (MIN)	GROSS COUNTS	GROSS WT IN	RADON pCi/m2s	± pCi/m2s	LLD pCi/m2s	PRECISION (RPD) [DIFF]/MEAN
	L13	16	30	17	20	7	30	95	16	37	1	2055	212.5	3.5	0.3	0.03	
RECOUNT	L13	16	30	17	20	7	29	95	19	27	1	2180	212.1	3.2	0.3	0.03	9.6%
	L18	16	35	17	25	7	30	95	16	41	2	1786	214.9	1.4	0.1	0.03	
RECOUNT	L18	16	35	17	25	7	29	95	19	27	1	985	214.9	1.3	0.1	0.03	4.3%
	L21	16	39	17	28	7	30	95	16	44	1	1674	213.5	2.8	0.3	0.03	
RECOUNT	L21	16	39	17	28	7	29	95	19	28	1	1939	213.5	2.8	0.3	0.03	0.0%
	L32	16	49	17	39	7	30	95	16	51	2	1488	216.9	1.1	0.1	0.03	
RECOUNT	L32	16	49	17	39	7	29	95	19	28	2	1635	216.9	1.0	0.1	0.03	4.4%
	L44	18	3	18	22	7	30	95	17	7	4	1162	214.9	0.3	0.0	0.03	
RECOUNT	L44	18	3	18	22	7	29	95	19	32	4	1242	214.9	0.2	0.0	0.03	2.6%
	L55	18	14	18	32	7	30	95	17	23	5	1020	214.3	0.1	0.0	0.03	
RECOUNT	L55	18	14	18	32	7	29	95	19	32	5	1024	214.3	0.1	0.0	0.03	14.9%
	L58	18	17	18	36	7	30	95	17	27	3	1026	214.8	0.3	0.0	0.03	
RECOUNT	L58	18	17	18	36	7	29	95	19	35	3	1105	214.8	0.3	0.0	0.03	3.4%
	L75	18	34	19	6	7	30	95	17	47	2	1280	211.5	0.9	0.1	0.03	
RECOUNT	L75	18	34	19	6	7	29	95	19	35	2	1446	211.5	0.9	0.1	0.03	1.0%
	L81	18	40	20	4	7	30	95	17	58	3	1068	214.4	0.4	0.0	0.03	
RECOUNT	L81	18	40	20	4	7	29	95	19	38	4	1545	214.4	0.3	0.0	0.03	2.9%
	L90	18	49	18	40	7	30	95	18	10	1	2215	219.2	3.9	0.4	0.03	
RECOUNT	L90	18	49	18	40	7	29	95	19	37	1	2420	219.1	3.6	0.4	0.03	7.5%
	L92	18	51	18	58	7	30	95	18	13	3	1254	213.3	0.5	0.0	0.03	
RECOUNT	L92	18	51	18	58	7	29	95	19	39	3	1364	213.3	0.5	0.0	0.03	4.0%

AVERAGE RELATIVE PERCENT PRECISION: 5.0%

A P P E N D I X   C

Radon Flux Laboratory Data
and Equipment Blank Data

CLIENT: ENERGY FUELS PROJECT: RADON FLUX MEASUREMENTS PROJECT NO.: 95004.00

PILE: #3 BATCH: H SURFACE: SOIL AIR TEMP MIN: 55°F WEATHER: CLEAR, WARM, NO RAIN
AREA: COVER DEPLOYMENT: 7 26 95 RETRIEVAL: 7 27 95 CHARCOAL BKG CPM: 154 NET WT OUT: 180.0 g.
FIELD TECHNICIANS: DLC, JD, SS, JM, SC COUNTED BY: DLC DATA ENTRY BY: DLC, SC TARE WEIGHT: 29.2 g.
COUNTING SYSTEM I.D.: M01/D21, M02/D20 CALIBRATION DUE: 6/17/96

GRID	SAMPLE	DEPLOY		RETRIV		ANALYSIS			MID-TIME		CNT	GROSS	GROSS	RADON	±	LLD	
LOCATION	I. D.	HR	MIN	HR	MIN	MO	DA	YR	HR	MIN	(MIN)	COUNTS	WT IN	pCi/m2s	pCi/m2s	pCi/m2s	COMMENTS:
	H01	12	54	14	30	7	30	95	18	20	1	1212	191.6	2.3	0.2	0.04	
	H02	12	56	14	30	7	30	95	18	20	1	1348	206.5	2.6	0.3	0.04	
	H03	12	57	14	31	7	30	95	18	23	3	1278	200.1	0.6	0.1	0.04	
	H04	12	58	14	31	7	30	95	18	23	3	1314	214.7	0.6	0.1	0.04	
	H05	12	59	14	32	7	30	95	18	26	3	1293	193.2	0.6	0.1	0.04	
	H06	13	1	14	32	7	30	95	18	26	3	1890	208.4	1.1	0.1	0.04	
	H07	13	3	14	33	7	30	95	18	27	1	1406	217.7	2.8	0.3	0.04	
	H08	13	5	14	33	7	30	95	18	27	1	1479	200.2	2.9	0.3	0.04	
	H09	13	7	14	34	7	30	95	18	28	1	2223	211.4	4.6	0.5	0.04	
	H10	13	9	14	34	7	30	95	18	28	2	1484	191.9	1.3	0.1	0.04	
	H11	13	10	14	35	7	30	95	18	30	2	1308	215.0	1.1	0.1	0.04	
	H12	13	12	14	35	7	30	95	18	30	3	1110	212.2	0.5	0.0	0.04	
	H13	13	14	14	36	7	30	95	18	34	4	1276	211.8	0.4	0.0	0.04	
	H14	13	16	14	36	7	30	95	18	34	4	1516	212.0	0.5	0.1	0.04	
	H15	13	17	14	37	7	30	95	18	38	4	1760	217.5	0.6	0.1	0.04	
	H16	13	18	14	38	7	30	95	18	38	4	1732	204.9	0.6	0.1	0.04	
	H17	13	20	14	38	7	30	95	18	42	4	1120	211.8	0.3	0.0	0.04	
	H18	13	22	14	39	7	30	95	18	42	4	1716	213.5	0.6	0.1	0.04	
	H19	13	25	14	39	7	30	95	18	45	3	1380	216.4	0.7	0.1	0.04	
	H20	13	27	14	40	7	30	95	18	43	1	2315	214.7	4.8	0.5	0.04	
	H21	13	30	14	43	7	30	95	18	46	1	1460	194.4	2.9	0.3	0.04	
	H22	13	32	14	43	7	30	95	18	44	1	1057	200.1	2.0	0.2	0.04	
	H23	13	34	16	44	7	30	95	18	47	1	3348	214.7	7.2	0.7	0.04	
	H24	13	36	14	45	7	30	95	18	45	1	1640	213.4	3.3	0.3	0.04	
	H25	13	38	14	46	7	30	95	18	50	3	1218	206.5	0.6	0.1	0.04	
	H26	13	40	14	47	7	30	95	18	49	4	1236	192.4	0.3	0.0	0.04	
	H27	13	43	14	47	7	30	95	18	44	4	1232	215.3	0.3	0.0	0.04	
	H28	13	45	14	48	7	30	95			VOID	SPILLED	CHARCOAL				
	H29	13	47	14	48	7	30	95	18	48	4	1540	217.2	0.5	0.1	0.04	
	H30	13	49	14	49	7	30	95	18	48	4	1240	[illegible]	0.4	0.0	0.04	
	H31	13	51	14	49	7	30	95	18	50	1	1793	218.2	3.7	0.4	0.04	
	H32	13	54	14	50	7	30	95	18	50	1	2891	213.2	6.2	0.6	0.04	
	H33	13	56	14	50	7	30	95	18	51	2	1056	213.5	0.8	0.1	0.04	
	H34	13	58	14	51	7	30	95	18	51	1	1629	200.1	3.3	0.3	0.04	
	H35	14	0	14	52	7	30	95	18	52	1	12650	213.2	28.3	2.8	0.04	
	H36	14	3	14	52	7	30	95	18	52	1	3658	193.6	8.0	0.8	0.04	
	H37	14	5	14	53	7	30	95	18	53	1	21690	207.3	48.9	4.9	0.04	
	H38	14	7	14	53	7	30	95	18	53	2	1166	214.4	1.0	0.1	0.04	
	H39	14	10	14	54	7	30	95	18	54	1	1471	217.1	3.0	0.3	0.04	
	H40	14	11	14	54	7	30	95	18	54	1	272.2	214.9	0.3	0.1	0.04	

CLIENT: ENERGY FUELS PROJECT: RADON FLUX MEASUREMENTS PROJECT NO.: 95004.00

PILE: #3 BATCH: H SURFACE: SOIL AIR TEMP MIN: 55°F WEATHER: CLEAR, WARM, NO RAIN
AREA: COVER DEPLOYMENT: 7 26 95 RETRIEVAL: 7 27 95 CHARCOAL BKG CPM: 154 NET WT OUT: 180.0 g.
FIELD TECHNICIANS: DLC, JD, SS, JM, SC COUNTED BY: DLC DATA ENTRY BY: DLC, SC TARE WEIGHT: 29.2 g.
COUNTING SYSTEM I.D.: M01/D21, M02/D20 CALIBRATION DUE: 6/17/96

GRID LOCATION	SAMPLE I. D.	DEPLOY HR	DEPLOY MIN	RETRIV HR	RETRIV MIN	ANALYSIS MO	ANALYSIS DA	ANALYSIS YR	MID-TIME HR	MID-TIME MIN	CNT (MIN)	GROSS COUNTS	GROSS WT IN	RADON pCi/m2s	± pCi/m2s	LLD pCi/m2s	COMMENTS:
	H41	14	13	14	55	7	30	95	18	57	3	1119	217.1	0.5	0.0	0.04	
	H42	14	15	14	55	7	30	95	18	57	3	1191	208.4	0.6	0.1	0.04	
	H43	14	18	14	56	7	30	95	19	0	2	1462	213.5	1.3	0.1	0.04	
	H44	14	20	14	56	7	30	95	19	0	3	999	194.8	0.4	0.0	0.04	
	H45	14	22	14	57	7	30	95	19	3	3	1359	212.0	0.7	0.1	0.04	
	H46	14	25	14	57	7	30	95	19	3	3	1071	215.0	0.5	0.0	0.04	
	H47	14	27	14	58	7	30	95	19	5	3	1176	213.9	0.5	0.1	0.04	
	H48	14	30	14	58	7	30	95	19	5	2	1012	212.9	0.8	0.1	0.04	
	H49	14	35	14	59	7	30	95	19	8	3	1257	215.1	0.6	0.1	0.04	
	H50	14	38	14	59	7	30	95	19	8	2	1912	196.5	1.9	0.2	0.04	
	H51	14	40	15	0	7	30	95	19	10	1	2597	210.1	5.7	0.6	0.04	
	H52	14	43	15	1	7	30	95	19	10	2	1108	210.2	0.9	0.1	0.04	
	H53	14	45	15	2	7	30	95	19	13	3	1086	215.5	0.5	0.0	0.04	
	H54	14	47	15	3	7	30	95	19	13	3	1041	214.9	0.4	0.0	0.04	
	H55	14	49	15	4	7	30	95	19	17	4	1192	212.8	0.3	0.0	0.04	
	H56	14	52	15	10	7	30	95	19	17	3	1209	218.1	0.6	0.1	0.04	
	H57	14	55	15	11	7	30	95	19	20	3	1311	192.2	0.7	0.1	0.04	
	H58	14	57	15	11	7	30	95	19	19	1	58558	211.0	135.7	13.6	0.04	
	H59	15	0	15	12	7	30	95	19	23	3	1194	220.9	0.6	0.1	0.04	
	H60	15	2	15	13	7	30	95	19	20	1	6243	214.2	14.2	1.4	0.04	
	H61	15	5	15	14	7	30	95	19	24	1	1239	209.6	2.5	0.3	0.04	
	H62	15	10	15	15	7	30	95	19	23	3	1026	216.6	0.4	0.0	0.04	
	H63	15	15	15	16	7	30	95	19	27	4	1440	192.9	0.5	0.0	0.04	
	H64	15	18	15	17	7	30	95	19	26	4	1276	195.3	0.4	0.0	0.04	
	H65	15	20	15	18	7	30	95	19	30	4	1700	201.9	0.6	0.1	0.04	
	H66	15	22	15	19	7	30	95	19	30	4	1368	210.8	0.4	0.0	0.04	
	H67	15	30	15	20	7	30	95	19	34	4	1296	212.2	0.4	0.0	0.04	
	H68	15	35	15	21	7	30	95	19	34	3	1626	200.1	0.9	0.1	0.04	
	H69	15	38	15	22	7	30	95	19	37	3	1002	213.6	0.4	0.0	0.04	
	H70	15	40	15	41	7	30	95	19	37	3	1161	194.6	0.5	0.1	0.04	
	H71	15	44	15	44	7	30	95	19	38	1	15814	193.9	36.6	3.7	0.04	
	H72	15	47	15	45	7	30	95	19	38	1	21250	216.3	49.4	4.9	0.04	
	H73	15	50	17	20	7	30	95	19	39	1	47183	215.8	102.9	10.3	0.04	
	H74	15	55	17	21	7	30	95	19	39	1	8931	210.5	19.2	1.9	0.04	
	H75	15	59	17	20	7	30	95	19	40	1	11504	220.6	25.0	2.5	0.04	
	H76	16	5	17	17	7	30	95	19	40	1	13534	211.9	29.6	3.0	0.04	
	H77	16	5	17	16	7	30	95	19	41	1	8500	212.3	18.5	1.8	0.04	
	H78	16	10	17	14	7	30	95	19	42	1	4589	214.9	9.9	1.0	0.04	
	H79	16	13	17	19	7	30	95	19	42	1	17528	215.4	38.6	3.9	0.04	
	H80	16	19	17	15	7	30	95	19	43	1	43236	213.4	96.3	9.6	0.04	

CLIENT: ENERGY FUELS   PROJECT: RADON FLUX MEASUREMENTS   PROJECT NO.: 95004.00

PILE: #3 - BATCH: H   SURFACE: SOIL   AIR TEMP MIN: 55°F   WEATHER: CLEAR, WARM, NO RAIN
AREA: COVER   DEPLOYMENT:-7 26 95 RETRIEVAL: 7 27 95 CHARCOAL BKG CPM: 154   NET WT OUT: 180.0 g.
FIELD TECHNICIANS: DLC, JL, SS, JM, SC COUNTED BY: DLC   DATA ENTRY BY: DLC, SC   TARE WEIGHT: 29.2 g.
COUNTING SYSTEM I.D.: M01/D21, M02/D20 CALIBRATION DUE: 6/17/96

GRID LOCATION	SAMPLE I. D.	DEPLOY HR	DEPLOY MIN	RETRIV HR	RETRIV MIN	ANALYSIS MO	ANALYSIS DA	ANALYSIS YR	MID-TIME HR	MID-TIME MIN	CNT (MIN)	GROSS COUNTS	GROSS WT IN	RADON pCi/m2s	± pCi/m2s	LLD pCi/m2s	COMMENTS:
	H81	16	24	17	16	7	30	95	19	43	1	34310	216.1	76.5	7.7	0.04	
	H82	16	28	17	17	7	30	95	19	44	1	34997	188.6	78.2	7.8	0.04	
	H83	16	32	17	14	7	30	95	19	47	3	1092	216.9	0.5	0.0	0.04	
	H84	16	35	17	26	7	30	95	19	48	1	12286	216.4	27.2	2.7	0.04	
	H85	16	40	17	27	7	30	95	19	48	1	3968	213.9	8.6	0.9	0.04	
	H86	16	44	17	28	7	30	95	19	51	3	1380	215.0	0.7	0.1	0.04	
	H87	16	48	17	28	7	30	95	19	51	3	1050	212.7	0.4	0.0	0.04	
	H88	16	53	17	48	7	30	95	19	52	1	3828	213.6	8.2	0.8	0.04	
	H89	16	58	17	23	7	30	95	19	53	2	1128	213.5	0.9	0.1	0.04	
	H90	17	5	17	31	7	30	95	20	0	2	1302	209.4	1.1	0.1	0.04	
	H91	17	6	17	33	7	30	95	20	3	5	1155	191.5	0.2	0.0	0.04	
	H92	17	7	17	35	7	30	95	20	3	5	1235	192.2	0.2	0.0	0.04	
	H93	17	8	17	43	7	30	95	20	4	1	2652	206.9	5.7	0.6	0.04	
	H94	17	9	17	53	7	30	95	20	4	1	2651	211.4	5.6	0.6	0.04	
	H95	17	10	17	54	7	30	95	20	5	2	1016	213.4	0.8	0.1	0.04	
	H96	17	11	17	40	7	30	95	20	5	1	32000	214.1	72.4	7.2	0.04	
	H97	17	12	17	41	7	30	95	20	7	3	1602	213.4	0.9	0.1	0.04	
	H98	17	13	17	13	7	30	95	20	7	1	23641	218.9	54.5	5.5	0.04	
	H99	17	14	17	36	7	30	95	20	10	3	1275	213.4	0.6	0.1	0.04	
	H100	17	15	17	37	7	30	95	20	10	2	1280	203.5	1.1	0.1	0.04	

AVERAGE RADON FLUX FOR CELL 3 COVER REGION: 11.1 pCi/m2s

CLIENT: ENERGY FUELS PROJECT: RADON FLUX MEASUREMENTS PROJECT NO.: 95004.00

PILE: #3 - BATCH: J SURFACE: SAND/CRUST AIR TEMP MIN: 58°F WEATHER: CLEAR, WARM, NO RAIN
AREA: TAILS DEPLOYMENT: 7 25 95 RETRIEVAL: 7 26 95 CHARCOAL BKG CPM: 154 NET WT OUT: 180.0 g.
FIELD TECHNICIANS: DLC, JD, SS, JH, SC COUNTED BY: DLC DATA ENTRY BY: DLC TARE WEIGHT: 29.2 g.
COUNTING SYSTEM I.D.: M01/D21, M02/D20 CALIBRATION DUE: 6/17/96

GRID	SAMPLE	DEPLOY		RETRIV		ANALYSIS			MID-TIME		CNT	GROSS	GROSS	RADON	±	LLD	
LOCATION	I. D.	HR	MIN	HR	MIN	MO	DA	YR	HR	MIN	(MIN)	COUNTS	WT IN	pCi/m2s	pCi/m2s	pCi/m2s	COMMENTS:
	J01	10	56	12	14	7	30	95	20	12	1	13099	221.7	35.7	3.6	0.05	
	J02	11	0	12	14	7	30	95	20	12	1	21507	223.8	60.1	6.0	0.05	
	J03	11	8	12	15	7	30	95	20	13	1	14693	227.7	40.4	4.0	0.05	
	J04	11	9	12	15	7	30	95	20	13	1	9504	217.9	26.0	2.6	0.05	
	J05	11	10	12	15	7	30	95	20	14	1	9122	214.7	24.9	2.5	0.05	
	J06	11	11	12	17	7	30	95	20	14	1	12068	221.1	33.1	3.3	0.05	
	J07	11	11	12	19	7	30	95	20	16	1	22354	222.1	61.6	6.2	0.05	
	J08	11	14	12	19	7	30	95	20	16	1	7598	218.5	20.7	2.1	0.05	
	J09	11	16	12	20	7	30	95	20	17	1	14493	218.2	39.9	4.0	0.05	
	J10	11	17	2	20	7	30	95	20	17	1	9520	220.4	45.0	4.5	0.09	
	J11	11	18	12	21	7	30	95	20	18	1	53816	222.9	149.3	14.9	0.05	
	J12	11	19	12	21	7	30	95	20	18	1	14997	219.9	41.3	4.1	0.05	
	J13	11	22	12	22	7	30	95	20	19	1	8924	218.4	24.4	2.4	0.05	
	J14	11	23	12	23	7	30	95	20	19	1	5129	219.2	13.9	1.4	0.05	
	J15	11	25	12	24	7	30	95	20	21	1	24695	216.0	68.4	6.8	0.05	
	J16	11	28	12	25	7	30	95	20	21	1	35246	200.2	98.0	9.8	0.05	
	J17	11	31	12	25	7	30	95	20	23	1	14060	218.9	38.9	3.9	0.05	
	J18	11	32	12	26	7	30	95	20	23	1	34154	218.3	95.1	9.5	0.05	
	J19	11	35	12	27	7	30	95	20	24	1	22575	203.3	62.8	6.3	0.05	
	J20	11	36	12	27	7	30	95	20	24	1	2104	220.9	5.5	0.5	0.05	
	J21	11	37	12	29	7	30	95	20	26	1	18899	222.1	52.5	5.2	0.05	
	J22	11	41	12	30	7	30	95	20	26	1	12134	225.7	33.6	3.4	0.05	
	J23	11	42	12	30	7	30	95	20	28	1	21198	222.9	59.1	5.9	0.05	
	J24	11	45	12	31	7	30	95	20	28	1	24397	220.8	68.1	6.8	0.05	
	J25	11	47	12	32	7	30	95	21	0	1	34783	220.6	97.8	9.8	0.05	
	J26	11	48	12	33	7	30	95	21	0	1	21841	219.7	61.2	6.1	0.05	
	J27	11	50	12	33	7	30	95	21	2	1	19900	222.9	55.8	5.6	0.05	
	J28	11	51	12	36	7	30	95	21	2	1	23419	222.2	65.7	6.6	0.05	
	J29	11	54	12	37	7	30	95	21	3	1	14434	197.1	40.4	4.0	0.05	
	J30	11	56	12	38	7	30	95	21	3	1	18828	206.9	52.8	5.3	0.05	
	J31	11	57	12	38	7	30	95	21	5	1	17329	220.0	48.6	4.9	0.05	
	J32	12	59	12	38	7	30	95	21	5	1	20177	217.5	58.9	5.9	0.05	
	J33	13	1	12	39	7	30	95	21	6	1	20063	217.9	58.6	5.9	0.05	
	J34	13	2	13	0	7	30	95	21	6	1	24677	200.1	71.1	7.1	0.05	
	J35	13	4	13	3	7	30	95	21	8	1	6323	213.3	17.9	1.8	0.05	
	J36	13	5	13	3	7	30	95	21	8	1	97148	197.9	281.1	28.1	0.05	
	J37	13	7	13	4	7	30	95	21	10	1	53635	221.9	155.1	15.5	0.05	
	J38	13	8	13	4	7	30	95	21	10	1	35504	225.8	102.6	10.3	0.05	
	J39	13	14	14	5	7	30	95	21	11	1	18286	218.7	50.5	5.0	0.05	
	J40	13	15	14	6	7	30	95	21	11	1	10248	195.5	28.1	2.8	0.05	

CLIENT: ENERGY FUELS PROJECT: RADON FLUX MEASUREMENTS PROJECT NO.: 95004.00

PILE: #3 BATCH: J SURFACE: SAND/CRUST AIR TEMP MIN: 58°F WEATHER: CLEAR, WARM, NO RAIN
AREA: TAILS DEPLOYMENT: 7 25 95 RETRIEVAL: 7 26 95 CHARCOAL BKG CPM: 154 NET WT OUT: 180.0 g.
FIELD TECHNICIANS: DLC, JD, SS, JM, SC COUNTED BY: DLC DATA ENTRY BY: DLC TARE WEIGHT: 29.2 g.
COUNTING SYSTEM I.D.: M01/D21, M02/D20 CALIBRATION DUE: 6/17/96

GRID LOCATION	SAMPLE I. D.	DEPLOY HR	DEPLOY MIN	RETRIV HR	RETRIV MIN	ANALYSIS MO	ANALYSIS DA	ANALYSIS YR	MID-TIME HR	MID-TIME MIN	CNT (MIN)	GROSS COUNTS	GROSS WT IN	RADON pCi/m2s	± pCi/m2s	LLD pCi/m2s	COMMENTS
	J41	13	18	14	7	7	30	95	21	12	1	7786	218.2	21.3	2.1	0.05	
	J42	13	21	14	8	7	30	95	21	12	1	8942	218.4	24.5	2.5	0.05	
	J43	13	23	14	9	7	30	95	21	13	1	6074	214.8	16.5	1.7	0.05	
	J44	13	24	14	10	7	30	95	21	13	1	12073	204.8	33.3	3.3	0.05	
	J45	13	26	14	11	7	30	95	21	15	1	12390	223.6	34.2	3.4	0.05	
	J46	13	28	14	11	7	30	95	21	15	1	13452	226.1	37.2	3.7	0.05	
	J47	13	30	14	12	7	30	95	21	17	1	16234	227.6	45.0	4.5	0.05	
	J48	13	32	14	13	7	30	95	21	17	1	32628	199.1	90.9	9.1	0.05	
	J49	13	35	14	14	7	30	95	21	19	1	26261	202.8	73.2	7.3	0.05	
	J50	13	35	14	15	7	30	95	21	19	1	21021	218.4	58.5	5.8	0.05	
	J51	13	37	14	15	7	30	95	21	20	1	11479	216.5	31.8	3.2	0.05	
	J52	13	47	14	16	7	30	95	21	20	1	6277	203.1	17.3	1.7	0.05	
	J53	13	49	14	17	7	30	95	21	22	1	1997	209.3	5.2	0.5	0.05	
	J54	13	51	14	19	7	30	95	21	22	1	19911	218.9	55.8	5.6	0.05	
	J55	13	53	14	18	7	30	95	21	23	2	1094	217.2	1.1	0.1	0.05	
	J56	13	53	14	45	7	30	95	21	23	1	22854	219.0	62.9	6.3	0.05	
	J57	13	57	14	46	7	30	95	21	25	1	1779	220.3	4.5	0.5	0.05	
	J58	13	59	14	47	7	30	95	21	25	1	4902	219.2	13.2	1.3	0.05	
	J59	14	0	14	49	7	30	95	21	27	1	15967	203.7	43.9	4.4	0.05	
	J60	14	3	14	50	7	30	95	21	27	1	12822	195.8	35.2	3.5	0.05	
	J61	14	5	14	52	7	30	95	21	30	1	15967	217.8	44.0	4.4	0.05	
	J62	14	8	14	53	7	30	95	21	30	1	18530	218.4	51.2	5.1	0.05	
	J63	14	12	14	54	7	30	95	21	31	1	23709	231.0	65.7	6.6	0.05	
	J64	14	15	14	55	7	30	95	21	31	2	1084	220.1	1.1	0.1	0.05	
	J65	14	18	16	37	7	30	95	21	33	1	1133	219.4	2.5	0.3	0.05	
	J66	14	21	16	38	7	30	95	21	33	1	46578	204.2	120.9	12.1	0.05	
	J67	14	23	16	50	7	30	95	21	35	1	20342	205.2	52.2	5.2	0.05	
	J68	14	25	16	51	7	30	95	21	35	1	23435	220.2	60.2	6.0	0.05	
	J69	14	28	16	52	7	30	95	21	40	1	13731	201.4	35.2	3.5	0.05	
	J70	14	29	16	36	7	30	95	21	40	1	6997	198.3	17.9	1.8	0.05	
	J71	14	53	16	59	7	30	95	21	42	1	7650	219.1	19.6	2.0	0.05	
	J72	14	36	16	35	7	30	95	21	42	1	7396	218.4	19.1	1.9	0.05	
	J73	14	39	16	53	7	30	95	21	45	2	1062	210.6	1.0	0.1	0.05	
	J74	14	42	16	54	7	30	95	21	45	1	2196	222.1	5.3	0.5	0.[illegible]	
	J75	14	42	16	55	7	30	95	21	46	1	8944	226.0	22.9	2.3	0.05	
	J76	14	44	16	55	7	30	95	21	46	1	11776	219.9	30.3	3.0	0.05	
	J77	14	46	16	23	7	30	95	22	0	1	18449	192.7	49.0	4.9	0.05	
	J78	14	48	17	2	7	30	95	22	0	1	13136	218.5	33.9	3.4	0.05	
	J79	14	49	16	25	7	30	95	22	3	1	12252	219.7	32.4	3.2	0.05	
	J80	14	50	16	26	7	30	95	22	3	1	14924	221.6	39.6	4.0	0.05	

CLIENT: ENERGY FUELS   PROJECT: RADON FLUX MEASUREMENTS   PROJECT NO.: 95004.00

PILE: #3 .   BATCH: J   SURFACE: SAND/CRUST   AIR TEMP MIN: 58°F   WEATHER: CLEAR, WARM, NO RAIN
AREA: TAILS   DEPLOYMENT: 7 25 95 RETRIEVAL: 7 26 95 CHARCOAL BKG CPM: 154   NET WT OUT: 180.0 g.
FIELD TECHNICIANS: DLC, JD, SS, JM, SC   COUNTED BY: DLC   DATA ENTRY BY: DLC   TARE WEIGHT: 29.2 g.
COUNTING SYSTEM I.D.: M01/D21, M02/D20   CALIBRATION DUE: 6/17/96

GRID LOCATION	SAMPLE I. D.	DEPLOY HR	DEPLOY MIN	RETRIV HR	RETRIV MIN	ANALYSIS MO	ANALYSIS DA	ANALYSIS YR	MID-TIME HR	MID-TIME MIN	CNT (MIN)	GROSS COUNTS	GROSS WT IN	RADON pCi/m2s	± pCi/m2s	LLD pCi/m2s	COMMENTS:
	J81	14	50	16	22	7	30	95	22	4	1	13949	192.6	37.1	3.7	0.05	
	J82	14	55	16	28	7	30	95	22	4	1	1468	216.5	3.5	0.4	0.05	
	J83	14	56	16	21	7	30	95	22	5	1	3019	219.9	7.7	0.8	0.05	
	J84	14	59	16	27	7	30	95	22	5	1	19701	214.1	52.6	5.3	0.05	
	J85	15	2	15	6	7	30	95	22	6	1	3298	223.5	9.0	0.9	0.05	
	J86	15	3	15	7	7	30	95	22	10	5	1155	210.7	0.2	0.0	0.05	
	J87	15	5	15	8	7	30	95	22	12	1	18372	194.0	52.2	5.2	0.05	
	J88	15	7	16	20	7	30	95	22	12	1	34939	204.5	94.7	9.5	0.05	
	J89	15	9	15	4	7	30	95	21	15	1	11165	194.7	31.5	3.2	0.05	
	J90	15	9	15	20	7	30	95	21	15	1	16405	218.7	46.0	4.6	0.05	
	J91	15	11	16	29	7	30	95	21	16	1	14655	221.7	39.0	3.9	0.05	
	J92	15	12	15	2	7	30	95	21	16	1	11413	216.9	32.3	3.2	0.05	
	J93	15	14	16	33	7	30	95	21	18	1	3546	218.4	9.1	0.9	0.05	
	J94	15	15	15	1	7	30	95	21	18	1	2595	209.7	7.0	0.7	0.05	
	J95	15	16	16	34	7	30	95	21	19	1	4591	221.8	11.9	1.2	0.05	
	J96	15	18	17	0	7	30	95	21	19	1	14000	224.9	36.6	3.7	0.05	
	J97	15	18	17	1	7	30	95	21	20	1	9160	221.2	23.8	2.4	0.05	
	J98	15	19	16	59	7	30	95	21	20	1	21862	200.0	57.5	5.7	0.05	
	J99	15	20	16	58	7	30	95	21	21	1	15210	218.9	39.9	4.0	0.05	
	J100	15	0	14	16	7	30	95	21	21	1	9450	230.9	27.5	2.7	0.05	

AVERAGE RADON FLUX FOR CELL 3 TAILINGS: 44.8 pCi/m2s

CLIENT: ENERGY FUELS   PROJECT: RADON FLUX MEASUREMENTS   PROJECT NO.: 95004.00

PILE: #2 - BATCH: K   SURFACE: WET/DRY SAND   AIR TEMP MIN: 52°F   WEATHER: CLEAR, WARM, NO RAIN
AREA: TAILS   DEPLOYMENT: 7 24 95 RETRIEVAL: 7 25 95 CHARCOAL BKG CPM: 154   NET WT OUT: 180.0 g.
FIELD TECHNICIANS: DLC, JD, SS, JM, SC COUNTED BY: DLC   DATA ENTRY BY: SMC   TARE WEIGHT: 29.2 g.
COUNTING SYSTEM I.D.: M01/D21, M02/D20   CAL. DUE: 06/17/96

GRID LOCATION	SAMPLE I. D.	DEPLOY HR	DEPLOY MIN	RETRIV HR	RETRIV MIN	ANALYSIS MO	ANALYSIS DA	ANALYSIS YR	MID-TIME HR	MID-TIME MIN	CNT (MIN)	GROSS COUNTS	GROSS WT IN	RADON pCi/m2s	± pCi/m2s	LLD pCi/m2s	COMMENTS:
	K01	9	43	9	50	7	29	95	17	20	1	3498	243.0	9.6	1.0	0.05	
	K02	9	47	9	50	7	[illegible]	95	17	20	1	7615	237.1	21.5	2.1	0.05	
	K03	9	48	9	51	7	29	95	17	21	1	6684	241.1	18.9	1.9	0.05	
	K04	9	50	9	52	7	29	95	17	21	1	6412	242.8	18.0	1.8	0.05	
	K05	9	52	9	52	7	29	95	17	22	1	12585	232.7	35.8	3.6	0.05	
	K06	9	53	9	53	7	29	95	17	22	1	11259	[illegible]	32.0	3.2	0.05	
	K07	9	54	9	54	7	29	95	17	23	1	7502	248.5	21.2	2.1	0.05	
	K08	9	57	9	57	7	29	95	17	23	1	1201	238.0	3.0	0.3	0.05	
	K09	9	59	9	58	7	29	95	17	24	1	2059	253.8	6.5	0.5	0.05	
	K10	10	1	9	59	7	29	95	17	24	1	7837	249.7	22.6	2.2	0.05	
	K11	10	2	9	59	7	29	95	17	25	1	86011	242.8	247.8	24.8	0.05	
	K12	10	5	10	0	7	29	95	17	25	1	4758	248.8	13.3	1.3	0.05	
	K13	9	59	10	0	7	29	95	17	26	1	12290	239.5	34.9	3.5	0.05	
	K14	10	1	10	3	7	29	95	17	26	1	24687	239.6	70.6	7.1	0.05	
	K15	10	2	10	3	7	29	95	17	27	1	45848	240.4	131.5	13.2	0.05	
	K16	10	3	10	4	7	29	95	17	27	1	36250	222.6	103.9	10.4	0.05	
	K17	10	14	10	4	7	29	95	17	28	1	2435	247.2	6.6	0.7	0.05	
	K18	10	16	10	4	7	29	95	17	28	1	7688	244.6	21.9	2.2	0.05	
	K19	10	18	10	5	7	29	95	17	30	1	10659	248.1	30.5	3.1	0.05	
	K20	10	20	10	5	7	29	95	17	30	1	4940	248.7	13.9	1.4	0.05	
	K21	10	22	10	6	7	29	95	17	31	1	4450	245.8	12.5	1.3	0.05	
	K22	10	23	10	28	7	29	95	17	31	1	9550	242.2	26.9	2.7	0.05	
	K23	10	25	10	28	7	29	95	17	32	1	11459	244.7	32.4	3.2	0.05	
	K24	10	26	10	29	7	29	95	17	32	1	80602	234.3	230.6	23.1	0.05	
	K26	10	30	10	30	7	29	95	17	33	1	20796	234.9	59.3	5.9	0.05	
	K27	10	30	10	30	7	29	95	17	33	3	1476	226.1	1.0	0.1	0.05	
	K28	10	42	10	42	7	29	95	17	35	1	8785	248.8	24.8	2.5	0.05	
	K29	10	45	10	46	7	29	95	17	35	1	3796	237.7	10.4	1.0	0.05	
	K30	10	47	10	46	7	29	95	17	36	1	6082	223.4	17.0	1.7	0.05	
	K31	10	51	10	51	7	29	95	17	36	2	1610	231.0	1.9	0.2	0.05	
	K32	10	54	11	38	7	29	95	17	38	1	1679	224.0	4.2	0.4	0.05	
	K33	10	56	11	38	7	29	95	17	38	2	1428	221.3	1.6	0.2	0.05	
	K34	10	58	11	39	7	29	95	17	40	1	2789	232.0	7.3	0.7	0.05	
	K35	11	0	11	39	7	29	95	17	40	1	1042	233.4	2.5	0.2	0.05	
	K36	11	2	11	40	7	29	95	17	42	2	1812	229.7	2.1	0.2	0.05	
	K37	11	4	11	40	7	29	95	17	42	3	1344	237.0	0.8	0.1	0.05	
	K38	11	6	11	41						VOID CHARCOAL	SPILLED	VOID				
	K39	11	7	11	42	7	29	95	17	44	1	13201	230.3	36.4	3.6	0.05	
	K25	10	28	10	38	7	29	95	17	45	1	23021	234.9	65.3	6.5	0.05	
	K40	11	9	11	43	7	29	95	17	46	1	1161	240.5	2.8	0.3	0.05	

CLIENT: ENERGY FUELS PROJECT: RADON FLUX MEASUREMENTS PROJECT NO.: 95004.00

PILE: #2 - BATCH: K SURFACE: WET/DRY SAND AIR TEMP MIN: 52°F WEATHER: CLEAR, WARM, NO RAIN
AREA: TAILS DEPLOYMENT: 7 24 95 RETRIEVAL: 7 25 95 CHARCOAL BKG CPM: 154 NET WT OUT: 180.0 g.
FIELD TECHNICIANS: DLC, JD, SS, JM, SC COUNTED BY: DLC DATA ENTRY BY: SMC TARE WEIGHT: 29.2 g.
COUNTING SYSTEM I.D.: M01/D21, M02/D20 CAL. DUE: 06/17/96

GRID LOCATION	SAMPLE I. D.	DEPLOY HR	DEPLOY MIN	RETRIV HR	RETRIV MIN	ANALYSIS MO	ANALYSIS DA	ANALYSIS YR	MID-TIME HR	MID-TIME MIN	CNT (MIN)	GROSS COUNTS	GROSS WT IN	RADON pCi/m2s	± pCi/m2s	LLD pCi/m2s	COMMENTS:
	K41	11	11	11	44	7	29	95	17	50	3	1314	237.0	0.8	0.1	0.05	
	K42	11	14	12	12	7	29	95	17	51	2	1638	239.6	1.8	0.2	0.05	
	K43	11	16	12	12	7	29	95	17	53	3	1404	233.0	0.9	0.1	0.05	
	K44	11	18	12	13	7	29	95	17	55	1	10348	225.3	28.0	2.8	0.05	
	K45	11	20	12	13	7	29	95	17	56	2	1132	233.8	1.1	0.1	0.05	
	K46	11	22	12	14	7	29	95	17	56	1	2014	240.0	5.1	0.5	0.05	
	K47	11	24	12	30	7	29	95	17	58	1	3022	236.6	7.8	0.8	0.05	
	K48	11	25	12	35	7	29	95	17	58	1	4552	226.6	11.9	1.2	0.05	
	K49	11	27	12	35	7	29	95	17	59	1	2414	235.7	6.1	0.6	0.05	
	K50	11	28	12	31	7	29	95	18	0	3	1209	234.7	0.7	0.1	0.05	
	K51	11	30	12	31	7	29	95	18	2	1	1699	230.6	4.2	0.4	0.05	
	K52	11	34	12	30	7	29	95	18	4	3	1353	235.3	0.8	0.1	0.05	
	K53	11	37	12	29	7	29	95	18	5	2	1074	234.7	1.1	0.1	0.05	
	K54	11	39	12	28	7	29	95	18	6	2	1898	235.0	2.2	0.2	0.05	
	K55	11	40	12	28	7	29	95	18	7	1	1031	231.2	2.4	0.2	0.05	
	K56	11	42	12	27	7	29	95	18	9	2	1002	235.9	1.0	0.1	0.05	
	K57	11	43	12	26	7	29	95	18	11	3	1302	233.9	0.8	0.1	0.05	
	K58	11	44	12	25	7	29	95	18	12	1	3356	235.1	8.9	0.9	0.05	
	K59	11	46	12	26	7	29	95	18	14	2	1048	241.1	1.0	0.1	0.05	
	K60	11	50	12	25	7	29	95	18	[illegible]	1	1582	239.0	4.0	0.4	0.05	
	K61	11	51	12	24	7	29	95	18	16	1	1081	235.9	2.6	0.3	0.05	
	K62	11	54	12	24	7	29	95	18	16	1	2858	218.1	7.6	0.8	0.05	
	K63	11	54	12	24	7	29	95	18	17	1	10213	236.7	28.1	2.8	0.05	
	K64	11	54	12	23	7	29	95	18	17	1	9085	241.3	25.0	2.5	0.05	
	K65	11	55	12	23	7	29	95	18	18	1	10931	232.8	30.2	3.0	0.05	
	K66	11	56	12	21	7	29	95	18	18	1	52001	241.0	145.4	14.5	0.05	
	K67	11	56	12	22	7	29	95	18	19	1	5646	244.0	15.4	1.5	0.05	
	K68	11	58	12	45	7	29	95	18	19	1	13145	242.4	35.8	3.6	0.05	
	K69	12	2	12	46	7	29	95	18	20	1	4775	223.8	12.8	1.3	0.05	
	K70	12	3	12	48	7	29	95	18	20	1	6460	223.6	17.4	1.7	0.05	
	K71	12	5	12	47	7	29	95	18	21	1	1511	230.6	3.8	0.4	0.05	
	K72	12	6	12	46	7	29	95	18	21	1	3130	220.9	8.2	0.8	0.05	
	K73	12	7	12	47	7	29	95	18	22	1	13610	240.1	37.3	3.7	0.05	
	K74	12	8	12	49								139.2		VOID, WEIGHT TOO LOW		
	K75	12	9	13	10	7	29	95	18	23	1	15402	[illegible]	41.6	4.2	0.05	
	K76	12	10	13	11	7	29	95	18	23	1	50273	237.1	136.7	13.7	0.05	
	K77	12	1	13	12	7	29	95	18	24	1	13054	241.9	35.0	3.5	0.05	
	K78	12	12	13	13	7	29	95	18	24	1	2798	219.0	7.2	0.7	0.05	
	K79	12	12	13	14	7	29	95	18	25	1	7260	236.1	19.4	1.9	0.05	
	K80	12	13	13	15	7	29	95	18	25	1	1776	227.5	4.4	0.4	0.05	

CLIENT: ENERGY FUELS PROJECT: RADON FLUX MEASUREMENTS PROJECT NO.: 95004.00

PILE: #2 BATCH: K SURFACE: WET/DRY SAND AIR TEMP MIN: 52°F WEATHER: CLEAR, WARM, NO RAIN
AREA: TAILS DEPLOYMENT: 7 24 95 RETRIEVAL: 7 25 95 CHARCOAL BKG CPM: 154 NET WT OUT: 180.0 g.
FIELD TECHNICIANS: DLC, JD, SS, JM, SC COUNTED BY: DLC DATA ENTRY BY: SMC TARE WEIGHT: 29.2 g.
COUNTING SYSTEM I.D. M01/D21, M02/D20 CAL. DUE: 06/17/96

GRID LOCATION	SAMPLE I. D.	DEPLOY HR	DEPLOY MIN	RETRIV HR	RETRIV MIN	ANALYSIS MO	ANALYSIS DA	ANALYSIS YR	MID-TIME HR	MID-TIME MIN	CNT (MIN)	GROSS COUNTS	GROSS WT IN	RADON pCi/m2s	± pCi/m2s	LLD pCi/m2s	COMMENTS:
	K81	12	14	13	16	7	29	95	18	26	1	15389	238.2	41.5	4.2	0.05	
	K82	12	15	13	17	7	29	95	18	26	1	11428	230.2	30.7	3.1	0.05	
	K83	12	16	13	18	7	29	95	18	28	1	23031	223.2	62.4	6.2	0.05	
	K84	12	16	13	19	7	29	95	18	28	1	3086	229.9	8.0	0.8	0.05	
	K85	12	17	13	20	7	29	95	18	29	1	6384	233.2	17.0	1.7	0.05	
	K86	12	18	13	21	7	29	95	18	29	1	2403	239.9	6.1	0.6	0.05	
	K87	12	20	13	31	7	29	95	18	30	1	7509	236.2	19.9	2.0	0.05	
	K88	12	21	13	32	7	29	95	18	30	1	12993	217.4	34.8	3.5	0.05	
	K89	12	22	12	48	7	29	95	18	31	1	3176	234.6	8.5	0.8	0.05	
	K90	12	23	12	48	7	29	95	18	31	1	2701	232.9	7.1	0.7	0.05	
	K91	12	26	13	29	7	29	95	18	32	1	8964	225.2	24.0	2.4	0.05	
	K92	12	27	13	22	7	29	95	18	32	1	49223	235.8	134.3	13.4	0.05	
	K93	12	28	13	23	7	29	95	18	33	1	11651	233.7	31.5	3.1	0.05	
	K94	12	29	13	24	7	29	95	18	33	1	23485	233.9	63.9	6.4	0.05	
	K95	12	30	13	25	7	29	95	18	34	1	2193	223.8	5.6	0.6	0.05	
	K96	12	31	13	26	7	29	95	18	34	1	24856	220.1	67.6	6.8	0.05	
	K97	12	32	13	27	7	29	95	18	36	1	9829	240.5	26.5	2.6	0.05	
	K98	12	33	13	28	7	29	95	18	36	1	4002	221.9	10.5	1.1	0.05	
	K99	12	34	13	30	7	29	95	18	37	1	20306	220.6	55.1	5.5	0.05	
	K100	12	35	12	45	7	29	95	18	37	1	4756	230.6	13.0	1.3	0.05	
	K101	12	37	12	40	7	29	95	18	38	1	12130	224.4	34.1	3.4	0.05	

AVERAGE RADON FLUX FOR CELL 2 TAILINGS: 28.4 pCi/m2s

CLIENT: ENERGY FUELS PROJECT: RADON FLUX MEASUREMENTS PROJECT NO.: 95004.00

PILE: #2 BATCH: L SURFACE: SOIL AIR TEMP MIN: 55°F WEATHER: CLEAR, WARM, NO RAIN
AREA: COVER DEPLOYMENT: 7 27 95 RETRIEVAL: 7 28 95 CHARCOAL BKG CPM: 154 NET WT OUT: 180.0 g.
FIELD TECHNICIANS: DLC, JD, SS, JM, SC COUNTED BY: DLC DATA ENTRY BY: DLC TARE WEIGHT: 29.2 g.
COUNTING SYSTEM I.D.: M01/D21, M02/D20 CALIBRATION DUE: 6/17/96

GRID LOCATION	SAMPLE I. D.	DEPLOY HR	DEPLOY MIN	RETRIV HR	RETRIV MIN	ANALYSIS MO	ANALYSIS DA	ANALYSIS YR	MID-TIME HR	MID-TIME MIN	CNT (MIN)	GROSS COUNTS	GROSS WT IN	RADON pCi/m2s	± pCi/m2s	LLD pCi/m2s	COMMENTS:
	L01	16	14	17	8	7	30	95	16	30	1	13183	213.3	23.8	2.4	0.03	
	L02	16	15	17	9	7	30	95	16	30	1	13717	213.2	24.7	2.5	0.03	
	L03	16	20	17	10	7	30	95	16	31	1	6233	212.5	11.1	1.1	0.03	
	L04	16	20	17	11	7	30	95	16	31	1	8714	215.9	15.6	1.6	0.03	
	L05	16	22	17	12	7	30	95	16	32	1	1675	211.5	2.8	0.3	0.03	
	L06	16	22	17	13	7	30	95	16	32	1	10803	210.7	19.5	1.9	0.03	
	L07	16	24	17	14	7	30	95	16	33	1	2559	212.9	4.4	0.4	0.03	
	L08	16	24	17	15	7	30	95	16	33	1	2601	211.2	4.5	0.4	0.03	
	L09	16	25	17	16	7	30	95	16	34	1	12710	214.7	22.9	2.3	0.03	
	L10	16	25	17	17	7	30	95	16	34	1	2175	215.5	3.7	0.4	0.03	
	L11	16	26	17	18	7	30	95	16	36	2	1622	214.3	1.2	0.1	0.03	
	L12	16	26	17	19	7	30	95	16	36	1	2211	217.4	3.8	0.4	0.03	
	L13	16	30	17	20	7	30	95	16	37	1	2055	212.5	3.5	0.3	0.03	
	L14	16	30	17	21	7	30	95	16	37	3	1416	214.2	0.6	0.1	0.03	
	L15	16	33	17	22	7	30	95	16	39	2	1984	212.6	1.5	0.2	0.03	
	L16	16	33	17	23	7	30	95	16	39	3	1244	213.5	0.5	0.0	0.03	
	L17	16	35	17	24	7	30	95	16	41	1	3647	214.8	6.4	0.6	0.03	
	L18	16	35	17	25	7	30	95	16	41	2	1786	214.9	1.4	0.1	0.03	
	L19	16	37	17	26	7	30	95	16	43	1	3462	214.7	6.0	0.6	0.03	
	L20	16	37	17	27	7	30	95	16	43	1	6437	212.6	11.5	1.1	0.03	
	L21	16	39	17	28	7	30	95	16	44	1	1674	213.5	2.8	0.3	0.03	
	L22	16	39	17	29	7	30	95	16	45	1	4613	213.4	8.1	0.8	0.03	
	L23	16	41	17	30	7	30	95	16	46	1	3981	214.2	7.0	0.7	0.03	
	L24	16	41	17	31	7	30	95	16	46	1	19118	215.8	34.6	3.5	0.03	
	L25	16	43	17	32	7	30	95	16	47	1	[illegible]	211.2	3.9	0.4	0.03	
	L26	16	43	17	33	7	30	95	16	47	1	10133	214.6	18.2	1.8	0.03	
	L27	16	45	17	34	7	30	95	16	48	1	2144	214.3	3.6	0.4	0.03	
	L28	16	45	17	35	7	30	95	16	48	1	2715	213.6	4.7	0.5	0.03	
	L29	16	47	17	36	7	30	95	16	49	1	2091	212.9	3.5	0.4	0.03	
	L30	16	47	17	37	7	30	95	16	49	3	1011	211.4	0.3	0.0	0.03	
	L31	16	49	17	38	7	30	95	16	51	3	1251	213.5	0.5	0.0	0.03	
	L32	16	49	17	39	7	30	95	16	51	2	1488	216.9	1.1	0.1	0.03	
	L33	16	54	17	40	7	30	95	16	54	2	1458	213.5	1.1	0.1	0.03	
	L34	16	54	17	42	7	30	95	16	54	1	13210	214.8	23.9	2.4	0.03	
	L35	16	56	17	44	7	30	95	16	56	2	1124	217.8	0.7	0.1	0.03	
	L36	16	56	17	44	7	30	95	16	56	1	3963	211.4	7.0	0.7	0.03	
	L37	16	58	17	45	7	30	95	16	59	3	1131	216.6	0.4	0.0	0.03	
	L38	16	58	17	45	7	30	95	16	59	3	1128	215.0	0.4	0.0	0.03	
	L39	17	0	17	46	7	30	95	17	3	4	1056	207.5	0.2	0.0	0.03	
	L40	17	0	17	47	7	30	95	17	3	1	14576	211.8	26.4	2.6	0.03	

CLIENT: ENERGY FUELS PROJECT: RADON FLUX MEASUREMENTS PROJECT NO.: 95004.00

PILE: #2 · BATCH: L SURFACE: SOIL AIR TEMP MIN: 55°F WEATHER: CLEAR, WARM, NO RAIN
AREA: COVER DEPLOYMENT: 7 27 95 RETRIEVAL: 7 28 95 CHARCOAL BKG CPM: 154 NET WT OUT: 180.0 g.
FIELD TECHNICIANS: DLC, JD, SS, JM, SC COUNTED BY: DLC DATA ENTRY BY: DLC TARE WEIGHT: 29.2 g.
COUNTING SYSTEM I.D.: M01/D21, M02/D20 CALIBRATION DUE: 6/17/96

GRID LOCATION	SAMPLE I. D.	DEPLOY HR	DEPLOY MIN	RETRIV HR	RETRIV MIN	ANALYSIS MO	ANALYSIS DA	ANALYSIS YR	MID-TIME HR	MID-TIME MIN	CNT (MIN)	GROSS COUNTS	GROSS WT IN	RADON pCi/m2s	± pCi/m2s	LLD pCi/m2s	COMMENTS:
	L41	17	2	17	48	7	30	95	17	5	2	1734	212.1	1.3	0.1	0.03	
	L42	17	2	17	48	7	30	95	17	5	2	1276	213.5	0.9	0.1	0.03	
	L43	18	2	18	21	7	30	95	17	7	3	1504	212.6	0.6	0.1	0.03	
	L44	18	3	18	22	7	30	95	17	7	4	1162	214.9	0.3	0.0	0.03	
	L45	18	4	18	23	7	30	95	17	11	1	10242	211.3	18.7	1.9	0.03	
	L46	18	5	18	23	7	30	95	17	11	3	1041	215.3	0.4	0.0	0.03	
	L47	18	6	18	24	7	30	95	17	14	3	1434	213.3	0.6	0.1	0.03	
	L48	18	7	18	24	7	30	95	17	14	3	1671	214.7	0.7	0.1	0.03	
	L49	18	8	18	21	7	30	95	17	16	4	1768	212.9	0.5	0.1	0.03	
	L50	18	9	18	25	7	30	95	17	16	1	21744	216.5	40.2	4.0	0.03	
	L51	18	10	18	26	7	30	95	17	18	1	8227	215.5	15.0	1.5	0.03	
	L52	18	11	18	27	7	30	95	17	18	1	7426	214.2	13.5	1.4	0.03	
	L53	18	12	18	30	7	30	95	17	20	2	1716	221.8	1.3	0.1	0.03	
	L54	18	13	18	31	7	30	95	17	20	2	1392	215.1	1.0	0.1	0.03	
	L55	18	14	18	32	7	30	95	17	23	5	1020	214.3	0.1	0.0	0.03	
	L56	18	15	18	33	7	30	95	17	23	5	1152	211.3	0.1	0.0	0.03	
	L57	18	16	18	34	7	30	95	17	27	1	3000	216.9	5.3	0.5	0.03	
	L58	18	17	18	36	7	30	95	17	27	3	1026	214.8	0.3	0.0	0.03	
	L59	18	18	19	40	7	30	95	17	30	2	1432	213.0	1.0	0.1	0.03	
	L60	18	19	19	41	7	30	95	17	30	3	1425	212.7	0.6	0.1	0.03	
	L61	18	20	18	40	7	30	95	17	33	VOID	SPILLED	CHARCOAL				
	L62	18	21	19	41	7	30	95	17	33	1	14811	214.2	26.0	2.6	0.03	
	L63	18	22	19	42	7	30	95	17	34	1	2118	212.5	3.5	0.3	0.03	
	L64	18	23	19	43	7	30	95	17	34	1	2269	215.0	3.8	0.4	0.03	
	L65	18	24	19	44	7	30	95	17	35	1	16766	212.9	29.5	2.9	0.03	
	L66	18	25	19	45	7	30	95	17	35	2	1568	214.9	1.1	0.1	0.03	
	L67	18	26	19	46	7	30	95	17	37	2	1368	215.1	0.9	0.1	0.03	
	L68	18	27	19	47	7	30	95	17	37	2	1152	218.8	0.7	0.1	0.03	
	L69	18	28	19	48	7	30	95	17	39	2	1760	215.0	1.3	0.1	0.03	
	L70	18	29	19	49	7	30	95	17	40	5	1238	210.6	0.2	0.0	0.03	
	L71	18	30	19	50	7	30	95	17	42	1	10218	213.7	17.9	1.8	0.03	
	L72	18	31	19	7	7	30	95	17	42	1	8255	216.5	14.9	1.5	0.03	
	L73	18	32	19	2	7	30	95	17	45	3	1026	219.6	0.3	0.0	0.03	
	L74	18	33	19	1	7	30	95	17	45	3	1416	212.7	0.6	0.1	0.03	
	L75	18	34	19	6	7	30	95	17	47	2	1280	211.5	0.9	0.1	0.03	
	L76	18	35	19	15	7	30	95	17	47	3	1413	214.9	0.6	0.1	0.03	
	L77	18	36	19	10	7	30	95	17	51	4	956	220.7	0.2	0.0	0.03	
	L78	18	37	19	21	7	30	95	17	51	4	1612	215.6	0.5	0.0	0.03	
	L79	18	38	19	20	7	30	95	17	55	4	1112	223.0	0.2	0.0	0.03	
	L80	18	39	19	16	7	30	95	17	55	2	1356	216.4	1.0	0.1	0.03	

CLIENT: ENERGY FUELS   PROJECT: RADON FLUX MEASUREMENTS   PROJECT NO.: 95004.00

PILE: #2   BATCH: L   SURFACE: SOIL   AIR TEMP MIN: 55°F   WEATHER: CLEAR, WARM, NO RAIN
AREA: COVER   DEPLOYMENT: 7 27 95 RETRIEVAL: 7 28 95 CHARCOAL BKG CPM: 154   NET WT OUT: 1[illegible]0.0
FIELD TECHNICIANS: DLC, JD, SS, JM, SC COUNTED BY: DLC   DATA ENTRY BY: DLC   TARE WEIGHT: 29.2 g.
COUNTING SYSTEM I.D.: M01/D21, M02/D20 CALIBRATION DUE: 6/17/96

GRID LOCATION	SAMPLE I. D.	DEPLOY HR	DEPLOY MIN	RETRIV HR	RETRIV MIN	ANALYSIS MO	ANALYSIS DA	ANALYSIS YR	MID-TIME HR	MID-TIME MIN	CNT (MIN)	GROSS COUNTS	GROSS WT IN	RADON pCi/m2s	± pCi/m2s	LLD pCi/m2s	COMMENTS:
	L81	18	40	20	4	7	30	95	17	58	3	1068	214.4	0.4	0.0	0.03	
	L82	18	41	20	4	7	30	95	17	58	1	22614	218.1	39.8	4.0	0.03	
	L83	18	42	20	3	7	30	95	18	2	4	1284	214.4	0.3	0.0	0.03	
	L84	18	43	20	3	7	30	95	18	2	4	1496	217.5	0.4	0.0	0.03	
	L85	18	44	20	2	7	30	95	18	6	4	1384	218.4	0.3	0.0	0.03	
	L86	18	45	20	2	7	30	95	18	6	4	1168	223.7	0.2	0.0	0.03	
	L87	18	46	19	5	7	30	95	18	8	2	1090	220.4	0.7	0.1	0.03	
	L88	18	47	18	53	7	30	95	18	8	1	4177	213.8	7.6	0.8	0.03	
	L89	18	48	18	52	7	30	95	18	10	2	1058	213.8	0.7	0.1	0.03	
	L90	18	49	18	40	7	30	95	18	10	1	2215	219.2	3.9	0.4	0.03	
	L91	18	50	19	0	7	30	95	18	13	3	1071	212.5	0.4	0.0	0.03	
	L92	18	51	18	58	7	30	95	18	13	3	1254	213.3	0.5	0.0	0.03	
	L93	18	52	18	46	7	30	95	18	16	4	1052	213.2	0.2	0.0	0.03	
	L94	18	53	18	43	7	30	95	18	16	1	5169	215.3	9.5	1.0	0.03	
	L95	18	54	19	25	7	30	95	18	17	2	1120	212.6	0.7	0.1	0.03	
	L96	18	55	19	24	7	30	95	18	17	1	2305	210.7	4.0	0.4	0.03	
	L97	18	56	19	26	7	30	95	18	18	1	1003	208.5	1.6	0.2	0.03	
	L98	18	57	19	27	7	30	95	18	18	1	1023	210.4	1.6	0.2	0.03	
	L99	18	58	19	56	7	30	95	18	19	1	1100	210.3	1.7	0.2	0.03	
	L100	18	59	18	45	7	30	95	18	19	1	1060	212.1	1.7	0.2	0.03	

AVERAGE RADON FLUX FOR CELL 2 COVER: 6.1 pCi/m2s

CLIENT: ENERGY FUELS PROJECT: RADON FLUX MEASUREMENTS PROJECT NO.: 95004.00

PILE: 2 & 3 BATCH: K,J,H,L SURFACE: ALL AIR TEMP MIN: 52°F WEATHER: CLEAR, WARM, NO RAIN
AREA: ALL DEPLOYMENT: VARIES RETRIEVAL: VARIES CHARCOAL BKG CPM: 154 NET WT OUT: 180.0 g.
FIELD TECHNICIANS: DLC, JD COUNTED BY: DLC DATA ENTRY BY: DLC TARE WEIGHT: 29.2 g.
COUNTING SYSTEM I.D.: M01/D21, M02/D20 CAL. DUE: 6/17/96

GRID LOCATION	SAMPLE I. D.	DEPLOY HR	DEPLOY MIN	RETRIV HR	RETRIV MIN	ANALYSIS MO	ANALYSIS DA	ANALYSIS YR	MID-TIME HR	MID-TIME MIN	CNT (MIN)	GROSS COUNTS	GROSS WT IN	RADON pCi/m2s	± pCi/m2s	LLD pCi/m2s	COMMENTS:
	KFB01	9	25	10	0	7	29	95	6	10	7	1117	211.2	0.02	0.00	0.05	
	KFB02	9	28	10	2	7	29	95	6	10	6	1034	213.0	0.05	0.01	0.05	
	KFB03	9	32	10	3	7	29	95	6	20	18	2803	213.3	0.01	0.00	0.05	
	KFB04	9	54	10	1	7	29	95	6	20	19	3144	211.7	0.03	0.00	0.05	
	KFB05	10	0	10	3	7	29	95	6	31	7	1105	213.7	0.01	0.00	0.05	
	JFB01	10	13	12	20	7	29	95	6	31	7	1207	209.8	0.04	0.00	0.04	
	JFB02	11	7	12	19	7	29	95	6	35	9	1504	191.0	0.03	0.00	0.04	
	JFB03	11	15	12	14	7	29	95	6	35	9	1530	213.1	0.04	0.00	0.04	
	JFB04	12	33	12	40	7	29	95	6	40	15	2555	212.0	0.04	0.00	0.04	
	JFB05	13	2	13	20	7	29	95	6	40	15	2615	212.2	0.05	0.00	0.04	
	HFB01	12	17	15	25	7	29	95	18	50	20	3540	196.4	0.04	0.00	0.03	
	HFB02	13	12	15	51	7	29	95	18	50	20	3539	205.4	0.04	0.00	0.03	
	HFB03	14	33	15	58	7	29	95	19	10	6	1038	210.0	0.04	0.00	0.03	
	HFB04	17	0	17	45	7	29	95	19	10	5	1021	211.0	0.10	0.01	0.03	
	HFB05	17	20	17	34	7	29	95	19	15	7	1148	211.8	0.02	0.00	0.03	
	LFB01	15	26	18	4	7	29	95	19	15	6	1201	210.6	0.07	0.01	0.03	
	LFB02	15	52	18	7	7	29	95	19	20	7	1246	209.7	0.04	0.00	0.03	
	LFB03	16	0	18	9	7	29	95	19	20	7	1449	211.5	0.08	0.01	0.03	
	LFB04	17	25	18	10	7	29	95	19	25	7	1183	210.2	0.02	0.00	0.03	
	LFB05	17	45	18	12	7	29	95	19	25	7	1211	210.2	0.03	0.00	0.03	

AVERAGE BLANK CANISTER ANALYSES RESULT: 0.04 pCi/m2s

A P P E N D I X   D

Field Data Sheets

TELLCO ENVIRONMENTAL

RADON FLUX - FIELD DATA SHEET

CLIENT: Energy Fuels PROJECT: NESHAPS- 1995 PROJECT NO.: 95004.00 SHEET 1 OF 3

PILE: 3 AREA: Cover SURFACE: Soil MIN. AIR TEMP DURING SAMPLE PERIOD: 55°F

BATCH: H BKG CPM: 154 WEIGHT OUT: 180g. DEPLOYMENT DATE: 7/26/95 RETRIEVAL DATE: 7/27/95

TECHNICIANS: DLC, JD, SS, JM, SC

COUNTING SYSTEM I. D.: M01/D21 & M02/D20 CALIBRATION DUE: 6/17/96 DLC TARE WEIGHT: 29.2g.

Counted By: DLC

GRID LOCATION	SAMPLE I. D.	DEPLOYMENT TIME	RETRIEVAL TIME	ANALYSIS DATE	ANALYSIS TIME	COUNT MIN.	GROSS COUNTS	WEIGHT IN	COMMENTS:
	H01	12:54	2:30	7/30/95	1820	1	1212	191.6	
	H02	12:56	2:30		1820	1	1348	206.3	
	H03	12:57	2:31		1823	3	1278	200.1	
	H04	12:58	2:31		1823	3	1314	214.7	
	H05	12:59	2:32		1826	3	1293	193.2	
	H06	1:01	2:32		1826	3	1890	208.4	
	H07	1:03	2:33		1827	1	1406	217.7	
	H08	1:05	2:33		1827	1	1479	200.2	
	H09	1:07	2:34		1828	1	2223	211.4	
	H10	1:09	2:34		1828	2	1484	191.9	
	H11	1:10	2:35		1830	2	1308	215.0	
	H12	1:12	2:35		1830	3	1110	212.2	
	H13	1:14	2:36		1834	4	1276	211.8	
	H14	1:16	2:34		1834	4	1516	217.0	
	H15	1:17	2:37		1838	4	1760	217.5	
	H16	1:18	2:38		1838	4	1932	204.4	
	H17	1:20	2:38		1842	4	1120	211.8	
	H18	1:22	2:39		1842	4	1716	213.5	
	H19	1:25	2:39		1845	3	1380	214.4	
	H20	1:27	2:40		1843	1	2315	214.7	
	H21	1:30	2:43		1846	1	1460	194.4	
	H22	1:32	2:43		1844	1	1057	200.1	
	H23	1:34	2:44		1847	1	3348	214.7	
	H24	1:36	2:45		1845	1	1640	213.4	
	H25	1:38	2:46		1850	3	1218	206.5	
	H26	1:40	2:47		1849	4	1236	192.4	
	H27	1:43	2:47		1844	4	1232	215.3	
	H28	1:45	2:48					Ø	Void Spilled Charc.
	H29	1:47	2:48		1848	4	1540	217.2	
	H30	1:49	2:49		1848	4	1240	200.2	
	H31	1:51	2:45		1850	1	1793	218.2	
	H32	1:54	2:50		1850	1	2891	213.2	
	H33	1:56	2:50		1851	2	1056	213.5	
	H34	1:58	2:51		1851	1	1629	200.1	
	H35	2:00	2:52		1852	1	12650	213.2	
	H36	2:03	2:52		1852	1	36548	193.6	
	H37	2:05	2:53		1853	1	21690	207.3	
	H38	2:07	2:53		1853	2	1166	214.4	
	H39	2:10	2:54		1854	1	1471	217.1	
	H40	2:11	2:54		1854	1	2722	214.9	
	H41	2:13	2:55		1857	3	1119	217.1	
	H42	2:15	2:55		1857	3	1191	208.4	
	H43	2:18	2:56		1900	2	1402	213.5	
	H44	2:20	2:56		1900	3	999	194.8	

TELLCO ENVIRONMENTAL

RADON FLUX - FIELD DATA SHEET

CLIENT: Energy Fuels PROJECT: NESHAPS-1995 PROJECT NO.: 95004.00 SHEET 2 OF 3

PILE: 3 AREA: Cover SURFACE: Soil MIN. AIR TEMP DURING SAMPLE PERIOD: 55°F

BATCH: H BKG CPM: 154 WEIGHT OUT: 180 g. DEPLOYMENT DATE: 7/26/95 RETRIEVAL DATE: 7/27/95

TECHNICIANS: DK, JD, SS, JM, SC

COUNTING SYSTEM I. D.: M01/D21 & M02/D20 CALIBRATION DUE: 6/17/96 TARE WEIGHT: 29.2 g.

Counted By: DK

GRID LOCATION	SAMPLE I. D.	DEPLOYMENT TIME PM	RETRIEVAL TIME PM	ANALYSIS DATE	ANALYSIS TIME	COUNT MIN.	GROSS COUNTS	WEIGHT IN	COMMENTS:
	H45	2:22	2:57	7/30/95	1903	3	1359	212.0	
	H46	2:25	2:57		1903	3	1071	215.0	
	H47	2:27	2:58		1905	3	1176	213.9	
	H48	2:30	2:58		1905	2	1012	212.9	
	H49	2:36	2:59		1908	3	1257	215.1	
	H50	2:38	2:59		1908	2	1912	196.5	
	H51	2:40	3:00		1910	1	2597	210.1	
	H52	2:43	3:01		1910	2	1108	210.2	
	H53	2:45	3:02		1913	3	1086	215.5	
	H54	2:47	3:03		1913	3	1041	214.9	
	H55	2:49	3:04		1917	4	1192	212.8	
	H56	2:52	3:10		1917	3	1209	218.1	
	H57	2:55	3:11		1920	3	1311	192.2	
	H58	2:57	3:11		1919	1	58558	211.0	
	H59	3:00	3:12		1923	3	1194	220.9	
	H60	3:02	3:13		1920	1	6243	214.2	
	H61	3:05	3:14		1924	1	1239	209.6	
	H62	3:10	3:15		1923	3	1026	216.6	
	H63	3:15	3:16		1927	4	1440	192.9	
	H64	3:18	3:17		1926	4	1276	195.3	
	H65	3:20	3:18		1930	4	1700	201.9	
	H66	3:22	3:19		1930	4	1368	210.8	
	H67	3:30	3:20		1934	4	1296	212.2	
	H68	3:35	3:21		1934	3	1626	200.1	
	H69	3:38	3:22		1937	3	1002	213.6	
	H70	3:40	3:41		1937	3	1161	194.9	
	H71	3:44	3:44		1938	1	15814	193.9	
	H72	3:47	3:45		1938	1	21250	216.3	
	H73	3:50	5:20		1939	1	4183	215.8	
	H74	3:55	5:21		1939	1	8931	210.5	
	H75	3:59	5:20		1940	1	11504	220.6	
	H76	4:05	5:17		1940	1	13534	211.9	
	H77	4:05	5:16		1941	1	8500	212.3	
	H78	4:10	5:14		1942	1	4589	214.9	
	H79	4:13	5:19		1942	1	17528	215.4	
	H80	4:19	5:15		1943	1	43236	213.4	
	H81	4:24	5:16		1943	1	34310	216.1	
	H82	4:28	5:17		1944	1	34097	188.6	
	H83	4:32	5:14		1947	3	1092	216.9	
	H84	4:35	5:26		1948	1	12286	216.4	
	H85	4:40	5:27		1948	1	3568	213.9	
	H86	4:44	5:28		1951	3	1380	214.0	
	H87	4:48	5:28		1951	3	1050	217.7	
	H88	4:53	5:48		1952	1	3828	213.6	

TELLCO ENVIRONMENTAL

RADON FLUX - FIELD DATA SHEET

CLIENT: Energy Fuels PROJECT: NESHAPS-1995 PROJECT NO.: 95004.00 SHEET 3 OF 3

PILE: 3 AREA: Cover SURFACE: Soil MIN. AIR TEMP DURING SAMPLE PERIOD: 55°F

BATCH: H BKG CPM: 154 WEIGHT OUT: 180 g. DEPLOYMENT DATE: ~~7/26/95~~ DLC 7/26/95 RETRIEVAL DATE: ~~7/27/95~~ D 7/27/95

TECHNICIANS: DLC, JP, SS, JM, SC

COUNTING SYSTEM I. D.: M01/D21 & M02/D20 CALIBRATION DUE: 6/17/96 TARE WEIGHT: 21.2 g.

Counted By: DLC

GRID LOCATION	SAMPLE I. D.	DEPLOYMENT TIME	RETRIEVAL TIME	ANALYSIS DATE	ANALYSIS TIME	COUNT MIN.	GROSS COUNTS	WEIGHT IN	COMMENTS:
	H89	4:58	5:23	7/30/95	1953	2	1128	213.5	
	H90	5:05	5:31	↓	2000	7	1302	209.4	
	H91	5:06	5:33		2003	5	1155	191.5	
	H92	5:07	5:35		2003	5	1235	193.2	
	H93	5:08	5:43		2004	1	2652	206.9	
	H94	5:09	5:53		2004	1	2651	211.4	
	H95	5:10	5:54		2005	2	1016	213.4	
	H96	5:11	5:40		2005	1	32000	214.1	
	H97	5:12	5:41		2007	2	1602	213.4	
	H98	5:13	5:13		2007	1	23641	218.4	
	H99	5:14	5:36		2010	3	1275	213.4	
	H100	5:15	5:37	↓	2010	2	1780	203.5	

TELLCO ENVIRONMENTAL

RADON FLUX - FIELD DATA SHEET

CLIENT: Energy Fuels PROJECT: NESHAPS- 1995 PROJECT NO.: 95004.00 SHEET 1 OF 3

PILE: 3 AREA: Tailings SURFACE: Sandy MIN. AIR TEMP DURING SAMPLE PERIOD: 58°F

BATCH: J BKG CPM: .94 WEIGHT OUT: 180 g. DEPLOYMENT DATE: 7/25/95 RETRIEVAL DATE: 7/26/95

TECHNICIANS: DL, JD, SS, JM, SC

COUNTING SYSTEM I. D.: M01/D21 & M02/D20 CALIBRATION DUE: 6/17/96 TARE WEIGHT: 29.2 g.

Counted By: DL

GRID LOCATION	SAMPLE I. D.	DEPLOYMENT TIME	RETRIEVAL TIME	ANALYSIS DATE	ANALYSIS TIME	COUNT MIN.	GROSS COUNTS	WEIGHT IN	COMMENTS:
	J01	10:56	12:14	7/30/95	2012	1	13099	221.7	
	J02	11:00	12:14		2012	1	21907	223.8	
	J03	11:08	12:15		2013	1	14693	222.7	
	J04	11:09	12:15		2013	1	9504	217.9	
	J05	11:10	12:15		2014	1	9122	214.7	
	J06	11:11	12:17		2014	1	12068	221.1	
	J07	11:11	12:19		2016	1	22354	222.1	
	J08	11:14	12:19		2016	1	7598	218.5	
	J09	11:16	12:20		2017	1	14493	218.2	
	J10	11:17	12:20		2017	1	9520	220.4	
	J11	11:18	12:21		2018	1	53816	222.9	
	J12	11:19	12:21		2018	1	14997	219.9	
	J13	11:22	12:22		2019	1	8924	218.4	
	J14	11:23	12:23		2019	1	5129	219.2	
	J15	11:25	12:24		2021	1	24695	216.0	
	J16	11:28	12:25		2021	1	35246	200.2	
	J17	11:31	12:25		2023	1	14060	218.9	
	J18	11:32	12:26		2023	1	34154	218.3	
	J19	11:35	12:27		2024	1	22575	203.3	
	J20	11:36	12:27		2024	1	2104	220.9	
	J21	11:37	12:29		2026	1	18899	222.1	
	J22	11:41	12:30		2026	1	12134	225.7	
	J23	11:42	12:30		2028	1	21198	222.9	
	J24	11:45	12:31		2028	1	24397	220.8	
	J25	11:47	12:32		2100	1	34703	220.6	
	J26	11:48	12:33		2100	1	21841	219.7	
	J27	11:50	12:33		2102	1	19900	222.9	
	J28	11:51	12:36		2102	1	23419	222.2	
	J29	11:54	12:37		2103	1	14434	197.1	
	J30	11:56	12:38		2103	1	188228	206.9	
	J31	11:57	12:38		2105	1	17329	220.0	
	J32	12:59	12:38		2105	1	30177	217.5	
	J33	1:01	12:39		2106	1	20063	217.9	
	J34	1:02	1:00		2106	1	24677	200.1	
	J35	1:04	1:03		2108	1	6323	213.3	
	J36	1:05	1:03		2108	1	97148	197.9	
	J37	1:07	1:04		2110	1	5656	221.0	
	J38	1:08	1:04		2110	1	35504	223.8	
	J39	1:14	2:05		2111	1	18286	218.7	
	J40	1:15	2:06		2111	1	10248	195.5	
	J41	1:18	2:07		2112	1	7786	218.2	
	J42	1:21	2:08		2112	1	8942	210.4	
	J43	1:23	2:09		2113		6074	214.8	
	J44	1:24	2:10		2113		12073	204.8	

TELLCO ENVIRONMENTAL

RADON FLUX - FIELD DATA SHEET

CLIENT: ~~Energy~~ Fuels PROJECT: NESHAPS - 1995 PROJECT NO.: 95004.00 SHEET 2 OF 3

PILE: 2 3 AREA: Tailings SURFACE: Sandy MIN. AIR TEMP DURING SAMPLE PERIOD: ~~52~~ 58 °F

BATCH: J BKG CPM: 154 WEIGHT OUT: 180 g. DEPLOYMENT DATE: 7/25/95 RETRIEVAL DATE: 7/26/95

TECHNICIANS:

COUNTING SYSTEM I. D.: M01/D21 & M02/D20 CALIBRATION DUE: 6/17/96 TARE WEIGHT: 29.2 g.

Counted By: DLC

GRID LOCATION	SAMPLE I. D.	DEPLOYMENT TIME	RETRIEVAL TIME	ANALYSIS DATE	ANALYSIS TIME	COUNT MIN.	GROSS COUNTS	WEIGHT IN	COMMENTS:
	J45	1:26	2:11	7/30/95	2116	1	12390	223.6	
	J46	1:28	2:11		2115	1	17452	226.1	
	J47	1:30	2:12		2117	1	16234	227.6	
	J48	1:32	2:13		2117	1	32620	199.1	
	J49	1:35	2:14		2119	1	26261	202.8	
	J50	1:35	2:15		2119	1	21021	218.4	
	J51	1:37	2:15		2120	1	11479	214.5	
	J52	1:47	2:16		2120	1	6277	203.1	
	J53	1:49	2:17		2122	1	1997	209.3	
	J54	1:51	2:19		2122	1	19911	218.9	
	J55	1:53	2:18		2123	2	1094	217.2	
	J56	1:53	2:45		2123	1	22854	219.0	
	J57	1:57	2:46		2125	1	1779	220.3	
	J58	1:59	2:47		2125	1	4902	219.2	
	J59	2:00	2:49		2127	1	~~15967~~	203.7	15967
	J60	2:03	2:50		2127	1	~~18530~~	195.8	17822
	J61	2:05	2:52		2130	1	15967	217.8	
	J62	2:08	2:53		2130	1	18530	218.4	
	J63	2:12	2:54		2131	1	23709	231.0	
	J64	2:15	2:55		2131	2	1084	220.1	
	J65	2:18	4:37		2133	1	1133	210.4	
	J66	2:21	4:38		2133	1	46598	204.2	
	J67	2:23	4:50		2135	1	70342	205.2	
	J68	2:25	4:51		2135	1	23435	220.2	
	J69	2:28	4:52		2140	1	13731	201.4	
	J70	2:29	4:36		2140	1	6997	198.3	
	J71	2:33	2:59		2142	1	7650	219.1	
	J72	2:36	4:35		2142	1	7396	218.4	
	J73	2:39	4:53		2145	2	1062	210.6	
	J74	2:42	4:54		2145	1	2196	222.1	
	J75	2:42	4:56		2146	1	8944	226.0	
	J76	2:44	4:55		2146	1	11776	219.9	
	J77	2:46	4:23		2200	1	18449	192.7	
	J78	2:48	5:03		2200	1	13136	218.2	
	J79	2:49	4:26		2203	1	12252	219.7	
	J80	3:30	4:26		2203	1	14924	221.4	
	J81	2:50	4:22		2204	1	13949	192.6	
	J82	2:55	4:28		2204	1	1468	216.5	
	J83	2:56	4:21		2205	1	9019	219.9	
	J84	2:59	4:27		2205	1	19701	214.1	
	J85	3:02	3:06		2206	1	3298	223.5	
	J86	3:03	3:07		2210	5	1155	210.7	
	J87	3:05	3:08		2212	1	18372	194.0	
	J88	3:07	4:20		2212	1	34939	204.6	

TELLCO ENVIRONMENTAL

RADON FLUX - FIELD DATA SHEET

CLIENT: EnergyFuels PROJECT: NESHAPS 1995 PROJECT NO.: 95004.00 SHEET 3 OF 3

PILE: 3 AREA: Tailings SURFACE: Sandy MIN. AIR TEMP DURING SAMPLE PERIOD: 58°F

BATCH: J BKG CPM: 15+ WEIGHT OUT: 180g. DEPLOYMENT DATE: 7/25/95 RETRIEVAL DATE: 7/26/95

TECHNICIANS: DLC, JD, SS, JM, SC

COUNTING SYSTEM I. D.: M01/D21 & M02/D20 CALIBRATION DUE: 6/17/96 TARE WEIGHT: 29.2 g.

GRID LOCATION	SAMPLE I. D.	DEPLOYMENT TIME	RETRIEVAL TIME	ANALYSIS DATE	ANALYSIS TIME	COUNT MIN.	GROSS COUNTS	WEIGHT IN	COMMENTS:
	J89	3:09	3:04	7/30/95	2115	1	11165	214.7	
	J90	3:09	3:20	↓	2115	1	16405	218.7	
	J91	3:11	4:29		2116	1	14655	221.7	
	J92	3:12	3:02		2116	1	11413	216.9	
	J93	3:14	4:33		2118	1	3646	218.4	
	J94	3:15	3:01		2118	1	2995	209.7	
	J95	3:16	4:34		2119	1	4591	221.6	
	J96	3:18	5:00		2119	1	18000	224.9	
	J97	3:18	5:01		2120	1	9160	221.4	
	J98	3:19	4:59		2120	1	21863	200.0	
	J99	3:20	4:58		2121	1	15240	218.9	
	J100	3:00	2:16	↓	2121	1	9450	230.9	

TELLCO ENVIRONMENTAL

RADON FLUX - FIELD DATA SHEET

CLIENT: Energy Fuels PROJECT: Weshops PROJECT NO.: 95004.00 SHEET 1 OF 3

PILE: 2 AREA: Tailings SURFACE: Sandy MIN. AIR TEMP DURING SAMPLE PERIOD: 52°F

BATCH: K BKG CPM: 154 WEIGHT OUT: 180 g. DEPLOYMENT DATE: 7/24/95 RETRIEVAL DATE: 7/25/95

TECHNICIANS: DK, JD, SS, JM, SC

COUNTING SYSTEM I. D.: M01/D21 & M02/D22 CALIBRATION DUE: 6/17/96 TARE WEIGHT: 29.2 g.

GRID LOCATION	SAMPLE I. D.	DEPLOYMENT TIME	RETRIEVAL TIME	ANALYSIS DATE	ANALYSIS TIME	COUNT MIN.	GROSS COUNTS	WEIGHT IN	COMMENTS:
	K01	9:43	9:50	7/29/95	1720	1	3498	245.0	
	K02	9:47	9:50		1720	1	7615	237.1	
	K03	9:48	9:51		1721	1	6684	241.1	
	K04	9:50	9:52		1721	1	6412	242.8	
	K05	9:52	9:52		1722	1	12585	232.7	
	K06	9:53	9:53		1722	1	11259	240.8	
	K07	9:54	9:54		1723	1	7502	248.5	
	K08	9:57	9:57		1723	1	1201	238.0	
	K09	9:59	9:58		1724	1	2059	253.8	
	K10	10:01	9:59		1724	1	7837	249.7	
	K11	10:02	9:59		1725	1	86011	242.8	
	K12	10:05	10:00		1725	1	4758	248.8	
	K13	[illegible]	10:00		1726	1	12790	239.5	
	K14	10:01	10:03		1726	1	24687	239.6	
	K15	10:02	10:03		1727	1	45848	240.4	
	K16	10:03	10:04		1727	1	36250	222.6	
	K17	10:14	10:04		1728	1	2435	247.4	
	K18	10:16	10:04		1728	1	7688	244.4	
	K19	10:18	10:05		1730	1	10659	248.1	
	K20	10:20	10:05		1730	1	4940	248.7	
	K21	10:22	10:06		1731	1	4450	245.8	
	K22	10:23	10:28		1731	1	9550	242.2	
	K23	10:25	10:28		1732	1	11469	244.7	
	K24	10:26	10:29		1732	1	30602	234.3	
	K26	10:30	10:30		1733	1	20796	234.9	
	K27	10:30	10:30		1733	3	1476	226.1	
	K28	10:42	10:42		1735	1	8785	246.8	
	K29	10:45	10:46		1735	1	5796	237.7	
	K30	10:47	10:46		1736	1	6082	223.4	
	K31	10:51	10:51		1736	2	1610	231.0	
	K32	10:54	11:38		1738	1	1679	224.0	
	K33	10:56	11:38		1738	2	1428	221.3	
	K34	10:58	11:39		1740	1	2789	232.0	
	K35	11:00	11:39		1740	1	1042	233.4	
	K36	11:02	11:40		1742	2	1812	229.7	
	K37	11:04	11:40		1742	3	1344	237.0	
	K38	11:06	11:41		~~1744~~	1.	13201	34.0	Void - lost cha
	K39.	11:07	11:42		1744	1	1161	230.3	13201
	K25	10:28	10:38		1745	1	~~23021~~	234.9	23021
	K40	11:09	11:43		1746	3	1314	240.5	1161
	K41	11:11	11:44		1750	1	~~23021~~	237.0	1314
	K42	11:14	12:12		1751	2	1638	239.6	
	K43	11:16	12:12		1752	3	1404	233.0	
	K44	11:18	12:13		1755	1	10348	229.3	

TELLCO ENVIRONMENTAL

RADON FLUX - FIELD DATA SHEET

CLIENT: Energy Fuels PROJECT: NESHAPS - 1995 PROJECT NO.: 95004.00 SHEET 2 OF 3

PILE: 2 AREA: Tailings SURFACE: Sandy MIN. AIR TEMP DURING SAMPLE PERIOD: 52°F

BATCH: K BKG CPM: 1.4 WEIGHT OUT: 180 g. DEPLOYMENT DATE: 7/24/95 RETRIEVAL DATE: 7/25/95

TECHNICIANS: DH, JD, SS, JM, SC

COUNTING SYSTEM I. D.: M01/D21 & M02/D20 CALIBRATION DUE: 6/17/96 TARE WEIGHT: 29.2 g.

GRID LOCATION	SAMPLE I. D.	DEPLOYMENT TIME	RETRIEVAL TIME	ANALYSIS DATE	ANALYSIS TIME	COUNT MIN.	GROSS COUNTS	WEIGHT IN	COMMENTS:
	K45	11:20	12:13	7/29/95	1756	2	1132	233.8	
	K46	11:22	12:14		1756	1	2014	240.0	
	K47	11:24	12:30		1758	1	3022	236.6	
	K48	11:25	12:35		1758	1	4552	226.6	
	K49	11:27	12:35		1759	1	2414	233.7	
	K50	11:28	12:31		1800	3	1209	234.7	
	K51	11:30	12:31		1802	1	1699	230.6	
	K52	11:34	12:30		1804	3	1353	235.3	
	K53	11:37	12:29		1805	2	1074	234.7	
	K54	11:39	12:28		1806	2	1898	233.0	
	K55	11:40	12:28		1807	1	1031	231.2	
	K56	11:42	12:27		1809	2	1002	235.9	
	K57	11:43	12:26		1811	3	1302	233.9	
	K58	11:44	12:25		1812	1	3356	235.1	
	K59	11:46	12:26		1814	2	1048	241.1	
	K60	11:50	12:25		1815	1	1582	237.0	
	K61	11:51	12:24		1816	1	1081	236.9	
	K62	11:54	12:24		1816	1	2858	218.1	
	K63	11:54	12:24		1817	1	10213	236.7	
	K64	11:54	12:23		1817	1	9085	241.3	
	K65	11:56	12:23		1818	1	10931	232.8	
	K66	11:56	12:21		1818	1	52001	24[illegible]	
	K67	11:56	12:22		1819	1	5646	[illegible]	
	K68	11:58	12:45		1819	1	13145	247.4	
	K69	12:02	12:46		1820	1	4775	223.8	
	K70	12:03	12:48		1820	1	6460	223.6	
	K71	12:05	12:47		1821	1	1511	230.6	
	K72	12:06	12:46		1821	1	3130	220.9	
	K73	12:07	12:47		1822	1	13610	240.1	
	K74	12:08	DESTROYED		1822	1	2608	139.2	Void - Lost Charcoal
	K75	12:09	13:16		1823	1	15408	239.7	
	K76	12:10	13:11		1823	1	50273	237.1	
	K77	12:11	13:12		1824	1	13054	241.9	
	K78	12:12	13:13		1824	1	2798	219.0	
	K79	12:12	13:14		1825	1	7260	236.1	
	K80	12:13	13:15		1825	1	1776	227.5	
	K81	12:14	13:16		1826	1	15389	238.2	
	K82	12:15	13:17		1826	1	11428	230.2	
	K83	12:16	13:18		1828	1	23031	223.2	
	K84	12:16	13:19		1828	1	3086	229.9	
	K85	12:17	13:20		1829	1	6384	233.2	
	K86	12:18	13:21		1829	1	2403	239.9	
	K87	12:20	13:31		1830	1	7509	236.2	
	K88	12:21	13:32		1830	1	12993	217.4	

TELLCO ENVIRONMENTAL

RADON FLUX - FIELD DATA SHEET

CLIENT: Energy Fuels PROJECT: NESHAPS - 1995 PROJECT NO.: 95004.00 SHEET 3 OF 3

PILE: 2 AREA: Tailings SURFACE: Sandy MIN. AIR TEMP DURING SAMPLE PERIOD: 52°F
BATCH: K BKG CPM: 56 WEIGHT OUT: 180 g. DEPLOYMENT DATE: 7/24/95 RETRIEVAL DATE: 7/25/95
TECHNICIANS: DLC, JD, SS, JM, SC
COUNTING SYSTEM I. D.: M01/D21 & M02/D20 CALIBRATION DUE: 6/17/96 TARE WEIGHT: 24.2 g.

GRID LOCATION	SAMPLE I. D.	DEPLOYMENT TIME	RETRIEVAL TIME	ANALYSIS DATE	ANALYSIS TIME	COUNT MIN.	GROSS COUNTS	WEIGHT IN	COMMENTS:
	K89	12:22	12:48	7/29/95	1831	1	3.76	234.4	
	K90	12:23	13:33	↓	1831	1	2701	232.9	
	K91	12:26	13:29	↓	1832	1	8964	225.2	
	K92	12:27	13:22	↓	1832	1	49223	239.8	
	K93	12:28	13:23	↓	1833	1	11651	233.7	
	K94	12:29	13:24	↓	1833	1	23485	233.9	
	K95	12:30	13:25	↓	1834	1	7193	223.8	
	K96	12:31	13:26	↓	1834	1	24826	220.1	
	K97	12:32	13:27	↓	1836	1	9829	240.5	
	K98	12:33	13:28	↓	1836	1	4002	221.9	
	K99	12:34	13:30	↓	1837	1	20306	220.6	
	K100	12:35	12:45	↓	1837	1	4756	230.6	
	K101	12:37	12:40	↓	1838	1	12130	224.4	

TELLCO ENVIRONMENTAL

RADON FLUX - FIELD DATA SHEET

CLIENT: Energy Fuels PROJECT: NESHAPS-1995 PROJECT NO.: 95004.00 SHEET 1 OF 3

PILE: 2 AREA: Cover SURFACE: Soil MIN. AIR TEMP DURING SAMPLE PERIOD: 55°F

BATCH: L BKG CPM: 154 WEIGHT OUT: 180 g. DEPLOYMENT DATE: 7/27/95 RETRIEVAL DATE: 7/28/95

TECHNICIANS: DLC, JD, SS, JM, SC

COUNTING SYSTEM I. D.: M01/D21 & M02/D20 CALIBRATION DUE: 6/17/96 TARE WEIGHT: 37.2g.

Counted by: DLC

GRID LOCATION	SAMPLE I. D.	DEPLOYMENT TIME	RETRIEVAL TIME	ANALYSIS DATE	ANALYSIS TIME	COUNT MIN.	GROSS COUNTS	WEIGHT IN	COMMENTS:
	L01	4:14	5:08	7/30/95	1630	1	13183	213.3	
	L02	4:15	5:09	↓	1630	1	13717	212.2	
	L03	4:20	5:10		1631	1	~~[illegible]~~	212.5	6233
	L04	4:20	5:11		1631	1	~~10803~~	215.9	8714
	L05	4:22	5:12		1632	1	~~2559~~	211.5	1675
	L06	4:22	5:13		1632	1	~~[illegible]~~	210.7	10803
	L07	4:24	5:14		1633	1	2559	212.9	
	L08	4:24	5:15		1633	1	2601	211.2	
	L09	4:25	5:16		1634	1	12710	214.7	
	L10	4:25	5:17		1634	1	2175	215.5	
	L11	4:26	5:18		1636	2	1622	214.3	
	L12	4:26	5:19		1636	1	2211	217.4	
	L13	4:30	5:20		1637	1	2055	212.2	
	L14	4:30	5:21		1637	3	1416	214.2	
	L15	4:33	5:22		1637	2	1904	212.4	
	L16	4:33	5:23		1639	3	1244	213.5	
	L17	4:35	5:24		1641	1	3647	214.3	
	L18	4:35	5:25		1641	2	1786	214.9	
	L19	4:37	5:26		1643	1	3462	214.7	
	L20	4:37	5:27		1643	1	6437	212.6	
	L21	4:39	5:28		1644	1	1674	213.5	
	L22	4:39	5:29		1645	1	4613	213.4	
	L23	4:41	5:30		1646	1	3981	214.2	
	L24	4:41	5:31		1646	1	19118	215.8	
	L25	4:43	5:32		1647	1	2304	211.2	
	L26	4:43	5:33		1647	1	10133	214.6	
	L27	4:45	5:34		1648	1	2144	214.3	
	L28	4:45	5:35		1648	1	2715	213.6	
	L29	4:47	5:36		1649	1	2091	212.9	
	L30	4:47	5:37		1649	3	1011	211.4	
	L31	4:49	5:38		1651	3	1251	219.5	
	L32	4:49	5:39		1651	2	1188	216.9	
	L33	4:54	5:40		1654	2	1458	213.5	
	L34	4:54	5:42		1654	1	13210	214.8	
	L35	4:56	5:44		1656	2	1124	217.9	
	L36	4:56	5:44		1656	1	3963	211.2	
	L37	4:58	5:45		1659	3	1131	216.6	
	L38	4:58	5:45		1659	3	1128	215.0	
	L39	5:00	5:46		1703	4	1056	207.5	
	L40	5:00	5:47		1703	1	14576	211.8	
	L41	5:02	5:48		1705	2	1734	212.1	
	L42	5:02	5:48		1705	2	1276	213.5	
	L43	6:02	6:21		1707	3	1504	212.4	
	L44	6:03	6:22	✓	1707	4	1162	214.9	

TELLCO ENVIRONMENTAL

RADON FLUX - FIELD DATA SHEET

CLIENT: Energy Fuels PROJECT: NESHAPS-1995 PROJECT NO.: 95004.00 SHEET 2 OF 3

PILE: 2 AREA: Cover SURFACE: Soil MIN. AIR TEMP DURING SAMPLE PERIOD: 55°F

BATCH: L BKG CPM: 154 WEIGHT OUT: 180g. DEPLOYMENT DATE: 7/27/95 RETRIEVAL DATE: 7/28/95

TECHNICIANS: DH, JD, SS, JM, SC

COUNTING SYSTEM I. D.: M01/D21 & M02/D20 CALIBRATION DUE: 6/17/96 TARE WEIGHT: 29.7g.

Counted By: DH

GRID LOCATION	SAMPLE I. D.	DEPLOYMENT TIME	RETRIEVAL TIME	ANALYSIS DATE	ANALYSIS TIME	COUNT MIN.	GROSS COUNTS	WEIGHT IN	COMMENTS:
	L45	6:04	6:23	7/30/95	1711	1	10242	211.3	
	L46	6:05	6:23		1711	3	1041	215.3	
	L47	6:06	6:24		1714	3	1434	212.3	
	L48	6:07	6:24		1714	3	1671	214.7	
	L49	6:08	6:21		1716	4	1768	212.9	
	L50	6:09	6:25		1716	1	21744	216.5	
	L51	6:10	6:26		1718	1	8227	215.5	
	L52	6:11	6:27		1718	1	7426	214.2	
	L53	6:12	6:30		1720	2	1716	221.8	
	L54	6:13	6:31		1720	2	1392	215.1	
	L55	6:14	6:32		1723	5	1020	214.3	
	L56	6:15	6:33		1723	5	1152	211.3	
	L57	6:16	6:34		1727	1	3000	216.9	
	L58	6:17	6:30		1727	3	1026	214.8	
	L59	6:18	7:40		1730	2	1632	213.0	
	L60	6:19	7:41		1730	3	1425	212.7	
	L61	6:20	6:40		1733	—	—	Ø	Void Spilled charcoal
	L62	6:21	7:41		1733	1	14811	214.2	
	L63	6:22	7:42		1734	1	2118	212.5	
	L64	6:23	7:43		1734	1	2269	215.0	
	L65	6:24	7:44		1735	1	16766	212.9	
	L66	6:25	7:45		1735	2	1568	214.9	
	L67	6:26	7:46		1737	2	1368	215.1	
	L68	6:27	7:47		1737	2	1152	218.8	
	L69	6:28	7:48		1739	2	1760	215.0	
	L70	6:29	7:49		1740	5	1238	210.6	
	L71	6:30	7:50		1742	1	10218	213.7	
	L72	6:31	7:07		1742	1	8255	216.5	
	L73	6:32	7:02		1745	3	1026	219.6	
	L74	6:33	7:01		1745	3	1416	212.7	
	L75	6:34	7:06		1747	2	1280	211.5	
	L76	6:35	7:15		1747	3	1413	214.9	
	L77	6:36	7:10		1751	4	956	220.7	
	L78	6:37	7:21		1751	4	1612	215.6	
	L79	6:38	7:20		1755	4	1112	223.0	
	L80	6:39	7:16		1755	2	1356	216.4	
	L81	6:40	8:04		1758	3	1068	214.4	
	L82	6:41	8:04		1758	1	22614	218.1	
	L83	6:42	8:03		1802	4	1284	214.4	
	L84	6:43	8:03		1802	4	1496	217.6	
	L85	6:44	8:02		1806	4	1384	212.4	
	L86	6:45	8:02		1806	4	1168	223.7	
	L87	6:46	7:05		1808	2	1090	220.4	
	L88	6:47	6:53		1808	1	4177	213.8	

TELLCO ENVIRONMENTAL

RADON FLUX - FIELD DATA SHEET

CLIENT: Energy Fuels PROJECT: NESHAPS - 1995 PROJECT NO.: 95004.00 SHEET 3 OF 3

PILE: 2 AREA: Cover SURFACE: 30.1 MIN. AIR TEMP DURING SAMPLE PERIOD: 55°F

BATCH: L BKG CPM: 154 WEIGHT OUT: 180 g. DEPLOYMENT DATE: 7/27/95 RETRIEVAL DATE: 7/28/95

TECHNICIANS: DLC, JD, SS, JM, SC

COUNTING SYSTEM I. D.: M01/D21 & M02/D20 CALIBRATION DUE: 6/17/96 TARE WEIGHT: 29.2 g.

Counted By: DLC

GRID LOCATION	SAMPLE I. D.	DEPLOYMENT TIME	RETRIEVAL TIME	ANALYSIS DATE	ANALYSIS TIME	COUNT MIN.	GROSS COUNTS	WEIGHT IN	COMMENTS:
	L89	6:48	6:52	7/30/95	1810	2	1058	213.8	
	L90	6:49	6:40	↓	1810	1	2215	219.2	
	L91	6:50	7:00		1813	3	1071	212.·	
	L92	6:51	6:58		1813	3	1254	213.3	
	L93	6:52	6:46		1816	4	1052	213.2	
	L94	6:53	6:43		1816	1	5169	215.3	
	L95	6:54	7:25		1817	2	1120	212.6	
	L96	6:55	7:24		1817	1	2305	210.7	
	L97	6:56	7:26		1818	1	1003	208.5	
	L98	6:57	7:27		1818	1	1023	210.4	
	L99	6:58	7:56		1819	1	1100	210.3	
	L100	6:59	6:45	↓	1819	1	1060	212.1	

TELLCO ENVIRONMENTAL

Recount H's

RADON FLUX - FIELD DATA SHEET

CLIENT: Energy Fuels PROJECT: NESHAPS - 1995 PROJECT NO.: 95004.00 SHEET 1 OF 4

PILE: 3 AREA: Cover SURFACE: Soil MIN. AIR TEMP DURING SAMPLE PERIOD: 56°F

BATCH: H BKG CPM: 154 WEIGHT OUT: 180g. DEPLOYMENT DATE: 7/26/95 RETRIEVAL DATE: 7/27/95

TECHNICIANS: DK, JD, SS, JM, SC

COUNTING SYSTEM I. D.: M01/D21 & M02/D20 CALIBRATION DUE: 6/17/96 TARE WEIGHT: 29.2g.

Counted By: DK

GRID LOCATION	SAMPLE I. D.	DEPLOYMENT TIME	RETRIEVAL TIME	ANALYSIS DATE	ANALYSIS TIME	COUNT MIN.	GROSS COUNTS	WEIGHT IN	COMMENTS:
	H04	12:58	2:31	7/29/95	1940	2	1029	214.7	
	H05	12:59	2:32	↓	1940	2	1005	193.2	
	H16	1:18	2:38		1943	3	1745	204.9	
	H17	1:20	2:38		1944	4	1561	211.7	
	H29	1:47	2:48		1945	3	1362	217.2	
	H40	2:11	2:54		1945	1	3015	214.9	
	H41	2:13	2:55		1948	3	1332	217.1	
	H53	2:45	3:02		1948	3	1260	215.5	
	H64	3:18	3:17		1951	4	1307	217.0	
	H65	3:20	3:18		1951	4	1612	201.8	
	H88	4:53	5:48		1953	1	4065	213.5	

TELLCO ENVIRONMENTAL

Recounts J's

RADON FLUX - FIELD DATA SHEET

CLIENT: Energy Fuels PROJECT: NESHAPS- 1995 PROJECT NO.: 95004.00 SHEET 2 OF 4

PILE: 3 AREA: Tailings SURFACE: Sandy MIN. AIR TEMP DURING SAMPLE PERIOD: 58°F

BATCH: J BKG CPM: 154 WEIGHT OUT: 180 g. DEPLOYMENT DATE: 7/25/95 RETRIEVAL DATE: 7/26/95

TECHNICIANS: DK, JD, SS, JM, SC

COUNTING SYSTEM I. D.: M01/D21 & M02/D20 CALIBRATION DUE: ~~7/~~ DK 6/17/96 TARE WEIGHT: 29.2 g.

GRID LOCATION	SAMPLE I. D.	DEPLOYMENT TIME	RETRIEVAL TIME	ANALYSIS DATE	ANALYSIS TIME	COUNT MIN.	GROSS COUNTS	WEIGHT IN	COMMENTS:
	J16	11:28	12:25	7/29/95	1954	1	38121	200.7	
	J40	1:15	2:06	↓	1954	1	11839	195.5	
	J41	1:18	2:07		1955	1	8718	218.2	
	J52	1:47	2:16		1955	1	7169	203.0	
	J53	1:49	2:17		1956	1	2258	204.3	
	J65	2:18	4:37		1956	1	1325	219.5	
	J76	2:44	4:35		1957	1	13012	220.0	
	J77	2:46	4:23		1957	1	22017	192.7	
	J88	3:07	4:20		1958	1	38145	204.5	
	J89	3:09	3:04		1958	1	13259	194.7	
	J100	3:00	2:16	↓	1959	1	10901	230.9	

TELLCO ENVIRONMENTAL

Recounts K's

RADON FLUX - FIELD DATA SHEET

CLIENT: Energy Fuels PROJECT: NESHAPS-1995 PROJECT NO.: 95004.00 SHEET 3 OF 4

PILE: 2 AREA: Tailings SURFACE: Sandy MIN. AIR TEMP DURING SAMPLE PERIOD: 52°F
BATCH: K BKG CPM: 154 WEIGHT OUT: 180g. DEPLOYMENT DATE: 7/24/95 RETRIEVAL DATE: 7/25/95
TECHNICIANS: DLC, JD, SS, JM, SC
COUNTING SYSTEM I. D.: M01/D21 & M02/D20 CALIBRATION DUE: 6/17/96 TARE WEIGHT: 29.2g.
Counted By: DLC

GRID LOCATION	SAMPLE I. D.	DEPLOYMENT TIME	RETRIEVAL TIME	ANALYSIS DATE	ANALYSIS TIME	COUNT MIN.	GROSS COUNTS	WEIGHT IN	COMMENTS:
	K03	9:48	9:51	7/30/95	1615	1	4123	241.2	
	K12	10:05	10:00	↓	1615	1	4355	248.8	
	K16	10:03	10:04	↓	1616	1	31697	222.6	
	K28	10:42	10:42	↓	1616	1	8002	248.8	
	K32	10:54	11:38	↓	1618	1	1401	224.1	
	K40	11:09	11:43	↓	1618	1	1095	240.6	
	K56	11:42	12:27	↓	1621	3	1377	236.1	
	K68	11:58	12:45	↓	1621	1	11855	242.8	
	K72	12:06	12:46	↓	1624	1	2755	221.1	
	K 84	12:16	13:19	↓	1624	1	2656	227.5	
	K90	12:23	13:33	↓	1626	1	2309	233.0	

TELLCO ENVIRONMENTAL

Recounts L's

RADON FLUX - FIELD DATA SHEET

CLIENT: Energy Fuels PROJECT: NESHAPS-1995 PROJECT NO.: 95004.00 SHEET 4 OF 4

PILE: 2 AREA: Cover SURFACE: Soil MIN. AIR TEMP DURING SAMPLE PERIOD: 55°F

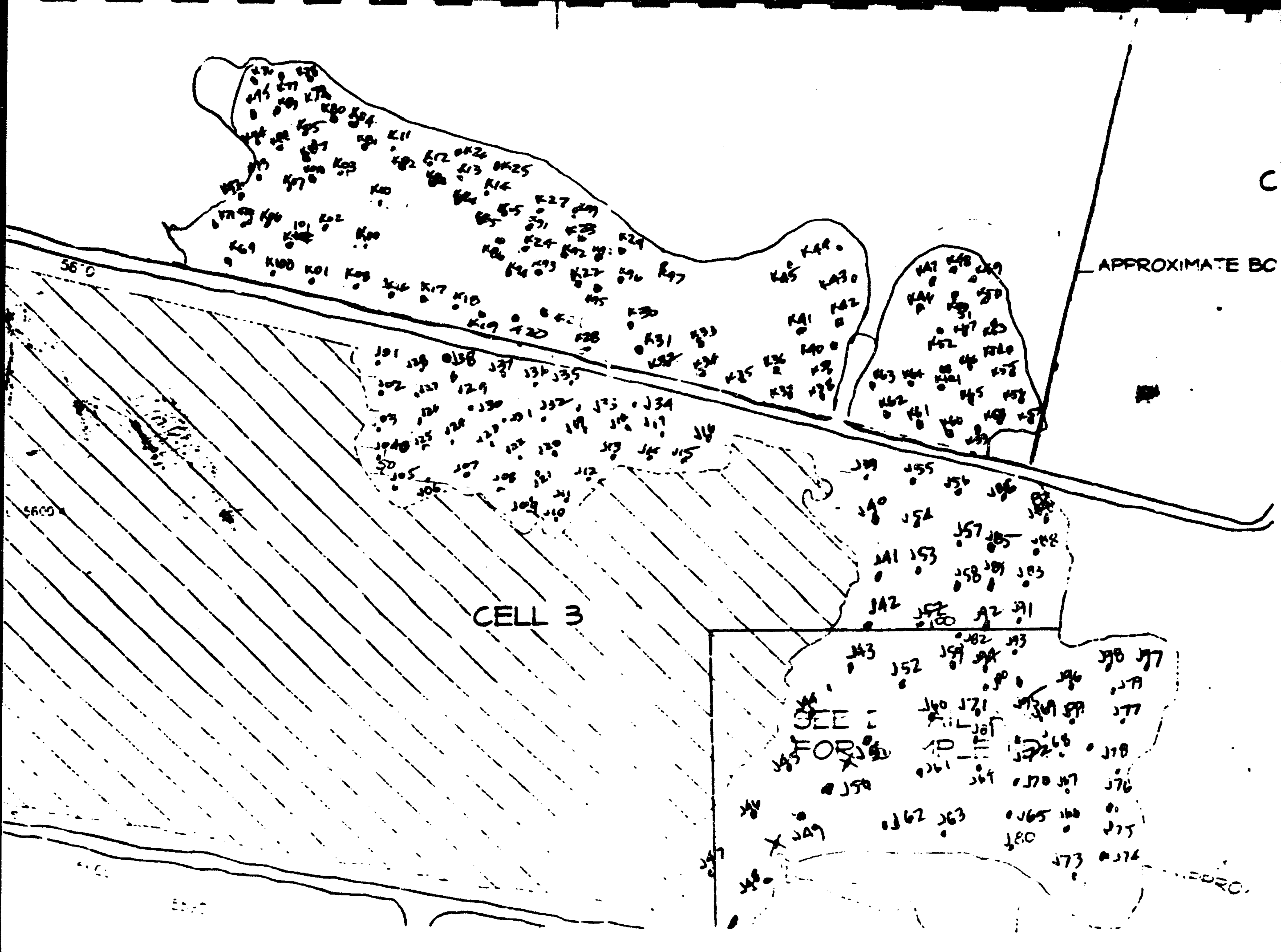
BATCH: L BKG CPM: 154 WEIGHT OUT: 180 g. DEPLOYMENT DATE: 7/27/95 RETRIEVAL DATE: 7/28/95

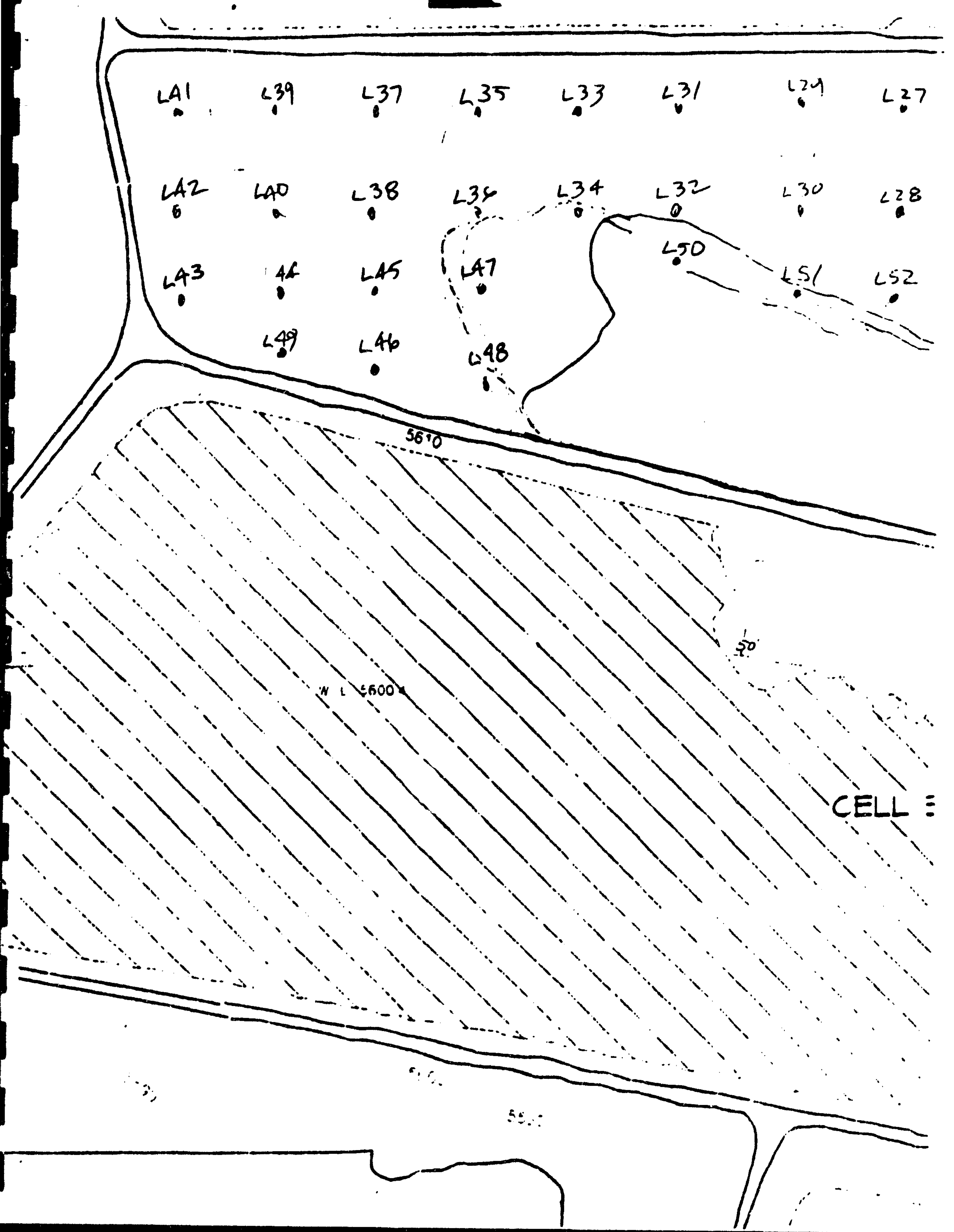
TECHNICIANS: DLC, JD, SS, JM, SC

COUNTING SYSTEM I. D.: M01/D21 & M02/D20 CALIBRATION DUE: 6/17/96 TARE WEIGHT: 29.2g.

Counted By: DLC

GRID LOCATION	SAMPLE I. D.	DEPLOYMENT TIME	RETRIEVAL TIME	ANALYSIS DATE	ANALYSIS TIME	COUNT MIN.	GROSS COUNTS	WEIGHT IN	COMMENTS:
	L13	4:30P	5:20P	7/29/95	1927	1	2180	212.1	
	L18	4:35P	5:25P	↓	1927	1	985	214.9	
	L21	4:39P	5:28P		1928	1	1939	213.5	
	L32	4:49P	5:39P		1928	2	1635	216.9	
	L44	10:03P	10:22P		1932	4	1242	214.9	
	L55	10:14P	10:32P		1932	5	1024	214.3	
	L58	10:17P	10:36P		1935	3	1105	214.8	
	L75	10:34P	7:06P		1935	2	1446	211.5	
	L81	10:40P	8:04P		1938	4	1345	214.4	
	L90	10:45P	10:40P		1937	1	2420	21[illegible]	
	L92	10:51P	10:58P	↓	1939	3	1364	213.3	


APPROXIMATE BC
C
CELL 3
560



LA1
L39
L37
L35
L33
L31
L29
L27
LA2
LA0
L38
L36
L34
L32
L30
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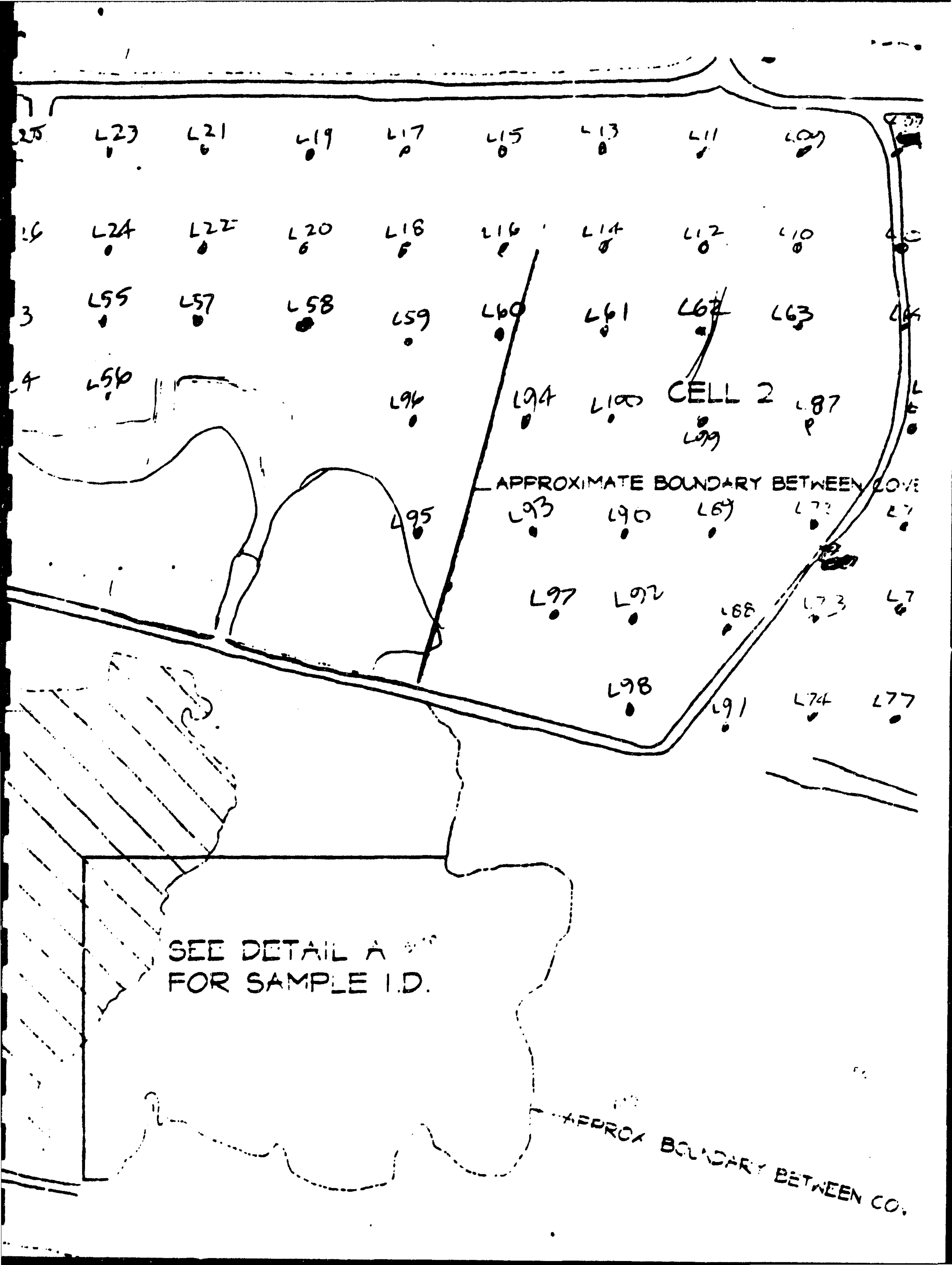
L52
L49
L46
L48
5610
W L 5600
CELL


L23
L21
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L17
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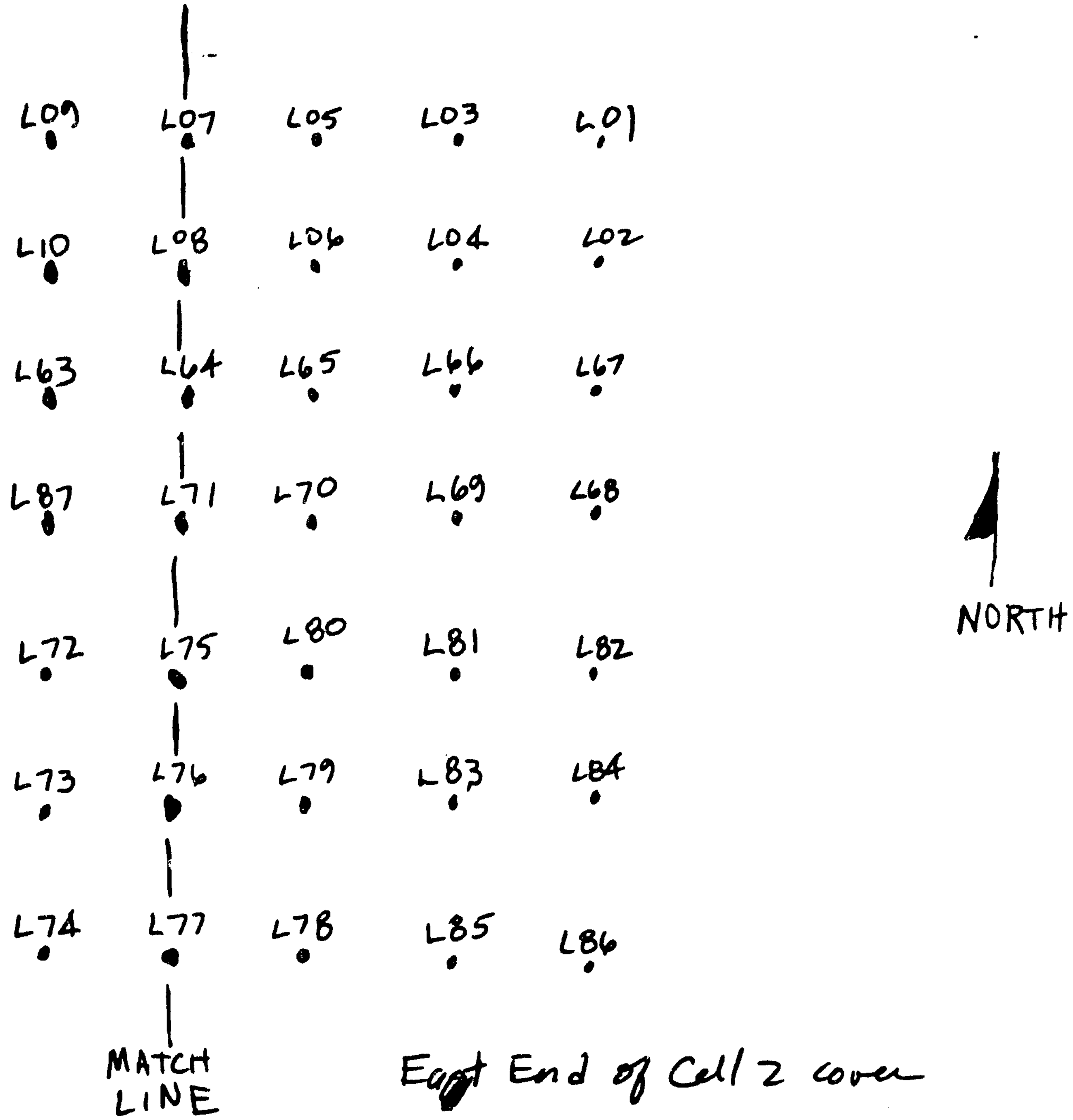
L55
L57
L58
L59
L60
L61
L63
L56
L96
L94
L100
CELL 2
L87
L99
APPROXIMATE BOUNDARY BETWEEN COVE
L95
L93
L90
L69
L97
L92
L88
L73
L98
L91
L74
L77
SEE DETAIL A
FOR SAMPLE I.D.
APPROX BOUNDARY BETWEEN CO.

TELLCO ENVIRONMENTAL

CLIENT Energy Fuels JOB NO. 9500A00

PROJECT 1995 NESHAPS CALCULATIONS FOR Cell 2 - Cover

MADE BY [illegible] DATE 9/24/95 CHECKED BY ____ DATE ____ SHEET ____ OF ____



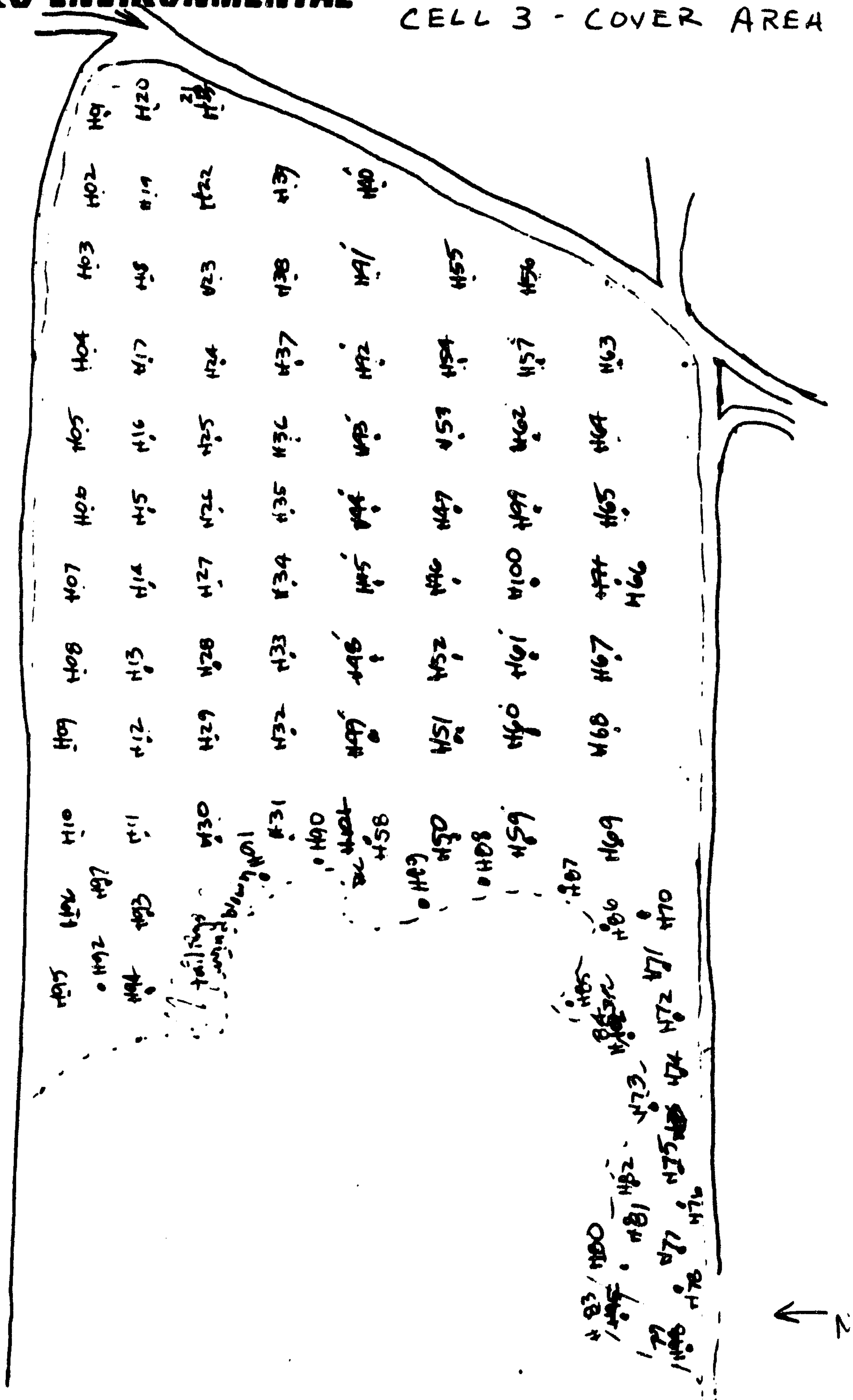
TELLCO ENVIRONMENTAL

CLIENT Energy Fuels - White Mesa Mill JOB NO. 950

PROJECT 1995 NESHAPS CALCULATIONS FOR Cell 3 - Cove

MADE BY DK DATE 9/26/95 CHECKED BY DATE SHEET

CELL 3 - COVER AREA



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SEMI-ANNUAL EFFLUENT REPORT

WHITE MESA MILL

SUA-1358 DOCKET NO. 40-8681

JULY THROUGH DECEMBER 1995

FOR

RECLAMATION

OF

WHITE MESA FACILITIES

BLANDING, UTAH

PREPARED BY

ENERGY FUELS NUCLEAR, INC.

1515 ARAPAHOE STREET, SUITE 900

THREE PARK CENTRAL

DENVER, COLORADO 80202

energy fuels nuclear, inc.
p.o. box 787 • blanding, utah 84511

February 26, 1996

Mr. Joseph Holonich
Branch Chief
U. S. Nuclear Regulatory Commission
High Level Waste and Uranium Recovery Projects Branch
Division of Waste Management, NMSS (T7 J9)
11555 Rockville Pike
Rockville, MD 20852-2738

Re: Energy Fuels Nuclear, Inc.
SUA-1358: Docket No. 40-8681
Semi-Annual Effluent Report

Dear Mr. Holonich:

Attached is the Semi-Annual Effluent Report for the period of July 1, 1995 through December 31, 1995.

If you or your staff have any questions regarding the effluent report, please contact me.

Sincerely yours,

William N. Deal
Plant Manager

xc: Linda Howell, Branch Chief, Fuels Cycle Decomissioning Branch
Bill Sinclair, State of Utah, Division of Radiation Control
Harold Roberts
Michelle Rehmann
Central File

2. Stack Sampling

White Mesa Mill started up mill operations on August 1, 1995 with the grinding of ore at the SAG Mill. Feed to the north yellowcake dryer began on September 8, 1995. Feed to the south yellowcake dryer began on November 9, 1995 due to refractory work with the south dryer center column and hearths. Because both dryers were not running simultaneously until November 1995, stack sampling was not conducted until December 10 through December 30, 1995 during the fourth quarter of 1995. Fourth quarter 1995 samples include the semi-annual Grizzly stack , the semi-annual Demister stack, and the quarterly north and south yellowcake dryers. First quarter 1996 stack sampling was conducted during January 27 through February 3, 1996. First quarter 1996 samples include the baghouse stack, north yellowcake dryer stack, and the south yellowcake dryer stack. Fourth quarter 1995 stack sampling results are listed in Table 24. The stack sampling was conducted by Mr. Don Smith. First quarter 1996 results will be reported in the January 1 through June 30, 1996 effluent report.

3. Environmental, Radiological, and Effluent Monitoring Data

3.1. Environmental Radon

Environmental radon concentrations are determined by Trak Etch detectors furnished by Landauer, previously known as Terradex Corporation. There is one detector at each of the five environmental monitoring stations with a duplicate at BHV-2, the nearest residence. Tellco Environmental e-perms have been discontinued due to the lack of sensitivity to meet the new 10 CFR 20 standard of 0.1 pCi/l. Figure 1 shows the locations of the environmental stations in relation to the mill.

Table 1 and Graphs 1 through 6 show the results. Background has been subtracted from the graph values for comparison to the limit of 0.1 pCi/l in an unrestricted area. Table 2 is used for quality control purposes. Table 2 is the linear regression results comparing BHV-2 to BHV-6 (the duplicate at BHV-2). The calculated r^2 for Landauer analyses shows, for the most part, a correlation attributable to chance. The sample cups for BHV-2 and BHV-6 are located on a power pole, with no vertical spacing and within one inch of each other.

The standard deviation of the differences between the measurements is 0.33 pCi/l. The differences in results between identical measuring devices located in essentially identical positions leads to the conclusion that radon probably cannot be reliably measured by these devices to 1.0 pCi/l let alone the new 10 CFR 20 standard of 0.1 pCi/l.

The mill area (including the ore storage pad and yellowcake dryer) are on a line in the prevailing wind direction with BHV-1 and BHV-2. BHV-1 shows lower radon measurements than BHV-2, nearest resident. It is felt that the agricultural activity at BHV-2 is the cause of higher radon readings. The agricultural activity includes tilling the earth and the application of fertilizers, either of which may cause elevated radon levels. It is also important to note that during the mill run, BHV-4 and BHV-5 radon levels increased. The levels can be attributed to the mill operations including dusting from ore stockpiles and increased traffic along the mill area roads.

Based on License Amendment 41 (issued on September 28, 1995 by the U.S. Nuclear Regulatory Commission), License Condition 24 B was removed from Energy Fuels Nuclear, Inc. Source Material License SUA-1358.

Amendment 41 states that Energy Fuels Nuclear, Inc. can use MILDOS modeling to show compliance at BHV-2 and thereby eliminate the need for quarterly monitoring of environmental radon. Environmental radon was discontinued at the end of the third quarter 1995. Compliance at BHV-2 will be demonstrated using MILDOS.

3.2. Environmental Gamma

Gamma radiation levels at the five environmental locations (with a duplicate at BHV 2, nearest resident) are determined by Thermal Luminescent Dosimeters (TLDs) furnished by Eberline Instruments. The badges are exchanged quarterly and the data is presented in Tables 3 through 7 and Graphs 7 through 13. Graph 7 shows that the readings appear to be more correlated to one another than location. That is, the levels tend to move up and down as a group. There appears to be an increasing trend since 1984 in the group as a whole. No trends are apparent in the data when background is subtracted. The duplicate at BHV 2 now has 23 quarters of data. There is minimal agreement among the samples with an r^2 of 0.39. Refer to Table 8 and Graph 13.

3.3. Vegetation Samples

Vegetation samples are collected at 3 locations around the mill periphery. The sampling locations are Northeast, Northwest, and Southwest of the mill facility. Vegetation samples are collected during early spring, late spring, and fall. Vegetation results are included as Tables 9 through 11 and Graphs 15 through 17. No trends are apparent as the Ra-226 and Pb-210 concentrations at each sampling location are remaining consistent.

3.4. Environmental Air Monitoring

Air monitoring at the White Mesa mill is accomplished by five high-volume stations. Figure 1 shows the locations. Tables 12 through 16 and Graphs 17 through 20 show the results.

Graphs 17 through 20 show an increase in U-Nat, Ra-226, and Pb-210 concentrations at BHV-5 during the fourth quarter of 1995. These concentrations can be attributed in particular to mill operations associated with the processing of yellowcake such as dusting from the ore stockpiles and increased truck traffic around the ore stockpile and mill areas. The concentrations observed are in line with those concentrations observed during previous operating periods.

Based on License Amendment 41, air particulate radionuclide monitoring at BHV-3 was discontinued at the end of the third quarter 1995 due to the sufficient amount of data (12 years) to establish background concentrations. As a result of this amendment, the air particulate radionuclide concentrations at each monitoring site are calculated by subtracting the appropriate quarterly background average as listed in Enclosure 2 to License Amendment 41. Table 17 shows the radionuclide concentrations at each location with background concentrations subtracted. Table 18 shows the results of the dose calculations including the 50 year dose commitment to the nearest residence. Graphs 21 through 23 show the yearly dose to the nearest resident. No trends are apparent.

3.5. Groundwater Monitoring

Tables 19 and 20 show the results of the groundwater monitoring program at the White Mesa mill. Table 21 shows the QC results for the third and fourth quarter of 1995.

Quarterly results are plotted for this report in Graphs 24 through 53. Table 21 QC results include a column where distilled water that has been flushed through the hose reel is analyzed (in addition to the blind duplicate). It is evident that there is some contamination introduced through the hose reel. It is also evident that the radionuclides are most affected, indicating that either radionuclide assays do not represent the true radionuclide content of the fluid, or that radionuclides preferentially dissolve in the distilled water over other constituents.

Graphs 24 and 25 show the phreatic elevations for the monitor wells. It appears that monitor well 4 and monitor well 11 phreatic elevations are decreasing. At this time, no determinations have been made as to the cause(s) of these decreasing elevations. The monitor wells will continue to be monitored closely and an investigation into possible causes will follow if these elevations continue to decrease. Graph 39.0 shows elevated selenium concentrations for monitor well 15. However, the third and fourth quarter 1995 samples have been sent out to a third party laboratory (Datachem) to confirm the vendor laboratory results. The internal laboratory reassayed both samples and had a consistent result of 0.03 mg/l. After third party laboratory results are received and reviewed, verification samples will be required before any conclusions can be made. In Graphs 40 and 41 which show Nickel concentrations at each well show a higher concentration than normal for all wells. However, the higher concentration is due to a change in the reported detection limit. The limit is 0.05 mg/l instead of 0.01 mg/l. This has been the case since 1994 when Energy Fuels Nuclear, Inc. changed the vendor laboratory to Energy Laboratories, Inc. No trends are apparent.

3.6. Surface Water Monitoring

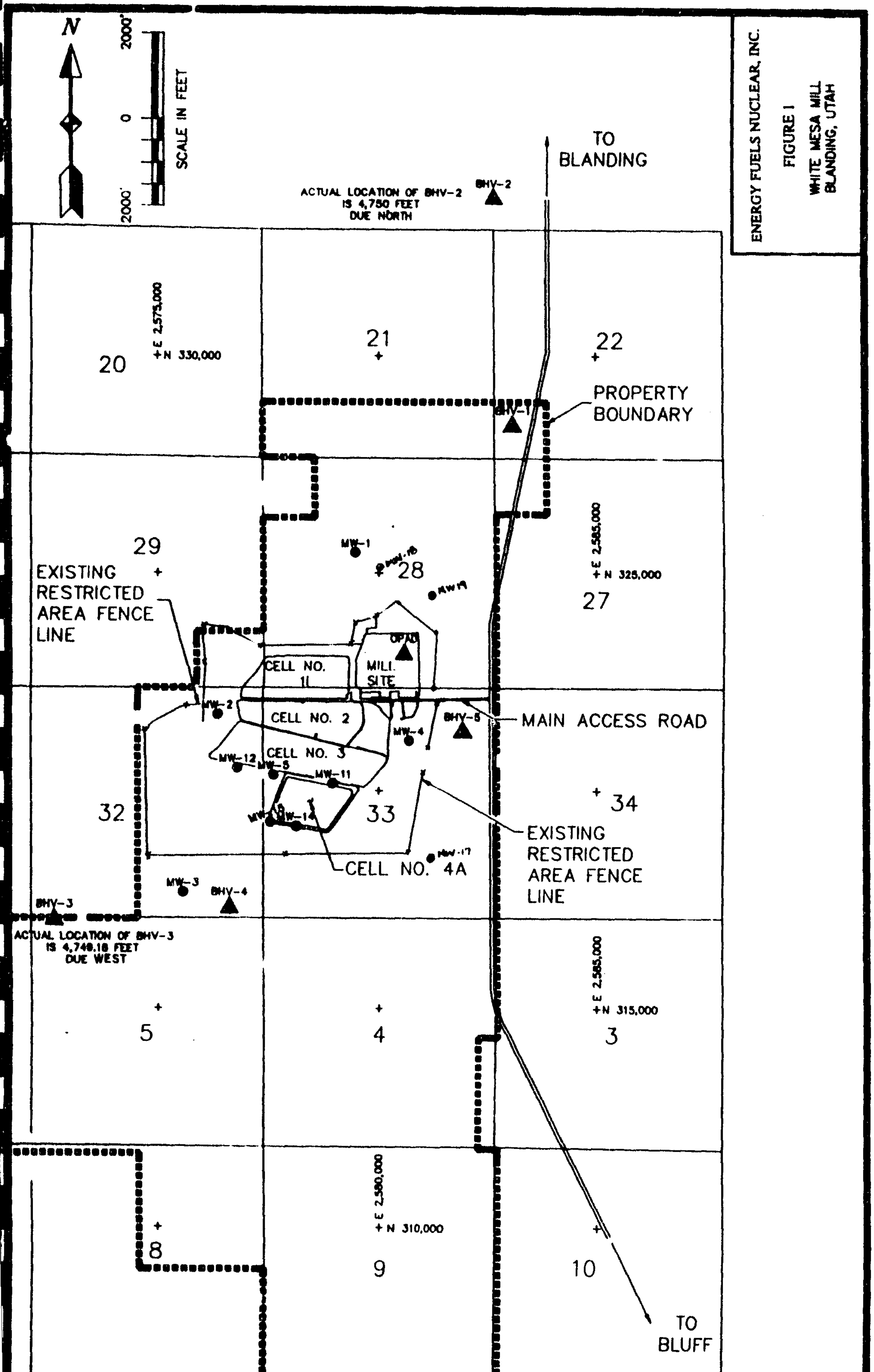
The results of surface water monitoring are presented in Table 22. Cottonwood Creek is sampled semi-annually and Westwater Creek is sampled on an annual basis. QC results are presented in Table 22 A. It is evident from the table that there is variation in the radionuclide concentrations between the samples and their duplicates. However, surface water samples are obtained during run-off, resulting in samples that have considerable amounts of solids present. Since the amount of solids may vary from sample to sample, it is difficult to obtain a duplicate sample that has the same concentrations. No trends are apparent.

3.7 Soil Sampling

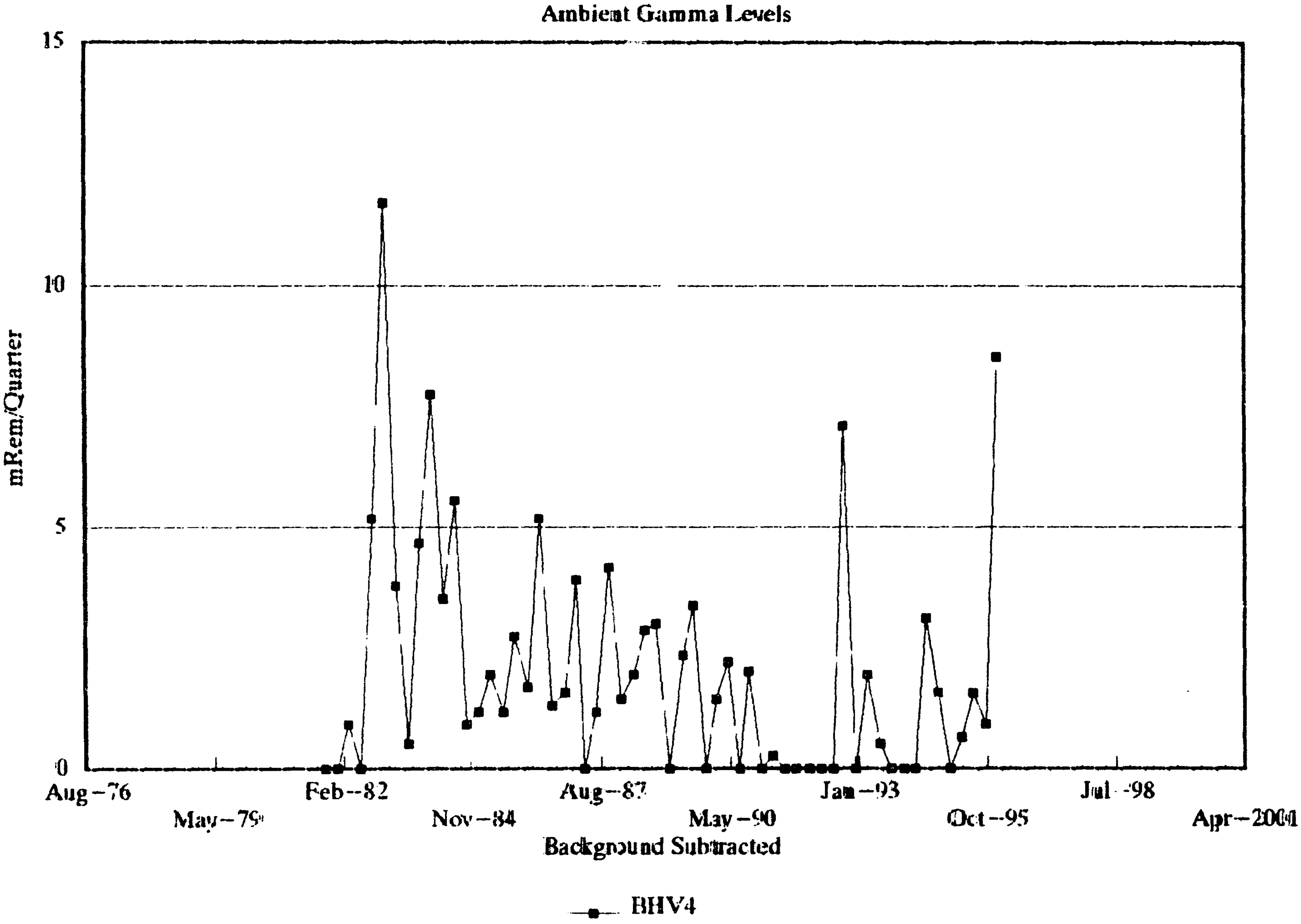
Soil samples were taken on August 28, 1995 at the five BHV locations. Table 23 shows the results.

4. Meteorological Data

The Semi Annual Air Quality and Meteorology Monitoring Report provided by Enecotech is attached as Appendix A.

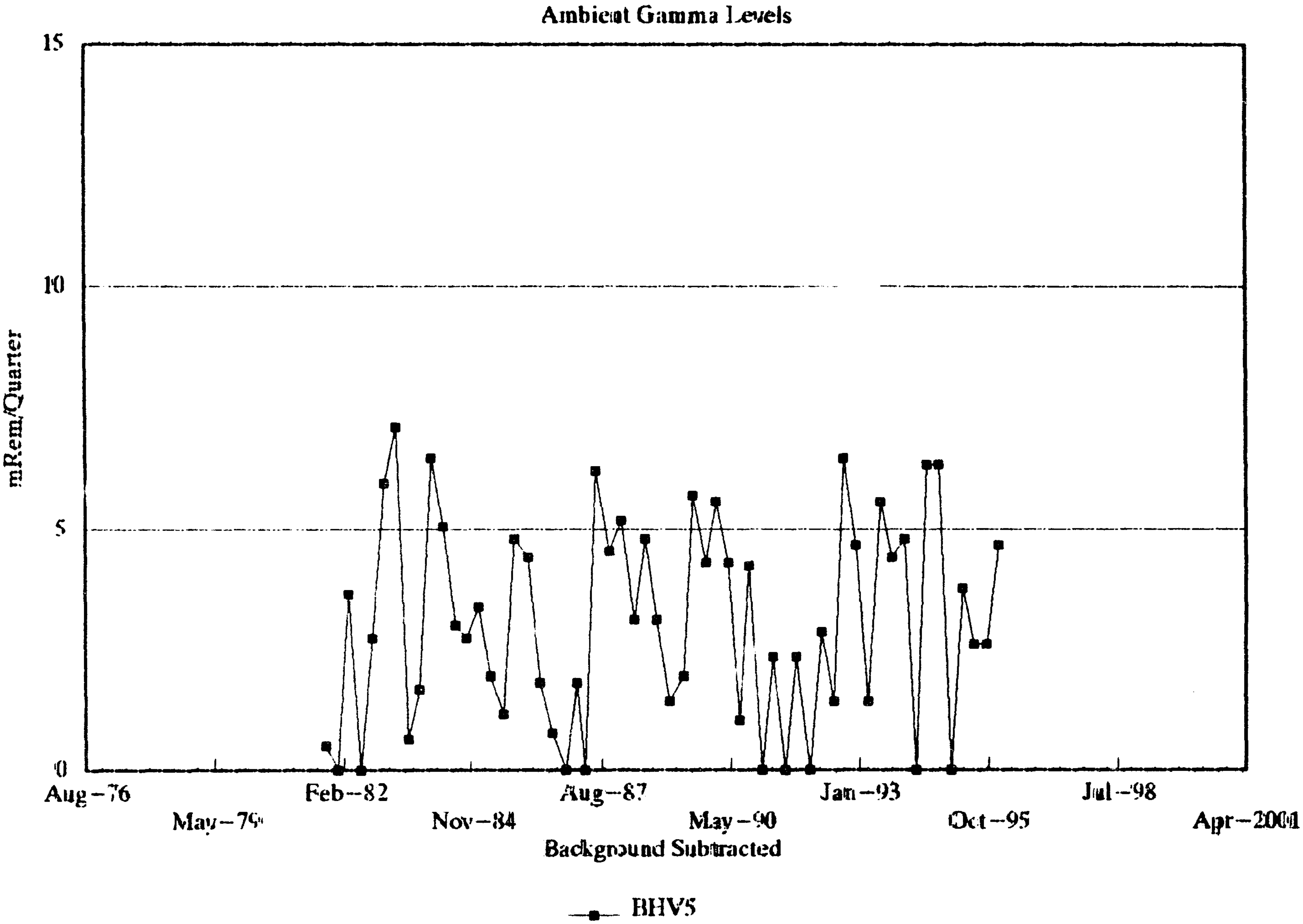

ENERGY FUELS NUCLEAR, INC.
FIGURE 1
WHITE MESA MILL
BLANDING, UTAH
N
SCALE IN FEET
2000
0
2000
TO BLANDING
ACTUAL LOCATION OF BHV-2 IS 4,750 FEET DUE NORTH
BHV-2
E 2,575,000
N 330,000
20
21
22
PROPERTY BOUNDARY
BHV-1
29
28
27
MW-1
E 2,585,000
N 325,000
EXISTING RESTRICTED AREA FENCE LINE
CELL NO. 1
MILL SITE
CELL NO. 2
CELL NO. 3
MW-2
MW-4
BHV-5
MAIN ACCESS ROAD
MW-12
MW-5
MW-11
MW-14
32
33
34
EXISTING RESTRICTED AREA FENCE LINE
CELL NO. 4A
MW-3
BHV-4
BHV-3
ACTUAL LOCATION OF BHV-3 IS 4,740.18 FEET DUE WEST
E 2,585,000
N 315,000
5
4
3
E 2,580,000
N 310,000
8
9
10
TO BLUFF

ENERGY FUELS NUCLEAR, INC.



GRAPH 11

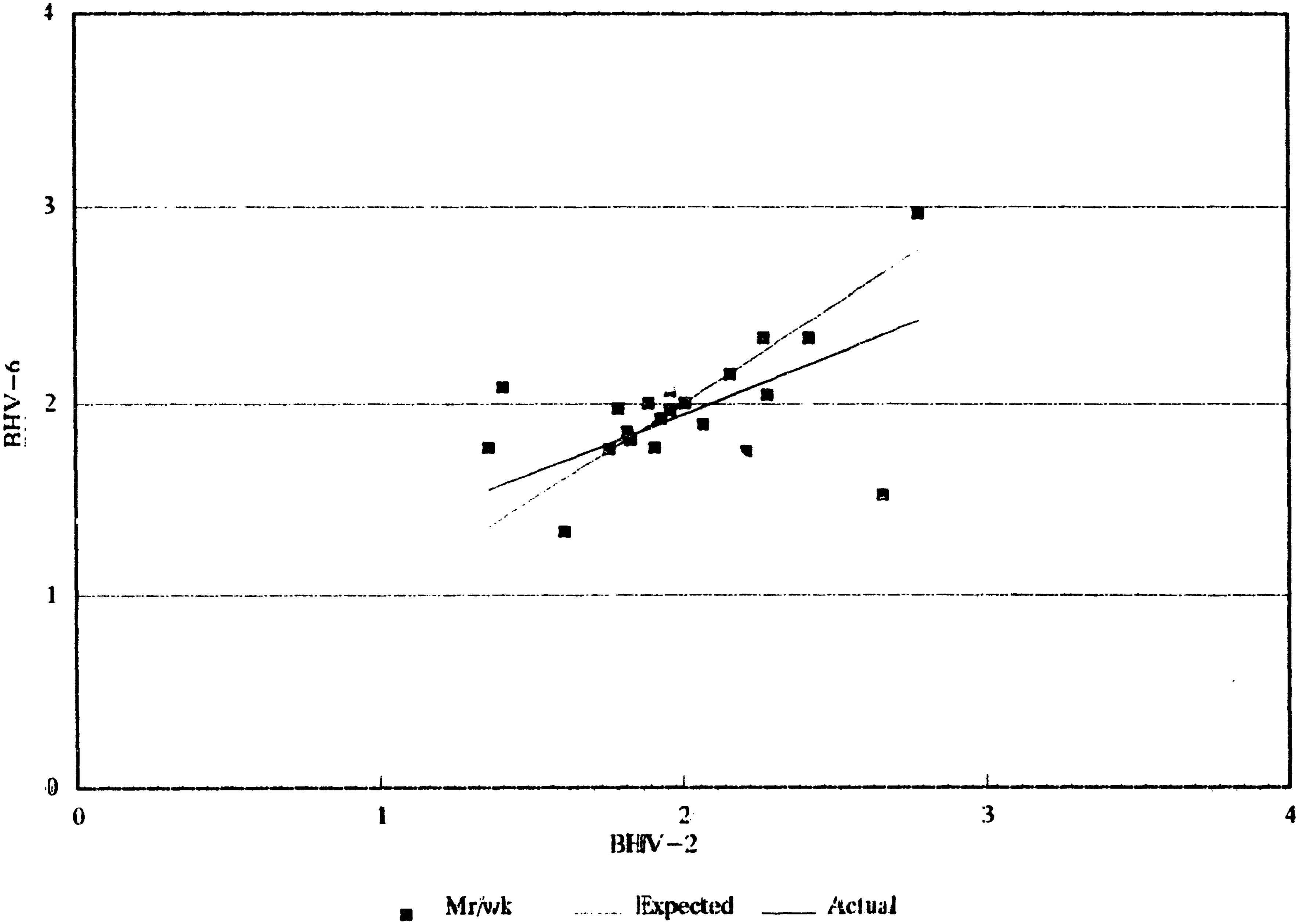
ENERGY FUELS NUCLEAR, INC.



GRAPH 12

ENERGY FUELS NUCLEAR, INC.

Comparison of Duplicate Gamma Values



GRAPH 13

TABLE 9

ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
FORAGE RADIONUCLIDE DATA
NORTH EAST OF MILL

SAMPLED DATE	Ra-226 VALUE uCi/Kg	Ra-226 ERROR uCi/Kg	LLD uCi/Kg 5.00E-08	Pb-210 VALUE uCi/Kg	Pb-210 ERROR uCi/Kg	LLD uCi/Kg 1.00E-06
27-Aug-81	3.90E-04	1.0E-05	5.0E-08	1.10E-03	1.0E-04	1.0E-06
20-Oct-81	1.40E-04	1.0E-05	5.0E-08	6.80E-04	8.0E-05	1.0E-06
15-Apr-82	1.31E-04	1.3E-05	1.0E-06	4.90E-04	7.0E-05	8.0E-05
01-Jul-82	1.60E-04	1.0E-05	5.0E-08	8.00E-04	1.7E-04	1.0E-07
30-Nov-82	2.67E-06	1.1E-06	1.0E-06	1.08E-04	9.0E-06	1.0E-05
13-Apr-83	9.36E-05	6.2E-06	8.0E-09	4.97E-04	9.3E-05	1.0E-04
01-Jul-83	1.12E-04	1.2E-05	6.0E-06	1.84E-04	1.2E-05	1.0E-06
30-Jan-84	1.09E-04	8.0E-06	4.0E-06	7.80E-04	6.2E-05	6.0E-05
28-Jun-84	3.47E-04	1.2E-05	2.0E-09	3.75E-03	1.6E-04	4.0E-08
14-Nov-84	5.61E-04	2.0E-04	2.0E-07	7.82E-03	3.3E-04	7.0E-08
27-Mar-85	1.05E-03	3.0E-05	2.0E-06	3.22E-03	1.4E-04	2.0E-05
15-Jul-85	8.20E-05	7.0E-06	3.0E-06	7.70E-04	1.3E-04	2.0E-04
09-Oct-85	1.15E-04	1.0E-05	3.0E-06	5.10E-04	3.0E-05	2.0E-05
24-Mar-86	5.72E-04	2.1E-05	4.0E-06	2.49E-03	1.0E-04	1.0E-05
10-Jul-86	5.01E-04	1.3E-05	3.0E-06	1.57E-03	1.7E-03	2.0E-04
18-Dec-86	8.70E-04	5.0E-05	3.0E-06	6.80E-04	3.0E-05	3.0E-06
20-Apr-87	5.90E-04	7.0E-05	5.0E-08	1.50E-03	1.0E-04	1.0E-06
05-Jun-87	1.60E-04	3.0E-05	5.0E-08	9.50E-04	4.0E-05	1.0E-06
22-Dec-87	2.10E-04	4.0E-05	5.0E-08	1.70E-03	1.0E-04	1.0E-06
19-Apr-88	4.50E-04	7.0E-05	5.0E-08	1.40E-03	1.0E-04	1.0E-06
28-Jul-88	3.20E-05	2.2E-05	5.0E-08	1.50E-04	4.4E-04	1.0E-06
07-Apr-89	5.60E-04	4.0E-05	***	1.10E-03	1.0E-01	***
06-Jun-89	1.50E-04	2.0E-05	***	2.30E-04	2.0E-05	***
07-Nov-89	6.00E-04	5.0E-05	7.0E-06	2.04E-03	7.0E-05	1.4E-05
17-Apr-90	2.60E-04	3.0E-05	4.0E-06	3.30E-04	2.0E-05	2.2E-05
20-Jun-90	1.80E-04	2.0E-05	5.0E-08	3.20E-04	2.0E-05	1.0E-06
17-Oct-90	1.60E-04	2.0E-05	5.0E-08	3.30E-04	2.0E-05	1.0E-06
10-Apr-91	1.20E-04	2.0E-05	5.0E-06	3.00E-04	2.0E-05	1.0E-06
11-Jun-91	9.10E-05	1.6E-05	2.0E-07	1.90E-04	2.0E-05	2.0E-07
20-Nov-91	4.50E-04	4.0E-05	5.0E-08	1.09E-03	5.0E-05	1.0E-06
22-Apr-92	3.60E-05	1.0E-05	2.0E-06	1.50E-04	2.0E-05	1.0E-05
10-Jun-92	1.00E-05	7.0E-06	2.0E-07	7.50E-05	2.0E-05	1.0E-06
10-Jun-92	7.90E-05	3.5E-05	3.0E-06	7.10E-04	7.0E-05	2.0E-05
13-Apr-93	3.70E-05	2.2E-05	3.0E-06	2.80E-04	3.0E-05	2.0E-05
26-Jun-93	3.00E-05	1.5E-05	3.0E-06	4.30E-05	3.5E-05	2.0E-05
12-Oct-93	6.60E-05	2.7E-05	3.0E-06	5.30E-04	6.0E-05	2.0E-05
11-May-94	1.80E-04	4.0E-05	3.0E-05	4.40E-04	6.0E-05	2.0E-04
19-Jul-94	1.71E-05	1.2E-06	9.0E-08	3.00E-05	6.1E-06	4.5E-06
28-Nov-94	2.40E-04	1.5E-05	1.7E-07	1.70E-04	1.1E-05	8.3E-07
11-Apr-95	6.70E-05	5.4E-06	1.6E-07	1.40E-04	1.3E-05	7.9E-07
06-Jul-95	1.50E-05	1.5E-06	1.5E-07	5.10E-05	4.5E-06	7.6E-07
15-Nov-95	5.50E-05	5.0E-06	1.8E-07	6.70E-05	1.0E-05	8.8E-07

# OBSERVED	42	42	42	42	42	42
MINIMUM	2.67E-06	1.1E-06	2.00E-09	3.00E-05	4.5E-06	4.00E-08
MAXIMUM	1.05E-03	2.0E-04	3.00E-05	7.82E-03	1.0E-01	2.00E-04
MEAN	2.40E-04	2.6E-05	2.19E-06	9.47E-04	2.5E-03	2.50E-05
STD. DEV.	2.44E-04	3.2E-05	4.73E-06	1.36E-03	1.5E-02	5.28E-05

TABLE 10

ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
FORAGE RADIONUCLIDE DATA
NORTH WEST OF MILL

SAMPLED DATE	Ra-226 VALUE uCi/Kg	Ra-226 ERROR uCi/Kg	LLD uCi/Kg 5.00E-08	Pb-210 VALUE uCi/Kg	Pb-210 ERROR uCi/Kg	LLD uCi/Kg 1.00E-06
27-Aug-81	2.73E-03	5.0E-05	5.0E-08	7.10E-03	3.0E-04	1.0E-06
20-Oct-81	2.00E-04	1.0E-05	5.0E-08	8.30E-04	5.0E-05	1.0E-06
15-Apr-82	1.04E-04	9.0E-06	7.0E-06	6.40E-04	5.0E-05	4.0E-05
01-Jul-82	2.00E-05	1.0E-05	5.0E-08	2.20E-04	9.0E-05	1.0E-07
30-Nov-82	2.36E-06	9.5E-07	1.0E-06	8.00E-05	1.0E-05	1.0E-05
13-Apr-83	8.58E-05	1.4E-05	2.0E-08	3.53E-04	1.9E-05	1.0E-05
01-Jul-83	1.19E-04	1.1E-05	5.0E-06	1.58E-04	1.3E-05	1.0E-05
30-Jan-84	9.78E-05	7.0E-06	2.0E-06	2.16E-03	3.4E-04	3.0E-04
28-Jun-84	2.08E-04	1.0E-05	3.0E-09	1.60E-03	7.0E-05	3.0E-08
14-Nov-84	6.05E-04	1.6E-04	2.0E-07	2.58E-03	1.1E-04	3.0E-08
27-Mar-85	1.10E-04	8.0E-06	3.0E-06	8.63E-04	4.2E-05	3.0E-05
15-Jul-85	6.10E-05	6.0E-06	2.0E-06	5.40E-04	5.0E-05	5.0E-05
09-Oct-85	1.07E-04	6.0E-06	2.0E-06	3.80E-04	3.0E-05	2.0E-05
24-Mar-86	8.86E-04	1.8E-05	2.0E-06	4.40E-03	1.9E-04	3.0E-05
10-Jul-86	6.66E-04	1.8E-05	3.0E-06	4.78E-03	2.1E-04	6.0E-05
18-Dec-86	5.20E-04	1.0E-04	3.0E-06	1.70E-03	1.0E-04	6.0E-05
20-Apr-87	4.10E-04	1.0E-04	5.0E-08	1.60E-03	1.0E-04	1.0E-06
05-Jun-87	1.60E-04	3.0E-05	5.0E-08	5.50E-04	4.0E-05	1.0E-06
22-Dec-87	3.60E-04	5.0E-05	5.0E-08	1.80E-03	1.0E-04	1.0E-06
19-Apr-88	2.60E-04	5.0E-05	5.0E-08	1.90E-03	1.0E-04	1.0E-06
28-Jul-88	3.10E-05	1.9E-05	5.0E-08	1.60E-04	4.0E-05	1.0E-06
07-Apr-89	6.20E-04	5.0E-05	***	1.70E-03	1.0E-04	***
06-Jun-89	3.40E-04	3.0E-05	***	7.40E-04	3.0E-05	***
07-Nov-89	5.10E-04	6.0E-05	7.0E-06	1.00E-03	7.0E-05	1.4E-05
18-Apr-90	3.60E-04	3.0E-05	4.0E-06	4.80E-04	2.0E-05	2.2E-05
26-Jun-90	1.70E-04	2.0E-05	5.0E-08	3.20E-04	2.0E-05	1.0E-06
22-Oct-90	8.80E-05	1.6E-05	5.0E-08	2.90E-04	2.0E-05	1.0E-06
10-Apr-91	3.00E-04	3.0E-05	5.0E-06	4.10E-04	2.0E-05	1.0E-06
11-Jun-91	3.10E-04	3.0E-05	2.0E-07	4.70E-04	2.0E-05	2.0E-07
20-Nov-91	5.00E-04	4.0E-05	5.0E-08	1.50E-03	1.0E-04	1.0E-06
22-Apr-92	2.00E-05	8.0E-06	2.0E-06	9.60E-05	1.4E-05	1.0E-05
10-Jun-92	6.50E-06	6.0E-06	2.0E-06	1.20E-04	2.0E-05	1.0E-06
08-Dec-92	1.20E-04	4.0E-05	3.0E-06	1.21E-03	8.0E-05	2.0E-05
13-Apr-93	1.80E-05	1.7E-05	3.0E-06	2.10E-04	3.0E-05	2.0E-05
26-Jun-93	5.20E-05	1.9E-05	3.0E-06	1.70E-05	3.6E-05	2.0E-05
21-Oct-93	5.10E-05	2.3E-05	3.0E-06	7.10E-04	6.0E-05	2.0E-05
11-May-94	1.20E-04	1.0E-05	3.0E-05	9.80E-04	1.6E-04	2.0E-04
19-Jul-94	3.73E-05	1.6E-06	8.4E-08	7.80E-05	7.1E-06	4.2E-07
16-Nov-94	2.40E-04	1.5E-05	1.7E-07	2.60E-04	1.3E-05	8.3E-07
12-Apr-95	8.40E-05	6.1E-06	1.5E-07	1.20E-04	1.1E-05	7.5E-05
06-Jul-95	1.90E-05	1.5E-06	1.4E-07	4.50E-05	4.3E-06	7.2E-07
29-Nov-95	1.20E-04	6.8E-06	1.4E-07	1.00E-05	5.8E-06	7.1E-07
# OBSERVED	42	42	42	42	42	42
MINIMUM	2.36E-06	9.5E-07	3.00E-09	1.00E-05	4.3E-06	3.00E-08
MAXIMUM	2.73E-03	1.6E-04	3.00E-05	7.10E-03	3.4E-04	3.00E-04
MEAN	2.82E-04	2.7E-05	2.23E-06	1.08E-03	6.9E-05	2.47E-05
STD. DEV.	4.37E-04	3.1E-05	4.74E-06	1.41E-03	7.4E-05	5.48E-05

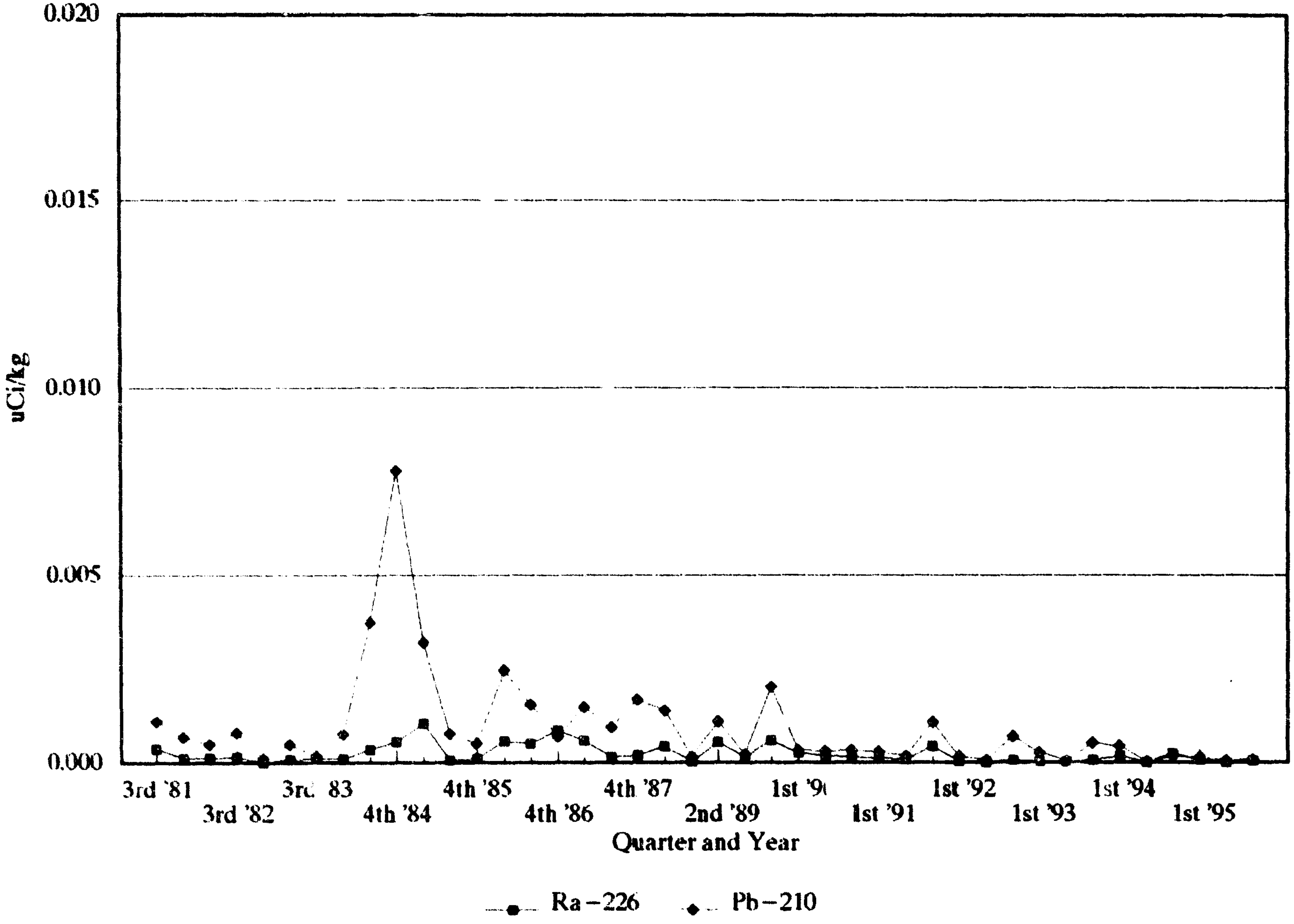
TABLE 11

ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
FORAGE RADIONUCLIDE DATA
SOUTH WEST OF MILL

SAMPLED DATE	Ra-226 VALUE uCi/Kg	Ra-226 ERROR uCi/Kg	LLD uCi/Kg 5.00E-08	Pb-210 VALUE uCi/Kg	Pb-210 ERROR uCi/Kg	LLD uCi/Kg 1.00E-06
27-Aug-81	9.50E-04	2.0E-05	5.0E-08	1.50E-04	1.0E-05	1.0E-06
21-Oct-81	3.00E-05	3.0E-06	5.0E-08	1.50E-04	2.0E-05	1.0E-06
15-Apr-82	1.37E-05	3.0E-06	3.0E-06	3.80E-04	4.0E-05	4.0E-05
01-Jul-82	3.40E-04	2.0E-05	5.0E-08	3.68E-03	2.7E-04	1.0E-07
30-Nov-82	1.75E-05	3.0E-06	2.0E-06	7.92E-04	4.0E-06	2.0E-05
14-Apr-83	7.13E-04	7.3E-05	9.0E-08	2.51E-03	3.0E-04	3.0E-04
01-Jul-83	5.39E-05	4.5E-06	2.0E-06	6.88E-04	4.3E-05	4.0E-05
30-Jan-84	6.40E-05	7.0E-06	4.0E-06	1.20E-03	1.0E-04	4.0E-05
28-Jun-84	8.27E-05	6.3E-06	3.0E-09	1.80E-03	1.0E-04	9.0E-08
14-Nov-84	2.72E-04	1.5E-04	2.0E-07	4.70E-03	7.2E-04	3.0E-07
27-Mar-85	4.73E-04	1.6E-07	3.0E-06	7.07E-04	3.6E-05	3.0E-05
15-Jul-85	6.60E-05	7.0E-06	4.0E-06	4.90E-04	3.0E-05	3.0E-05
09-Oct-85	2.83E-04	2.0E-05	7.0E-06	1.50E-03	1.0E-04	7.0E-05
24-Mar-86	1.57E-04	1.0E-05	4.0E-06	4.14E-03	1.8E-04	3.0E-05
1[illegible]86	3.78E-04	1.0E-05	2.0E-06	1.65E-02	7.0E-04	1.0E-04
18-D[illegible]	2.60E-04	2.0E-05	2.0E-06	1.70E-03	1.0E-04	1.0E-04
20-A[illegible]	4.10E-04	7.0E-05	5.0E-08	2.20E-03	1.0E-04	1.0E-06
05-[illegible]-87	2.90E-04	4.0E-05	5.0E-08	7.50E-04	5.0E-05	1.0E-06
22-Dec-87	1.80E-04	3.0E-05	5.0E-08	2.40E-03	1.0E-04	1.0E-06
19-Apr-88	2.30E-04	5.0E-05	5.0E-08	2.90E-03	1.0E-04	1.0E-06
28-Jul-88	1.50E-04	3.0E-05	5.0E-08	4.30E-03	2.0E-04	1.0E-06
07-Apr-89	3.10E-04	4.0E-05	***	4.20E-03	1.0E-04	***
06-Jun-89	1.30E-04	2.0E-05	***	1.50E-03	1.0E-04	***
07-Nov-89	4.30E-04	5.0E-05	1.4E-05	3.50E-03	1.4E-04	2.7E-05
28-Mar-90	2.50E-04	3.0E-05	5.0E-06	2.39E-03	5.0E-05	2.5E-05
13-Jun-90	1.10E-04	2.0E-05	5.0E-08	6.60E-04	3.0E-05	1.0E-06
23-Oct-90	6.10E-05	1.4E-05	5.0E-08	6.10E-04	3.0E-05	1.0E-06
10-Apr-91	3.40E-05	1.1E-05	5.0E-06	2.20E-04	1.0E-05	1.0E-06
11-Jun-91	8.00E-05	6.0E-06	2.0E-07	1.20E-04	1.0E-05	2.0E-07
20-Nov-91	6.50E-05	1.4E-05	5.0E-08	9.10E-04	5.0E-05	1.0E-06
22-Apr-92	1.60E-05	7.0E-06	2.0E-06	3.20E-04	2.0E-05	1.0E-05
10-Jun-92	1.90E-05	1.0E-05	2.0E-07	2.20E-04	2.0E-05	1.0E-06
08-Dec-92	1.60E-05	1.8E-05	3.0E-06	7.60E-04	6.0E-05	2.0E-05
13-Apr-93	2.60E-05	2.0E-05	3.0E-06	3.40E-04	3.0E-05	2.0E-05
27-Jun-93	3.00E-05	1.4E-05	3.0E-06	0.00E+00	3.0E-05	2.0E-05
27-Oct-93	3.10E-05	1.6E-05	3.0E-06	4.20E-04	6.0E-05	2.0E-05
01-May-94	2.00E-05	5.0E-06	3.0E-05	3.90E-04	8.0E-05	2.0E-04
19-Jul-94	1.75E-05	1.7E-06	7.6E-08	1.30E-04	7.8E-06	3.8E-07
16-Nov-94	1.00E-04	9.0E-06	1.5E-07	2.60E-04	1.2E-05	7.4E-07
05-Apr-95	1.70E-05	1.5E-06	1.6E-07	1.60E-04	1.5E-05	8.1E-07
07-Jul-95	6.40E-06	6.0E-07	1.4E-07	4.40E-05	4.2E-06	7.0E-07
09-Nov-95	2.30E-05	2.2E-06	1.7E-07	6.60E-05	9.6E-06	8.3E-07
# OBSERVED	42	42	42	42	42	42
MINIMUM	6.40E-06	1.6E-07	0.00E+00	0.00E+00	4.0E-06	0.00E+00
MAXIMUM	9.50E-04	1.5E-04	3.00E-05	1.65E-02	7.2E-04	3.00E-04
MEAN	1.72E-04	2.1E-05	2.45E-06	1.69E-03	9.9E-05	2.76E-05
STD. DEV.	2.00E-04	2.6E-05	5.04E-06	2.68E-03	1.5E-04	5.65E-05

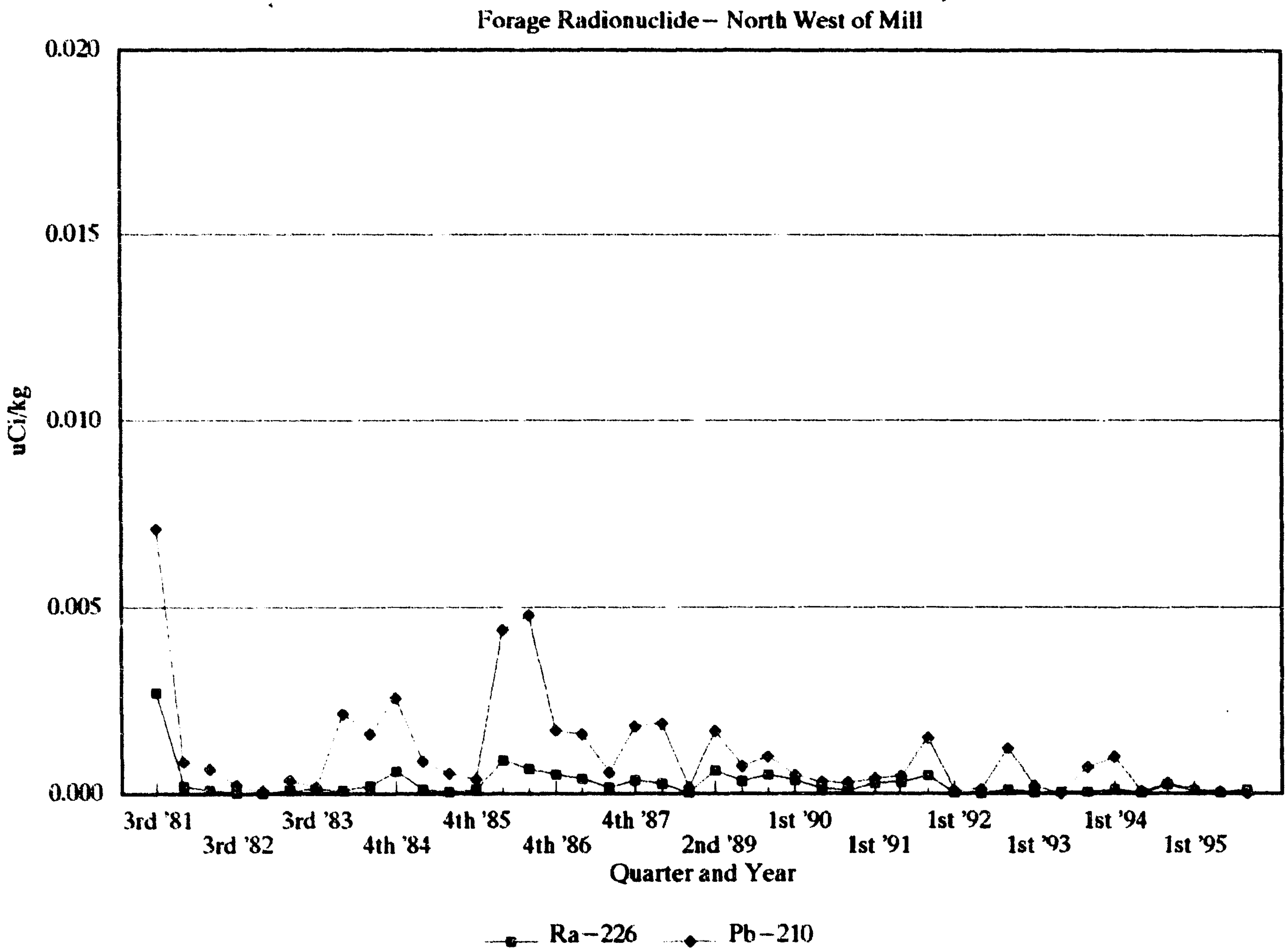
ENERGY FUELS NUCLEAR, INC.

Forage Radionuclide – North East of Mill



GRAPH 14

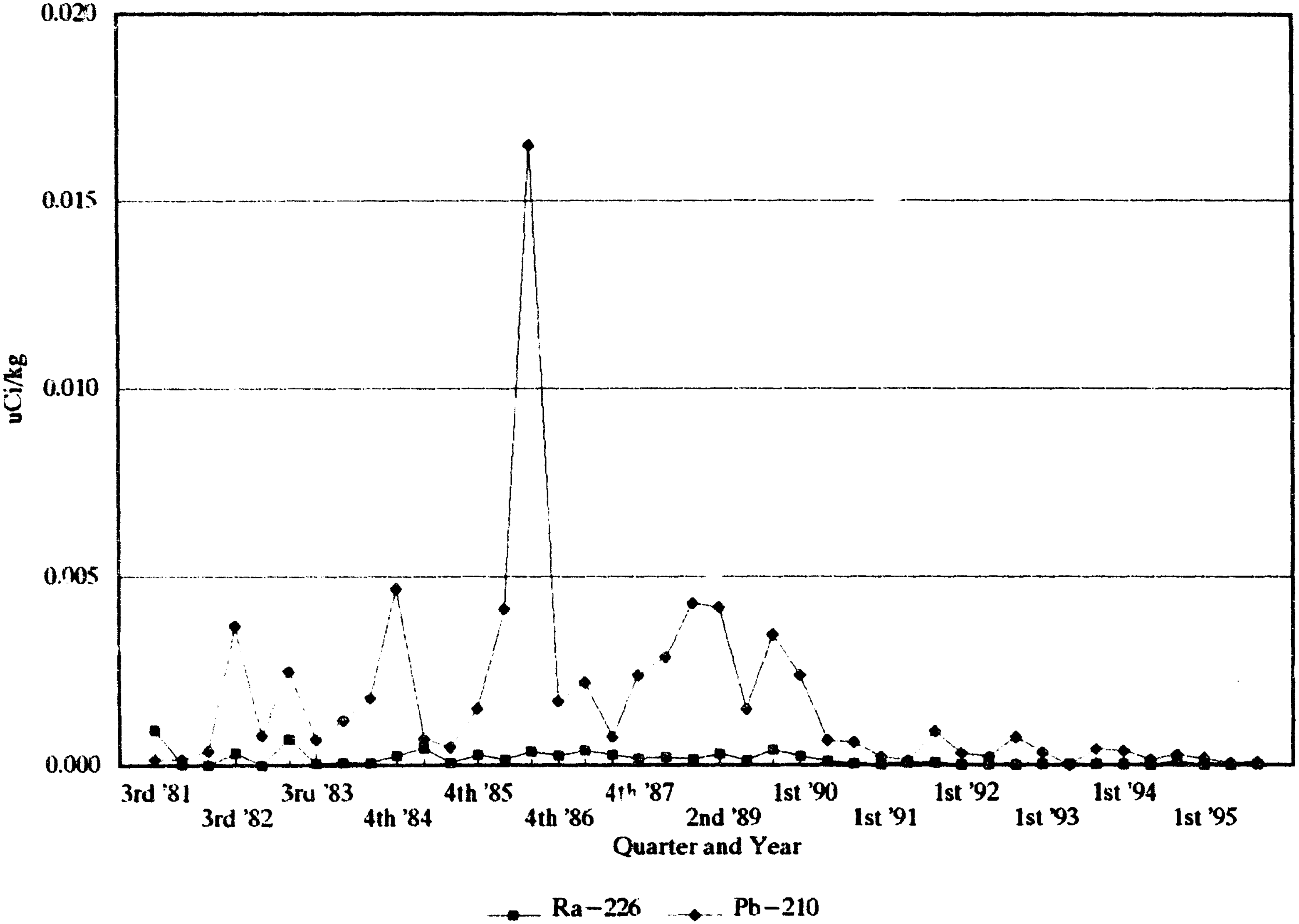
ENERGY FUELS NUCLEAR, INC.



GRAPH 15

ENERGY FUELS NUCLEAR, INC.

Forage Radionuclide – South West of Mill



GRAPH 16

TABLE 12

ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
AMBIENT AIR RADIONUCLIDE PARTICULATES
µCi/ml
LOCATION: BHV-1

Current Quarter	1st	2nd	3rd	4th
% time operated	99.7%	57.6%	82.5%	90.6%
Air Volume, SCF x 1e6	4.19	3.74	3.86	3.79

PERIOD ENDING	URANIUM NAT GROSS CONC.	URANIUM NAT LLD (1E-16)	URANIUM NAT % MPC*	THORIUM-230 GROSS CONC.	THORIUM-230 COUNTING ERROR	THORIUM-230 LLD (1E-16)	THORIUM-230 % MPC*	RADIUM-226 GROSS CONC.	RADIUM-226 COUNTING ERROR	RADIUM-226 LLD (1E-16)	RADIUM-226 % MPC*	LEAD-210 GROSS CONC.	LEAD-210 COUNTING ERROR	LEAD-210 LLD (2E-15)	LEAD-210 % MPC*
28-Sep-81	2.38E-15	5E-17	4.70E-02	7.82E-16	2.78E-16	1E-16	2.81E-01	1.08E-15	1.24E-16	1E-16	5.30E-02	2.87E-14	1.82E-15	2E-15	3.21E-01
14-Dec-81	1.56E-15	5E-17	3.12E-02	1.49E-15	2.10E-16	1E-16	4.07E-01	1.93E-15	3.34E-16	1E-16	9.66E-02	2.04E-14	2.28E-15	2E-15	3.30E-01
29-Mar-82	2.16E-15	9E-16	4.32E-02	2.93E-15	1.15E-15	3E-15	9.77E-01	1.16E-15	5.78E-16	4E-15	5.80E-02	2.08E-14	2.78E-15	2E-14	2.81E-01
30-Jun-82	4.69E-15	1E-16	9.38E-02	3.48E-15	3.28E-16	1E-16	1.16E+00	2.38E-15	4.77E-16	6E-16	1.19E-01	2.14E-14	3.70E-15	6E-15	2.89E-01
27-Sep-82	4.45E-15	1E-16	8.90E-02	3.29E-15	4.78E-16	1E-16	1.10E+00	3.23E-15	4.02E-16	1E-16	1.62E-01	1.89E-14	3.80E-15	2E-15	2.48E-01
03-Jan-83	4.39E-15	5E-17	8.78E-02	5.91E-16	1.34E-16	7E-17	1.97E-01	9.14E-16	1.03E-16	6E-17	4.57E-02	4.87E-14	2.70E-15	2E-15	6.08E-01
04-Apr-83	7.51E-16	5E-17	1.50E-02	2.13E-16	3.06E-17	2E-17	7.10E-02	3.20E-16	7.63E-17	5E-17	1.60E-02	1.88E-14	1.00E-15	6E-16	2.35E-01
30-Jun-83	2.68E-16	5E-17	5.36E-03	6.92E-16	1.32E-16	9E-17	2.31E-01	7.82E-16	1.32E-16	1E-16	3.98E-02	2.00E-14	2.00E-15	1E-15	2.50E-01
03-Oct-83	Sample Lost														
03-Jan-84	2.87E-15	1E-16	5.74E-02	1.14E-16	4.98E-17	8E-17	3.80E-02	1.79E-16	7.69E-17	1E-16	8.95E-03	1.03E-14	1.88E-15	2E-15	1.33E-01
02-Apr-84	1.59E-15	5E-17	3.18E-02	3.40E-16	1.01E-16	3E-17	1.13E-01	3.71E-16	7.80E-17	7E-17	1.86E-02	3.34E-14	1.68E-15	1E-15	4.18E-01
02-Jul-84	3.10E-15	6E-17	6.20E-02	1.00E-15	3.69E-16	3E-16	3.33E-01	2.09E-16	2.29E-16	1E-16	1.06E-01	1.88E-14	1.10E-15	9E-16	2.35E-01
01-Oct-84	6.42E-16	5E-17	1.28E-02	1.39E-16	1.17E-16	7E-17	4.63E-02	1.94E-16	1.11E-16	9E-17	9.70E-03	1.85E-14	1.39E-15	1E-15	2.31E-01
02-Jan-85	5.08E-16	5E-16	1.01E-02	4.58E-16	2.28E-16	2E-16	1.52E-01	3.49E-19	1.32E-16	1E-16	1.75E-02	3.09E-14	1.17E-15	7E-16	3.79E-01
01-Apr-85	0.00E+00	5E-17	0.00E+00	1.25E-15	2.52E-16	4E-17	4.10E-01	4.88E-16	1.09E-16	9E-17	2.44E-02	8.08E-15	8.89E-16	8E-16	1.01E-01
01-Jul-85	7.17E-16	5E-17	1.43E-02	0.00E+00	4.78E-14	1E-16	0.00E+00	1.05E-15	1.50E-16	7E-17	5.25E-02	2.15E-14	1.32E-15	5E-16	2.69E-01
30-Sep-85	6.13E-16	5E-16	1.23E-02	1.18E-16	1.18E-16	1E-16	3.95E-02	3.71E-16	6.56E-17	7E-17	1.85E-02	3.64E-15	6.61E-16	9E-16	4.55E-02
02-Jan-86	3.42E-15	9E-16	6.84E-02	4.74E-16	1.32E-16	2E-16	1.58E-01	1.22E-16	2.15E-16	2E-16	6.11E-03	5.00E-16	3.22E-16	2E-15	6.25E-03
01-Apr-86	3.99E-15	2E-16	7.98E-02	9.74E-16	2.06E-16	5E-16	3.25E-01	1.50E-15	2.07E-16	4E-16	7.51E-02	1.41E-14	4.08E-16	1E-16	1.76E-01
30-Jun-86	1.93E-15	1E-17	3.87E-02	3.52E-16	3.13E-17	2E-16	1.17E-01	1.37E-15	3.01E-17	4E-16	6.87E-02	1.29E-14	6.01E-16	6E-16	1.54E-01
27-Oct-86	1.99E-15	2E-16	3.98E-02	3.06E-16	8.00E-17	3E-16	1.02E-01	1.25E-15	1.00E-16	2E-16	6.25E-02	1.08E-14	2.00E-16	4E-16	1.35E-01
15-Dec-86	1.67E-15	3E-16	3.34E-02	1.16E-16	4.00E-17	2E-17	3.87E-02	5.96E-16	1.00E-16	4E-17	2.98E-02	1.37E-14	2.00E-16	3E-17	1.71E-01
16-Mar-87	2.33E-15	3E-16	4.66E-02	4.30E-16	9.00E-17	6E-16	1.43E-01	1.92E-16	5.00E-17	5E-16	9.60E-03	5.59E-14	1.00E-15	6E-16	6.99E-01
11-May-87	2.36E-15	5E-16	4.72E-02	[illegible]	1.60E-16	5E-16	2.59E-01	8.76E-16	1.00E-16	5E-16	4.38E-02	1.45E-14	3.00E-16	3E-17	1.81E-01
09-Sep-87	2.27E-15	1E-19	4.54E-02	2.44E-15	2.00E-16	6E-16	8.13E-01	8.51E-16	1.40E-16	4E-16	4.26E-02	3.14E-14	5.00E-16	8E-16	3.93E-01
02-Nov-87	2.75E-15	1E-17	5.50E-02	2.46E-15	3.00E-16	1E-17	8.20E-01	1.34E-15	2.00E-16	1E-17	6.70E-02	2.79E-14	1.00E-15	5E-17	3.49E-01
16-Feb-88	1.07E-15	5E-16	2.14E-02	1.47E-16	5.00E-17	2E-17	4.90E-02	4.44E-16	5.00E-17	3E-17	2.22E-02	4.01E-14	2.00E-16	5E-17	5.01E-01
18-May-88	1.99E-15	3E-16	3.98E-02	1.25E-15	1.00E-16	2E-17	4.17E-01	6.40E-16	7.00E-17	1E-17	3.20E-02	1.07E-14	1.00E-16	3E-17	1.34E-01
15-Aug-88	2.06E-15	3E-16	4.12E-02	3.41E-15	2.00E-16	1E-17	1.14E+00	5.08E-16	6.00E-17	2E-17	2.54E-02	1.62E-14	3.00E-16	2E-17	2.03E-01
14-Nov-88	3.94E-15	3E-16	7.88E-02	2.12E-15	1.00E-16	1E-17	7.07E-01	1.01E-15	5.00E-17	1E-17	5.06E-02	2.47E-14	1.00E-16	3E-17	3.09E-01
13-Feb-89	1.99E-15	4E-17	3.98E-02	5.73E-16	7.88E-17	1E-16	1.91E-01	5.98E-16	3.49E-17	2E-16	3.00E-02	3.23E-14	2.38E-16	5E-16	4.04E-01
15-May-89	1.70E-15	7E-16	3.40E-02	6.32E-16	7.00E-17	7E-16	2.11E-01	5.86E-16	5.00E-17	7E-16	2.93E-02	6.16E-15	1.00E-16	3E-17	7.70E-02
14-Aug-89	2.31E-15	2E-16	4.62E-02	2.31E-16	3.00E-17	6E-16	7.70E-02	1.77E-16	5.00E-17	8E-16	8.85E-03	7.66E-15	1.00E-16	4E-17	9.58E-02
13-Nov-89	4.72E-15	2E-17	9.44E-02	1.71E-15	2.00E-16	3E-16	5.70E-01	1.52E-15	2.00E-16	8E-16	7.61E-02	1.89E-14	3.00E-16	2E-17	2.37E-01
12-Feb-90	3.44E-16	3E-16	6.88E-03	8.39E-16	1.00E-16	6E-16	2.80E-01	8.31E-16	8.00E-17	2E-17	4.16E-02	2.57E-14	3.00E-16	5E-17	3.21E-01
14-May-90	3.03E-15	1E-16	6.06E-02	1.47E-15	2.00E-16	1E-16	4.90E-01	1.04E-15	1.00E-15	1E-16	5.20E-02	1.79E-14	3.00E-16	2E-16	2.24E-01
13-Aug-90	1.64E-15	1E-16	3.28E-02	1.49E-15	7.00E-17	1E-16	4.97E-01	3.34E-16	5.00E-17	1E-16	1.67E-02	8.27E-15	2.00E-16	2E-16	1.03E-01
12-Nov-90	1.48E-15	1E-16	2.96E-02	7.50E-16	1.10E-16	1E-16	2.50E-01	5.80E-16	7.00E-17	1E-16	2.90E-02	2.16E-14	4.00E-16	2E-16	2.70E-01
11-Feb-91	1.90E-16	1E-16	3.80E-03	3.48E-17	2.10E-17	1E-16	1.16E-02	7.91E-17	2.30E-17	1E-16	3.96E-03	3.79E-14	1.00E-15	2E-16	4.74E-01
13-May-91	3.42E-16	1E-16	6.84E-03	1.34E-15	1.00E-16	1E-16	4.47E-01	7.39E-16	9.00E-17	1E-16	3.70E-02	1.46E-14	1.00E-15	2E-15	1.83E-01
12-Aug-91	2.77E-16	1E-16	5.54E-03	4.17E-17	8.00E-18	1E-16	1.39E-02	1.45E-16	7.00E-17	1E-16	7.25E-03	1.80E-14	3.00E-16	2E-15	2.25E-01
11-Nov-91	6.65E-17	1E-19	1.33E-03	9.13E-17	3.00E-17	2E-17	3.04E-02	2.77E-17	2.00E-17	2E-17	1.39E-03	1.06E-14	2.00E-16	1E-16	1.33E-01
10-Feb-92	1.94E-16	1E-16	3.88E-03	4.24E-18	3.00E-17	2E-17	1.41E-03	4.08E-17	2.20E-17	2E-17	2.04E-03	3.51E-14	6.00E-17	1E-16	4.39E-01
11-May-92	2.54E-16	1E-16	5.08E-03	6.49E-16	5.00E-17	2E-19	2.16E-01	6.86E-17	4.00E-17	2E-19	3.43E-03	1.38E-14	2.00E-16	1E-16	1.73E-01
10-Aug-92	1.73E-16	2E-16	3.46E-03	1.55E-16	4.00E-17	4E-16	5.17E-02	1.20E-16	6.00E-17	2E-16	6.00E-03	1.53E-14	2.00E-16	2E-17	1.91E-01
09-Nov-92	1.56E-16	3E-16	3.12E-03	3.19E-17	2.10E-17	4E-16	1.06E-02	4.90E-18	2.20E-17	3E-16	2.45E-04	1.86E-14	2.00E-16	2E-17	2.33E-01
09-Feb-93	2.10E-16	1E-13	4.20E-03	0.00E+00	4.60E-17	4E-16	0.00E+00	3.89E-17	7.30E-17	3E-16	1.95E-03	2.52E-14	4.00E-16	2E-17	3.15E-01
10-May-93	0.00E+00	3E-16	0.00E+00	4.11E-17	3.60E-17	4E-16	1.37E-02	6.43E-17	4.00E-17	3E-16	3.22E-03	1.26E-14	2.00E-16	2E-17	1.58E-01
10-Aug-93	2.30E-16	2E-18	4.60E-03	6.00E-17	5.00E-17	4E-16	2.00E-02	6.43E-17	8.10E-17	3E-16	3.22E-03	1.60E-14	2.00E-16	2E-17	2.00E-01
08-Nov-93	0.00E+00	2E-16	0.00E+00	0.00E+00	5.80E-17	4E-16	0.00E+00	0.00E+00	1.00E-16	3E-16	0.00E+00	1.57E-14	3.00E-16	2E-17	1.96E-01
07-Feb-94	1.82E-16	3E-21	3.03E-01	5.00E-16	6.00E-17	4E-16	1.67E-02	4.30E-17	1.60E-16	3E-16	4.78E-03	2.59E-14	5.00E-16	2E-17	4.32E+00
09-May-94	3.60E-16	2E-17	6.00E-01	2.70E-16	1.10E-16	4E-17	9.00E-01	2.87E-16	1.00E-16	3E-17	3.19E-02	1.60E-14	3.00E-16	2E-16	2.67E+00
09-Aug-94	4.04E-16	1E-16	6.73E-01	2.70E-16	6.71E-17	1E-16	9.00E-01	2.94E-16	2.90E-17	1E-16	3.27E-02	2.00E-15	1.00E-16	2E-15	3.33E-01
07-Nov-94	9.18E-17	1E-16	1.53E-01	3.60E-16	4.42E-17	1E-16	1.20E+00	2.91E-16	2.48E-17	1E-16	3.23E-02	2.00E-15	7.61E-17	2E-15	3.33E-01
07-Feb-95	1.77E-16	1E-16	2.95E-01	9.70E-17	1.00E-16	1E-16	3.23E-01	9.70E-17	1.00E-16	1E-16	1.08E-02	8.60E-15	3.76E-16	1E-16	1.43E+00
09-May-95	9.40E-17	1E-22	1.57E-01	5.39E-16	4.39E-17	1E-16	1.79E+00	1.90E-15	7.17E-17	1E-16	1.76E-01	3.84E-15	2.05E-16	1E-16	6.40E-01
09-Aug-95	2.70E-16	1E-16	4.50E-01	1.60E-16	1.50E-17	1E-16	5.33E-01	2.76E-16	4.68E-17	1E-16	3.07E-02	3.76E-15	2.68E-16	2E-15	6.27E-01
07-Nov-95	4.80E-15	1E-16	8.00E+00	6.41E-16	5.75E-17	2E-16	2.14E+00	8.93E-16	4.24E-16	2E-16	9.92E-02	5.20E-15	2.40E-16	1E-15	8.67E-01

*1/1/94 Derived air concentrations were implemented as per 10 CFR 20

TABLE 13

ENERGY FUELS NUCLEAR, INC
WHITE MESA MILL
AMBIENT AIR RADIONUCLIDE PARTICULATES
μCi/ml
LOCATION: BHV-2

	Current Quarter	1st	2nd	3rd	4th
	% time operated	99.9%	99.3%	99.9%	93.4%
Air Volume	SCF x 1e6	4.20	4.23	4.32	3.59

PERIOD ENDING	URANIUM NAT. GROSS CONC.	URANIUM NAT. LLD (1E-16)	URANIUM NAT. % MPC	THORIUM-230 GROSS CONC	THORIUM-230 COUNTING ERROR	THORIUM-230 LLD (1E-16)	THORIUM-230 % MPC	RADIUM-226 GROSS CONC	RADIUM-226 COUNTING ERROR	RADIUM-226 LLD (1E-16)	RADIUM-226 % MPC	LEAD-210 GROSS CONC.	LEAD-210 COUNTING ERROR	LEAD-210 LLD (2E-15)	LEAD-210 % MPC
28-Sep-81	1.30E-16	1E-16	2.70E-02	3.08E-16	2.00E-16	1E-16	1.23E-01	5.92E-16	1.35E-16	1E-16	2.86E-02	1.67E-14	1.21E-15	2E-15	2.08E-01
14-Dec-81	4.62E-16	1E-16	9.24E-03	6.03E-16	3.02E-16	1E-16	2.88E-01	3.62E-16	1.72E-16	1E-16	1.81E-02	1.33E-14	2.20E-15	2E-15	1.66E-01
29-Mar-82	7.07E-16	6E-16	1.41E-02	1.10E-15	6.48E-16	3E-15	3.67E-01	7.27E-16	3.96E-16	4E-15	3.64E-02	1.52E-14	3.63E-15	2E-14	1.90E-01
30-Jun-82	8.84E-16	7E-17	1.77E-02	7.73E-16	2.38E-16	6E-17	2.58E-01	4.78E-16	1.68E-16	3E-16	2.39E-02	1.98E-14	1.70E-15	2E-15	2.48E-01
27-Sep-82	1.23E-15	1E-16	2.46E-02	3.60E-16	1.36E-16	1E-16	1.20E-01	8.73E-16	2.71E-16	1E-16	4.37E-02	2.36E-14	6.43E-15	2E-15	2.94E-01
03-Jan-83	2.64E-15	5E-17	5.28E-02	2.56E-16	1.09E-16	5E-17	8.50E-02	1.98E-16	5.08E-17	6E-17	9.90E-03	2.86E-14	2.60E-15	2E-15	3.58E-01
04-Apr-83	2.14E-16	8E-17	4.28E-03	1.02E-16	3.98E-17	5E-17	3.40E-02	1.57E-16	7.63E-17	5E-17	7.85E-03	2.48E-14	1.19E-15	6E-16	3.10E-01
30-Jun-83	2.85E-16	5E-17	5.70E-03	2.06E-16	5.06E-17	6E-17	6.87E-02	2.24E-16	8.66E-17	1E-16	1.12E-02	1.79E-14	9.94E-16	6E-16	2.24E-01
03-Oct-83	2.70E-16	5E-17	5.40E-03	3.36E-16	6.49E-17	4E-17	1.12E-01	4.37E-16	9.81E-17	5E-17	2.18E-02	1.78E-14	1.06E-15	4E-16	2.23E-01
03-Jan-84	2.78E-15	1E-16	5.56E-02	1.20E-16	1.11E-16	1E-16	4.00E-02	6.64E-17	4.52E-16	6E-17	3.32E-03	9.14E-15	1.46E-15	2E-15	1.14E-01
02-Apr-84	4.28E-16	5E-17	8.56E-03	1.75E-16	5.18E-17	5E-17	5.83E-02	4.57E-17	5.03E-17	6E-17	2.28E-03	3.55E-14	1.79E-15	2E-15	4.44E-01
02-Jul-84	2.78E-15	6E-17	5.56E-02	8.12E-16	3.36E-16	0E+00	2.71E-01	1.90E-16	1.00E-16	1E-16	9.50E-03	1.68E-14	1.20E-01	1E-15	2.10E-01
01-Oct-84	2.69E-16	6E-17	5.38E-03	2.66E-17	8.02E-17	1E-16	8.87E-03	0.00E+00	1.17E-16	1E-16	0.00E+00	1.77E-14	1.22E-15	6E-16	2.21E-01
02-Jan-85	2.15E-16	5E-16	4.30E-03	7.85E-16	2.09E-16	9E-17	2.62E-01	2.87E-16	1.14E-16	1E-16	1.44E-02	3.10E-14	1.55E+00	1E-15	3.88E-01
01-Apr-85	0.00E+00	5E-17	0.00E+00	1.67E-16	1.78E-16	3E-17	5.57E-02	6.75E-17	7.66E-17	6E-17	3.38E-03	7.56E-15	8.83E-16	6E-16	9.45E-02
01-Jul-85	3.70E-17	5E-17	7.40E-04	9.00E-16	4.76E-14	3E-16	3.00E-01	4.90E-17	1.05E-16	9E-17	2.45E-03	1.31E-14	1.32E-15	1E-15	1.64E-01
30-Sep-85	9.32E-17	5E-16	1.86E-03	2.16E-16	4.63E-17	3E-16	7.20E-02	3.71E-16	4.64E-17	7E-17	1.86E-02	3.64E-15	2.85E-16	2E-15	4.55E-02
02-Jan-86	1.56E-15	1E-15	3.12E-02	2.16E-16	1.12E-15	7E-16	7.20E-02	2.15E-17	2.31E-16	2E-16	1.08E-03	3.04E-16	1.71E-15	2E-15	3.80E-03
01-Apr-86	1.31E-15	2E-15	2.61E-02	1.50E-16	7.16E-17	5E-16	5.00E-02	3.71E-16	6.45E-17	4E-16	1.86E-02	2.90E-15	2.10E-16	9E-17	3.63E-02
30-Jun-86	2.23E-16	1E-17	4.47E-03	1.32E-16	4.32E-17	2E-17	4.39E-02	7.06E-17	8.61E-16	4E-16	3.58E-03	2.63E-14	2.60E-15	3E-15	3.10E-01
27-Oct-86	6.41E-16	1E-16	1.28E-02	1.74E-16	4.00E-17	2E-16	5.80E-02	3.67E-16	1.00E-16	1E-16	1.84E-02	1.04E-14	2.00E-16	3E-16	1.30E-01
15-Dec-86	3.56E-16	3E-16	7.12E-03	0.00E+00	2.00E-17	2E-17	0.00E+00	1.05E-16	5.00E-17	3E-17	5.25E-03	7.81E-15	1.00E-16	3E-17	9.76E-02
16-Mar-87	5.31E-16	3E-16	1.06E-02	1.30E-16	4.00E-17	5E-16	4.33E-02	7.74E-17	3.00E-17	4E-16	3.87E-03	3.80E-14	1.00E-15	6E-16	4.75E-01
11-May-87	4.06E-16	4E-16	8.12E-03	6.63E-17	7.00E-17	4E-16	2.21E-02	1.34E-16	4.00E-17	4E-16	6.70E-03	1.10E-14	3.00E-16	2E-17	1.38E-01
09-Sep-87	2.74E-16	6E-16	5.48E-03	2.38E-16	5.00E-17	6E-17	7.93E-02	1.38E-16	6.00E-17	2E-17	6.90E-03	1.04E-14	3.00E-16	1E-16	1.30E-01
02-Nov-87	3.73E-16	1E-17	7.46E-03	3.11E-16	8.00E-17	6E-16	1.04E-01	1.83E-16	7.00E-17	6E-17	9.16E-03	1.17E-14	3.00E-16	3E-17	1.46E-01
16-Feb-88	2.78E-15	5E-16	5.56E-02	2.31E-17	6.00E-17	2E-17	7.70E-03	1.20E-16	3.00E-17	9E-17	6.00E-03	3.55E-14	2.00E-16	5E-17	4.44E-01
18-May-88	4.63E-16	3E-16	9.26E-03	1.49E-16	6.00E-17	2E-17	4.97E-02	2.30E-16	6.00E-17	2E-17	1.15E-02	1.18E-14	2.00E-16	4E-17	1.48E-01
15-Aug-88	8.06E-16	3E-16	1.61E-02	8.69E-16	1.50E-16	1E-17	2.90E-01	1.80E-16	4.00E-17	2E-17	9.00E-03	1.42E-14	2.00E-16	2E-17	1.78E-01
14-Nov-88	4.34E-16	3E-16	8.68E-03	6.76E-16	6.00E-17	1E-17	2.25E-01	1.57E-16	3.00E-17	1E-17	7.85E-03	2.25E-14	2.00E-16	3E-17	2.81E-01
13-Feb-89	5.80E-16	4E-17	1.16E-02	2.85E-16	3.06E-17	4E-17	9.50E-02	1.55E-16	2.32E-17	2E-16	7.75E-03	2.80E-14	2.32E-16	6E-16	3.50E-01
15-May-89	5.06E-16	7E-16	1.01E-02	2.28E-16	7.00E-17	7E-16	7.60E-02	1.63E-16	3.00E-17	7E-16	8.15E-03	6.06E-15	1.00E-16	4E-17	7.58E-02
14-Aug-89	4.71E-16	2E-16	9.42E-03	9.60E-16	8.00E-17	8E-16	3.20E-01	1.26E-15	1.00E-16	8E-16	6.30E-02	6.65E-15	1.00E-16	4E-17	8.31E-02
13-Nov-89	1.14E-15	2E-17	2.27E-02	4.08E-16	6.00E-17	3E-16	1.36E-01	4.18E-16	6.00E-17	7E-16	2.09E-02	1.50E-14	3.00E-16	2E-17	1.88E-01
12-Feb-90	1.09E-15	4E-16	2.18E-02	3.26E-16	7.00E-17	7E-16	1.09E-01	3.74E-16	9.00E-17	3E-17	1.87E-02	1.98E-14	3.00E-16	8E-17	2.48E-01
14-May-90	9.32E-16	1E-16	1.86E-02	5.27E-16	1.00E-16	1E-16	1.76E-01	3.87E-16	1.00E-16	1E-16	1.90E-02	1.68E-14	3.00E-16	2E-16	2.11E-01
13-Aug-90	1.66E-16	1E-16	3.32E-03	5.49E-16	3.00E-17	1E-16	1.83E-01	4.75E-17	2.00E-17	1E-16	2.38E-03	1.27E-15	2.00E-16	2E-16	1.59E-02
12-Nov-90	6.06E-16	1E-16	1.21E-02	2.64E-16	6.00E-17	1E-16	8.80E-02	1.93E-16	4.00E-17	1E-16	9.65E-03	2.25E-14	3.00E-16	2E-16	2.81E-01
11-Feb-91	8.72E-17	1E-16	1.74E-03	7.00E-18	1.60E-17	1E-16	2.33E-03	3.33E-17	1.80E-17	1E-16	1.67E-03	3.49E-14	1.00E-15	2E-16	4.36E-01
13-May-91	1.16E-16	1E-16	2.32E-03	3.88E-16	9.00E-17	1E-16	1.29E-01	2.80E-16	7.00E-17	1E-16	1.40E-02	1.50E-14	1.00E-15	2E-15	1.88E-01
12-Aug-91	9.02E-17	1E-16	1.80E-03	8.82E-17	5.00E-17	1E-16	2.94E-02	7.66E-17	6.00E-17	1E-16	3.83E-03	1.58E-14	3.00E-16	2E-15	1.98E-01
11-Nov-91	4.81E-17	1E-16	9.62E-04	3.82E-17	2.00E-17	2E-17	1.27E-02	2.54E-17	2.00E-17	2E-17	1.27E-03	1.45E-14	4.00E-16	1E-16	1.81E-01
10-Feb-92	1.54E-16	1E-16	3.08E-03	6.82E-17	4.00E-17	2E-17	2.27E-02	1.40E-17	2.40E-17	2E-17	7.00E-04	3.41E-14	6.00E-17	1E-16	4.26E-01
11-May-92	2.39E-16	1E-16	4.78E-03	7.63E-17	4.00E-17	2E-19	2.54E-02	3.07E-17	3.00E-17	2E-19	1.54E-03	1.27E-14	2.00E-16	1E-16	1.59E-01
10-Aug-92	1.01E-16	2E-16	2.02E-03	7.07E-17	2.60E-17	4E-18	2.36E-02	2.80E-17	4.20E-17	2E-18	1.40E-03	1.41E-14	2.00E-16	2E-17	1.76E-01
09-Nov-92	5.20E-17	3E-21	1.04E-03	3.66E-17	2.40E-17	4E-18	1.22E-02	1.76E-17	2.80E-17	3E-18	8.80E-04	1.71E-14	2.00E-16	2E-17	2.14E-01
09-Feb-93	2.39E-16	1E-22	4.78E-03	2.97E-17	8.30E-17	4E-18	9.90E-03	6.31E-17	5.00E-17	3E-18	3.16E-03	3.41E-14	5.00E-16	2E-17	4.26E-01
10-May-93	0.00E+00	3E-16	0.00E+00	7.11E-17	5.00E-17	4E-18	2.37E-02	3.19E-17	3.20E-17	3E-18	1.60E-03	1.34E-14	2.00E-16	2E-17	1.68E-01
10-Aug-93	1.90E-16	2E-16	3.80E-03	0.00E+00	3.70E-17	4E-18	0.00E+00	0.00E+00	8.10E-17	3E-18	0.00E+00	1.80E-14	4.00E-16	2E-17	2.25E-01
08-Nov-93	0.00E+00	2E-16	0.00E+00	0.00E+00	5.90E-17	4E-18	0.00E+00	0.00E+00	1.90E-16	3E-18	0.00E+00	1.49E-14	2.00E-16	2E-17	1.86E-01
07-Feb-94	2.23E-16	2E-16	3.72E-01	0.00E+00	6.00E-17	4E-18	0.00E+00	1.84E-16	2.00E-16	3E-18	2.04E-02	2.16E-14	5.00E-15	2E-16	3.08E+00
09-May-94	2.16E-16	2E-17	3.60E-01	7.20E-17	8.00E-17	4E-18	2.40E-01	9.98E-17	7.00E-17	3E-17	1.10E-02	1.57E-14	3.00E-16	2E-16	2.28E+00
09-Aug-94	9.29E-17	1E-16	1.55E-01	2.96E-16	2.23E-16	4E-18	9.87E-01	3.04E-16	3.04E-17	1E-16	3.38E-02	0.00E+00	2.14E-16	1E-16	0.00E+00
07-Nov-94	9.21E-17	1E-16	1.54E-01	2.36E-16	3.16E-17	4E-18	7.83E-01	1.00E-16	1.26E-17	1E-16	1.11E-02	0.00E+00	5.26E-17	1E-15	0.00E+00
07-Feb-95	1.18E-16	1E-16	1.97E-01	9.70E-17	1.00E-16	4E-18	3.23E-01	9.70E-17	1.00E-16	1E-16	1.08E-02	7.42E-15	3.59E-16	1E-15	1.24E+00
09-May-95	9.40E-17	1E-16	1.57E-01	1.20E-16	1.00E-16	4E-18	4.00E-01	3.50E-16	3.25E-17	1E-16	3.89E-02	3.90E-15	1.59E-17	1E-16	6.50E-01
09-Aug-95	8.90E-17	1E-16	1.48E-01	9.67E-17		1E-18	3.22E-01	1.35E-16	3.94E-17	1E-16	1.50E-02	2.30E-16	2.00E-15	2E-15	3.07E-02
07-Nov-95	2.83E-15	1E-16	4.72E+00	4.09E-16	3.45E-17	2E-16	1.36E+00	5.23E-16	7.34E-17	2E-16	5.81E-02	6.77E-15	6.38E-16	1E-15	1.13E+00

*1/1/94 Derived air concentrations were implemented as per 10 CFR 20

TABLE 14

ENERGY FUELS NUCLEAR, INC.
W WHITE MESA MILL
AMBIENT AIR RADIONUCLIDE PARTICULATES
µCi/ml
LOCATION: BHV-3

	Current Quarter	1st	2nd	3rd	4th
	% time operated	71.1%	82.4%	41.6%	0.0%
Air Volume	SCF x 1e6	2.99	3.94	1.77	0.00

	URANIUM NAT			THORIUM-230				RADIUM-226				LEAD-210			
PERIOD ENDING	GROSS CONC	LLD (1E-16)	% MPC	GROSS CONC	COUNTING ERROR	LLD (1E-16)	% MPC	GROSS CONC.	COUNTING ERROR	LLD (1E-16)	% MPC	GROSS CONC.	COUNTING ERROR	LLD (2E-15)	% MPC
28-Sep-81	1.74E-15	1E-16	3.40E-02	9.02E-16	4.40E-16	1E-16	3.01E-01	2.87E-16	2.23E-16	1E-16	1.44E-02	1.64E-14	2.63E-15	2E-15	1.89E-01
14-Dec-81	1.80E-15	1E-16	3.18E-02	5.03E-16	3.00E-16	1E-16	1.08E-01	1.30E-16	1.38E-16	1E-16	6.50E-03	2.28E-14	2.13E-15	2E-15	2.81E-01
28-Mar-82	3.70E-16	9E-16	7.52E-03	5.26E-16	6.36E-16	3E-16	1.75E-01	4.08E-16	3.72E-16	4E-15	2.04E-02	1.90E-14	3.40E-15	2E-14	2.48E-01
30-Jun-82	3.63E-16	9E-17	7.06E-03	2.16E-16	2.24E-16	9E-17	7.20E-02	1.41E-15	1.03E-15	2E-16	7.06E-02	2.[illegible]E-14	2.10E-15	2E-15	3.00E-01
27-Sep-82	5.96E-16	1E-16	1.19E-02	1.44E-15	2.74E-16	1E-16	4.80E-01	5.38E-16	2.35E-16	1E-16	2.69E-02	1.43E-14	3.00E-15	2E-15	1.78E-01
03-Jan-83	2.05E-16	9E-17	4.10E-03	1.23E-16	3.11E-17	2E-17	4.10E-02	1.10E-16	5.82E-17	7E-17	5.50E-03	3.01E-14	2.10E-15	2E-15	3.76E-01
04-Apr-83	Lost in Lab			6.94E-17	2.31E-17	8E-17	2.31E-02	6.11E-17	5.95E-17	8E-17	3.06E-03	1.39E-14	1.00E-15	1E-15	1.74E-01
30-Jun-83	3.06E-16	1E-16	6.12E-03	9.59E-17	1.52E-16	2E-16	3.20E-02	2.08E-16	1.62E-16	2E-16	1.04E-02	1.70E-14	2.00E-15	2E-15	2.13E-01
03-Oct-83	1.91E-16	1E-16	3.82E-03	3.06E-16	4.99E-17	9E-18	1.02E-01	2.79E-16	5.73E-17	1E-17	1.40E-02	1.76E-14	4.83E-16	1E-16	2.20E-01
03-Jan-84	3.01E-16	1E-16	6.02E-03	9.51E-17	6.19E-17	1E-16	3.17E-02	0.00E+00	5.73E-17	1E-16	0.00E+00	9.17E-15	5.10E-16	5E-16	1.15E-01
02-Apr-84	8.22E-16	5E-17	1.64E-02	7.52E-16	1.72E-16	5E-17	2.51E-01	5.20E-17	4.89E-17	7E-17	2.60E-03	3.47E-14	1.70E-15	1E-15	4.34E-01
02-Jul-84	5.29E-16	5E-17	1.06E-02	6.18E-16	7.89E-16	8E-16	2.06E-01	1.40E-16	9.15E-17	1E-16	7.00E-03	1.32E-14	9.96E-16	1E-14	1.66E-01
01-Oct-84	1.74E-16	9E-17	3.48E-03	7.10E-17	6.18E-17	4E-17	2.37E-02	0.00E+00	9.15E-17	1E-16	0.00E+00	1.09E-14	1.22E-15	1E-16	1.36E-01
02-Jan-85	1.00E-17	5E-16	2.00E-04	7.10E-17	1.27E-16	7E-17	2.37E-02	7.80E-17	9.35E-17	7E-17	3.90E-03	2.73E-14	1.28E-15	6E-16	3.41E-01
01-Apr-85	0.00E+00	5E-17	0.00E+00	2.76E-16	2.02E-16	7E-17	9.20E-02	4.10E-17	6.82E-17	6E-17	2.05E-03	1.12E-14	9.33E-16	8E-16	1.40E-01
01-Jul-85	1.04E-16	5E-17	2.08E-03	0.00E+00	4.78E-14	4E-16	0.00E+00	0.00E+00	9.36E-17	6E-17	0.00E+00	1.64E-14	1.24E-15	8E-16	2.05E-01
30-Sep-85	0.00E+00	5E-16	0.00E+00	1.00E-15	1.31E-16	7E-17	3.34E-01	0.00E+00	4.66E-17	7E-17	0.00E+00	1.73E-14	1.01E-15	8E-16	2.16E-01
02-Jan-86	1.03E-15	1E-15	2.06E-02	3.17E-16	3.71E-15	4E-15	1.06E-01	1.25E-16	4.49E-16	3E-16	6.25E-03	1.21E-17	3.61E-15	4E-15	1.51E-04
01-Apr-86	8.04E-16	2E-16	1.61E-02	1.93E-17	6.94E-17	6E-18	6.42E-03	1.54E-16	8.33E-17	4E-18	7.71E-03	1.69E-14	4.07E-16	1E-16	2.12E-01
30-Jun-86	4.29E-16	2E-17	8.58E-03	1.77E-16	2.18E-17	1E-17	5.89E-02	2.83E-16	1.72E-17	5E-18	1.42E-02	1.97E-14	1.50E-15	2E-15	2.46E-01
27-Oct-86	6.45E-16	1E-16	1.2[illegible]E-02	9.90E-17	4.00E-17	2E-16	3.30E-02	4.16E-15	1.00E-16	2E-16	2.08E-01	1.64E-14	2.00E-16	4E-16	2.06E-01
15-Dec-86	1.31E-16	3E-16	2.62E-03	0.00E+00	2.00E-17	2E-17	0.00E+00	4.16E-17	4.00E-17	3E-17	2.08E-03	4.60E-15	1.00E-16	3E-17	5.75E-02
16-Mar-87	2.01E-16	3E-16	4.02E-03	1.20E-16	4.00E-17	5E-16	4.00E-02	5.73E-17	3.00E-17	4E-16	2.87E-03	1.60E-14	1.00E-15	6E-16	2.00E-01
11-May-87	2.16E-16	4E-16	4.32E-03	1.96E-16	9.00E-17	4E-16	6.53E-02	7.36E-17	3.00E-17	4E-16	3.68E-03	1.59E-14	2.00E-16	2E-17	1.99E-01
09-Sep-87	2.41E-16	2E-17	4.82E-03	2.18E-16	1.50E-16	2E-16	7.27E-02	3.52E-17	1.10E-16	7E-17	1.76E-03	1.46E-14	1.00E-15	1E-16	1.83E-01
02-Nov-87	2.44E-16	4E-17	4.8[illegible]E-03	2.32E-16	6.00E-17	4E-16	7.73E-02	2.37E-17	3.00E-17	4E-17	1.19E-03	2.48E-14	5.00E-16	2E-17	3.10E-01
16-Feb-88	8.08E-16	8E-[illegible]	1.62E-02	2.56E-16	6.00E-17	2E-17	6.80E-02	3.42E-16	5.00E-17	3E-17	1.71E-02	5.61E-14	3.00E-16	6E-17	7.01E-01
16-May-88	1.14E-16	3E-16	2.28E-03	4.14E-17	1.00E-16	1E-17	1.38E-02	0.00E+00	4.00E-17	1E-17	0.00E+00	1.20E-14	1.00E-16	4E-17	1.50E-01
15-Aug-88	2.08E-16	3E-16	4.16E-03	3.06E-16	8.00E-17	1E-17	1.02E-01	3.66E-17	3.10E-17	2E-17	1.83E-03	1.36E-14	2.00E-16	2E-17	1.70E-01
14-Nov-88	4.21E-16	3E-16	8.42E-03	2.93E-16	3.00E-17	1E-17	9.77E-02	1.09E-16	2.00E-17	1E-17	5.45E-03	2.48E-14	1.00E-16	3E-17	3.10E-01
13-Feb-89	4.45E-16	4E-17	8.90E-03	4.78E-17	1.65E-17	1E-16	1.59E-02	2.47E-17	1.65E-17	2E-17	1.24E-03	3.34E-14	3.29E-16	6E-16	4.18E-01
15-May-89	1.05E-[illegible]	1E-18	2.10E-03	0.00E+00	1.60E-17	7E-18	0.00E+00	2.46E-17	1.40E-17	7E-18	1.23E-03	6.56E-15	1.00E-16	3E-17	8.20E-02
14-Aug-89	1.31E-16	2E-18	2.62E-03	5.8[illegible]E-17	2.10E-17	9E-18	1.96E-02	3.97E-17	3.60E-17	9E-18	1.99E-03	6.75E-15	1.00E-16	5E-17	8.44E-02
13-Nov-89	1.67E-16	2E-17	3.36E-03	3.87E-17	4.00E-17	3E-16	1.29E-02	8.03E-17	3.00E-17	6E-18	4.02E-03	1.69E-14	3.00E-16	2E-17	2.11E-01
12-Feb-90	4.43E-16	3E-18	8.86E-03	0.00E+00	4.00E-17	7E-18	0.00E+00	3.50E-17	4.00E-17	2E-17	1.75E-03	2.37E-14	3.00E-16	4E-17	2.96E-01
14-May-90	3.84E-16	1E-16	7.68E-03	2.54E-16	1.00E-16	1E-16	8.47E-02	1.02E-16	6.00E-17	1E-16	5.10E-03	1.68E-14	3.00E-16	2E-16	2.10E-01
13-Aug-90	7.27E-17	1E-16	1.45E-03	2.87E-16	2.00E-17	1E-16	9.57E-02	1.21E-17	2.00E-17	1E-16	6.05E-04	7.66E-15	2.00E-16	2E-16	9.83E-02
12-Nov-90	1.84E-[illegible]	1E-16	3.69E-03	1.34E-16	6.00E-17	1E-16	4.47E-02	8.53E-17	4.00E-17	1E-16	4.27E-03	2.01E-14	4.00E-16	2E-16	2.51E-01
11-Feb-91	4.0[illegible]	1E-16	9.32E-04	8.48E-16	6.00E-17	1E-16	2.83E-01	1.94E-17	1.60E-17	1E-16	9.70E-04	3.69E-14	1.00E-15	2E-16	4.61E-01
13-May-91	5.0[illegible]	1E-16	1.01E-03	7.40E-17	6.00E-17	1E-16	2.47E-02	7.00E-18	4.00E-17	1E-16	3.50E-04	1.50E-14	1.00E-15	2E-16	1.88E-01
12-Aug-91	7.14E-17	1E-16	1.43E-03	6.22E-17	8.00E-17	1E-16	2.07E-02	7.06E-17	8.00E-17	1E-16	3.96E-03	1.77E-14	5.00E-16	2E-15	2.21E-01
11-Nov-91	1.41E-17	1E-16	2.82E-04	2.19E-18	3.00E-16	2E-17	7.30E-04	2.76E-17	2.00E-17	2E-17	1.38E-03	1.18E-14	2.00E-16	1E-16	1.48E-01
10-Feb-92	8.12E-17	1E-16	1.62E-03	2.35E-17	3.80E-17	2E-17	7.83E-03	2.76E-18	1.30E-17	2E-17	1.38E-04	3.57E-14	6.00E-17	1E-16	4.46E-01
11-May-92	9.18E-17	1E-[illegible]	1.84E-03	5.60E-17	2.00E-16	2E-19	1.89E-02	3.38E-17	3.00E-17	2E-19	1.69E-03	1.28E-14	2.00E-16	1E-16	1.60E-01
10-Aug-92	2.00E-18	2E-18	4.00E-05	4.19E-17	2.30E-17	4E-18	1.40E-02	2.00E-18	4.30E-17	2E-18	1.00E-04	1.50E-14	2.00E-16	2E-17	1.00E-01
08-Nov-92	4.60E-17	3E-21	8.00E-04	2.66E-17	1.80E-17	4E-18	8.93E-03	1.07E-17	2.10E-17	3E-18	5.35E-04	1.61E-14	2.00E-16	2E-17	2.20E-01
09-Feb-93	7.94E-17	1E-22	1.59E-03	0.00E+00	5.30E-17	4E-18	0.00E+00	1.09E-16	9.00E-17	3E-18	5.45E-03	2.09E-14	4.00E-16	2E-17	3.30E-01
10-May-93	1.60E-17	3E-22	5.20E-04	5.07E-17	4.40E-17	4E-18	1.69E-02	7.64E-17	4.00E-17	3E-18	3.82E-03	1.29E-14	2.00E-16	2E-17	1.50E-01
10-Aug-93	6.00E-17	2E-16	1.20E-03	6.00E-18	3.40E-17	4E-18	2.00E-03	0.00E+00	4.30E-17	3E-18	0.00E+00	1.50E-14	3.00E-16	2E-17	1.00E-01
08-Nov-93	0.00E+00	2E-18	0.00E+00	0.00E+00	4.20E-17	4E-18	0.00E+00	0.00E+00	1.50E-16	3E-18	0.00E+00	2.10E-14	4.00E-16	2E-17	2.63E-01
07-Feb-94	1.61E-16	2E-16	2.68E-01	0.00E+00	6.00E-17	4E-18	0.00E+00	2.22E-16	2.20E-16	3E-18	2.47E-02	2.23E-14	4.00E-16	2E-17	3.72E+00
09-May-94	2.77E-16	2E-17	4.62E-01	2.30E-17	1.40E-16	4E-17	9.33E-02	8.37E-16	1.00E-16	3E-17	9.30E-04	1.40E-14	4.00E-16	2E-16	2.33E+00
09-Aug-94	7.30E-17	1E-16	1.23E-01	1.00E-16	1.00E-16	1E-16	3.33E-01	1.14E-16	2.02E-17	1E-16	1.27E-02	1.00E-16	1.00E-16	2E-16	1.07E-02
07-Nov-94	9.05E-17	1E-16	1.51E-01	1.00E-16	1.00E-16	1E-16	3.33E-01	1.00E-16	7.84E-18	1E-16	1.11E-02	1.00E-16	1.16E-16	2E-15	1.07E-02
07-Feb-95	7.99E-17	1E-16	1.33E-01	9.60E-17	1.00E-16	1E-16	3.20E-01	9.60E-17	1.00E-16	1E-16	1.07E-02	9.05E-15	4.73E-16	1E-16	1.51E+00
08-May-95	9.40E-17	1E-16	1.57E-01	9.80E-17	1.00E-16	1E-16	3.27E-01	8.60E-17	1.00E-16	1E-16	9.53E-03	2.88E-15	1.70E-16	1E-16	4.80E-01
09-Aug-95	7.30E-17	1E-16	1.22E-01	9.20E-17		1E-16	3.07E-01	4.40E-17		1E-16	4.89E-03	1.96E-15		1E-16	3.27E-01
07-Nov-95	3.19E-16			1.31E-16				6.58E-17				1.91E-14			

*1/1/94 Derived air concentrations were implemented as per 10 CFR 20

** BHV-3 was taken down due to excessive vandalisms and Quarterly averages are being used in the place of samples

TABLE 18

ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
AMBIENT AIR RADIONUCLIDE PARTICULATES
µCi/ml
LOCATION: BHV-4

Current Quarter	1st	2nd	3rd	4th
% time operated	99.9%	95.1%	90.8%	98.4%
Air Volume, SCF x 1e6	4.20	4.06	2.80	4.15

	URANIUM NAT			THORIUM-230				RADIUM-226				LEAD-210			
PERIOD ENDING	GROSS CONC	LLD (1E-16)	% MPC	GROSS CONC	COUNTING ERROR	LLD (1E-16)	% MPC	GROSS CONC.	COUNTING ERROR	LLD (1E-16)	% MPC	GROSS CONC.	COUNTING ERROR	LLD (2E-15)	% MPC
29-Sep-81	6.20E-15	1E-16	1.04E-01	3.21E-15	5.70E-16	1E-16	1.07E+00	2.74E-15	6.18E-16	1E-16	1.37E-01	1.84E-14	2.72E-15	2E-15	2.30E-01
14-Dec-81	4.53E-15	1E-16	9.08E-02	2.93E-15	5.08E-16	1E-16	9.77E-01	2.29E-15	3.34E-16	1E-16	1.15E-01	2.34E-14	2.13E-15	2E-15	3.18E-01
29-Mar-82	1.06E-15	9E-16	2.12E-02	1.78E-15	1.12E-15	3E-16	5.93E-01	1.07E-15	4.71E-16	4E-15	5.38E-02	2.31E-14	4.18E-15	2E-14	2.88E-01
30-Jun-82	6.03E-15	6E-17	1.21E-01	1.42E-14	1.18E-15	6E-17	4.73E+00	2.62E-15	3.08E-16	3E-16	1.31E-01	2.28E-14	3.00E-15	2E-15	2.81E-01
27-Sep-82	1.28E-14	1E-16	2.52E-01	1.57E-14	7.17E-15	1E-16	5.23E+00	5.35E-15	5.47E-16	1E-16	2.69E-01	2.88E-14	3.88E-15	2E-15	3.36E-01
03-Jan-83	4.33E-15	5E-17	8.68E-02	7.58E-16	1.18E-16	5E-17	2.53E-01	6.04E-16	9.16E-17	6E-17	3.02E-02	2.57E-14	1.80E-15	2E-15	3.21E-01
04-Apr-83	1.25E-15	5E-17	2.50E-02	6.52E-16	5.56E-17	5E-17	2.17E-01	6.78E-16	1.38E-16	1E-16	3.38E-02	2.00E-14	1.09E-15	8E-16	2.80E-01
30-Jun-83	3.73E-16	1E-16	7.46E-03	7.17E-16	2.14E-16	2E-16	2.39E-01	4.13E-16	1.88E-16	2E-16	2.07E-02	1.20E-14	2.00E-15	2E-15	1.50E-01
03-Oct-83	2.54E-16	4E-17	5.08E-03	9.43E-16	1.13E-16	2E-17	3.14E-01	2.66E-16	5.73E-17	3E-17	1.33E-02	2.50E-14	1.14E-15	4E-16	3.13E-01
03-Jan-84	2.76E-15	1E-16	5.52E-02	1.51E-16	3.92E-17	4E-17	5.03E-02	1.05E-16	6.78E-17	8E-17	5.25E-03	1.50E-16	8.00E-16	8E-16	1.88E-03
02-Apr-84	4.27E-16	5E-17	8.54E-03	1.60E-16	9.08E-17	1E-16	5.33E-02	6.28E-16	9.83E-17	8E-17	3.14E-02	3.07E-14	1.79E-06	1E-15	4.88E-01
02-Jul-84	2.57E-15	5E-17	5.14E-02	2.33E-16	1.03E-16	8E-17	7.77E-02	1.11E-16	7.93E-17	1E-16	5.58E-03	1.58E-14	1.08E-15	1E-15	1.98E-01
01-Oct-84	4.18E-16	5E-17	8.36E-03	1.36E-16	6.57E-17	4E-17	4.53E-02	1.10E-17	9.55E-17	8E-17	5.50E-04	9.83E-15	1.43E-15	2E-15	1.23E-01
02-Jan-85	5.30E-17	5E-16	1.06E-03	3.54E-16	1.60E-16	5E-17	1.18E-01	7.00E-18	6.98E-17	7E-17	3.50E-04	2.57E-14	1.48E-15	1E-15	3.21E-01
01-Apr-85	0.00E+00	5E-17	0.00E+00	3.56E-17	1.97E-16	1E-16	1.18E-02	4.36E-17	6.88E-17	5E-17	2.18E-03	5.02E-15	8.70E+00	8E-16	6.28E-02
01-Jul-85	9.38E-16	5E-17	1.87E-02	6.00E-16	4.70E-14	6E-16	2.00E-01	2.36E-16	1.14E-16	7E-17	1.18E-02	7.48E-15	1.08E-15	8E-16	9.36E-02
30-Sep-85	1.46E-15	6E-16	2.91E-02	2.33E-16	8.01E-17	7E-17	7.78E-02	5.38E-16	1.08E-16	9E-17	2.69E-02	7.88E-15	7.50E-16	6E-16	9.83E-02
02-Jan-86	8.40E-15	2E-15	1.68E-01	7.69E-16	1.60E-15	1E-15	2.56E-01	2.90E-16	8.13E-16	3E-16	1.50E-02	2.12E-14	2.80E-14	5E-15	2.65E-01
01-Apr-86	5.79E-15	2E-16	1.16E-01	7.60E-16	9.98E-17	5E-16	2.53E-01	1.34E-15	5.50E-17	4E-16	6.71E-02	1.33E-14	3.06E-16	1E-16	1.66E-01
30-Jun-86	5.19E-15	1E-17	1.04E-01	5.80E-16	3.73E-17	4E-16	1.93E-01	2.20E-15	4.00E-17	5E-16	1.10E-01	7.14E-16	7.66E-16	1E-15	8.93E-03
27-Oct-86	4.60E-15	1E-16	9.20E-02	7.83E-16	1.10E-16	2E-16	2.61E-01	2.37E-15	1.00E-16	1E-16	1.19E-01	1.13E-14	2.00E-16	3E-16	1.41E-01
15-Dec-86	2.75E-15	3E-16	5.50E-02	4.07E-16	9.00E-17	2E-17	1.56E-01	9.30E-16	1.00E-16	4E-17	4.70E-02	1.20E-14	2.00E-16	4E-17	1.50E-01
16-Mar-87	4.64E-15	3E-16	9.26E-02	5.90E-16	1.20E-16	6E-16	1.97E-01	4.97E-16	1.00E-16	6E-16	2.49E-02	5.88E-14	1.00E-16	1E-17	7.36E-01
11-May-87	4.35E-15	6E-16	8.70E-02	1.18E-15	2.00E-16	6E-16	3.93E-01	1.13E-15	1.00E-16	6E-17	5.65E-02	2.21E-14	6.00E-16	3E-17	2.76E-01
09-Sep-87	6.30E-15	6E-16	1.26E-01	1.23E-14	1.00E-15	1E-16	4.10E+00	2.26E-15	2.00E-16	4E-17	1.13E-01	1.57E-14	1.00E-15	1E-16	1.96E-01
02-Nov-87	6.72E-15	6E-16	1.34E-01	1.50E-14	1.00E-15	4E-16	5.00E+00	2.20E-15	2.00E-16	6E-16	1.10E-01	2.56E-14	1.00E-15	3E-17	3.19E-01
16-Feb-88	1.91E-15	5E-16	3.82E-02	4.53E-16	7.00E-17	2E-17	1.51E-01	4.42E-16	6.00E-17	2E-17	2.21E-02	4.44E-14	2.00E-16	6E-17	5.55E-01
16-May-88	1.78E-14	3E-16	3.56E-01	1.35E-14	3.00E-16	2E-17	4.50E+00	4.9[illegible]-16	8.00E-17	2E-17	2.46E-02	1.38E-14	2.00E-16	4E-17	1.73E-01
15-Aug-88	7.56E-15	4E-16	1.51E-01	4.39E-14	1.00E-15	1E-17	1.46E+01	1.51E-15	1.00E-16	2E-17	7.55E-02	1.97E-14	2.00E-16	2E-17	2.46E-01
14-Nov-88	1.47E-14	4E-16	2.94E-01	3.31E-14	3.00E-16	1E-17	1.10E+01	2.57E-15	1.00E-16	1E-17	1.29E-01	2.12E-14	2.00E-16	3E-17	2.65E-01
13-Feb-89	2.47E-15	4E-17	4.94E-02	1.56E-15	1.02E-16	1.02E-16	5.20E-01	6.94E-16	5.10E-17	2.04E-16	3.47E-02	2.12E-14	3.06E-16	6.10E-16	2.65E-01
15-May-89	2.50E-16	1E-16	5.00E-03	3.14E-15	1.00E-16	7E-16	1.05E+00	9.03E-16	7.00E-17	7E-16	4.52E-02	8.06E-15	1.00E-16	4E-17	1.01E-01
14-Aug-89	6.50E-15	5E-17	1.30E-01	7.68E-15	2.00E-16	9E-16	2.56E+00	2.36E-15	2.00E-16	9E-16	1.18E-01	9.96E-15	1.00E-16	6E-17	1.24E-01
13-Nov-89	9.63E-15	2E-17	1.93E-01	4.72E-15	2.00E-16	3E-16	1.57E+00	4.03E-15	2.00E-16	8E-16	2.01E-01	1.99E-14	3.00E-16	2E-17	2.49E-01
12-Feb-90	3.92E-15	3E-16	1.78E-01	4.06E-15	2.00E-16	6E-16	1.35E+00	2.89E-15	2.00E-16	2E-17	1.45E-01	2.68E-14	2.00E-16	4E-17	3.36E-01
14-May-90	8.90E-15	1E-16	1.78E-01	3.58E-15	3.00E-16	1E-16	1.19E+00	2.33E-15	2.00E-16	1E-16	1.17E-01	2.08E-14	4.00E-16	2E-16	2.61E-01
13-Aug-90	1.92E-15	1E-16	3.84E-02	3.58E-15	8.00E-17	1E-16	1.19E+00	5.06E-16	6.00E-17	1E-16	2.53E-02	8.88E-15	2.00E-16	2E-16	1.11E-01
12-Nov-90	2.91E-15	1E-16	5.82E-02	1.87E-15	2.00E-16	1E-16	6.23E-01	1.08E-15	1.00E-16	1E-16	5.40E-02	2.19E-14	4.00E-16	2E-16	2.74E-01
11-Feb-91	1.67E-16	1E-16	3.34E-03	2.25E-17	2.10E-17	1E-16	7.50E-03	6.36E-17	2.50E-17	1E-16	3.19E-03	4.19E-14	1.00E-15	2E-16	5.24E-01
13-May-91	1.87E-16	1E-16	3.74E-03	7.89E-16	1.00E-16	1E-16	2.63E-01	3.54E-16	9[illegible]-17	1E-16	1.77E-02	1.40E-14	1.00E-15	2E-15	1.75E-01
12-Aug-91	4.85E-16	1E-16	9.70E-03	2.61E-15	2.00E-16	1E-16	8.70E-01	1.27E-16	[illegible]-17	1E-16	6.35E-03	2.20E-14	6.00E-16	2E-15	2.75E-01
11-Nov-91	1.77E-16	1E-16	3.54E-03	4.38E-16	7.00E-17	2E-17	1.46E-01	3.76E-17	[illegible]-17	2E-17	1.88E-03	1.15E-14	2.00E-16	1E-16	1.44E-01
10-Feb-92	1.83E-16	1E-16	3.66E-03	1.46E-16	8.00E-17	2E-17	4.87E-02	1.33E-16	4.00E-17	2E-17	6.65E-03	3.36E-14	6.00E-17	1E-16	4.18E-01
11-May-92	4.40E-16	1E-16	8.80E-03	1.36E-15	1.00E-16	2E-18	6.60E-01	4.04E-16	8.00E-17	2E-18	2.02E-02	1.41E-14	2.00E-16	1E-18	1.76E-01
10-Aug-92	9.06E-17	2E-18	1.62E-03	2.56E-16	4.00E-17	4E-18	8.53E-02	4.50E-17	4.60E-17	2E-18	2.25E-03	1.57E-14	2.00E-16	2E-17	1.96E-01
09-Nov-92	2.07E-16	3E-21	4.14E-03	1.15E-16	3.00E-17	4E-18	3.83E-02	3.62E-17	2.80E-17	3E-18	1.81E-03	2.34E-14	3.00E-16	2E-17	2.80E-01
09-Feb-93	1.73E-16	1E-22	3.46E-03	0.00E+00	8.00E-17	4E-18	0.00E+00	2.90E-17	4.30E-17	3E-18	1.45E-03	3.08E-14	5.00E-16	2E-17	3.85E-01
10-May-93	2.70E-17	3E-22	5.40E-04	2.76E-17	3.20E-17	4E-18	9.20E-03	8.74E-17	5.00E-17	3E-18	4.37E-03	1.26E-14	2.00E-16	2E-17	1.58E-01
10-Aug-93	9.00E-17	2E-18	1.90E-03	2.50E-17	3.90E-17	4E-18	8.33E-03	0.00E+00	3.70E-17	3E-18	0.00E+00	1.50E-14	3.00E-16	2E-17	1.88E-01
08-Nov-93	0.00E+00	2E-18	0.00E+00	1.76E-16	8.00E-17	4E-18	5.87E-02	6.00E-17	1.80E-16	3E-18	3.00E-03	1.76E-14	4.00E-16	2E-17	2.19E-01
07-Feb-94	1.10E-16	2E-18	1.83E-01	0.00E+00	1.58E-16	4E-18	0.00E+00	2.21E-16	2.30E-16	3E-18	2.49E-02	3.08E-14	6.00E-16	2E-17	5.13E+00
09-May-94	3.80E-16	2E-17	6.33E-01	3.38E-16	1.20E-16	4E-17	1.13E+00	3.46E-16	1.00E-16	3E-17	3.84E-02	1.73E-14	2.00E-16	2E-16	2.88E+00
09-Aug-94	3.85E-16	1E-16	6.42E-01	2.82E-16	9.81E-17	1E-16	9.40E-01	1.00E-16	1.73E-17	1E-16	1.11E-02	1.00E-16	1.00E-16	2E-15	1.67E-02
07-Nov-94	6.21E-17	1E-16	1.03E-01	3.53E-16	4.21E-17	1E-16	1.18E+00	1.96E-16	2.08E-17	1E-16	2.18E-02	1.00E-16	1.00E-16	2E-15	1.67E-02
07-Feb-95	3.70E-16	1E-16	6.17E-01	9.70E-17	1.00E-16	1E-16	3.23E-01	9.70E-17	3.02E-17	1E-16	1.08E-02	8.84E-15	3.86E-16	2E-15	1.47E+00
09-May-95	9.40E-17	1E-16	1.57E-01	9.80E-17	1.00E-13	1E-16	3.27E-01	1.90E-16	2.48E-17	1E-16	2.1[illegible]E-02	2.80E-15	1.70E-16	2E-15	4.63E-01
08-Aug-95	1.45E-16	1E-16	2.42E-01	2.86E-16	3.78E-17	1E-16	9.53E-01	7.10E-17	3.62E-17	1E-16	7.89E-03	2.70E-15	2.17E-16	2E-15	4.50E-01
07-Nov-95	1.43E-14	1E-16	2.38E+01	2.31E-15	1.24E-16	2E-16	7.70E+00	2.61E-15	7.51E-17	2E-13	2.90E-01	5.60E-15	2.48E-16	1E-15	9.33E-01

*1/1/94 Derived air concentrations were implemented as per 10 CFR 20

TABLE 16

ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
AMBIENT AIR RADIONUCLIDE PARTICULATES
µCi/ml
LOCATION: BHV-6

Current Quarter	1st	2nd	3rd	4th
% time operated	99.0%	94.4%	97.9%	53.8%
Air Volume SCF x 1e6	4.21	4.05	4.23	2.24

PERIOD ENDING	URANIUM NAT GROSS CONC	URANIUM NAT LLD (1E-16)	URANIUM NAT % MPC	THORIUM-230 GROSS CONC	THORIUM-230 COUNTING ERROR	THORIUM-230 LLD (1E-16)	THORIUM-230 % MPC	RADIUM-226 GROSS CONC	RADIUM-226 COUNTING ERROR	RADIUM-226 LLD (1E-16)	RADIUM-226 % MPC	LEAD-210 GROSS CONC.	LEAD-210 COUNTING ERROR	LEAD-210 LLD (2E-15)	LEAD-210 % MPC
28-Sep-81	2.44E-15	1E-16	4.88E-02	1.53E-15	4.11E-16	1E-16	5.10E-01	7.84E-16	4.31E-16	1E-16	3.77E-02	1.06E-14	2.57E-15	2E-15	2.11E-01
14-Dec-81	4.84E-15	1E-16	9.68E-02	2.78E-15	3.56E-16	1E-16	9.27E-01	1.84E-15	2.84E-16	1E-16	9.20E-02	1.53E-14	2.28E-15	2E-15	1.91E-01
29-Mar-82	1.04E-15	9E-16	2.08E-02	2.62E-15	9.49E-16	3E-16	8.73E-01	1.11E-15	4.62E-16	4E-15	5.56E-02	2.98E-14	8.16E-15	2E-14	3.73E-01
30-Jun-82	3.61E-15	8E-17	7.22E-02	7.61E-15	9.40E-16	7E-17	2.54E+00	1.39E-15	2.16E-16	2E-16	6.95E-02	1.80E-15	1.00E-15	2E-15	2.25E-02
27-Sep-82	1.71E-14	1E-16	3.42E-01	9.48E-15	6.02E-16	1E-16	3.16E+00	3.80E-15	4.66E-16	1E-16	1.90E-01	2.36E-14	4.06E-15	2E-15	2.94E-01
03-Jan-83	1.90E-14	8E-17	3.80E-01	5.77E-15	1.96E-16	3E-17	1.92E+00	9.34E-17	3.10E-16	6E-17	4.67E-03	4.32E-14	2.80E-15	2E-15	5.40E-01
04-Apr-83	Lost in Lab			2.33E-15	1.00E-16	2E-17	7.77E-01	5.93E-16	1.06E-16	9E-17	2.97E-02	3.01E-14	1.40E-15	9E-16	3.76E-01
30-Jun-83	7.62E-16	8E-17	1.52E-02	3.26E-15	1.70E-16	9E-17	1.09E+00	6.28E-15	3.59E-16	1E-16	3.14E-01	2.69E-14	1.00E-15	1E-15	3.36E-01
03-Oct-83	4.86E-16	1E-16	9.72E-03	1.10E-15	3.09E-16	1E-16	3.67E-01	3.63E-16	1.06E-16	1E-16	1.82E-02	2.08E-14	1.13E-15	8E-16	2.60E-01
03-Jan-84	6.98E-15	1E-16	1.39E-01	9.69E-16	9.88E-17	5E-17	3.23E-01	9.60E-16	6.53E-17	1E-16	4.80E-02	1.83E-14	2.02E-15	2E-15	2.29E-01
02-Apr-84	1.64E-15	5E-17	3.28E-02	1.34E-15	1.20E-16	7E-17	4.47E-01	3.88E-15	2.29E-16	5E-17	1.94E-01	4.67E-14	2.10E-01	1E-15	5.84E-01
02-Jul-84	1.12E-15	8E-17	2.24E-02	1.92E-15	1.69E-16	7E-17	6.40E-01	3.31E-15	2.70E-16	1E-16	1.66E-01	2.21E-14	1.20E-15	1E-15	2.76E-01
01-Oct-84	1.11E-15	8E-17	2.22E-02	3.13E-16	1.28E-16	8E-17	1.04E-01	4.21E-16	1.34E-16	1E-16	2.11E-02	1.57E-14	1.36E-15	1E-15	1.96E-01
02-Jan-85	7.32E-16	8E-16	1.46E-02	6.71E-16	1.06E-16	5E-17	2.24E-01	4.94E-16	1.35E-16	1E-16	2.47E-02	2.42E-14	1.28E-15	9E-16	3.03E-01
01-Apr-85	2.36E-16	5E-17	4.72E-03	5.43E-16	2.16E-16	1E-16	1.81E-01	[illegible]	9.00E-17	7E-17	1.36E-02	1.29E-14	1.02E-15	8E-16	1.86E-01
01-Jul-85	7.58E-16	5E-17	1.52E-02	4.00E-16	9.43E-16	6E-16	1.33E-01	[illegible]	1.50E-16	9E-17	3.46E-02	2.16E-14	1.42E-15	8E-16	2.66E-01
30-Sep-85	7.47E-15	7E-16	1.49E-01	1.16E-15	1.42E-16	8E-17	3.87E-01	2.19E-15	2.21E-15	1E-16	1.10E-01	9.20E-15	1.11E-15	1E-15	1.16E-01
02-Jan-86	1.75E-14	6E-16	3.50E-01	7.24E-15	2.20E-15	1E-15	2.41E+00	3.83E-15	3.83E-15	1E-16	1.92E-01	1.12E-16	1.00E-15	1E-15	1.41E-03
01-Apr-86	2.99E-14	2E-16	5.98E-01	7.94E-15	6.30E-17	4E-16	2.65E+00	1.51E-14	5.02E-16	4E-16	7.57E-01	2.22E-14	5.04E-16	6E-17	2.78E-01
30-Jun-86	2.23E-14	1E-17	4.47E-01	5.19E-15	3.30E-16	2E-17	1.73E+00	1.05E-14	1.00E-16	4E-16	5.24E-01	2.16E-14	2.00E-15	2E-15	2.70E-01
27-Oct-86	2.33E-14	1E-16	4.66E-01	7.76E-15	3.00E-1?	2E-16	2.59E+00	1.60E-14	1.00E-15	1E-16	8.00E-01	2.02E-14	2.00E-16	3E-16	2.53E-01
15-Dec-86	3.40E-14	3E-17	6.80E-01	5.35E-15	2.00E-1?	2E-17	1.78E+00	1.47E-14	5.00E-16	4E-17	7.35E-01	2.82E-14	2.00E-16	3E-17	3.53E-01
16-Mar-87	2.06E-14	3E-16	4.12E-01	4.50E-15	3.00E-16	8E-16	1.50E+00	6.74E-15	2.00E-16	4E-16	3.37E-01	7.29E-14	1.00E-15	7E-16	9.11E-01
11-May-87	2.50E-14	5E-16	5.00E-01	8.54E-15	2.00E-16	5E-16	2.85E+00	8.16E-15	3.00E-16	8E-16	4.08E-01	3.28E-14	2.00E-16	2E-17	4.10E-01
09-Sep-87	2.65E-14	5E-16	5.30E-01	6.62E-15	3.00E-16	7E-17	2.21E+00	9.34E-15	3.00E-16	2E-17	4.67E-01	2.77E-14	4.00E-16	1E-16	3.46E-01
02-Nov-87	1.90E-14	4E-16	3.80E-01	7.09E-15	3.00E-16	4E-16	2.36E+00	7.20E-15	3.00E-16	4E-16	3.60E-01	1.77E-14	5.00E-16	2E-17	2.21E-01
16-Feb-88	1.01E-14	5E-16	2.02E-01	2.98E-15	1.00E-16	2E-17	9.93E-01	3.93E-15	1.00E-16	2E-17	1.97E-01	3.36E-14	2.00E-16	5E-17	4.20E-01
16-May-88	1.79E-14	3E-16	3.58E-01	8.14E-15	3.00E-16	2E-17	2.71E+00	7.43E-15	3.00E-16	2E-17	3.72E-01	2.12E-14	2.00E-16	4E-17	2.65E-01
15-Aug-88	1.79E-14	3E-16	3.58E-01	1.46E-14	1.00E-15	1E-17	4.87E+00	5.34E-15	2.00E-16	2E-17	2.67E-01	2.45E-14	3.00E-16	2E-17	3.06E-01
14-Nov-88	4.46E-14	3E-16	8.92E-01	1.39E-14	2.00E-16	1E-17	4.63E+00	1.17E-14	2.00E-16	1E-17	5.86E-01	3.43E-14	2.00E-16	3E-17	4.29E-01
13-Feb-89	1.67E-14	4E-17	3.34E-01	5.54E-15	1.02E-16	1E-16	1.85E+00	7.20E-15	1.40E-16	2E-16	3.60E-01	5.02E-14	2.10E-16	5E-16	6.28E-01
15-May-89	2.03E-14	1E-16	4.06E-01	7.05E-15	2.00E-16	6E-17	2.35E+00	9.56E-16	2.00E-16	6E-16	4.78E-02	1.43E-14	1.00E-16	3E-17	1.79E-01
14-Aug-89	2.81E-15	2E-16	5.62E-02	3.78E-15	2.00E-16	8E-16	1.26E+00	9.26E-15	3.00E-16	6E-16	4.63E-01	1.50E-14	1.00E-16	4E-17	1.88E-01
13-Nov-89	5.36E-14	2E-17	1.08E+00	8.01E-15	3.00E-16	3E-16	2.67E+00	1.81E-14	3.00E-16	7E-16	9.06E-01	4.09E-14	5.00E-16	2E-17	5.12E-01
12-Feb-90	4.48E-14	3E-16	8.96E-01	1.48E-14	1.00E-15	6E-16	4.93E+00	1.28E-14	2.00E-17	2E-17	6.40E-01	3.88E-14	3.00E-16	5E-17	4.85E-01
14-May-90	2.16E-14	1E-16	4.30E-01	1.70E-14	1.00E-15	1E-16	5.67E+00	1.59E-14	1.00E-15	1E-16	7.96E-01	3.48E-14	1.00E-15	2E-16	4.36E-01
13-Aug-90	9.53E-15	1E-16	1.91E-01	1.70E-14	1.00E-15	1E-16	5.67E+00	3.27E-15	1.10E-16	1E-16	1.64E-01	1.27E-14	2.00E-16	2E-16	1.59E-01
12-Nov-90	1.11E-14	1E-16	2.22E-01	5.27E-15	3.00E-14	1E-16	1.76E+00	5.36E-15	3.00E-16	1E-16	2.68E-01	1.58E-14	4.00E-16	2E-16	1.98E-01
11-Feb-91	6.35E-16	1E-16	1.27E-02	3.13E-16	6.00E-17	1E-16	1.04E-01	2.31E-16	4.00E-17	1E-16	1.16E-02	3.88E-14	1.00E-15	2E-16	4.86E-01
13-May-91	1.22E-15	1E-16	2.44E-02	6.14E-15	3.00E-16	1E-16	2.05E+00	4.41E-15	2.00E-16	1E-16	2.21E-01	2.50E-14	1.00E-15	2E-15	3.13E-01
12-Aug-91	7.84E-16	1E-16	1.57E-02	1.43E-15	2.00E-16	1E-16	4.77E-01	4.47E-16	1.10E-16	1E-16	2.24E-02	1.84E-14	4.00E-16	2E-15	2.30E-01
11-Nov-91	5.37E-16	1E-16	1.07E-02	4.20E-16	7.00E-17	2E-17	1.40E-01	1.37E-16	3.00E-17	2E-17	6.86E-03	1.27E-14	3.00E-16	1E-16	1.58E-01
10-Feb-92	3.54E-16	[illegible]	7.08E-03	1.18E-16	6.00E-17	2E-17	3.93E-02	4.08E-17	3.00E-17	2E-17	2.04E-03	3.69E-14	6.00E-17	1E-16	4.61E-01
11-May-92	4.71E-16	[illegible]	9.42E-03	9.56E-16	1.00E-16	2E-16	3.19E-01	8.31E-17	4.00E-18	2E-18	4.16E-03	1.43E-14	2.00E-16	1E-16	1.78E-01
10-Aug-92	5.32E-15	2E-16	1.06E-01	3.36E-16	6.00E-17	4E-16	1.12E-01	1.65E-16	7.00E-17	2E-16	8.25E-03	1.56E-14	2.00E-16	2E-17	1.95E-01
09-Nov-92	3.66E-16	3E-21	7.32E-03	2.28E-16	4.00E-17	4E-16	7.60E-02	1.08E-16	3.00E-17	3E-16	5.40E-03	2.24E-14	2.00E-16	2E-17	2.80E-01
08-Feb-93	2.05E-16	1E-22	4.10E-03	9.14E-17	4.00E-17	4E-16	3.05E-02	6.31E-17	5.00E-17	3E-16	3.16E-03	3.41E-14	5.00E-16	2E-17	4.26E-01
10-May-93	4.80E-16	3E-22	9.60E-03	8.26E-16	1.20E-16	4E-16	2.75E-01	1.26E-15	1.00E-16	3E-16	6.30E-02	1.83E-14	4.00E-16	2E-17	2.29E-01
10-Aug-93	9.30E-16	2E-16	1.86E-02	1.90E-16	7.00E-17	4E-16	6.33E-02	2.10E-16	9.00E-17	3E-16	1.05E-02	1.70E-14	5.00E-16	2E-17	2.13E-01
08-Nov-93	2.70E-16	2E-16	5.40E-03	8.00E-17	8.00E-17	4E-16	2.67E-02	7.00E-17	1.70E-16	3E-16	3.50E-03	2.34E-14	3.00E-16	2E-17	2.93E-01
07-Feb-94	3.16E-16	2E-16	5.30E-01	0.00E+00	5.80E-17	4E-16	0.00E+00	5.16E-16	2.80E-16	3E-16	5.70E-02	3.04E-14	7.00E-16	2E-17	6.07E+00
09-May-94	1.60E-15	2E-17	3.00E+00	9.76E-16	2.00E-16	4E-17	3.26E+00	1.10E-15	2.00E-16	3E-17	1.22E-01	8.30E-15	2.00E-16	2E-16	1.36E+00
09-Aug-94	2.67E-15	1E-16	4.48E+00	1.11E-15	1.70E-16	1E-16	3.70E+00	4.96E-16	3.87E-17	1E-16	5.50E-02	0.00E+00	2.10E-16	1E-16	0.00E+00
07-Nov-94	9.21E-17	1E-16	1.84E-01	1.59E-15	8.00E-17	1E-16	5.30E+00	1.66E-15	5.70E-17	1E-16	1.84E-01	0.00E+00	1.66E-15	1E-15	0.00E+00
07-Feb-95	1.51E-15	1E-16	2.52E+00	9.50E-16	9.29E-16	1E-16	3.17E+00	9.70E-17	6.60E-17	1E-16	1.08E-02	9.36E-15	4.00E-16	1E-15	1.56E+00
08-May-95	2.21E-16	1E-16	3.68E-01	8.56E-16	5.41E-17	1E-16	2.85E+00	3.08E-15	9.49E-17	1E-16	3.43E-01	4.34E-15	2.08E-16	1E-15	7.23E-01
08-Aug-95	1.66E-16	1E-16	2.77E-01	1.67E-15	1.29E-16	1E-16	5.57E+00	3.90E-15	1.34E-16	1E-16	4.33E-01	5.60E-15	1.29E-16	2E-15	9.33E-01
07-Nov-95	2.04E-14	1E-16	3.40E+01	6.70E-1?	2.32E-16	2E-16	2.23E+01	7.65E-15	1.24E-16	2E-16	8.50E-01	4.47E-15	2.25E-16	1E-15	7.45E-01

*1/1/94 Derived air concentrations were implemented as per 10 CFR 20

TABLE 1

ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
AMBIENT RADON LEVELS
pCi/Liter

PERIOD ENDING	BHV-1	BHV-2	BHV-3	BHV-4	BHV-5	BHV-6*	BHV-7**
09-Sep-86	0.56	0.57	0.13	0.60	0.72	0.37	
21-Dec 86	0.5	0.6	0.4	0.6	1.1	0.4	
23-Mar-87	0.4	0.4	0.2	0.6	1.0	0.4	
18-Jun-87	1.7	1.9	1.7	1.7	2.0	3.0	
09-Sep-87	0.6	0.7	0.3	0.5	0.7	0.7	
31-Dec-87	1.4	0.8	0.7	0.7	1.3	0.6	
21-Apr-87	0.3	0.5	0.5	0.6	0.6	0.4	
27-Jun-88	0.4	0.6	0.7	1.0	1.2	1.0	
03-Oct-88	1.0	0.4	0.2	0.6	1.4	0.5	
03-Jan-89	0.6	0.6	0.6	0.9	2.3	1.7	
04-Apr-89	1.3	3.1	0.5	0.7	2.5	1.0	
30-Jun-89	0.6	1.3	0.6	3.0	3.3	1.1	
28-Sep-89	0.4	0.4	0.4	0.5	1.9	0.7	
02-Jan-90	0.8	1.7	0.5	1.4	2.5	1.2	
02-Apr-90	0.5	0.4	0.5	0.8	1.1	0.6	
02-Jul-90	0.4	0.5	0.3	0.3	0.5	0.3	
01-Oct-90	1.0	1.5	0.7	0.6	1.0	0.7	
02-Jan-91	0.6	0.4	0.2	0.5	1.1	0.4	
01-Apr-91	0.4	0.6	0.3	0.6	1.2	0.4	
01-Jul-91	0.5	0.3	0.2	0.3	0.5	0.3	
30-Sep-91	0.6	0.6	0.3	0.4	0.8	0.5	
03-Jan-92	0.8	1.2	0.3	0.4	0.9	0.6	
06-Apr-92	1.0	0.5	0.7	0.8	1.3	1.0	
02-Jul-92	0.7	0.4	0.1	0.3	0.5	0.6	
01-Oct-92	0.8	0.8	0.4	0.5	1.1	0.8	
04-Jan-93	0.8	0.5	0.2	0.9	1.5	0.6	
05-Apr-93	0.5	0.2	0.3	0.3	0.7	0.2	
08-Jul-93	0.9	0.9	0.4	0.6	0.8	0.4	1.6
04-Oct-93	0.8	0.7	0.3	0.4	1	0.6	1.2
10-Jan-94	0.8	0.7	0.4	0.8	1.8	0.8	3.3
01-Apr-94	1.2	1.1	0.6	1.3	2.2	0.8	3
05-Jul-94	1.3	1.1	0.7	1.9	1.5	1.2	3.2
05-Oct-94	0.8	0.4	0.2	0.4	1.1	0.7	1.9
03-Jan-95	1.3	0.9	0.7	1.4	3.3	0.9	5.9
03-Apr-95	0.6	0.7	0.6	1.0	1.9	0.4	4.7
03-Jul-95	1.0	0.8	0.7	1.0	1.7	0.8	4.4
09-Oct-95	1.4	0.8	0.4	1.0	2.0	1	5.4
MEAN	0.79	0.80	0.46	0.81	1.41	0.75	1.32
Count	37	37	37	37	37	37	47
Std Dev	0.347	0.548	0.282	0.536	0.728	0.493	1.400

* BHV-6 is a duplicate located at BHV-2.
** BHV-7 is a trip blank kept in it's wrapper in the office.

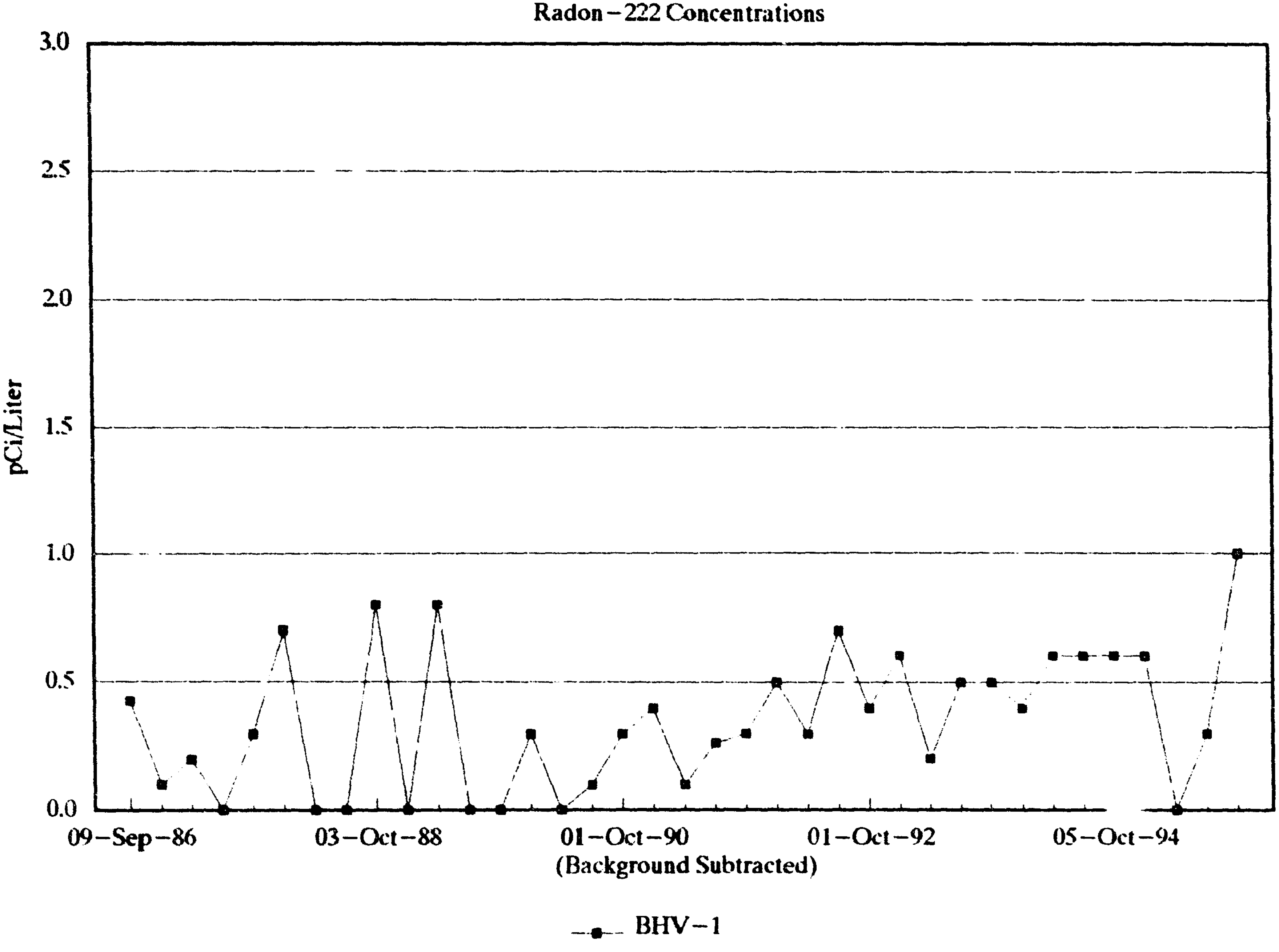
Note: Vendor laboratories and analytical methods were switched third quarter, 1986 and again in th 2nd quarter of 1994.

TABLE 2

ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
BHV-2 versus BHV-6

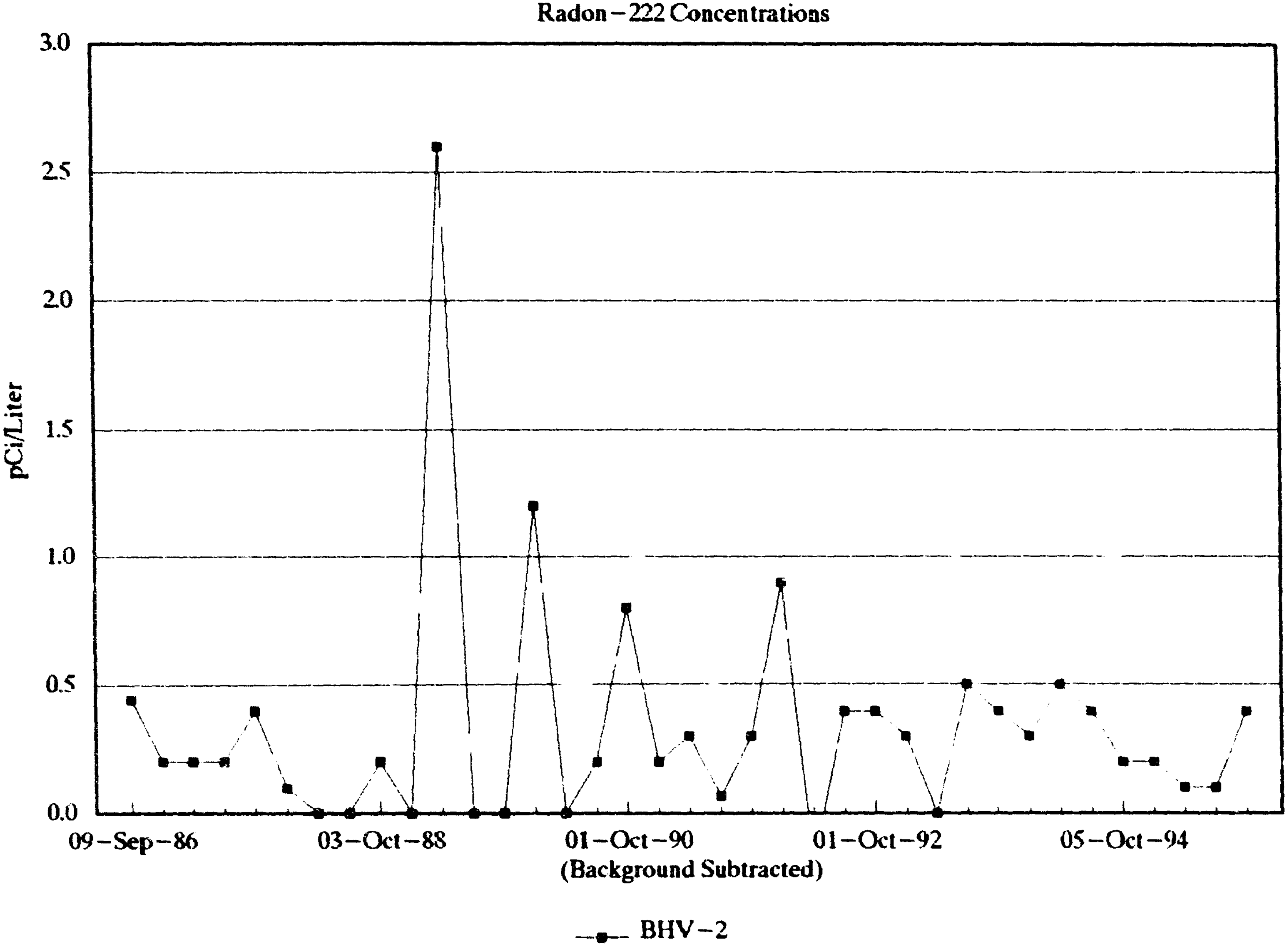
Regression Output:		
Constant		0.09948
Std Err of Y Est		0.41
R Squared		0.33
No. of Observations		37
Degrees of Freedom		35
X Coefficient(s)	0.81986	
Std Err of Coef.	0.19655	

ENERGY FUELS NUCLEAR, INC.



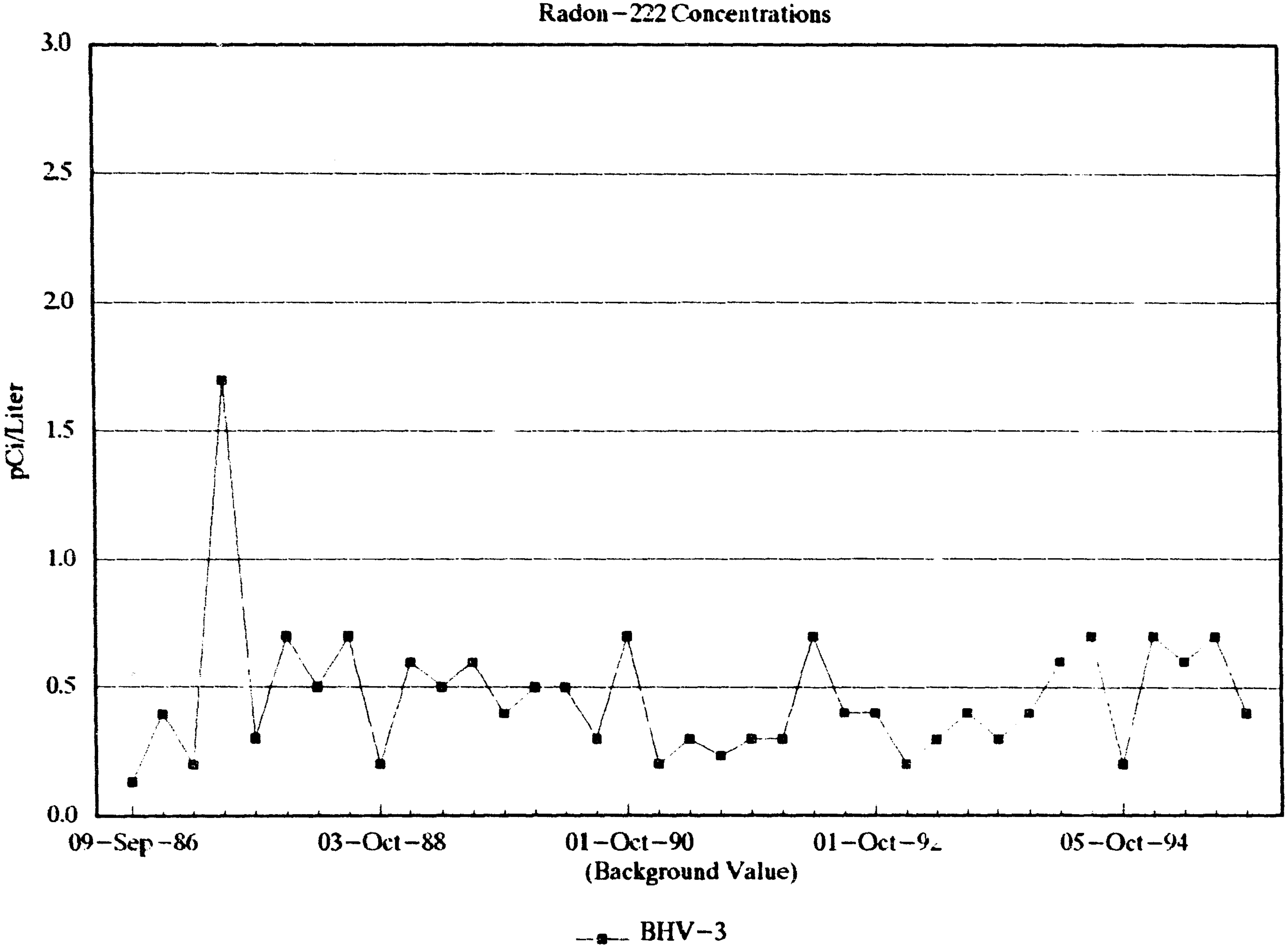
GRAPH 1

ENERGY FUELS NUCLEAR, INC.



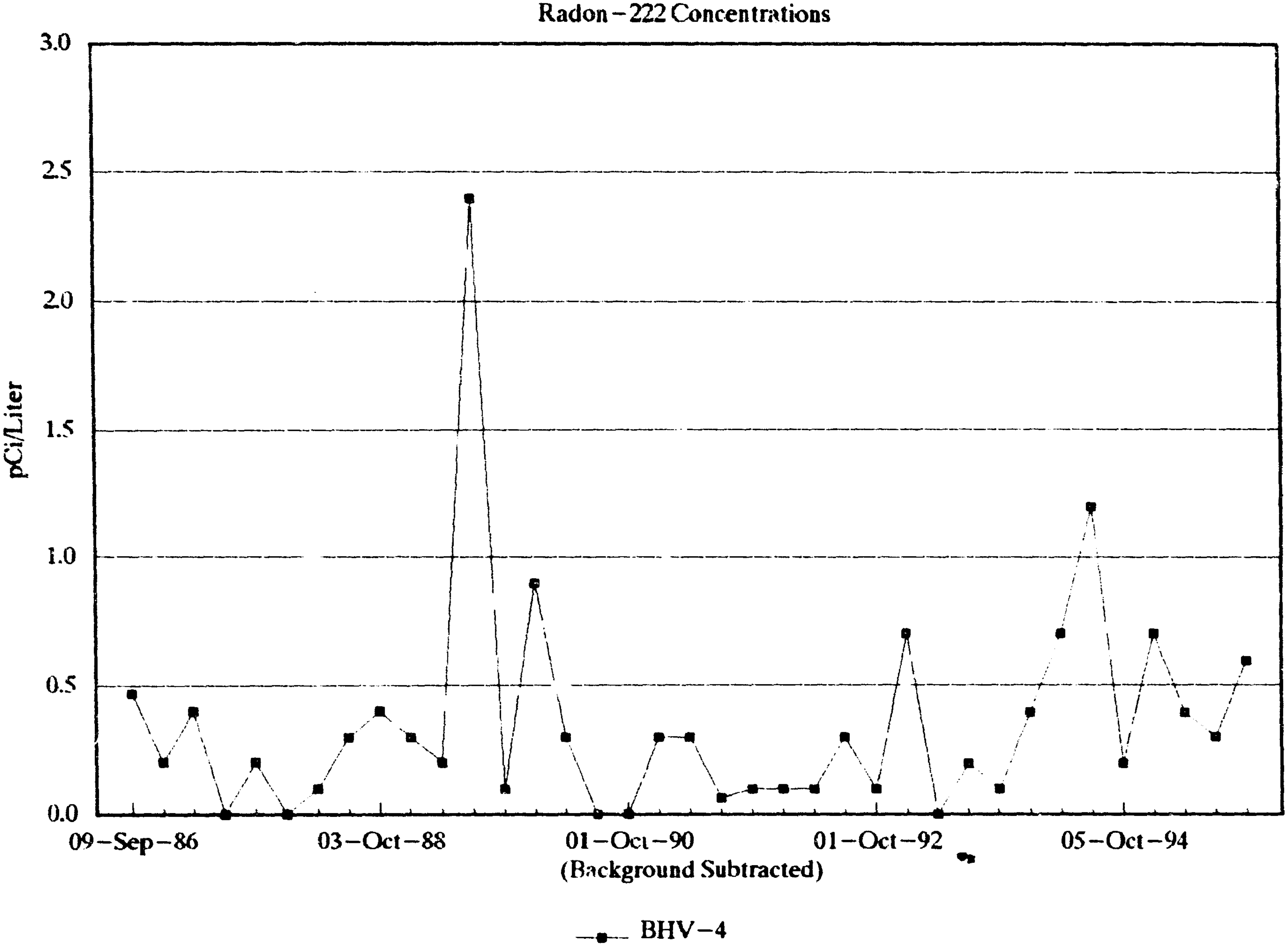
GRAPH 2

ENERGY FUELS NUCLEAR, INC.



GRAPH 3

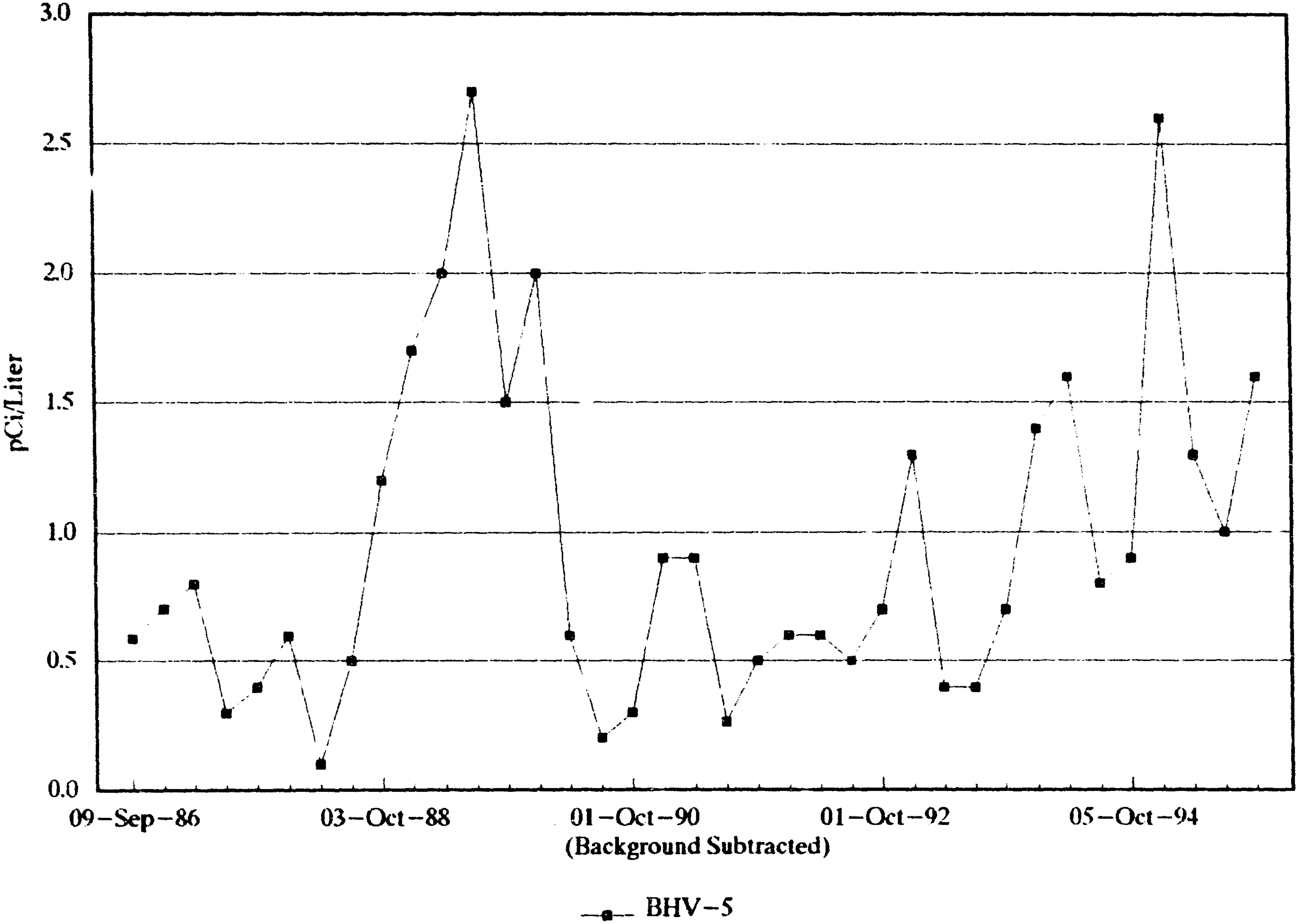
ENERGY FUELS NUCLEAR, INC.



GRAPH 4

ENERGY FUELS NUCLEAR, INC.

Radon-222 Concentrations



GRAPH 5

TABLE 3

ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
DIRECT RADIATION
MR/QTR
Location: BHV-1, Meterological Station

Period Ending	Total Exposure Rate	Counting Error	Net Exposure Rate	Net Error	Total Rate Mr/week	Counting Error Mr/week
30-Sep-81	23.66	0.00	3.90	0.00	1.82	
31-Dec-81	25.87	0.00	-2.21	0.00	1.99	
31-Mar-82	26.00	0.00	1.69	0.00	2.00	
30-Jun-82	24.05	0.00	-3.64	0.00	1.85	
01-Oct-82	25.35	0.00	3.12	0.00	1.95	
03-Jan-83	30.55	0.00	4.94	0.00	2.35	
04-Apr-83	22.49	0.00	-1.82	0.00	1.73	
05-Jul-83	32.11	0.00	7.54	0.00	2.47	
03-Oct-83	20.54	0.00	-1.43	0.00	1.58	
03-Jan-84	22.75	0.00	-0.91	0.00	1.75	
03-Apr-84	24.70	0.00	1.56	0.00	1.90	
02-Jul-84	22.49	0.00	1.69	0.00	1.73	
02-Oct-84	19.89	2.21	1.82	4.37	1.53	0.17
02-Jan-85	21.58	3.12	1.30	4.89	1.66	0.24
04-Apr-85	23.40	10.01	1.04	10.70	1.80	0.77
08-Jul-85	16.90	6.50	4.55	7.58	1.30	0.50
07-Oct-85	20.28	1.58	1.56	2.49	1.56	0.12
17-Jan-86	23.79	5.89	1.43	6.32	1.83	0.45
22-Apr-86	23.92	-0.70	0.91	0.92	1.84	-0.05
21-Jul-86	17.94	26.40	-6.37	30.31	1.38	2.03
03-Nov-86	19.63	0.09	-2.99	4.59	1.51	0.01
03-Feb-87	20.67	0.05	1.30	1.55	1.59	0.00
01-Apr-87	22.75	1.92	-8.19	2.09	1.75	0.15
01-Jul-87	Sample lost in the field					
09-Oct-87	17.94	0.03	1.95	1.07	1.38	0.00
14-Jan-88	20.80	1.58	-0.13	1.63	1.6	0.12
19-Apr-88	25.61	2.32	1.43	3.43	1.97	0.18
15-Jul-88	26.52	7.37	1.69	8.28	2.04	0.57
11-Oct-88	20.02	5.81	-0.39	5.81	1.54	0.45
19-Jan-89	23.14	2.61	-1.17	5.30	1.78	0.20
08-May-89	30.42	5.61	0.26	7.14	2.34	0.43
21-Jul-89	27.43	6.73	1.17	6.95	2.11	0.52
30-Oct-89	25.09	12.58	2.34	15.12	1.93	0.97
18-Jan-90	23.27	9.23	0.78	10.97	1.79	0.71
19-Apr-90	26.26	4.12	2.86	5.11	2.02	0.32
16-Jul-90	22.75	2.05	-1.56	3.12	1.75	0.16
01-Oct-90	22.10	1.95	0.45	1.95	1.70	0.15
02-Jan-91	25.61	2.24	-6.76	9.60	1.97	0.17
01-Apr-91	22.49	2.35	-1.30	4.94	1.73	0.18
01-Jul-91	23.92	5.62	-7.67	5.83	1.84	0.43
30-Sep-91	23.27	0.97	-0.39	0.98	1.79	0.07
13-Jan-92	34.97	0.97	11.31	0.98	2.69	0.07
10-Apr-92	22.10	1.62	-15.34	6.60	1.70	0.12
15-Jul-92	23.14	1.26	-3.90	6.44	1.78	0.10
01-Oct-92	21.97	5.50	-3.64	5.91	1.69	0.42
04-Jan-93	27.04	1.53	4.55	4.56	2.08	0.12
08-Apr-93	21.45	3.13	-10.92	9.85	1.65	0.24
13-Jul-93	24.05	7.89	0.26	9.01	1.85	0.61
08-Oct-93	26.65	1.57	-4.94	2.21	2.05	0.12
13-Jan-94	31.85	4.50	8.19	4.50	2.45	0.35
11-Apr-94	31.20	1.03	-8.24	6.48	2.4	0.08
11-Jul-94	23.01	3.02	-4.03	7.00	1.77	0.23
11-Oct-94	22.62	6.08	-2.99	6.45	1.74	0.47
11-Jan-95	19.11	15.77	-3.38	16.35	1.47	1.21
11-Apr-95	21.97	2.04	-7.67	2.64	1.69	0.13
11-Jul-95	23.79	6.61	1.04	7.07	1.83	0.51
16-Oct-95	25.48	7.62	2.73	8.02	1.96	0.59
16-Jan-96	16.64	4.06	-2.34	4.51	1.28	0.31
Mean	23.36	3.59	-0.58	4.94	1.83	0.35
Std. Dev.	4.81	4.60	4.54	5.11	0.29	0.36

TABLE 4

ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
DIRECT RADIATION
MR/CTR
Location: BHV-2, Nearset Residence

Period Ending	Total Exposure Rate	Counting Error	Net Exposure Rate	Net Error	Total Rate Mr/week	Counting Error Mr/week
30-Sep-81	19.11	0.00	-0.65	0.00	1.47	
31-Dec-81	24.57	0.00	-3.51	0.00	1.89	
31-Mar-82	27.04	0.00	2.73	0.00	2.08	
30-Jun-82	23.66	0.00	-4.03	0.00	1.82	
01-Oct-82	22.88	0.00	0.65	0.00	1.76	
03-Jan-83	25.61	0.00	0.00	0.00	1.97	
04-Apr-83	22.88	0.00	-1.43	0.00	1.76	
05-Jul-83	23.66	0.00	-0.91	0.00	1.82	
03-Oct-83	22.75	0.00	0.78	0.00	1.75	
03-Jan-84	29.38	0.00	5.72	0.00	2.26	
03-Apr-84	23.92	0.00	0.78	0.00	1.84	
02-Jul-84	20.02	0.00	-0.78	0.00	1.54	
02-Oct-84	23.92	3.12	5.85	4.89	1.84	0.24
02-Jan-85	22.23	3.38	1.95	5.06	1.71	0.26
04-Apr-85	9.10	3.77	-13.26	5.33	0.70	0.29
07-Jul-85	15.47	5.72	3.12	6.92	1.19	0.44
07-Oct-85	21.32	-0.12	2.60	1.93	1.64	-0.01
17-Jan-86	21.97	8.89	-0.39	9.18	1.69	0.68
22-Apr-86	29.51	9.90	6.50	9.92	2.27	0.76
21-Jul-86	25.35	7.30	1.04	16.59	1.95	0.56
03-Nov-86	22.88	0.09	0.26	4.59	1.76	0.01
03-Feb-87	29.25	-0.75	9.88	1.7[illegible]	2.25	-0.06
01-Apr-87	22.88	0.82	-8.06	1.16	1.76	0.06
01-Jul-87	30.29	4.61	5.20	8.65	2.33	0.35
09-Oct-87	17.81	3.73	1.82	3.88	1.37	0.29
14-Jan-88	21.19	4.08	0.26	4.10	1.63	0.31
19-Apr-88	27.82	4.72	3.64	5.35	2.14	0.36
15-Jul-88	25.48	6.67	0.65	7.66	1.96	0.51
11-Oct-88	25.35	8.51	4.94	8.51	1.95	0.65
19-Jan-89	24.44	5.21	0.13	6.96	1.88	0.40
08-May-89	32.37	2.61	2.21	5.12	2.49	0.20
21-Jul-89	27.95	2.33	1.69	2.90	2.15	0.18
30-Oct-89	22.88	2.58	0.13	8.77	1.76	0.20
18-Jan-90	24.05	2.43	1.56	6.41	1.85	0.19
19-Apr-90	24.83	0.42	1.43	3.05	1.91	0.03
16-Jul-90	23.14	0.65	-1.17	2.44	1.78	0.05
01-Oct-90	23.14	7.55	[illegible].49	7.55	1.78	0.58
02-Jan-91	30.42	5.34	-1.95	10.76	2.34	0.41
01-Apr-91	25.61	9.95	1.82	10.86	1.97	0.77
01-Jul-91	24.70	4.12	-6.89	4.41	1.9	0.32
30-Sep-91	25.74	6.77	2.08	6.77	1.98	0.52
13-Jan-92	38.61	8.70	14.95	8.70	2.97	0.67
10-Apr-92	23.66	1.22	-13.78	6.52	1.82	0.09
15-Jul-92	26.13	4.56	-0.91	7.79	2.01	0.35
01-Oct-92	23.01	6.40	-2.60	6.75	1.77	0.49
04-Jan-93	26.65	-0.67	4.16	4.35	2.05	-0.05
08-Apr-93	22.88	4.53	-9.49	10.38	1.76	0.35
13-Jul-93	17.42	3.79	-6.37	5.77	1.34	0.29
08-Oct-93	26.91	4.27	-4.68	4.55	2.07	0.33
13-Jan-94	30.42	4.30	6.76	4.30	2.34	0.33
11-Apr-94	19.89	7.53	-17.55	9.88	1.53	0.56
11-Jul-94	26.13	6.32	-0.91	8.94	2.01	0.49
11-Oct-94	25.09	10.18	-0.52	10.41	1.93	0.78
12-Jan-95	28.08	-0.03	5.59	4[illegible]	2.16	-0.00
11-Apr-95	24.18	4.34	-5.46	4[illegible]	1.86	0.33
11-Jul-95	24.18	3.81	1.43	4.5[illegible]	1.86	0.29
16-Oct-95	27.17	7.52	4.42	7.93	2.09	0.58
18-Jan-96	[illegible]7.81	5.06	-1.17	5.43	1.37	0.39
Mean	24.39	3.56	0.03	5.11	1.88	0.34
Std. Dev.	4.35	3.17	5.39	3.71	0.33	0.22

TABLE 5

ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
DIRECT RADIATION
MR/QTR
Location: BHV-3, Black Mesa (Background)

Period Ending	Total Exposure Rate	Counting Error	Net Exposure Rate	Net Error	Total Rate Mr/week	Counting Error Mr/week
30-Sep-81	19.76	0.00	0.00	0.00	1.52	
31-Dec-81	28.08	0.00	0.00	0.00	2.16	
31-Mar-82	24.31	0.00	0.00	0.00	1.87	
30-Jun-82	27.69	0.00	0.00	0.00	2.13	
01-Oct-82	22.23	0.00	0.00	0.00	1.71	
03-Jan-83	25.61	0.00	0.00	0.00	1.97	
04-Apr-83	24.31	0.00	0.00	0.00	1.87	
05-Jul-83	24.57	0.00	0.00	0.00	1.89	
03-Oct-83	21.97	0.00	0.00	0.00	1.69	
03-Jan-84	23.66	0.00	0.00	0.00	1.82	
03-Apr-84	23.14	0.00	0.00	0.00	1.78	
02-Jul-84	20.80	0.00	0.00	0.00	1.60	
02-Oct-84	18.07	3.77	0.00	5.33	1.39	0.29
02-Jan-85	20.28	3.77	0.00	5.33	1.56	0.29
04-Apr-85	22.36	3.77	0.00	5.33	1.72	0.29
07-Jul-85	12.35	3.90	0.00	5.52	0.95	0.30
07-Oct-85	18.72	1.93	0.00	2.73	1.44	0.15
17-Jan-86	22.36	2.29	0.00	3.24	1.72	0.18
22-Apr-86	23.01	0.60	0.00	0.85	1.77	0.05
21-Jul-86	24.31	14.90	0.00	21.07	1.87	1.15
03-Nov-86	22.62	4.59	0.00	6.49	1.74	0.35
03-Feb-87	19.37	1.55	0.00	2.19	1.49	0.12
01-Apr-87	30.94	0.82	0.00	1.16	2.38	0.06
01-Jul-87	25.09	7.32	0.00	10.35	1.93	0.56
09-Oct-87	15.99	-1.07	0.00	1.51	1.23	-0.08
14-Jan-88	20.93	-0.42	0.00	0.59	1.61	-0.03
19-Apr-88	24.18	2.52	0.00	3.56	1.86	0.19
15-Jul-88	24.83	3.77	0.00	5.33	1.91	0.29
11-Oct-88	20.41	0.21	0.00	0.30	1.57	0.02
19-Jan-89	24.31	4.61	0.00	6.52	1.87	0.35
08-May-89	30.16	4.41	0.00	6.24	2.32	0.34
21-Jul-89	26.26	1.73	0.00	2.45	2.02	0.13
30-Oct-89	22.75	8.38	0.00	11.85	1.75	0.64
18-Jan-90	22.49	5.93	0.00	8.39	1.73	0.46
19-Apr-90	23.40	3.02	0.00	4.27	1.8	0.23
16-Jul-90	24.31	2.35	0.00	3.32	1.87	0.18
01-Oct-90	21.65	0.00	0.00	0.00	1.665	0.00
02-Jan-91	32.37	9.34	0.00	13.21	2.49	0.72
01-Apr-91	23.79	4.35	0.00	6.15	1.83	0.33
01-Jul-91	31.59	-1.56	0.00	2.21	2.43	-0.12
30 Sep-91	23.66	0.17	0.00	0.24	1.82	0.01
13-Jan-92	37.44	6.40	0.00	9.05	2.88	0.49
10-Apr-92	27.04	6.32	0.00	8.94	2.08	0.49
15-Jul-92	25.61	2.16	0.00	3.05	1.97	0.17
01-Oct-92	22.49	4.30	0.00	6.08	1.73	0.33
04-Jan-93	29.64	-1.67	0.00	2.36	2.28	-0.13
08-Apr-93	23.66	-0.17	0.00	0.24	1.82	-0.01
13-Jul-93	22.88	2.19	0.00	3.10	1.76	0.17
08-Oct-93	24.83	2.57	0.00	3.63	1.91	0.20
12-Jan-94	30.94	3.00	0.00	4.24	2.38	0.23
11-Apr-94	31.46	4.93	0.00	6.97	2.42	0.38
11-Jul-94	24.05	1.12	0.00	1.58	1.85	0.09
11-Oct-94	21.97	2.68	0.00	3.79	1.69	0.21
12-Jan-95	25.87	14.77	0.00	20.89	1.99	1.14
11-Apr-95	23.01	2.04	0.00	2.88	1.77	0.16
11-Jul-95	22.75	2.51	0.00	3.55	1.75	0.19
16-Oct-95	26.26	1.12	0.00	1.58	2.02	0.09
16-Jan-96	18.98	1.96	0.00	2.77	1.46	0.15
Mean	24.10	2.64	0.00	3.97	1.85	0.26
Std. Dev.	4.16	3.35	0.00	4.54	0.32	0.26

TABLE 6

ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
DIRECT RADIATION
MR/QTR
Location: BHV-4, South Tailings Area

Period Ending	Total Exposure Rate	Counting Error	Net Exposure Rate	Net Error	Total Rate Mr/week	Counting Error Mr/week
30-Sep-81	18.33	0.00	-1.43	0.00	1.41	
31-Dec-81	25.61	0.00	-2.47	0.00	1.97	
31-Mar-82		0.00	-24.31	0.00	0.00	
30-Jun-82		0.00	-27.69	0.00	0.00	
01-Oct-82	27.43	0.00	5.20	0.00	2.1[illegible]	
03-Jan-83	37.31	0.00	11.70	0.00	2.87	
04-Apr-83	28.08	0.00	3.77	0.00	2.16	
05-Jul-83	25.09	0.00	0.52	0.00	1.93	
03-Oct-83	26.65	0.00	4.68	0.00	2.05	
03-Jan-84	31.46	0.00	7.80	0.00	2.42	
03-Apr-84	26.65	0.00	3.51	0.00	2.05	
02-Jul-84	26.39	0.00	5.59	0.00	2.03	
02-Oct-84	18.98	4.94	0.91	6.21	1.46	0.38
02-Jan-85	21.45	1.56	1.17	4.08	1.65	0.12
04-Apr-85	24.31	1.69	1.95	4.13	1.87	0.13
07-Jul-85	13.52	4.42	1.17	5.8[illegible]	1.04	0.34
07-Oct-85	21.45	0.68	2.73	2.0[illegible]	1.65	0.05
17-Jan-86	24.05	6.69	1.69	7.07	1.85	0.51
22-Apr-86	28.21	23.40	5.20	23.41	2.17	1.80
21-Jul-86	25.61	3.60	1.30	15.33	1.97	0.28
03-Nov-86	24.18	2.69	1.56	5.32	1.86	0.21
03-Feb-87	23.27	2.55	3.90	2.98	1.79	0.20
01-Apr-87	22.36	2.12	-8.58	2.27	1.72	0.16
01-Jul-87	26.26	14.71	1.17	16.43	2.02	1.13
09-Oct-87	20.15	-0.87	4.16	1.38	1.55	-0.07
14-Jan-88	22.36	2.68	1.43	2.71	1.72	0.21
19-Apr-88	26.13	-1.68	1.95	3.03	2.01	-0.13
15-Jul-88	27.69	1.77	2.86	4.16	2.13	0.14
11-Oct-88	23.40	2.81	2.99	2.82	1.80	0.22
19-Jan-89	24.18	3.91	-0.13	6.04	1.86	0.30
08-May-89	32.50	0.61	2.34	4.45	2.5	0.05
21-Jul-89	29.64	-0.57	3.38	1.82	2.28	-0.04
30-Oct-89	21.97	-1.32	-0.78	8.48	1.69	-0.10
18-Jan-90	23.92	9.23	1.43	10.97	1.84	0.71
19-Apr-90	25.61	2.62	2.21	4.00	1.97	0.20
16-Jul-90	21.58	2.75	-2.73	3.62	1.66	0.21
01-Oct-90	23.66	0.25	2.01	0.25	1.82	0.02
02-Jan-91	24.83	1.74	-7.54	9.50	1.91	0.13
01-Apr-91	24.05	0.45	0.26	4.37	1.85	0.03
01-Jul-91	26.00	5.62	-5.59	5.83	2	0.43
30-Sep-91	23.40	2.37	-0.26	2.38	1.8	0.18
13-Jan-92	34.58	10.80	-2.86	12.55	2.66	0.83
10-Apr-92	25.74	1.02	-1.30	6.40	1.98	0.08
15-Jul-92	23.92	-0.64	-1.69	2.25	1.84	-0.05
01-Oct-92	29.64	6.90	7.15	8.13	2.28	0.53
04-Jan-93	28.73	8.73	-0.91	8.89	2.21	0.67
08-Apr-93	25.61	3.83	1.95	3.83	1.97	0.29
13-Jul-93	23.40	4.49	0.52	5.00	1.8	0.35
08-Oct-93	22.36	6.17	-2.47	6.68	1.72	0.47
13-Jan-94	29.51	5.80	-1.43	6.53	2.27	0.45
11-Apr-94	29.64	3.73	-1.82	6.18	2.28	0.29
11-Jul-94	27.17	6.82	3.12	6.91	2.09	0.52
11-Oct-94	23.53	3.98	1.56	4.80	1.81	0.31
12-Jan-95	23.14	10.37	-2.73	18.05	1.78	0.80
11-Apr-95	23.66	2.84	0.65	3.50	1.82	0.22
11-Jul-95	24.31	3.31	1.30	3.89	1.87	0.25
16-Oct-95	27.17	5.82	0.91	5.93	2.09	0.45
16-Jan-96	27.56	1.56	8.58	2.51	2.12	0.12
Mean	25.31	3.22	0.34	4.88	1.88	0.31
Std. Dev.	3.84	4.26	6.08	4.79	0.46	0.34

TABLE 7

ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
DIRECT RADIATION
MR/QTR
Location: BHV-5, East Tailings Area

Period Ending	Total Exposure Rate	Counting Error	Net Exposure Rate	Net Error	Total Rate Mr/week	Counting Error Mr/week
30-Sep-81	20.28	0.00	0.52	0.00	1.56	
31-Dec-81		0.00	-28.08	0.00	0.00	
31-Mar-82	27.95	0.00	3.64	0.00	2.15	
30-Jun-82	26.52	0.00	-1.17	0.00	2.04	
01-Oct-82	24.96	0.00	2.73	0.00	1.92	
03-Jan-83	31.59	0.00	5.98	0.00	2.43	
04-Apr-83	31.46	0.00	7.15	0.00	2.42	
05-Jul-83	25.22	0.00	0.65	0.00	1.94	
03-Oct-83	23.66	0.00	1.69	0.00	1.82	
03-Jan-84	30.16	0.00	6.50	0.00	2.32	
03-Apr-84	28.21	0.00	5.07	0.00	2.17	
02-Jul-84	23.79	0.00	2.99	0.00	1.83	
02-Oct-84	20.80	1.56	2.73	4.08	1.60	0.12
02-Jan-85	23.66	4.03	3.38	5.52	1.82	0.31
04-Apr-85	24.31	6.50	1.95	7.51	1.87	0.50
07-Jul-85	13.52	2.99	1.17	4.91	1.04	0.23
07-Oct-85	23.53	-0.92	4.81	2.14	1.81	-0.07
17-Jan-86	26.78	9.09	4.42	9.37	2.06	0.70
22-Apr-86	24.83	8.40	1.82	8.42	1.91	0.65
21-Jul-86	25.09	1.80	0.78	15.01	1.93	0.14
03-Nov-86	21.97	0.29	-0.65	4.60	1.69	0.02
03-Feb-87	21.19	1.65	1.82	2.26	1.63	0.13
01-Apr-87	23.14	9.52	-7.80	9.56	1.78	0.73
01-Jul-87	31.33	13.11	6.24	15.02	2.41	1.01
09-Oct-87	20.54	2.23	4.55	2.47	1.58	0.17
14-Jan-88	26.13	-1.22	5.20	1.29	2.01	-0.09
19-Apr-88	27.30	3.82	3.12	4.58	2.10	0.29
15-Jul-88	29.64	2.07	4.81	4.30	2.28	0.16
11-Oct-88	23.53	1.51	3.12	1.52	1.81	0.12
19-Jan-89	25.74	6.21	1.43	7.73	1.98	0.48
08-May-89	32.11	4.91	1.95	6.60	2.47	0.38
21-Jul-89	31.98	0.93	5.72	1.96	2.46	0.07
30-Oct-89	27.04	6.88	4.29	10.84	2.08	0.53
18-Jan-90	28.08	4.03	5.59	7.17	2.16	0.31
19-Apr-90	27.69	2.62	4.29	4.00	2.13	0.20
16-Jul-90	25.35	2.35	1.04	3.32	1.95	0.18
01-Oct-90	25.87	1.85	4.23	1.85	1.99	0.14
02-Jan-91	27.69	9.94	-4.68	13.64	2.13	0.76
01-Apr-91	26.13	1.15	2.34	4.50	2.01	0.09
01-Jul-91	27.04	0.42	-4.55	1.62	2.08	0.03
30-Sep-91	26.00	2.97	2.34	2.97	2.00	0.23
13-Jan-92	37.18	9.20	-0.26	11.21	2.86	0.71
10-Apr-92	29.90	10.52	2.86	12.27	2.30	0.81
15-Jul-92	27.04	3.56	1.43	4.16	2.08	0.27
01-Oct-92	28.99	3.60	6.50	5.61	2.23	0.28
04-Jan-93	34.32	8.93	4.68	9.08	2.64	0.69
08-Apr-93	25.09	2.23	1.43	2.24	1.93	0.17
13-Jul-93	28.47	5.29	5.59	5.73	2.19	0.41
08-Oct-93	29.25	7.87	4.42	8.28	2.25	0.61
13-Jan-94	35.75	7.60	4.81	8.17	2.75	0.58
11-Apr-94	30.42	13.13	-1.04	14.03	2.34	1.01
11-Jul-94	30.42	1.12	6.37	1.58	2.34	0.09
11-Oct-94	28.34	4.58	6.37	5.31	2.18	0.35
12-Jan-95	20.02	14.87	-5.85	20.96	1.54	1.14
11-Apr-95	26.78	3.74	3.77	4.26	2.06	0.29
11-Jul-95	25.35	11.21	2.34	11.39	1.95	0.86
16-Oct-95	28.86	7.92	2.60	8.00	2.22	0.61
16-Jan-96	23.66	10.46	4.08	10.64	1.82	0.80
Mean	26.70	4.08	2.13	5.37	2.02	0.40
Std. Dev.	4.07	4.13	5.04	4.79	0.41	0.31

TABLE 8

ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
DIRECT RADIATION
MR/QTR
Location: BHV-2 VERSUS BHV-6, DUPLICATION

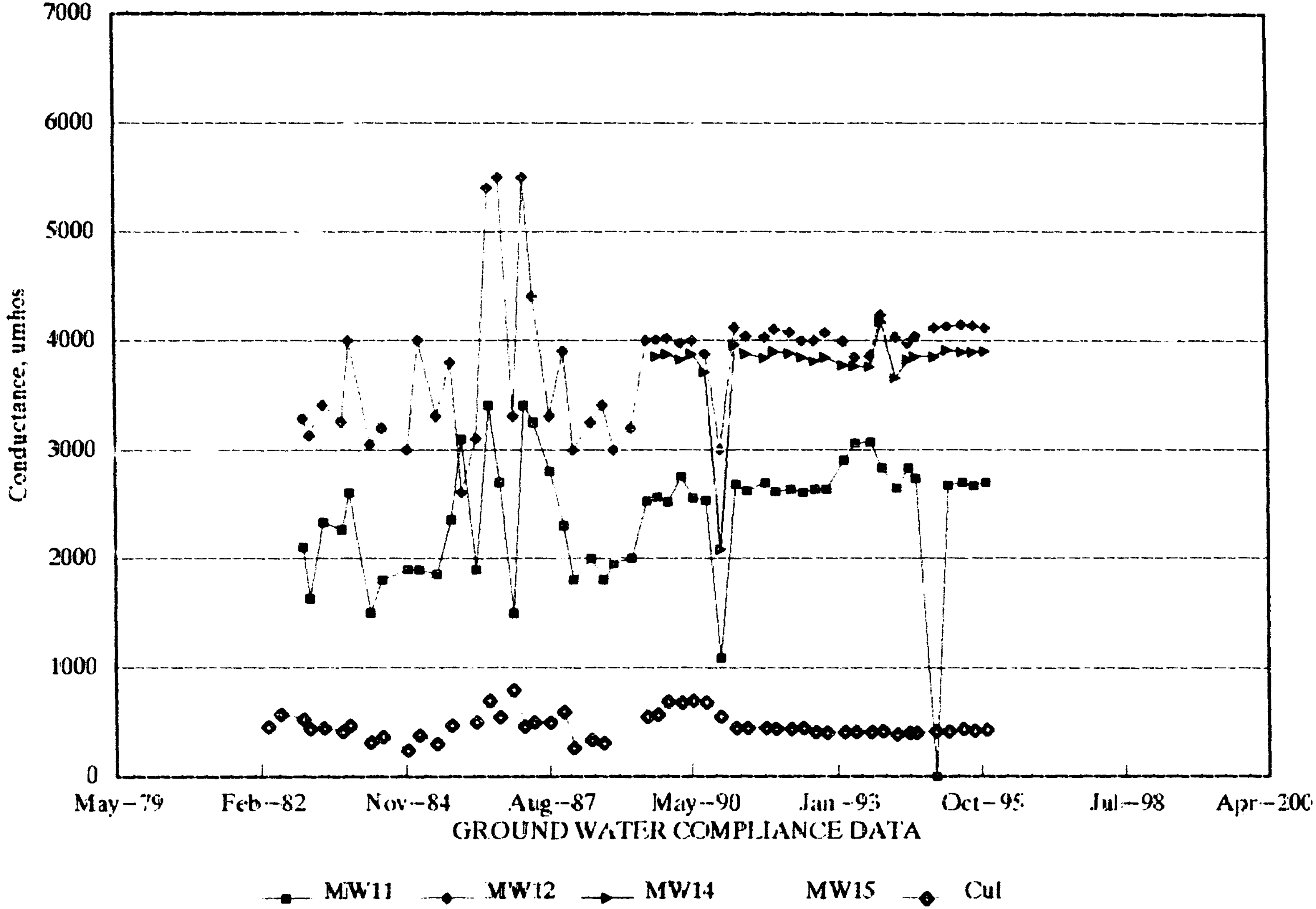
Period Ending	Total Exposure Rate	Counting Error	Net Exposure Rate	Net Error	Total Rate Mr/week	Counting Error Mr/week
16-Jul-90	24.83	0.55	0.52	0.55	1.91	0.04
01-Oct-90	17.68	23.75	-3.97	[illegible]75	1.36	1.83
02-Jan-91	29.51	1.74	7.87	[illegible]74	2.27	0.13
01-Apr-91	25.48	6.75	-6.89	6.75	1.96	0.52
01-Jul-91	26.91	4.92	3.12	4.9[illegible]	2.07	0.38
30-Sep-91	23.27	2.97	4.29	2.9[illegible]	1.79	0.23
13-Jan-92	36.14	7.50	17.16	7.50	2.78	0.58
10-Apr-92	23.79	4.82	4.81	4.82	1.83	0.37
15-Jul-92	24.57	3.86	5.59	3.86	1.89	0.30
01-Oct-92	22.88	7.50	3.90	7.50	1.76	0.58
04-Jan-93	29.64	8.33	10.66	8.33	2.28	0.64
08-Apr-93	28.73	3.03	5.85	3.61	2.21	0.23
13-Jul-93	20.93	1.39	-3.90	1.39	1.61	0.11
08-Oct-93	25.48	2.77	-5.46	3.83	1.96	0.21
13-Jan-94	31.46	5.90	0.00	6.78	2.42	0.45
11-[illegible]pr-94	34.58	15.63	10.53	15.63	2.66	1.20
1[illegible]-Jul-94	26.13	7.82	4.16	7.82	2.01	0.60
11-Oct-94	25.09	7.68	-0.78	7.68	1.93	0.59
12-Jan-95	28.08	4.77	5.07	4.77	2.16	0.37
11-Apr-95	2[illegible]66	6.94	4.68	6.94	1.82	0.53
11-Jul-95	23.66	4.91	4.68	4.91	1.82	0.38
16-Oct-95	26.13	8.22	7.15	8.22	2.01	0.63
16-Jan-96	18.33	4.96	18.33	4.96	1.41	0.38

Regression Output:

Constant		0.711
Std Err of Y Est		0.268
R Squared		0.39
No. of Observations		23
Degrees of Freedom		21
X Coefficient(s)	0.617	
Std Err of Coef.	0.167	

ENERGY FUELS NUCLEAR, INC.

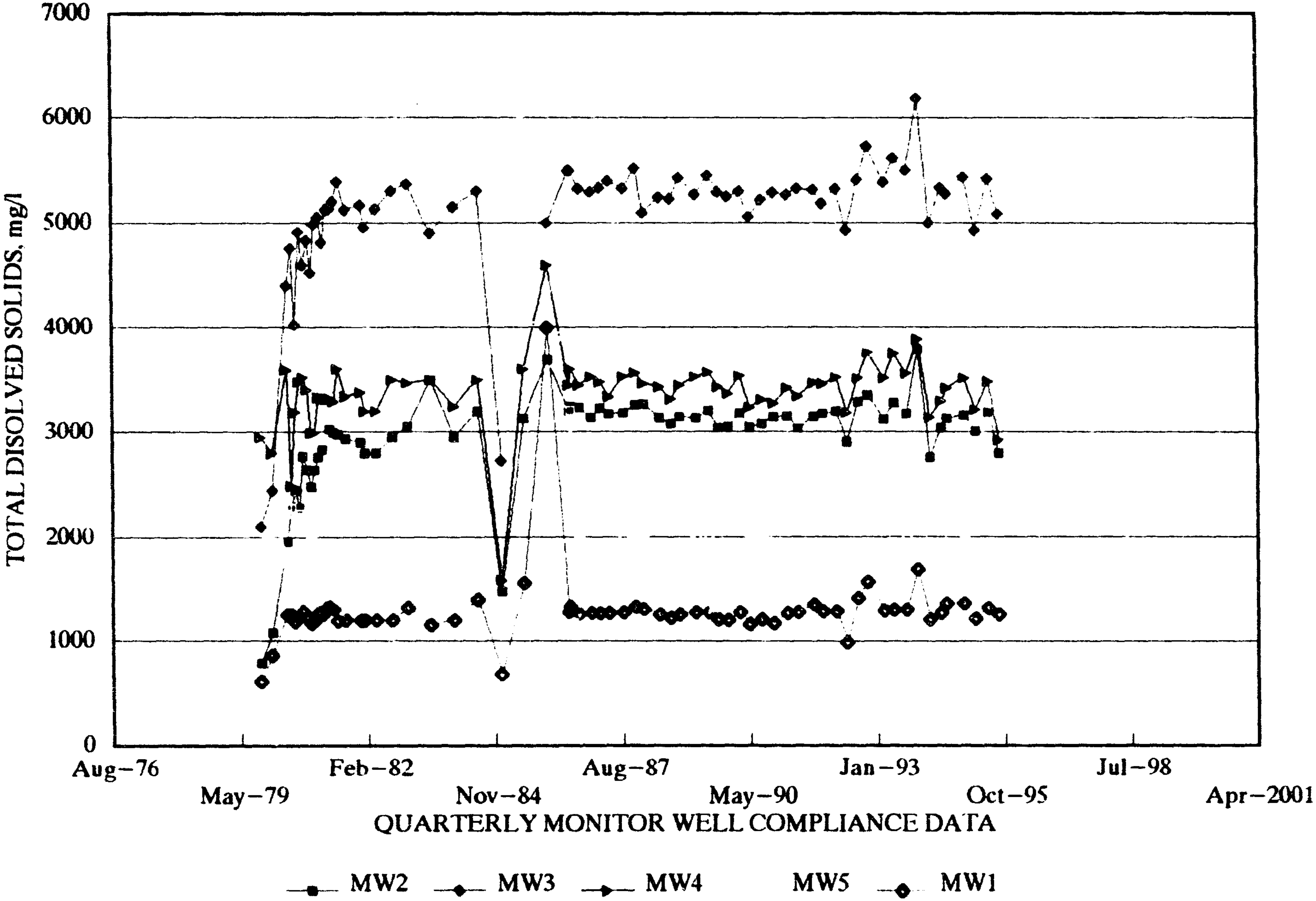
WHITE MESA MILL



GRAPH 29

ENERGY FUELS NUCLEAR, INC.

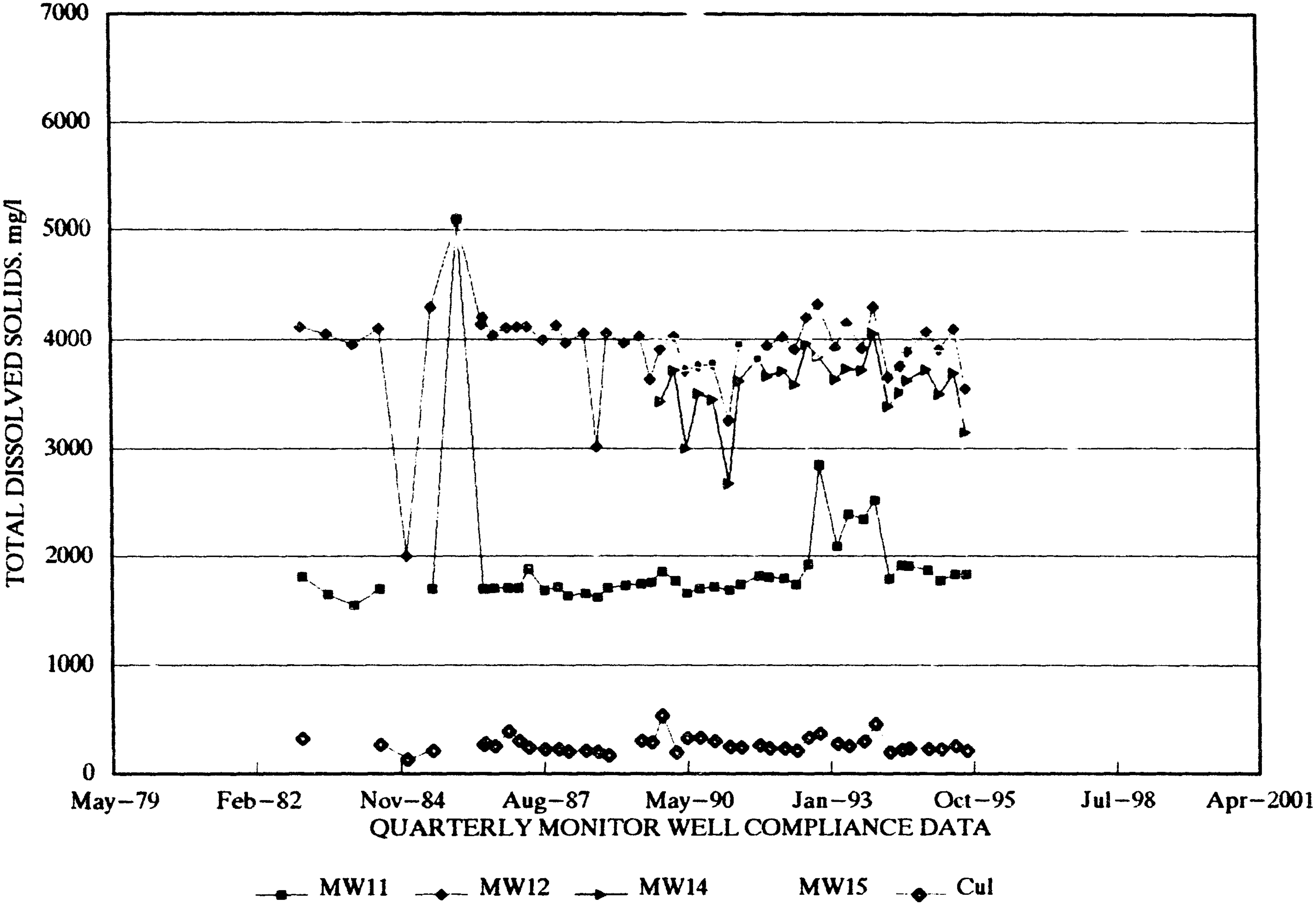
WHITE MESA MILL



GRAPH 30

ENERGY FUELS NUCLEAR, INC.

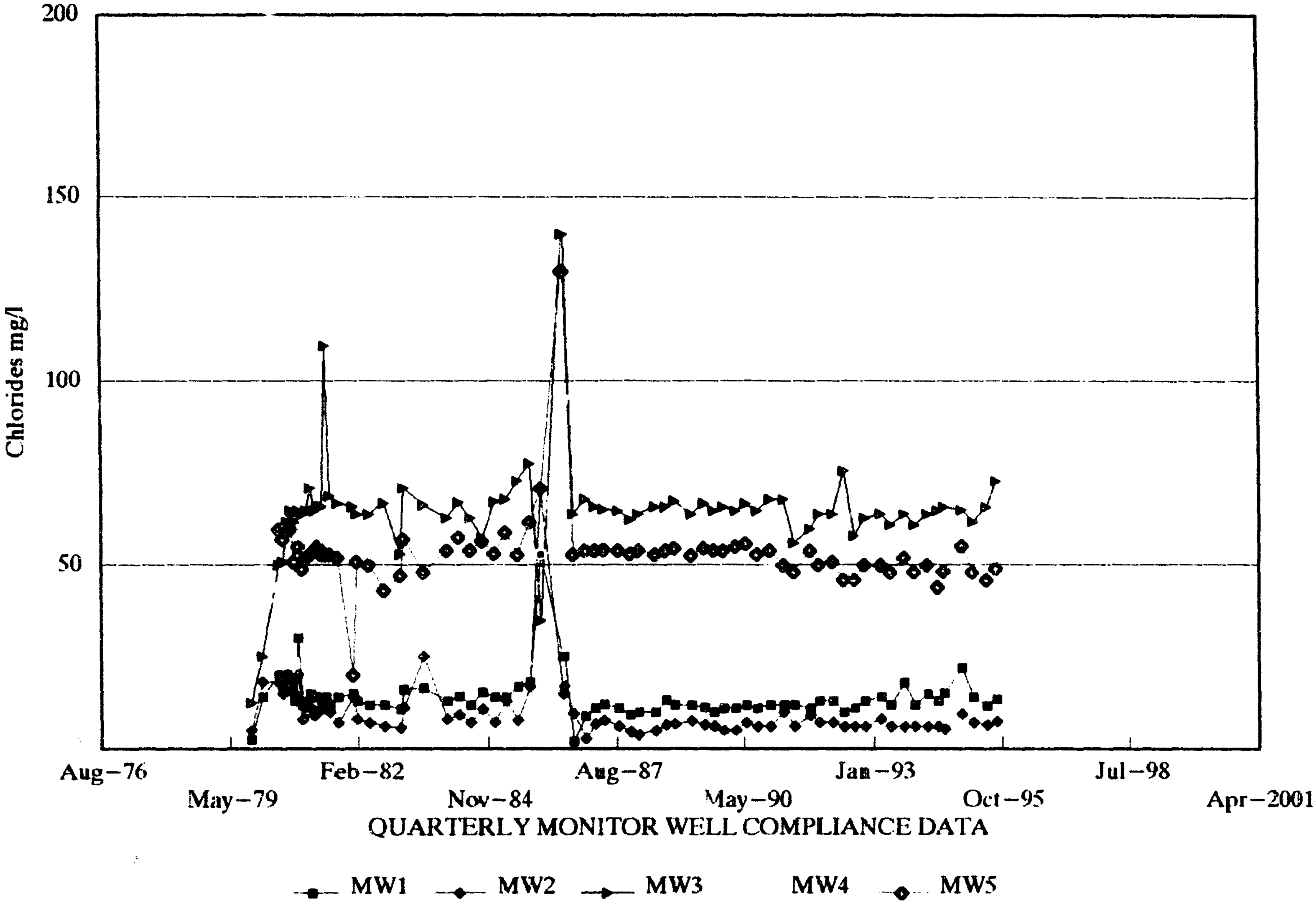
WHITE MESA MILL



GRAPH 31

ENERGY FUELS NUCLEAR, INC.

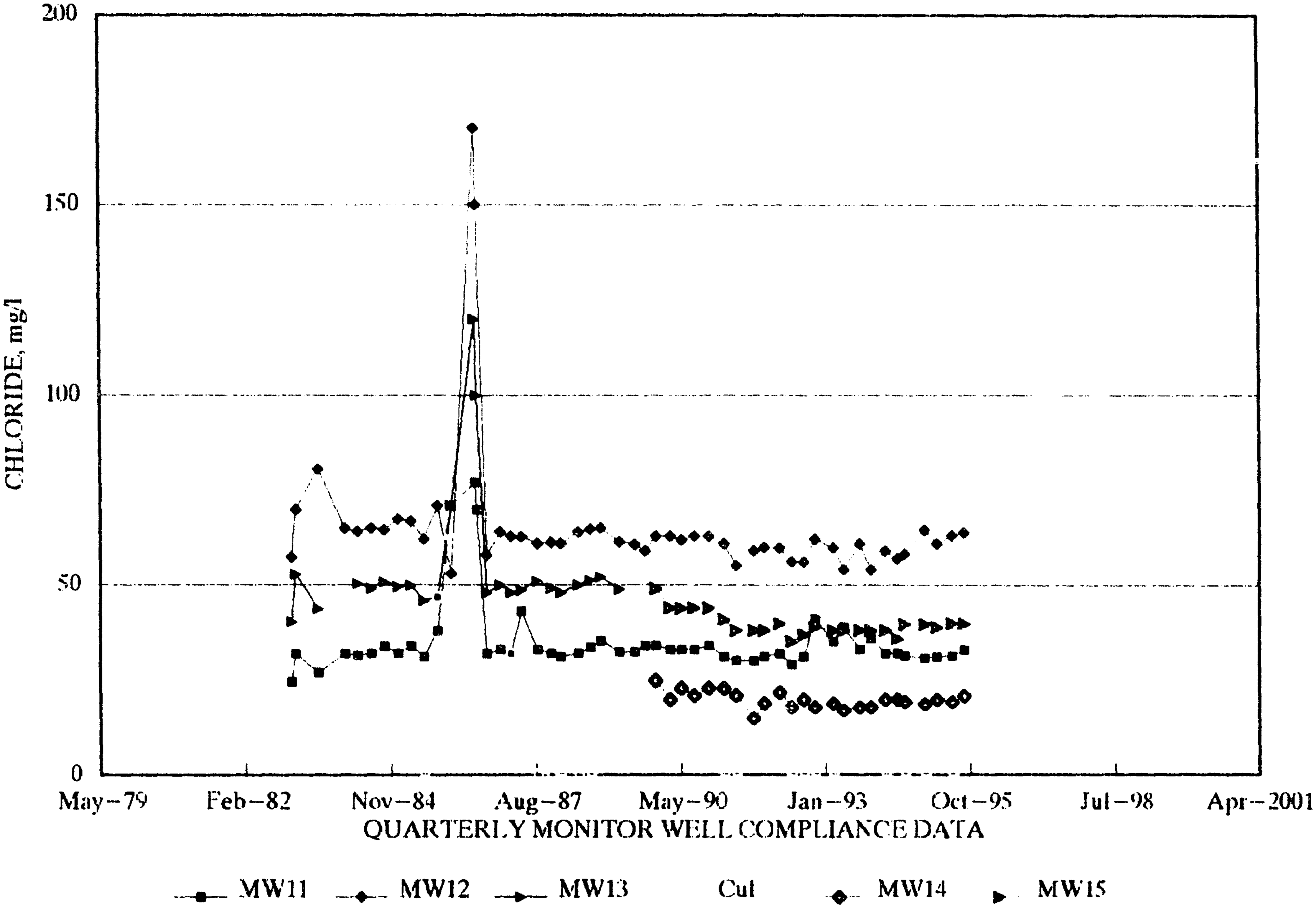
WHITE MESA MILL



GRAPH 32

ENERGY FUELS NUCLEAR, INC.

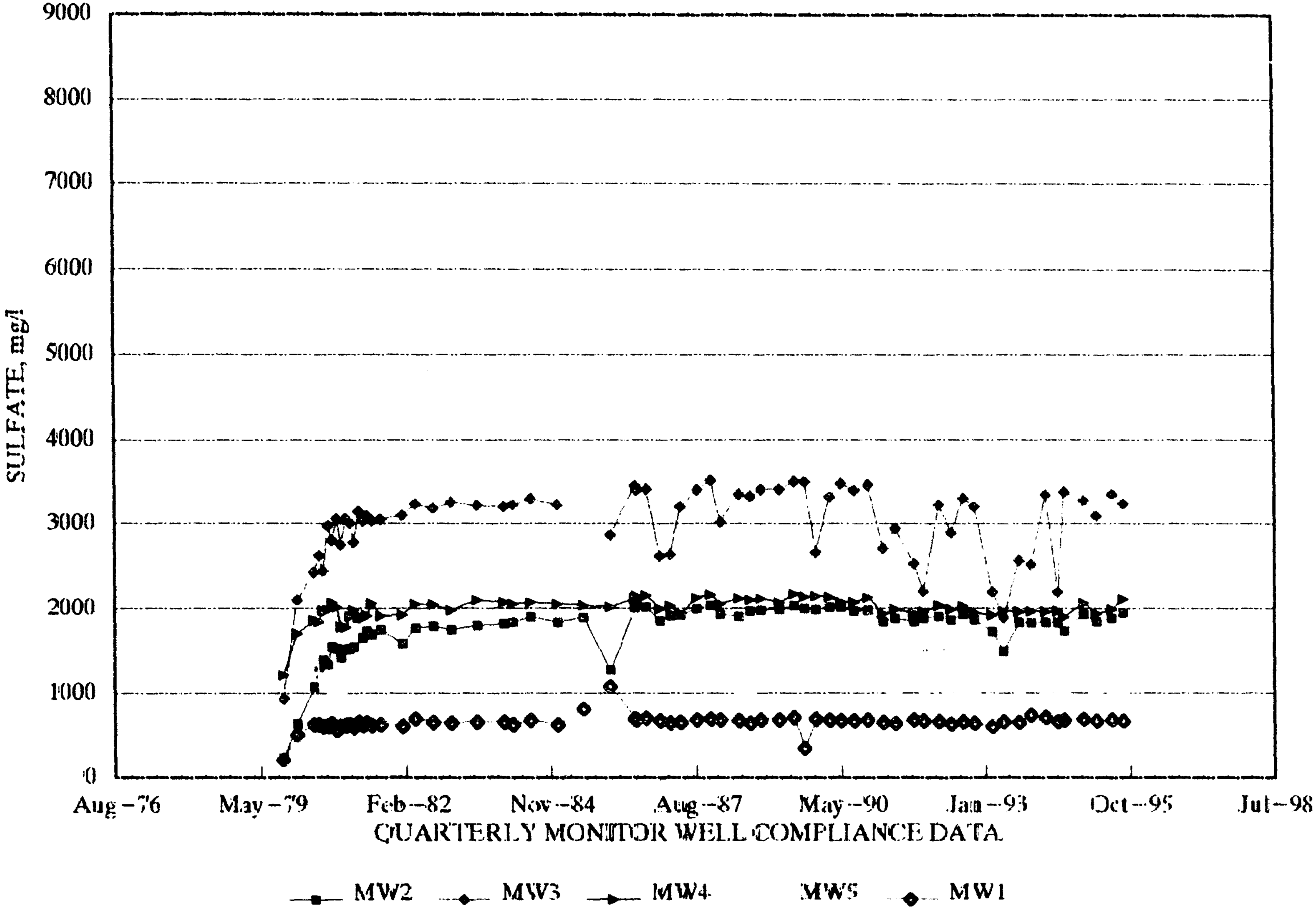
WHITE MESA MILL



GRAPH 33

ENERGY FUELS NUCLEAR, INC.

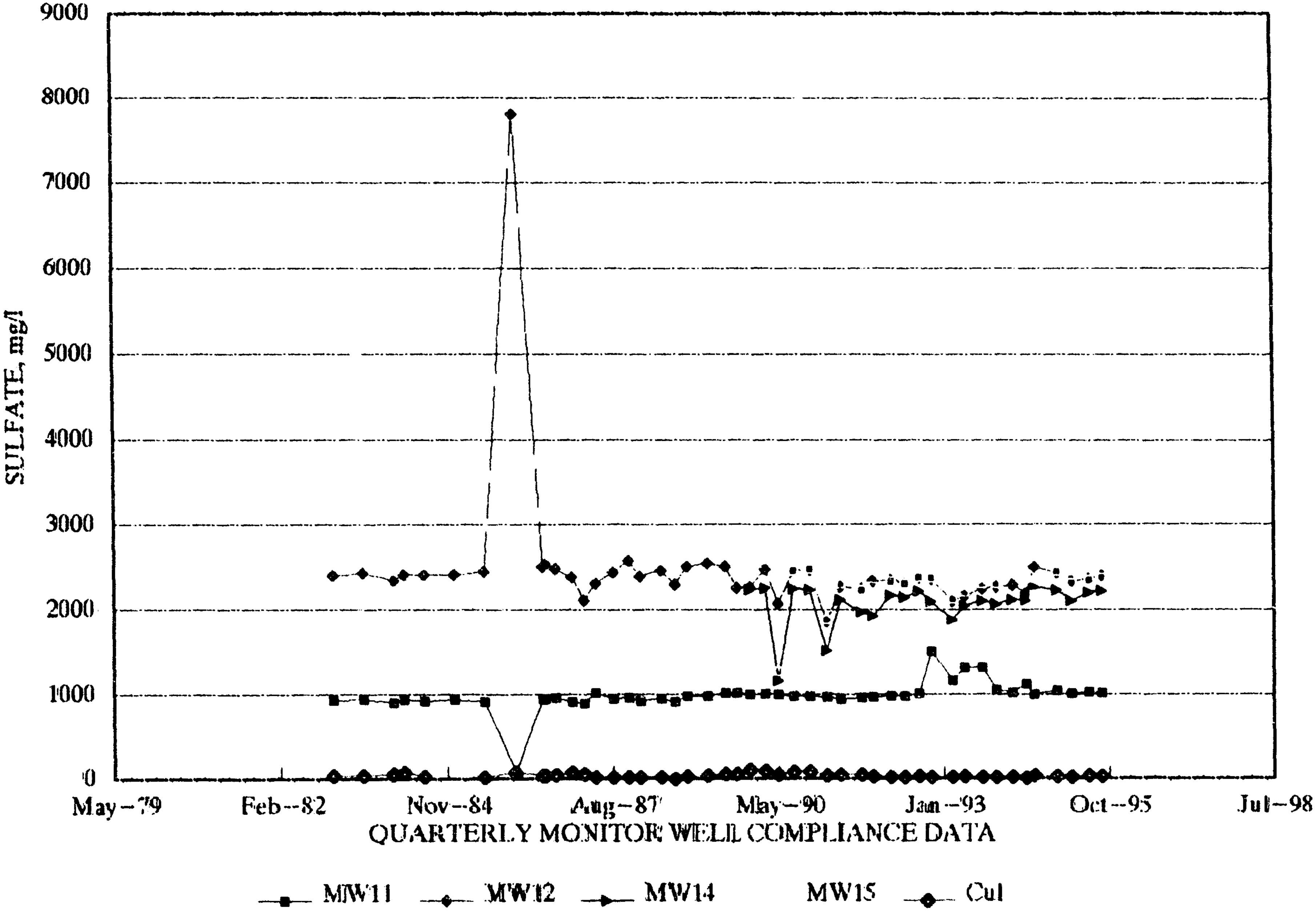
WHITE MESA MILL



GRAPH 34

ENERGY FUELS NUCLEAR, INC.

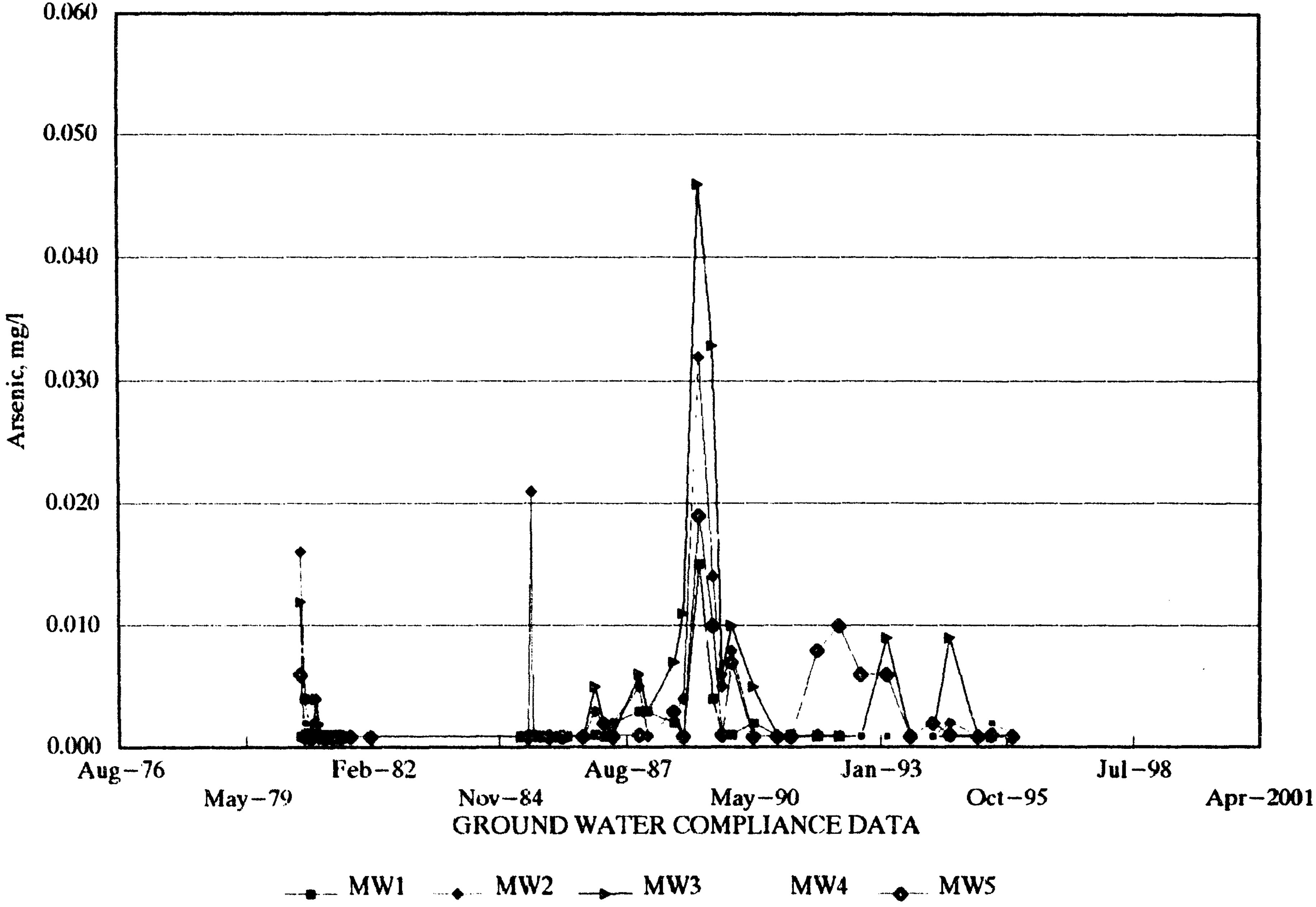
WHITE MESA MILL



GRAPH 35

ENERGY FUELS NUCLEAR, INC.

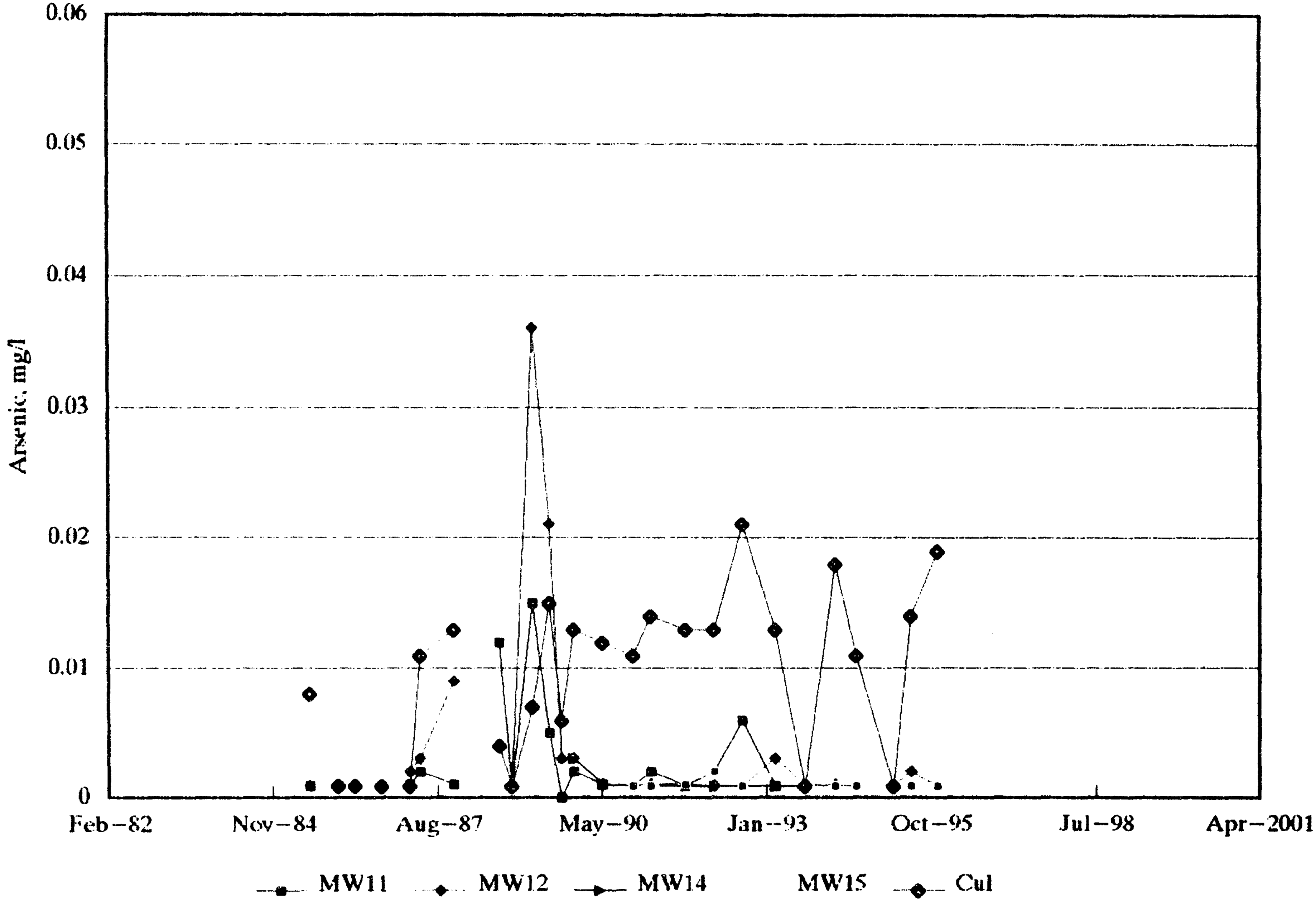
WHITE MESA MILL



GRAPH 36

ENERGY FUELS NUCLEAR, INC.

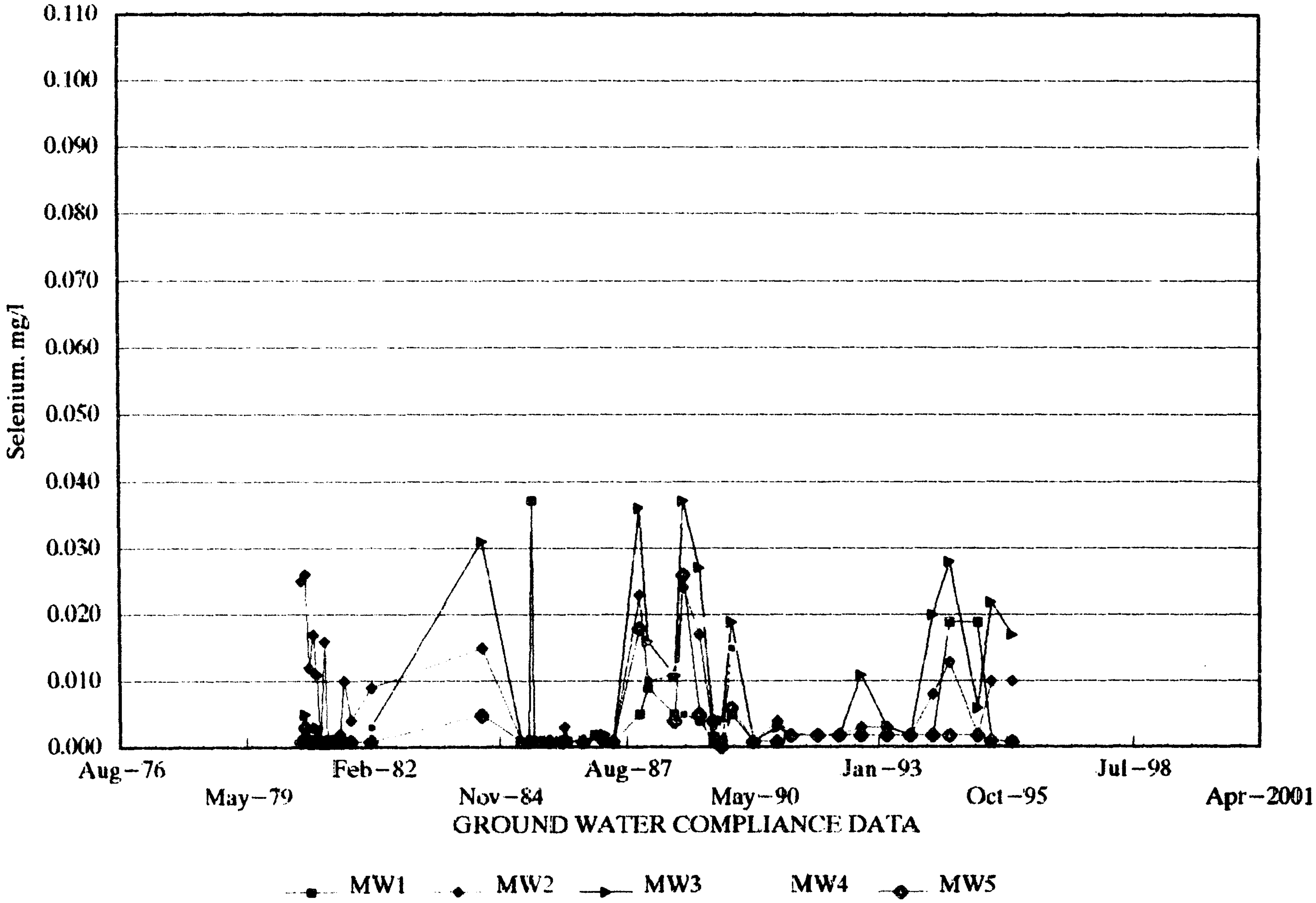
White Mesa Mill



GRAPH 37

ENERGY FUELS NUCLEAR, INC.

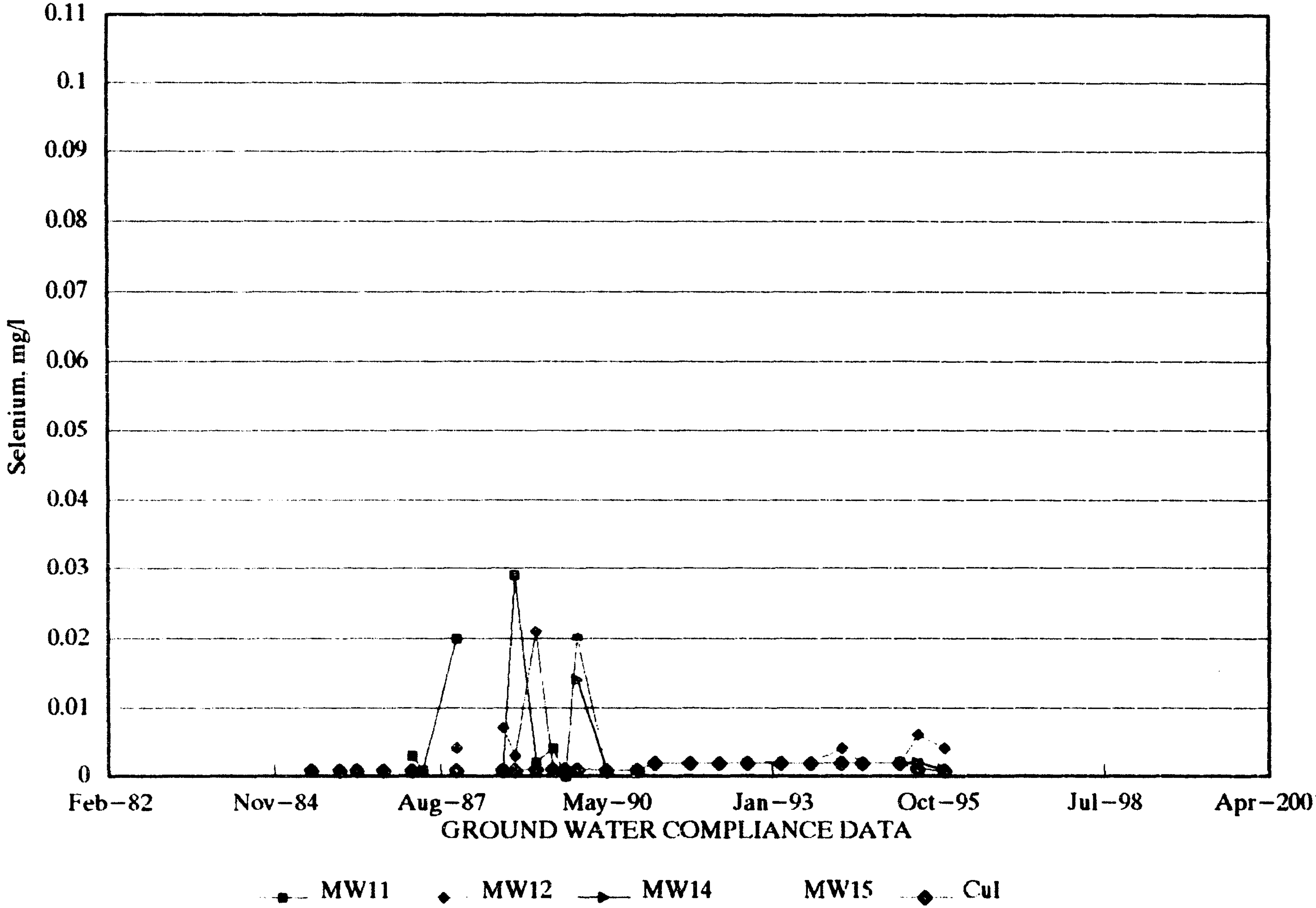
WHITE MESA MILL



GRAPH 38

ENERGY FUELS NUCLEAR, INC.

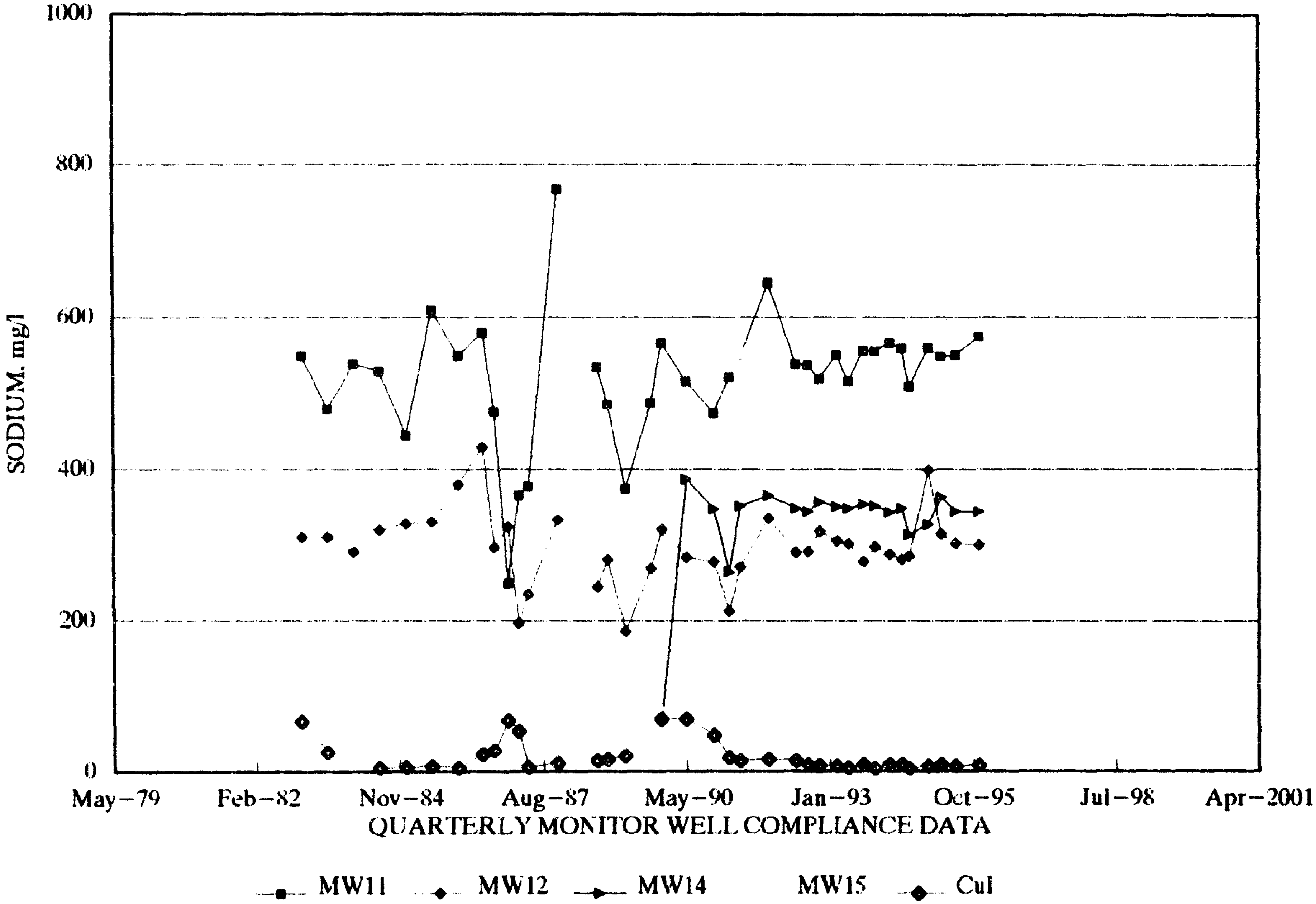
WHITE MESA MILL



GRAPH 39

ENERGY FUELS NUCLEAR, INC.

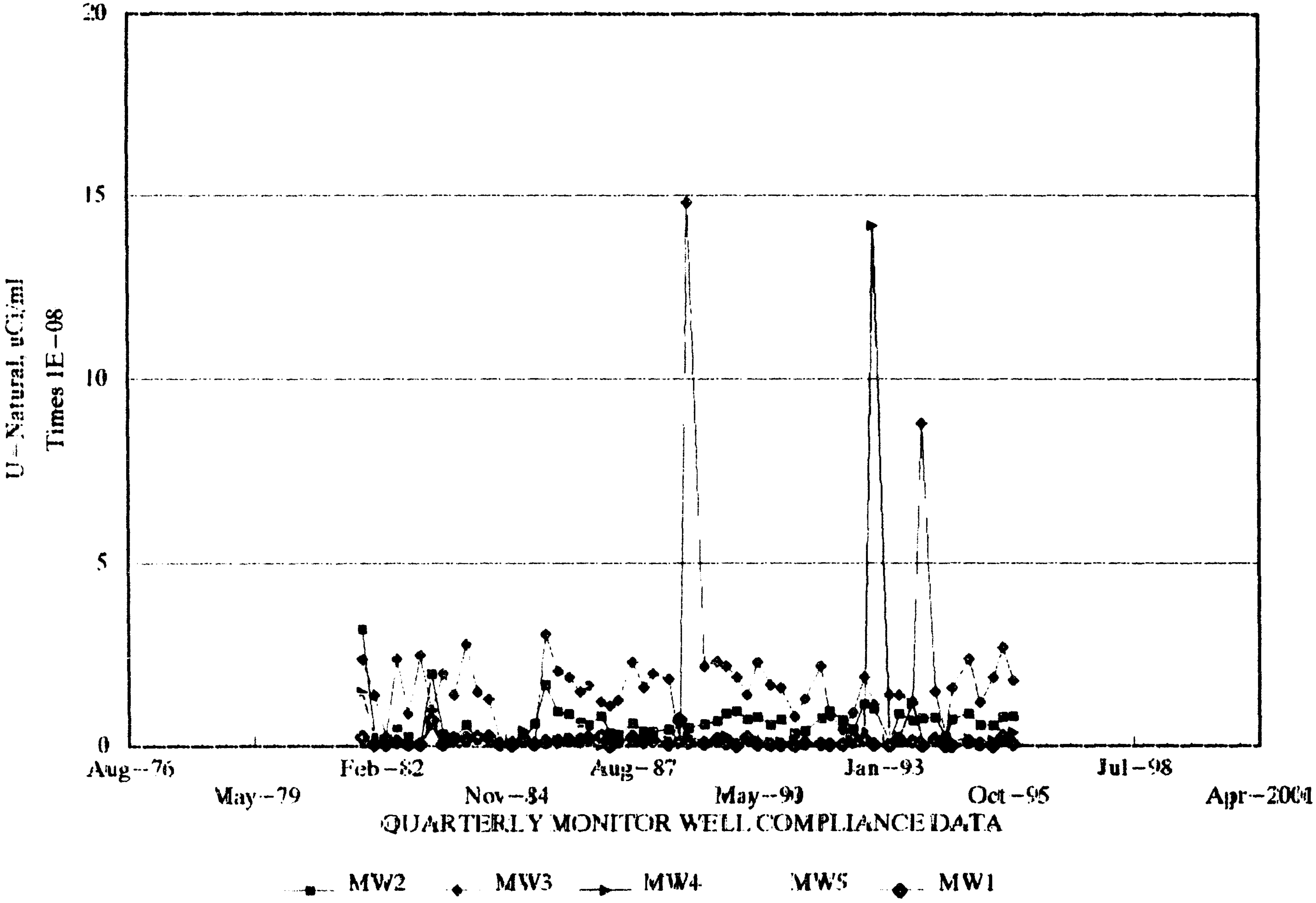
WHITE MESA MILL



GRAPH 45

ENERGY FUELS NUCLEAR, INC.

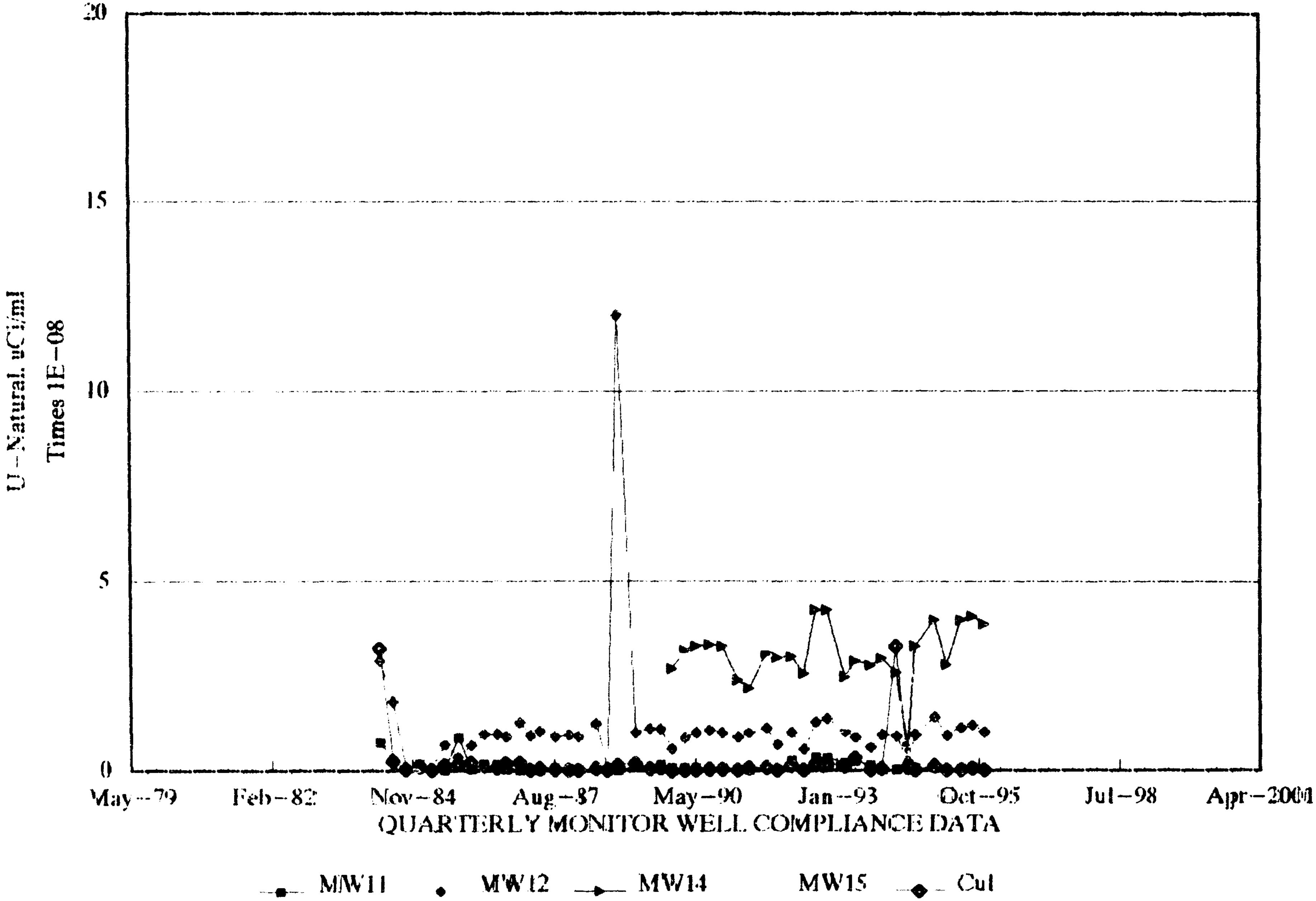
WHITE MESA MILL



GRAPH 46

ENERGY FUELS NUCLEAR, INC.

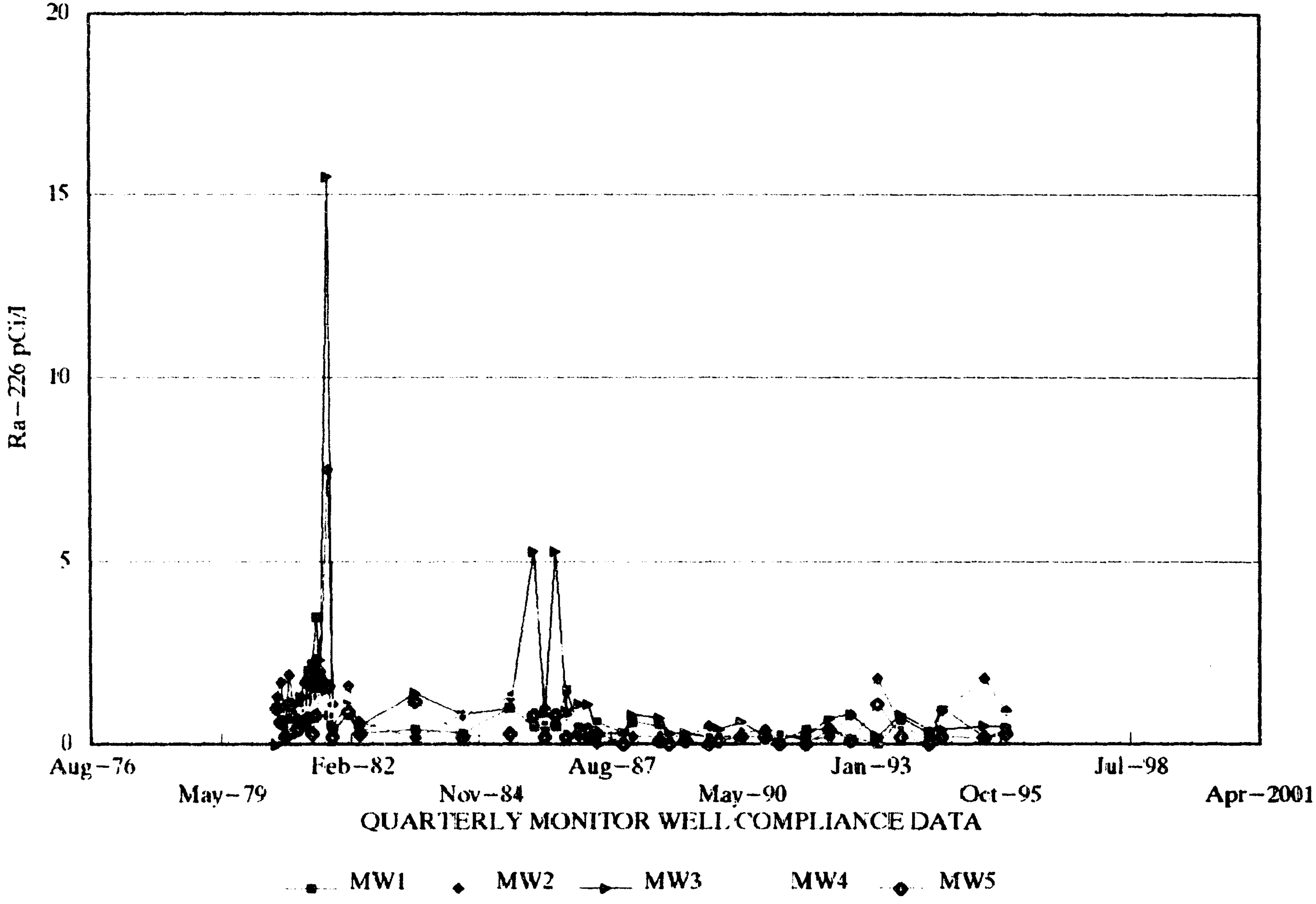
WHITE MESA MILL



GRAPH 47

ENERGY FUELS NUCLEAR, INC.

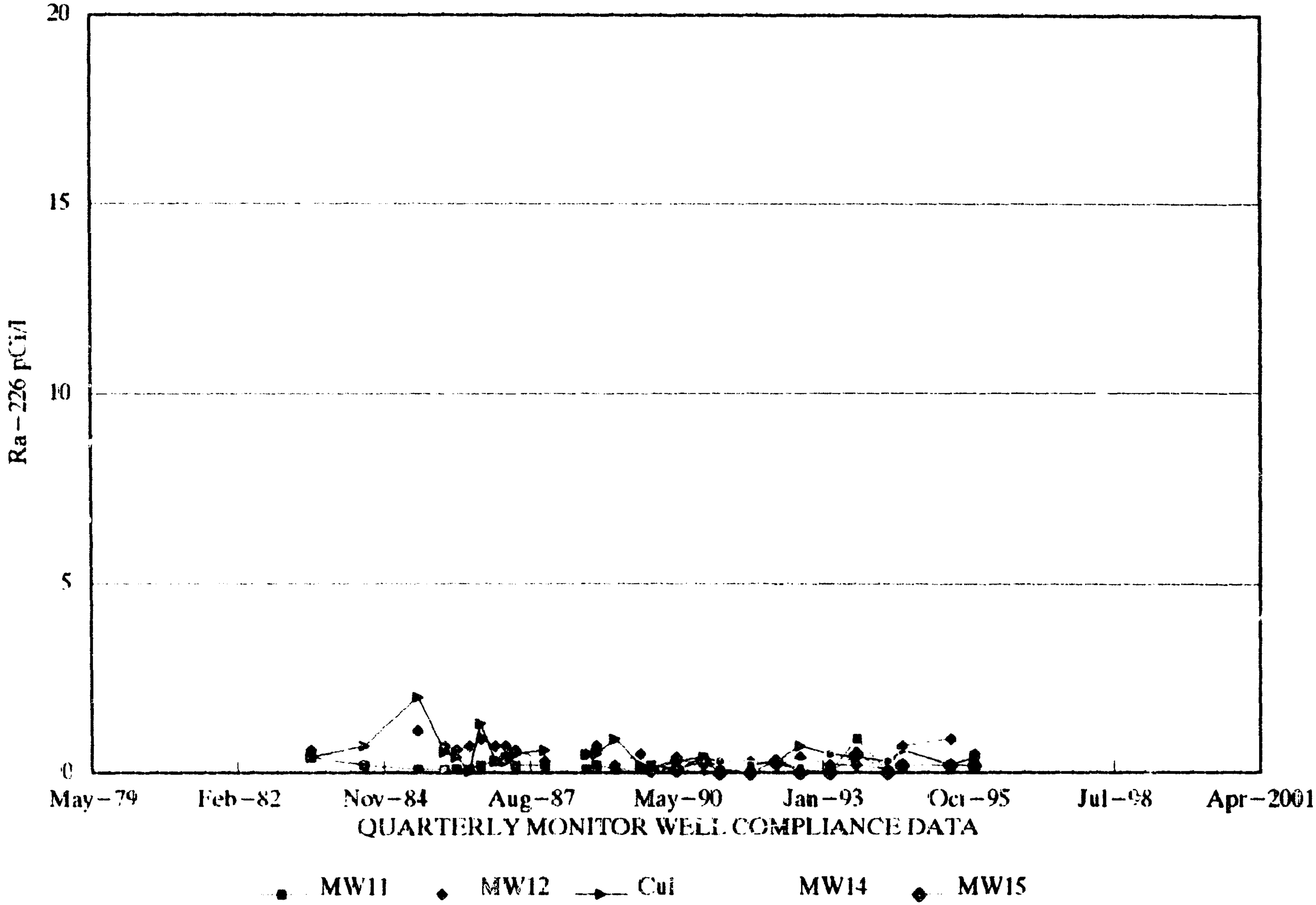
WHITE MESA MILL



GRAPH 48

ENERGY FUELS NUCLEAR, INC.

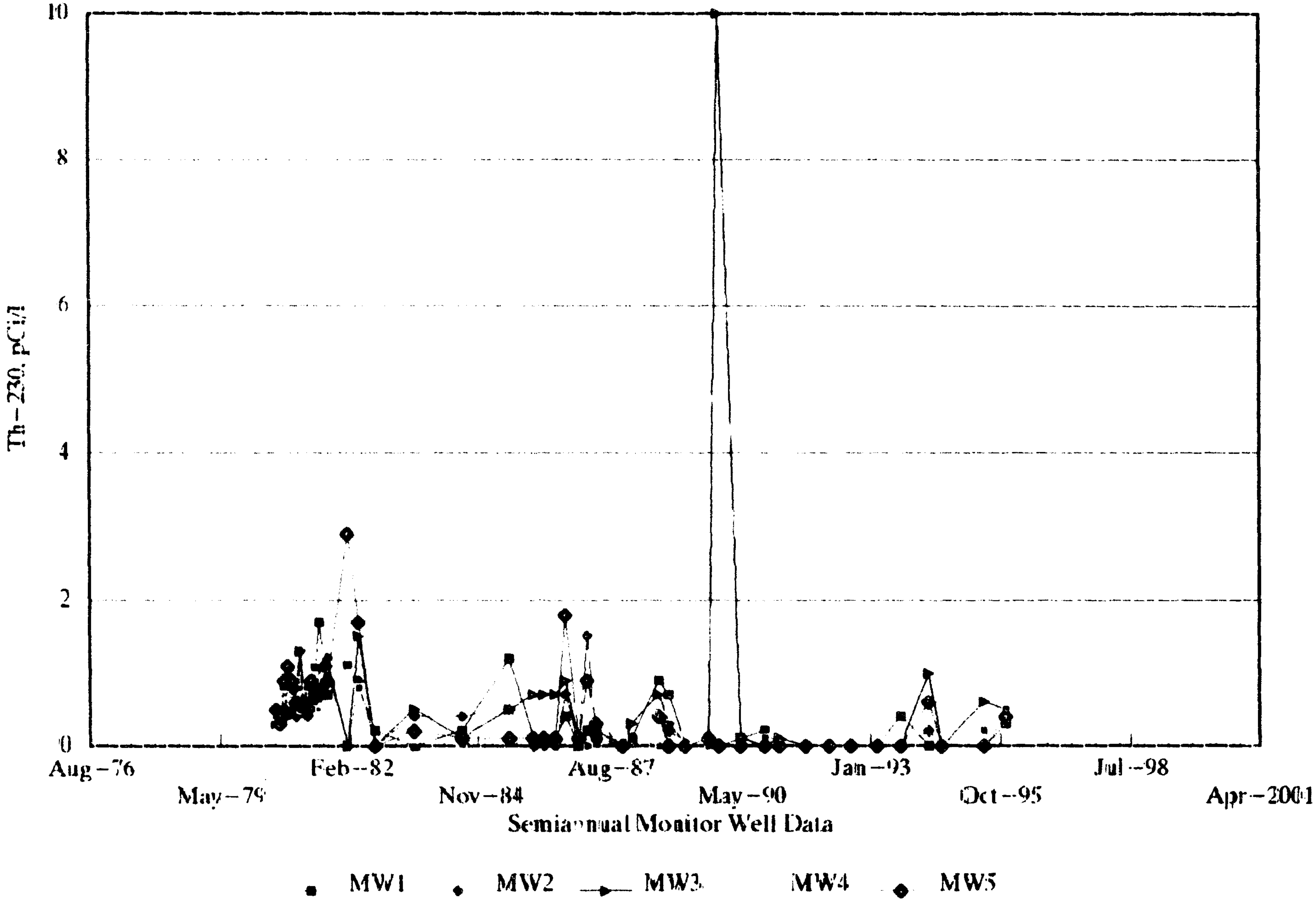
WHITE MESA MILL



GRAPH 49

ENERGY FUELS NUCLEAR, INC.

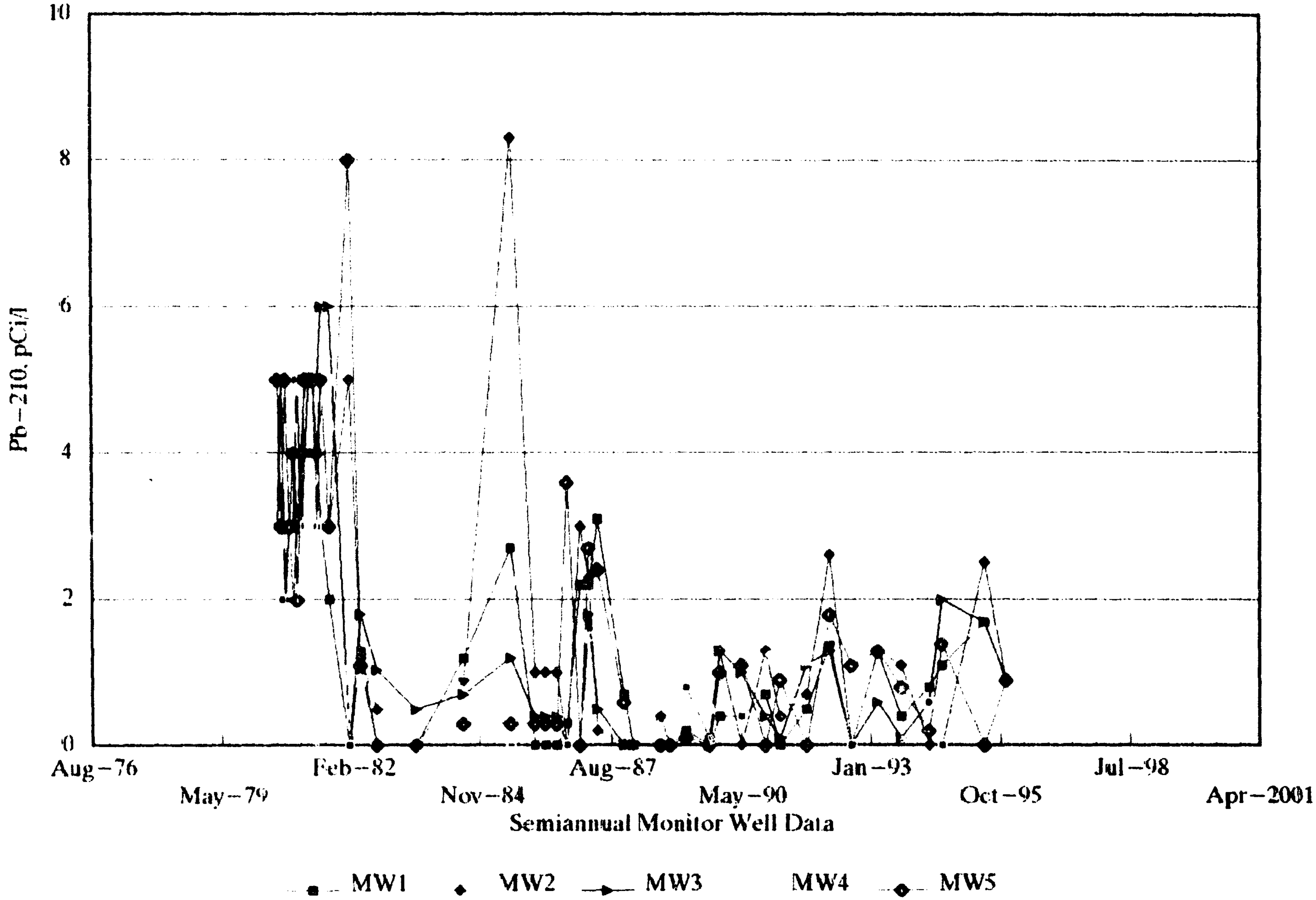
WHITE MESA MILL



GRAPH 50

ENERGY FUELS NUCLEAR, INC.

WHITE MESA MILL



GRAPH 52

TABLE 22

ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
SURFACE WATER ANALYSIS
SEMI-ANNUAL EFFULENT REPORT

	Cottonwood 1st 95	2nd 95	3rd 95	4th 95	Westwater** 1st 95	2nd 95	3rd 95	4th 95
Date of Sample	03/09/95	06/05/95	09/30/95	11/07/95	03/09/94			
Field Temperature, C	8.9	9.5	8.9	6.2	9.1			
Field pH	8.42	8.5	8.55	8.63	8.06			
Field Sp.Cond.(µmhos)	706	718	720	724	1776			
TDS (mg/l)	469	17		392	1240			
TSS (mg/l)	50			12	26			
Ra-226 suspended (þCi/l)		<0.2	1.0E-08					
Ra-226 dissolved (þCi/l)		<0.2	4.9E-10					
LLD (þCi/l)		0.2	2.0E-10					
Th-230 suspended (þCi/l)		<0.2	4.2E-09					
Th-230 dissolved (þCi/l)		<0.2	1.0E-09					
LLD (þCi/l)		0.2	2.0E-10					
U-nat. suspended (µCi/ml)	1.25E-08	5.82E-09	1.9E-09	2.3E-09	2.44E-09			
U-nat. dissolved (µCi/ml)	1.31E-08	4.87E-09	9.0E-10	2.0E-10	2.50E-09			
LLD (µg/l)	2.0E-10	2.0E-10	2.0E-10	2.0E-10	2.00E-10			

** Westwater is now on an annual sample basis. Westwater is checked weekly and after significant precipitation events.

TABLE 22A

ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL

QUALITY CONTROL DUPLICATE SAMPLES

THIRD QUARTER 1995

	COTTONWOOD CREEK	Blind Duplicate	Per Cent Difference
U-Nat Total	1.9E-09	3.4E-09	44.12%
U-Nat Dissolved	9.0E-10	1.4E-09	35.71%
Ra-226 Total	1.0E-08	1.4E-08	28.57%
Ra-226 Dissolved	4.9E-10	4.8E-10	2.04%
Th-230 Total	4.2E-09	3.8E-09	9.52%
Th-230 Dissolved	1.0E-09	2.0E-10	80.00%

FOURTH QUARTER 1995

	COTTONWOOD CREEK	Blind Duplicate	Per Cent Difference
TDS	392	408	3.92%
TSS	12	12	0.00%
Gross Alpha	1	1.7	41.18%
U-Nat Total	2.3E-09	9.5E-09	75.74%
U-Nat Dissolved	2.0E-10	4.6E-09	95.65%

TABLE 23

ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
Soil Sampling Results

(VALUES) x 10E−3 μCi/Kg

Date	BHV−1		BHV−2		BHV−3		BHV−4		BHV−5	
	Ra−226	U−Nat	Ra−226	U−Nat	Ra−226	U−Nat	Ra−226	U−Nat	Ra−226	U−Nat
Sep−80	0.650	0.420	0.340	0.420	0.420	0.420	0.410	12.194	0.230	14.891
Sep−81	0.400	1.800	0.300	0.600	0.300	0.600	0.200	3.000	0.300	0.600
Dec−81	0.790	0.770	0.440	0.560	0.890	0.420	0.750	0.630	0.550	0.420
Jun−82	0.423	0.384	0.412	0.180	0.265	0.207	0.478	0.260	0.449	0.216
May−83	0.471	0.4[illegible]	0.569	0.550	0.461	0.340	0.643	0.340	0.147	0.140
Jan−84	0.713	0.8[illegible]	0.618	0.683	0.489	0.471	0.124	0.324	0.132	0.310
Oct−84	2.960	0.886	2.330	0.069	2.880	0.721	3.490	0.804	2.550	0.817
Aug−85	1.630	0.800	2.190	0.424	2.270	0.424	4.330	0.294	1.280	0.577
Aug−86	0.369	0.654	0.466	0.866	0.382	0.694	0.396	0.826	0.728	0.836
Aug−87	0.600	0.800	1.500	0.900	0.800	0.600	1.200	0.700	1.500	1.300
Aug−88	1.500	1.600	1.300	0.700	0.600	0.900	1.000	1.300	3.800	5.000
Aug−89	1.200	1.600	1.100	3.000	0.800	1.000	1.100	1.400	2.900	5.700
Aug−90	2.900	5.800	1.000	1.400	0.800	1.400	1.800	1.300	3.700	3.200
Aug−91	3.900	8.800	1.700	2.600	2.600	5.700	1.800	2.600	2.500	4.400
Aug−92	1.200	2.200	0.900	1.400	0.800	1.200	0.900	0.900	1.100	1.800
Aug−93	2.000	1.700	1.400	1.700	1.100	1.900	0.800	1.600	4.800	3.500
Aug−94	1.000	1.600	0.700	0.800	0.700	0.900	0.700	1.100	3.000	3.800
Aug−95	2.810	4.700	0.680	0.200	0.880	0.650	0.580	0.240	2.800	1.600
Mean	1.42	1.99	1.00	0.95	0.97	1.03	1.15	1.66	1.80	2.73
Std. Dev.	1.04	2.17	0.61	0.78	0.76	1.20	1.08	2.66	1.43	3.43

TABLE 24

ENERGY FUELS NUCLEAR, INC.

1995 STACK SAMPLING RESULTS

PARAMETER	N. YC STACK	S. YC STACK	DEMISTER STACK	GRIZZLY STACK
DRY STANDARD CUBIC FEET	135.293	157.395	187.356	143.209
U-NAT µCi/ml	1.03E-10	1.87E-09	6.27E-12	1.66E-12
LLD	9E-14	9E-14	9E-14	8E-14
RA-226 µCi/ml	7.37E-14 ± 3.89E-14	6.72E-14 ± 4.41E-14	4.38E-14 ± 3.14E-14	1.07E-13 ± 6.74E-14
LLD	2E-14	2E-14	2E-14	2E-14
TH-230 µCi/ml	2.57E-13 ± 4.61E-14	8.91E-13 ± 1.09E-13	1.06E-13 ± 5.6E-14	2.45E-13 ± 1.02E-13
LLD	2E-15	2E-15	2E-15	2E-15
PB-210 µCi/ml	3.49E-13 ± 0	6.73E-12 ± 2.74E-12	2.74E-13 ± 0	4.68E-13 ± 0
LLD	2E-15	2E-15	3E-15	2E-15
URANIUM RELEASE RATE KG/QTR	0.8	10.2	0.6	0.1
URANIUM RELEASE RATE Ci/QTR	5.5E-04	7.04E-03	4.23E-04	1.24E-05

A P P E N D I X

A

SEMI-ANNUAL METEOROLOGY MONITORING REPORT FOR THE BLANDING PROJECT JULY THROUGH DECEMBER 1995

Prepared for:

ENERGY FUELS NUCLEAR, INC.
P.O. Box 669
Blanding, Utah 84511

Prepared by:

ENECOTECH INC.
1580 Lincoln Street, Suite 1000
Denver, Colorado 80203

FEBRUARY 1996

PROJECT NUMBER: 105-017

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LIST OF APPENDICES

1.0 INTRODUCTION

In 1977, meteorological, air quality, and radiological monitoring was initiated at the White Mesa Mill. The original purpose of these monitoring programs was to document the regional atmospheric baseline and to provide adequate data to assess the potential air quality impacts resulting from the mill. After construction of the mill the monitoring programs were modified to address compliance of mill operations. This report summarizes the meteorological data collected from this monitoring program for the period July through December 1995.

2.0 MONITORING PROGRAM DESCRIPTION

The meteorological parameters collected were wind speed, wind direction, standard deviation of horizontal wind direction, and atmospheric stability. The data were collected and processed under general site operations protocol and quality assurance activities.

2.1 Site Description

The region encompassing the Energy Fuels Nuclear Inc. White Mesa Mill (Blanding Station) is shown in Figure 1. The mill is located on White Mesa approximately five miles south of the town of Blanding, Utah, just west of State Highway 47. The surrounding terrain slopes up towards the north and down to the south through southwest. The meteorological monitoring station, located on the northern property boundary of the mill, is situated in the southwest corner of Section 22, T37S, R22E at an elevation of 5660 feet above mean sea level (AMSL). The location was chosen for the purpose of compliance monitoring for operations at the mill.

2.2 Monitoring Instrumentation

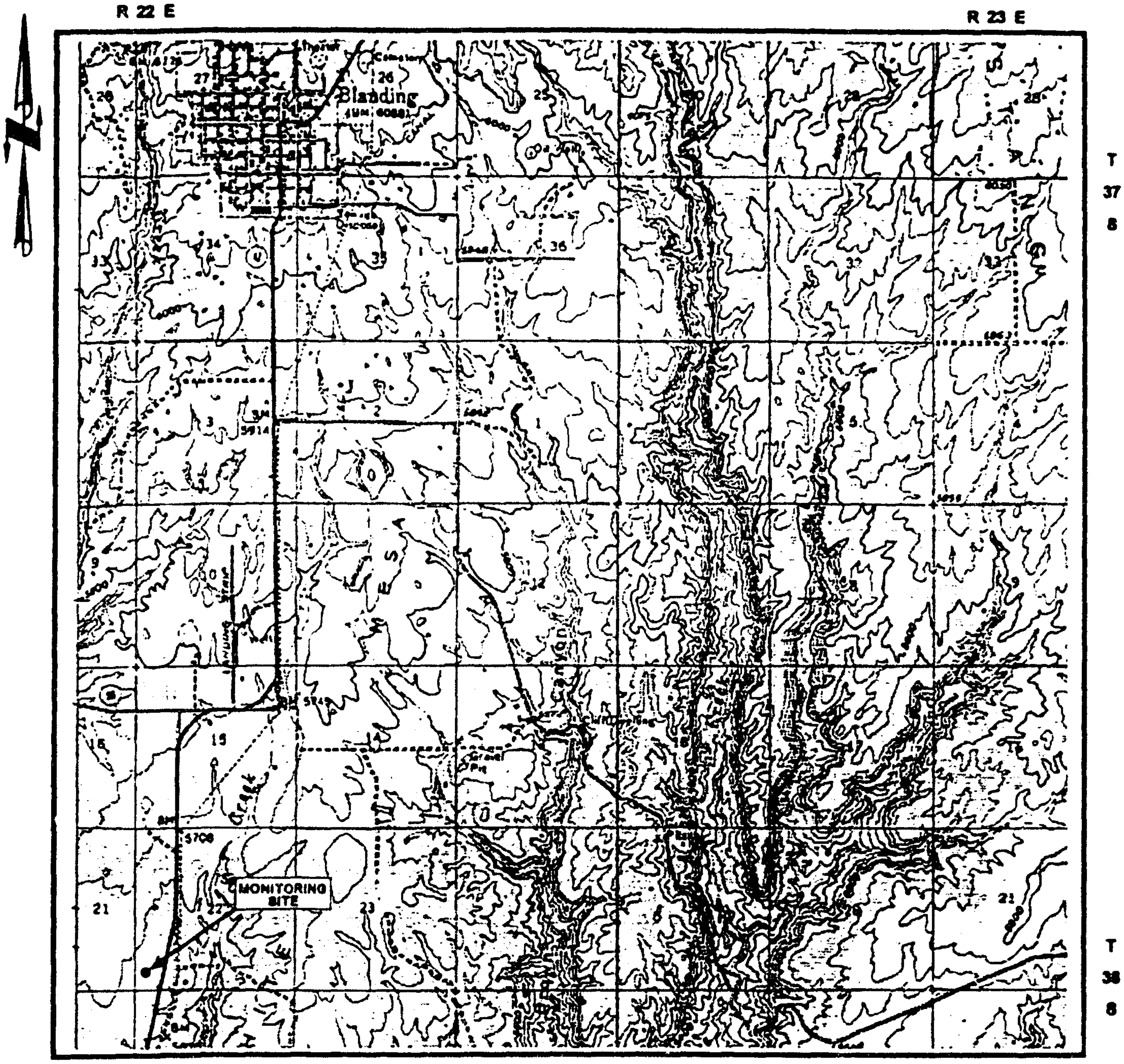
The sensors, their accuracies and the sampling heights used in the monitoring program are shown in Table 2.1. Weathertronics wind cup anemometer and wind vane were connected to a Campbell Scientific CR-10 Data Logger, which continuously recorded wind speed and wind direction at the standard ten-meter height. Hourly averages of these parameters and hourly were calculated and retained in the data logger. Data stored in the logger was then transferred to a solid state storage module on a monthly basis

2.3 Data Collection and Processing

The storage modules from the CR-10 were sent to EnecoTech's Denver office, where they were subsequently downloaded onto a computer. The data were processed for subsequent analysis.

2.4 Quality Assurance

After the meteorological data were downloaded and processed, it was checked for any apparent anomalies. If any were discovered, the project manager was notified and the reasons for the erroneous data along with possible solutions to the problem were discussed. The site technician was then contacted and given instructions for any necessary repairs. If required, an EnecoTech scientist was dispatched to the site. Any anomalous data was corrected, if possible. If the erroneous data could not be corrected it was coded as invalid in the data files.



SCALE 1: 62,500

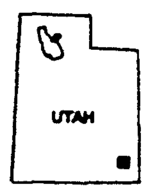
1 0 1 2 3 4 MILES

3000 0 3000 3000 6000 9000 12000 15000 18000 21000 FEET

1 .5 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL: 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

BLANDING, UTAH
N3730-W10915/15
1957
DMA 4159 III-SERIES V797



QUADRANGLE LOCATION

EnecoTech
ENVIRONMENTAL CONSULTANTS

Project: ENERGY FUELS NUCLEAR, INC.			AIR MONITORING LOCATION		
BLANDING, UTAH					
File No.: 109-009	ACAD File No.: 190009F1.CDR		Date: 2/14/96		REV.
Drawn By: WJF	Design By: JWK	Checked By:	Approved By:		Figure No.: 2.1

TABLE 2.1

INSTRUMENT SPECIFICATIONS FOR THE UMETCO MINERALS CORPORATION WHITE MESA MILL

Parameter	Instrument Reading Accuracy	Height	Manufacturer and Model Number
Wind Speed	0.34 m/sec	10 m	Weathertronics 2030
Wind direction	± 2.0°	10 m	Weathertronics 2030
	-	10 m	Mathmatical
Data logger	-	-	Campbell Scientific CR-10

3.0 ANALYSIS RESULTS

Meteorological data were collected at the White Mesa Mill site and processed according to the procedures described in Section 2.0. The data were also subjected to a calm processing routine in which any hour's average wind speed less than or equal to 1.0 m/s was set equal to 1.0 m/s and the wind direction was set equal to the last non-calm hour's wind direction. The stability class was determined for each hour (see Section 3.3) and the data set was then analyzed by time of day and stability classification.

3.1 Hourly Data Presentation

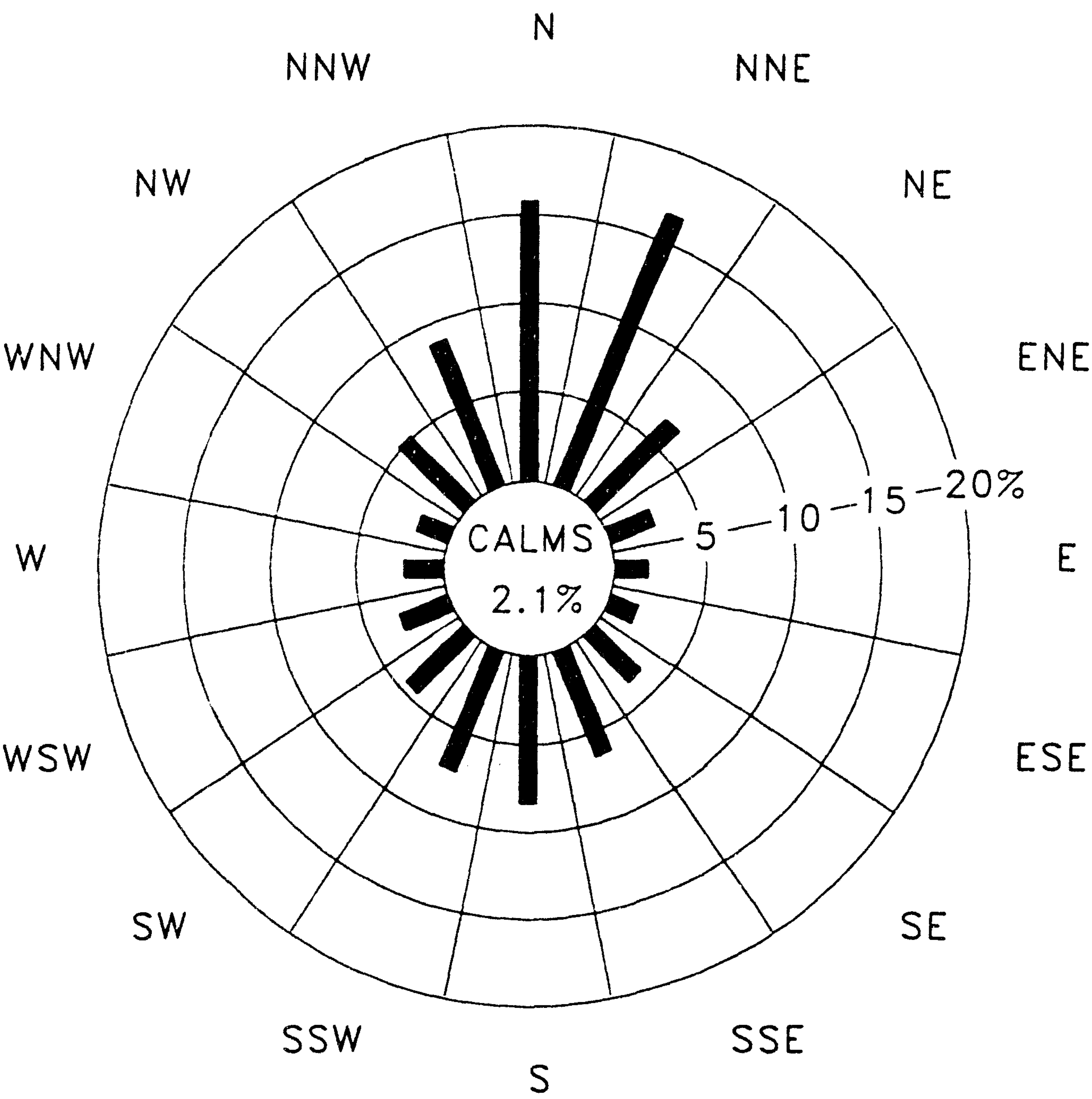
Hourly averaged val , of wind speed, wind direction, and are presented in Appendix A in the Storage and Retrieval of Aerometric Data (SAROAD) format. This format is a method of presenting air quality and meteorological data. The SAROAD format also includes, when applicable, average monthly values for each hour, daily averages and monthly averages.

3.2 Wind Analysis by Hour of the Day

The standard wind frequency distribution for the reporting period is presented graphically in Figure 3.1. To show the diurnal wind patterns, additional wind frequency distributions were developed graphically in 4-hour segments throughout the day (midnight to 4:00 a.m., 4:00 a.m. to 8:00 a.m., etc.) and are presented in Figure 3.2. A joint frequency distribution of wind direction by wind speed was produced from the data collected at the site over the reporting period and is presented in Table 3.1. The joint frequency distributions for Figure 3.2 are presented in Appendix B, Tables B-1 through B-6. For reference, one meter per second (m/s) equals 2.24 miles per hour (mph).

Figure 3.1 shows the dominant flow for the period was a drainage wind out of the north northeast occurring 16.7 percent of the time. This flow was a result of the surrounding terrain's influence on the site.

Figure 3.2 confirms the downslope wind pattern seen in Figure 3.1 and displays the diurnal pattern of this flow as well as other less prominent flows. During the nighttime hours from 20-08 Mountain Standard Time (MST) the north-northeasterly winds were most prominent. These drainage winds occurred over 35 percent of the time during the evening hours, with speeds averaging 3.15 m/s (7.0 mph). For the daylight hours from 08-16 MST, the prominent winds were from the south and south-southeast. These were return or upslope flows and occurred on average 16 percent of the time during the daytime hours with a mean speed of 3.3 m/s (7.4 mph).



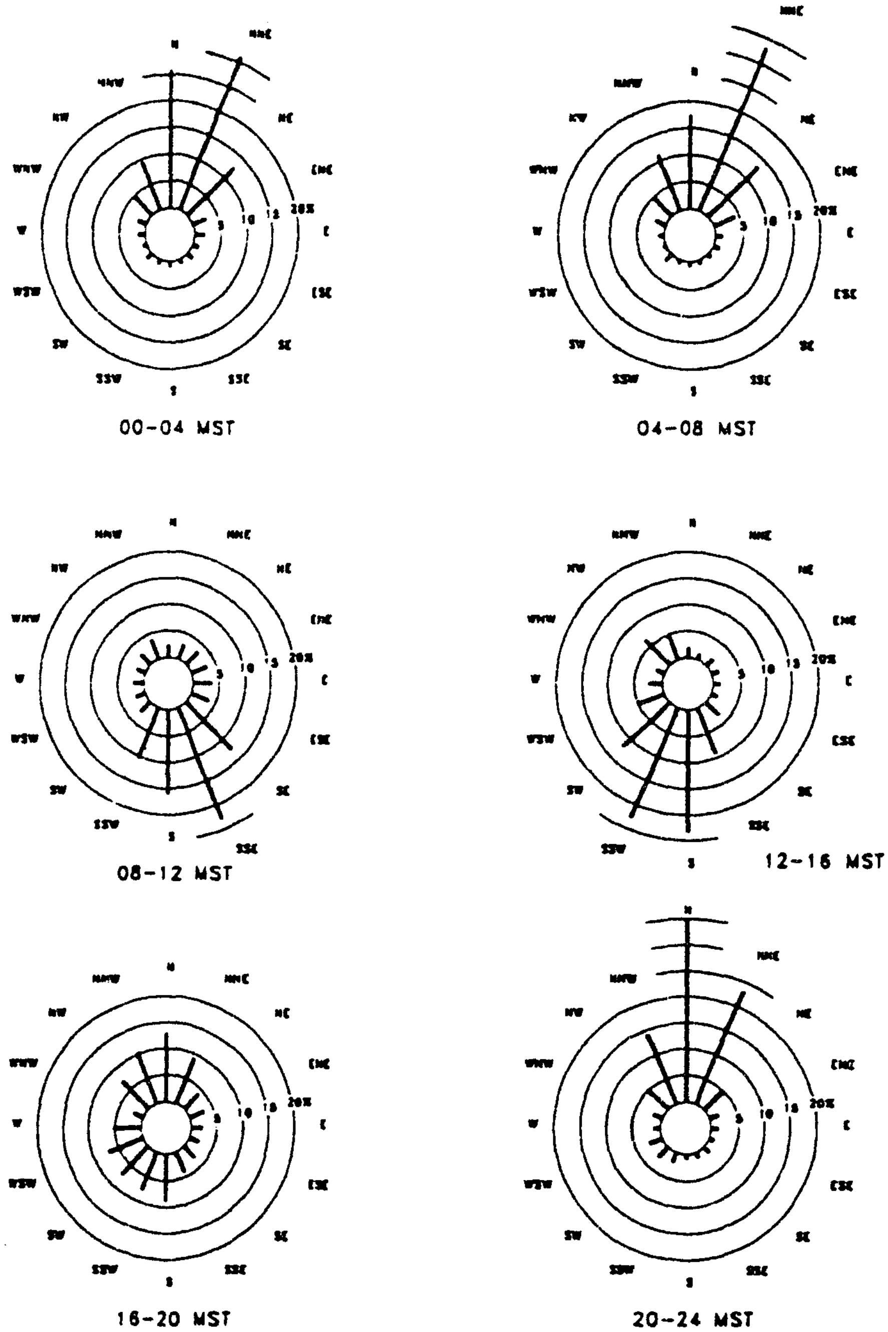
EnecoTech
ENVIRONMENTAL CONSULTANTS

Energy Fuels Nuclear, Inc.

Project: White Mesa Mill

Wind Frequency Distribution
For All Hours
(July through December 1995)

File No.: 109-009 | Date: January 1996 | Figure No.: 3.1



EnecoTech
ENVIRONMENTAL CONSULTANTS

Energy Fuels Nuclear, Inc.

Project: White Mesa Mill

Wind Frequency Distribution
By Hour of the Day
(July through December 1995)

File No.: 109-009 | Date: January 1996 | Figure No.: 3.2

TABLE 3-1
FREQUENCY OF WINDS BY DIRECTION AND SPEED
FOR STABILITY CLASS ALL
JULY THROUGH DECEMBER 1995
ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL

Speed Class Interval (m/s)

Direction	1,<1.5	1.5,<3	3,<5	5,<8	8,<11	>11	All	Mean Speed
N	0.75	5.84	8.37	0.86	0.09	0.02	15.93	3.3
NNE	0.72	7.38	8.17	0.45	0.00	0.00	16.73	3.0
NE	0.84	4.12	1.43	0.25	0.00	0.00	6.63	2.5
ENE	0.54	1.47	0.50	0.20	0.00	0.00	2.72	2.5
E	0.45	1.13	0.27	0.09	0.00	0.00	1.95	2.3
ESE	0.29	1.06	0.29	0.00	0.05	0.00	1.70	2.4
SE	0.43	1.95	1.09	0.18	0.09	0.00	3.73	2.9
SSE	0.23	3.60	2.22	0.43	0.00	0.00	6.47	2.9
S	0.45	3.64	3.83	0.52	0.05	0.00	8.49	3.1
SSW	0.25	2.67	3.35	1.13	0.00	0.00	7.40	3.5
SW	0.16	1.31	2.29	0.81	0.02	0.05	4.64	3.8
WSW	0.16	0.75	1.02	0.86	0.20	0.00	2.99	4.3
W	0.09	0.81	0.79	0.43	0.16	0.02	2.31	3.9
WNW	0.14	0.84	0.59	0.32	0.00	0.05	1.92	3.5
NW	0.09	1.40	2.17	1.13	0.32	0.20	5.32	4.5
NNW	0.50	2.42	2.97	2.31	0.68	0.16	9.03	4.4
All	6.09	40.40	39.34	9.98	1.65	0.50	97.96	3.3

Calm (less than 1.0 m/s) = 2.1%

The overall mean wind speed from July through December 1995 was 3.3 m/s (7.4 mph). The highest average directional wind speed, 4.5 m/s (10.1 mph), was out of the northwest while the lowest average directional wind speed, 2.3 m/s (5.1 mph), was out of the east. Calm conditions (mean wind speed less than or equal to 1.0 m/s or 2.2 mph) occurred 2.1 percent of the time.

The average wind speed of 3.3 m/s (7.4 mph) for the second half of 1995 compared well with the average wind speeds reported in previous semiannual reports for the same time period. The first half of 1986 through 1991 had mean speeds ranging from 2.4 m/s (5.4 mph) to 3.4 m/s (7.6 mph). The dominant wind direction for these same time periods was north-northeasterly. The differences in wind speed for these time periods can be attributed to year-to-year variability.

3.3 Atmospheric Stability

Atmospheric dispersion stability classifications in the standard Pasquill scheme have been calculated for the Blanding site using the Mitchell-Timbre technique. In this technique, Pasquill stability classes are derived from the hourly sigma theta average wind speed, and the solar angle algorithm to differentiate daytime from nighttime conditions. The Pasquill stability classification scheme involves delineating stability into six classes, A through F. Classes A through C reflect unstable conditions, with Class A being most unstable, and can only occur during the day. Stable conditions are represented by Classes E and F, with Class F being more stable than Class E, and can only occur at night. Neutral conditions are denoted by a D classification and can occur anytime.

Typically, unstable conditions occur when there is good solar heating (clear days) and low wind speeds. Neutral conditions occur with cloudy skies and/or high wind speeds. Stable conditions typically occur when there is radiational cooling (clear nights) and low wind speeds. Usually stable conditions result in the worst dispersion of atmospheric released pollutants.

Table3.2 presents the total frequency of occurrence of each stability class observed at the White Mesa Mill site throughout the reporting period, not including calm winds. Neutral (D) conditions had the highest frequency of occurrence at 34.2 percent, with slightly stable (E) conditions following at 21.1 percent. Slightly unstable (C) had the next highest frequency at 13.3 percent. Moderately unstable (B) had a frequency of occurrence of 13.1 percent and moderately stable (F) had a frequency of 8.2 percent. Extremely unstable (A) had the least frequency of occurrence at 8.1 percent. This type of distribution is generally consistent with what has been observed in previous reports for the calendar six month period. Table 3.3 presents the frequency distribution of wind direction by stability class including calm winds. The highest frequency of occurrence of direction by stability class was observed for north northeast winds under E (slightly stable) conditions at 7.1 percent.

Figure 3.3 presents graphically the wind distribution for each stability class. As anticipated, this figure demonstrates that the atmospheric stability conditions tracked well with the local drainage/return flow pattern of the area observed in Figure 3. Unstable conditions (Classes A through C) were associated with winds from the south-

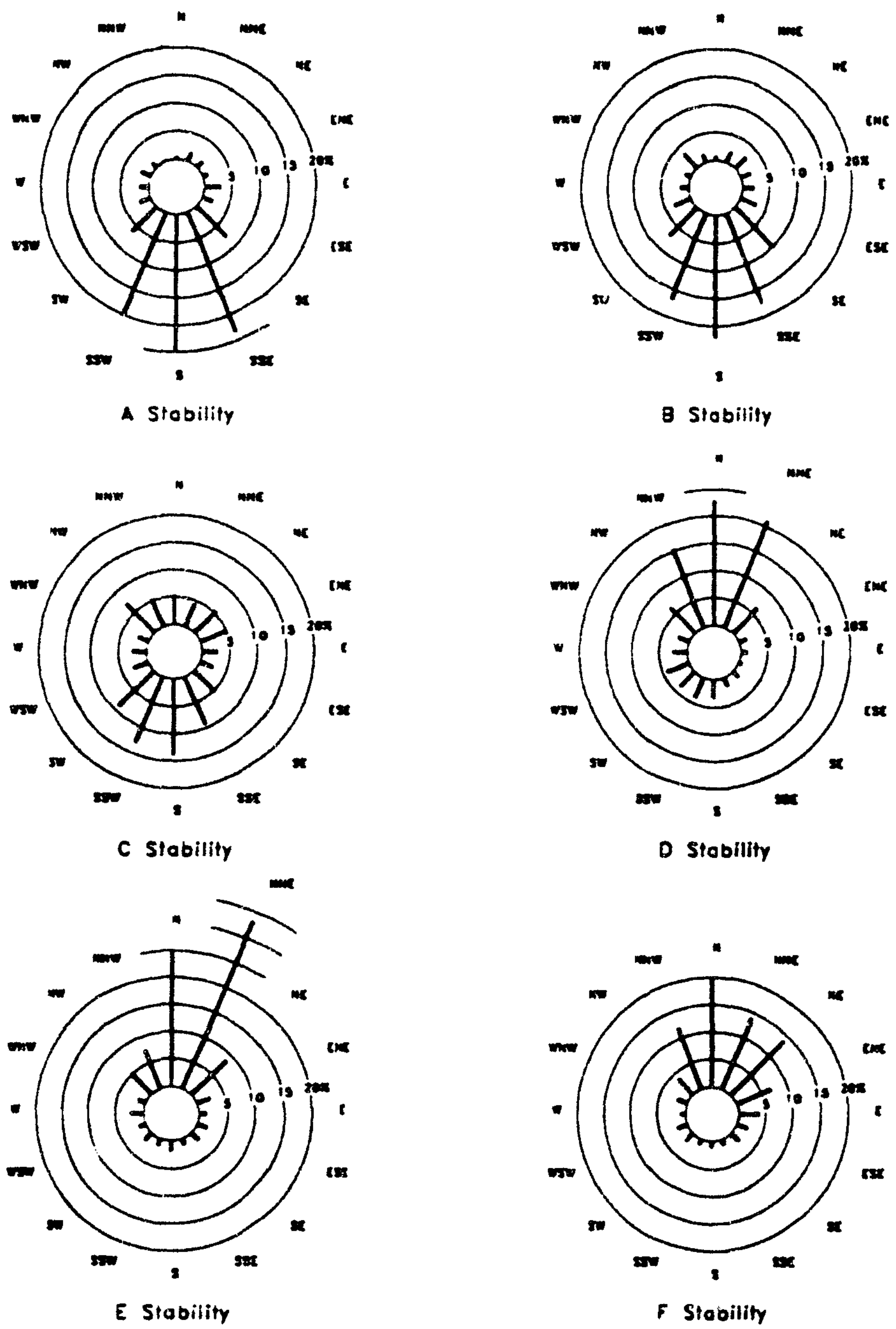
TABLE 3.2

STABILITY CLASSIFICATION AND FREQUENCY OF OCCURRENCE
OF PASQUILL STABILITY CLASSES
JANUARY THROUGH JUNE 1994
ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL

Stability Classification	Pasquill Categories	Percent Occurrence
Extremely Unstable	A	8.1
Moderately Unstable	B	13.1
Slightly Unstable	C	13.3
Neutral	D	34.2
Slightly Stable	E	21.1
Moderately Stable	F	8.2

TABLE 3.3
FREQUENCY OF WINDS BY STABILITY CLASS
JULY THROUGH DECEMBER 1995
ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL

	Stability Category						
Direction	A	B	C	D	E	F	All
N	0.05	0.11	0.72	7.88	5.32	1.86	15.93
NNE	0.14	0.27	0.61	7.29	7.18	1.24	16.73
NE	0.11	0.36	0.75	2.22	1.90	1.29	6.63
ENE	0.07	0.27	0.70	0.50	0.52	0.66	2.72
E	0.25	0.29	0.38	0.41	0.25	0.36	1.95
ESE	0.16	0.43	0.34	0.20	0.36	0.20	1.70
SE	0.63	1.34	0.72	0.48	0.38	0.18	3.73
SSE	1.90	2.35	1.29	0.54	0.23	0.16	6.47
S	1.99	2.97	1.92	1.15	0.41	0.05	8.49
SSW	1.65	2.24	1.79	1.36	0.25	0.11	7.40
SW	0.52	0.97	1.24	1.34	0.38	0.18	4.64
WSW	0.18	0.45	0.41	1.47	0.27	0.20	2.99
W	0.14	0.23	0.36	0.95	0.54	0.09	2.31
WNW	0.16	0.16	0.29	0.81	0.32	0.18	1.92
NW	0.09	0.48	1.00	2.26	1.13	0.36	5.32
NNW	0.02	0.20	0.75	5.34	1.65	1.06	9.03
All	8.06	13.13	13.29	34.20	21.10	8.19	97.96



EnecoTech
ENVIRONMENTAL CONSULTANTS

Energy Fuels Nuclear, Inc.

Project: White Mesa Mill

Wind Frequency Distribution
by Stability Class
(July through December 1995)

File No.: 109-009 Date: January 1996 Figure No.: 3.3

southeast through south-southwest (upslope flow) since these winds typically occurred during the daylight hours. Also seen in Figure 3.3, stable conditions (Classes E and F) primarily occurred with the nocturnal drainage (north and north-northeast) winds. Neutral (D) conditions had prominent north-northeast flow. The joint frequency distributions of wind direction by wind speed for each stability class are presented in Appendix C, Tables C-1 through C-7.

3.4 Data Recovery

Table 3.4 summarizes the data recovery for this semiannual reporting period. Data recoveries for wind speed, wind direction, stability were at approximately 100 percent.

TABLE 3.4

PERCENT DATA RECOVERY
JULY THROUGH DECEMBER 1995
ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL

Parameter	Percentage
Wind Speed	100.0
Wind Direction	100.0
Standard Deviation of Horizontal Wind Direction	100.0
Stability	100.0

4.0 SUMMARY

Meteorological data was collected from July through December, 1995 at the White Mesa Mill site with an overall recovery rate of 100 percent. The results of the meteorological data collected during this reporting period are representative of the monitoring location. The dominant feature of the winds observed at the site was a local nocturnal drainage flow from the higher elevations to the north and northeast and a daytime upslope (return) flow from the south-southeast through south-southwest. Neutral conditions were the most prominent of the stability classes and the period mean wind speed was 3.3 m/s (7.4 mph).

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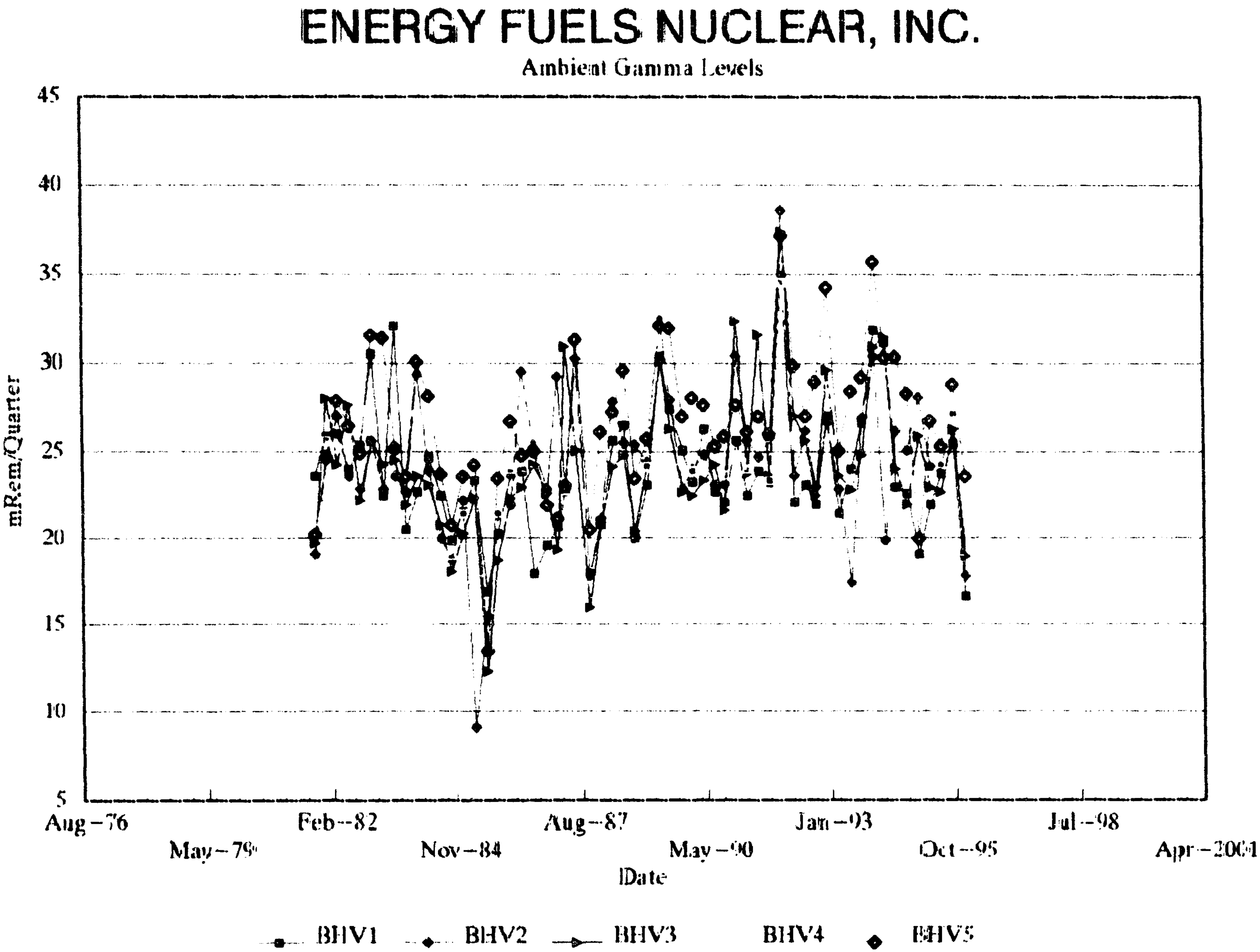
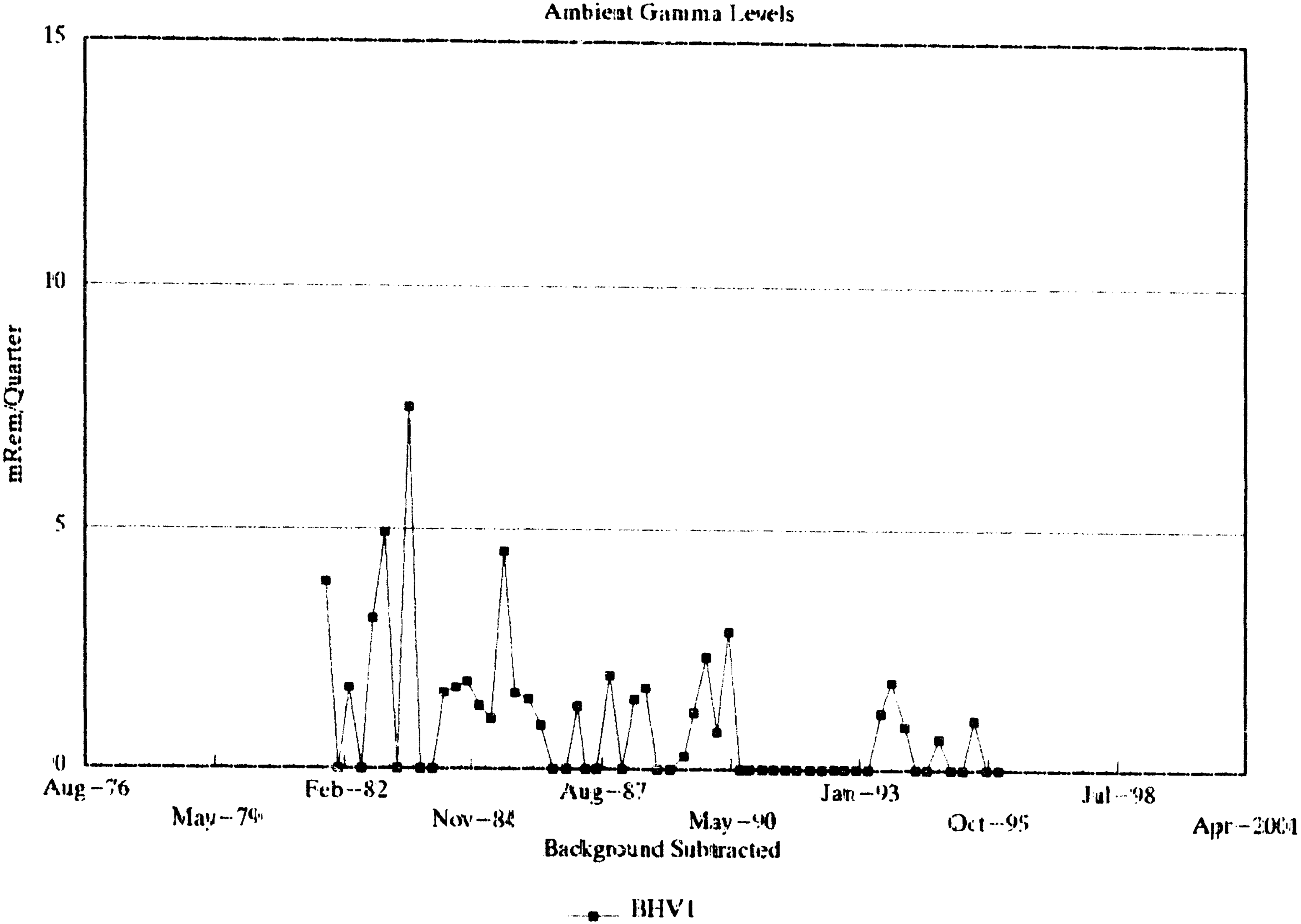


ENERGY FUELS NUCLEAR, INC.
Ambient Gamma Levels
45
40
35
30
25
20
15
10
5
mRem/Quarter
Aug-76
May-79
Feb-82
Nov-84
Aug-87
May-90
Jan-93
Oct-95
Jul-98
Apr-2001
Date
BHV1
BHV2
BHV3
BHV4
BHV5

GRAPH 7

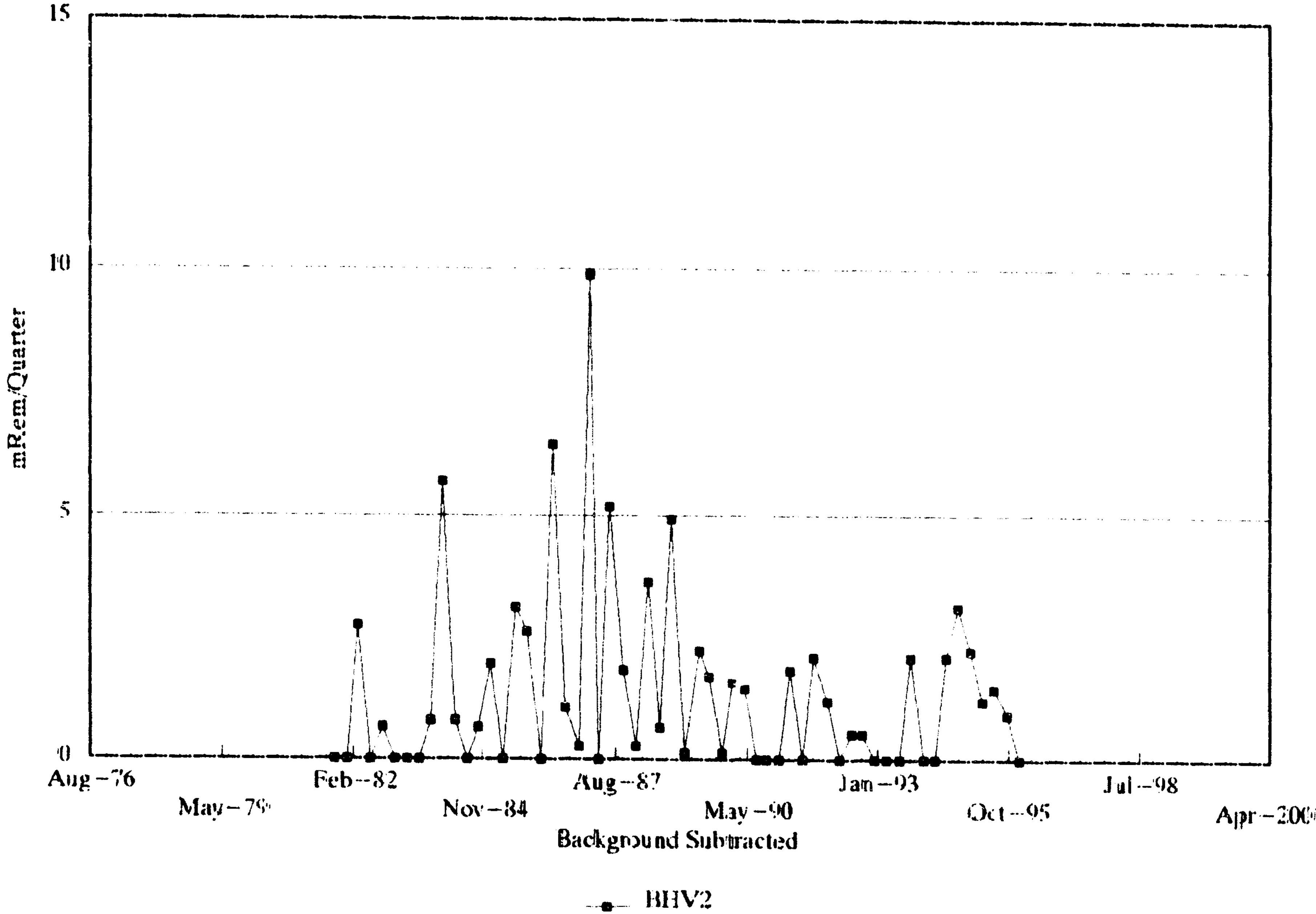
ENERGY FUELS NUCLEAR, INC.



GRAPH 8

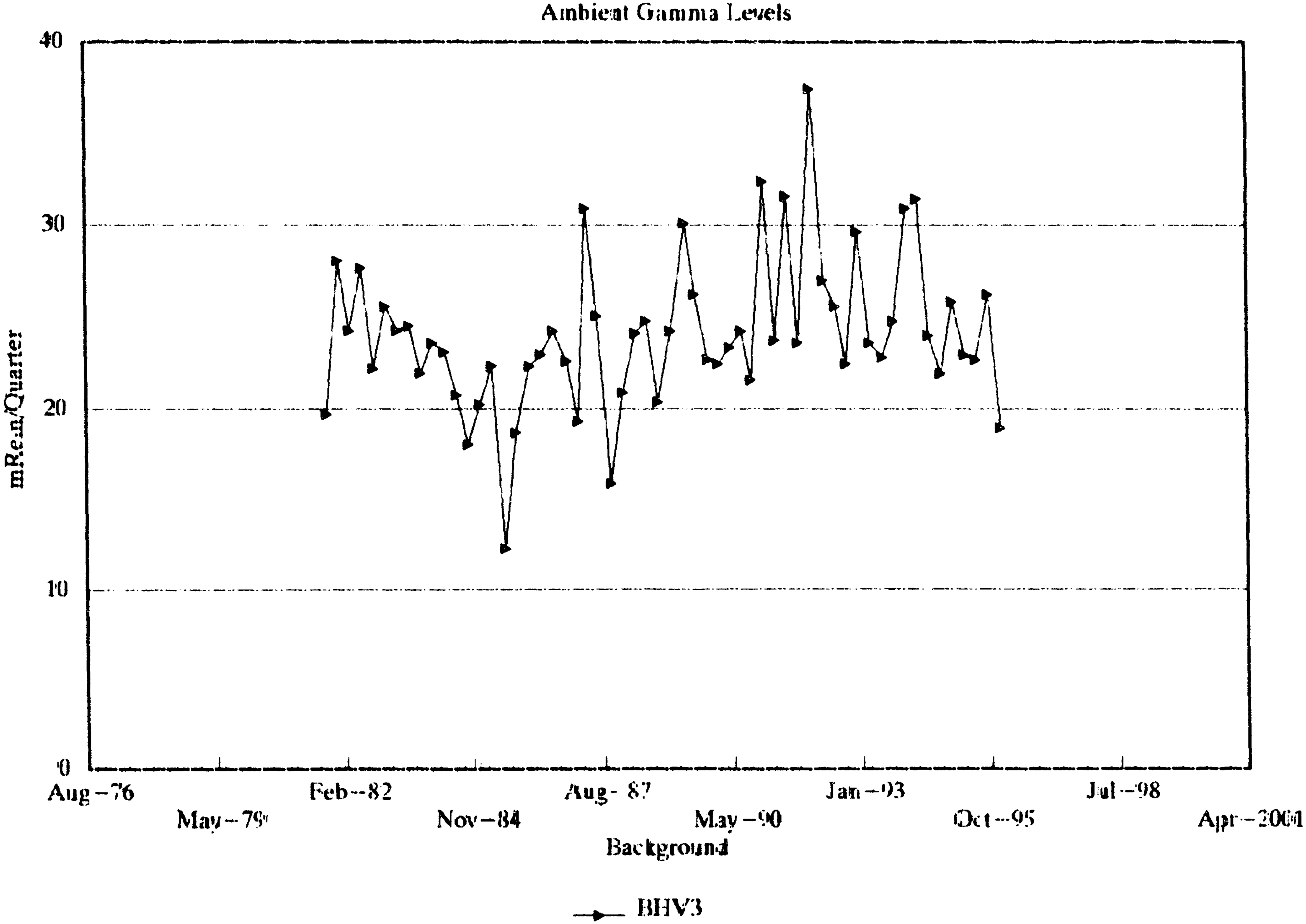
ENERGY FUELS NUCLEAR, INC.

Ambient Gamma Levels



GRAPH 9

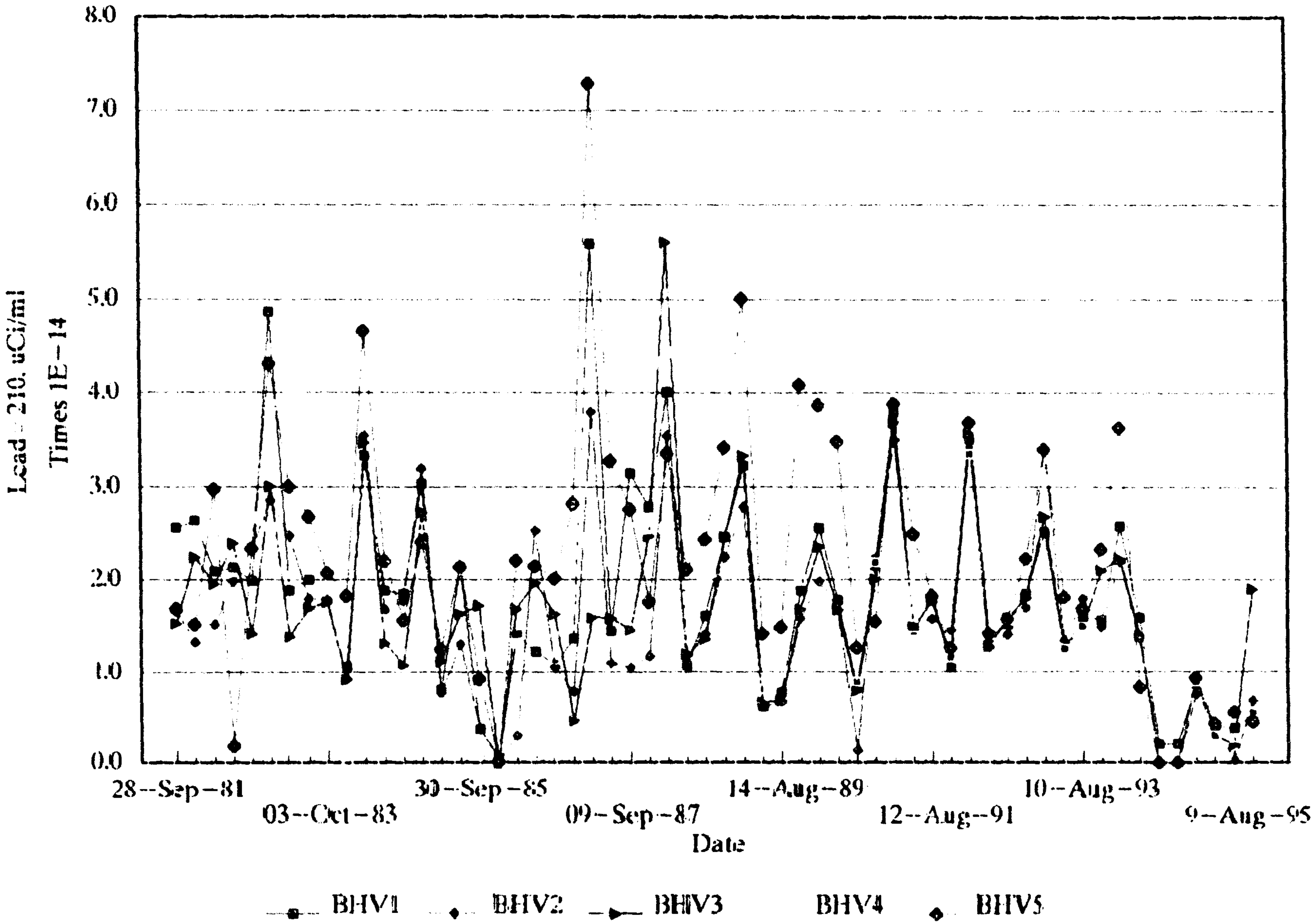
ENERGY FUELS NUCLEAR, INC.



GRAPH 10

ENERGY FUELS NUCLEAR, INC.

Particulate Radionuclides



GRAPH 20

TABLE 17

ENERGY FUELS NUCLEAR, INC.
WHITE MESA URANIUM MILL
SEMIANNUAL EFFLUENT AND MONITORING REPORT
Source Material License No. SUA-1358 Docket No. 40-8681

AIR PARTICULATES

Sampling Period and Location	Radionuclide	Net Release From Site(Background Subtracted) μCi/ml	Sampling Period and Location	Radionuclide	Net Release From Site(Background Subtracted) μCi/ml
5/9/94-8/9/95	U-Nat.	1.97E-16	8/9/95-11/11/95	U-Nat.	4.48E-15
Met. Station	Th-230	6.8[illegible]E-17	Met. Station	Th-230	5.10E-16
BHV-1	Ra-226	2.32E-16	BHV-1	Ra-226	8.27E-16
	Pb-210	1.80E-15		Pb-210	0.00E+00
5/9/94-8/9/95	U-Nat.	1.60E-17	8/9/95-11/11/95	U-Nat.	2.51E-15
Nearest Residence	Th-230	4.70E-18	Nearest Residence	Th-230	2.78E-16
BHV-2	Ra-226	9.10E-17	BHV-2	Ra-226	4.57E-16
	Pb-210	0.00E+00		Pb-210	0.00E+00
5/9/94-8/9/95	U-Nat.	7.20E-17	8/9/95-11/11/95	U-Nat.	1.40E-14
South Tailing Area	Th-230	1.94E-16	South Tailing Area	Th-230	2.18E-15
BHV-4	Ra-226	2.70E-17	BHV-4	Ra-226	2.54E-15
	Pb-210	7.40E-16		Pb-210	0.00E+00
5/9/94-8/9/95	U-Nat.	9.30E-17	8/9/95-11/11/95	U-Nat.	2.01E-14
S.E. Tailing Area	Th-230	1.58E-15	S.E. Tailing Area	Th-230	6.57E-15
BHV-5	Ra-226	3.86E-15	BHV-5	Ra-226	7.58E-15
	Pb-210	3.64E-15		Pb-210	0.00E+00

TABLE 18

ENERGY FUELS NUCLEAR, INC.
WHITE MESA URANIUM MILL
SEMIANNUAL EFFLUENT AND MONITORING REPORT
Source Material License No. SUA-1358 Docket No. 40-8681

RADIOLOGICAL 50 YEAR DOSE COMMITMENT
TO THE NEAREST RESIDENT FROM THE
INHALATIO'J OF AIRBORNE PARTICULATES
THIRD QUARTER

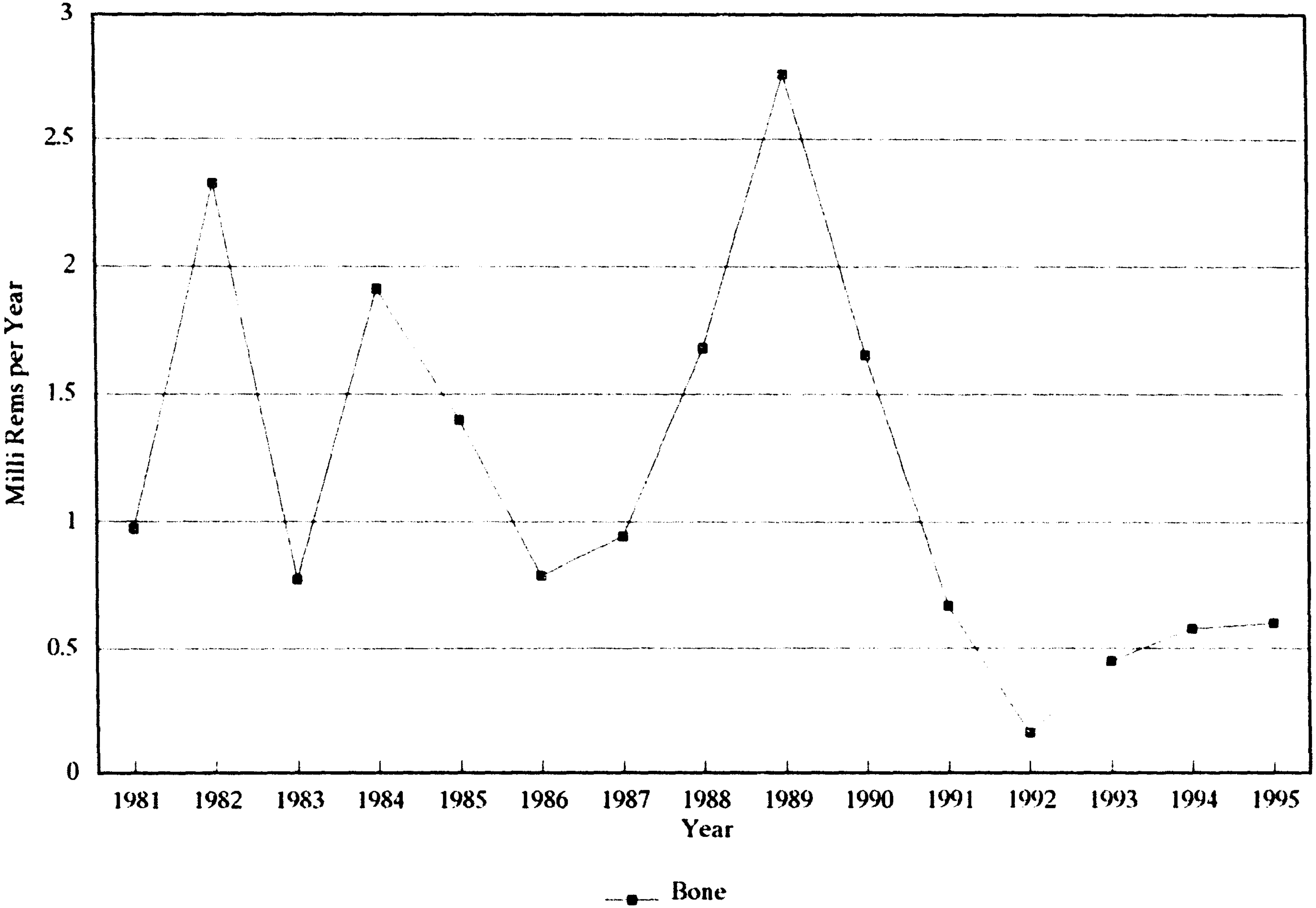
Radionuclide	Net Concentration (Background Subtracted) µCi/ml	Dose mrem/Year WHOLE BODY	BONE	MASS AVERAGE LUNG
U-238	7.84E-18	0.0000	0.0006	0.0012
U-234	7.84E-18	0.0000	0.0006	0.0014
Th-230	4.70E-18	0.0008	0.0280	0.0151
Ra-226	9.10E-17	0.0028	0.0281	0.6015
Pb-210	0.00E+00	0.0000	0.0000	0.0000
TOTAL		0.0037	0.0573	0.6193

FOURTH QUARTER

Radionuclide	Net Concentration (Background Subtracted) µCi/ml	Dose mrem/Year WHOLE BODY	BONE	MASS AVERAGE LUNG
U-238	1.23E-15	0.0053	0.0974	0.1943
U-234	1.23E-15	0.0061	0.0978	0.2214
Th-230	2.78E-16	0.0461	1.6541	0.8952
Ra-226	4.57E-16	0.0141	0.1412	3.0208
Pb-210	0.00E+00	0.0000	0.0000	0.0000
		0.0716	1.9905	4.3316

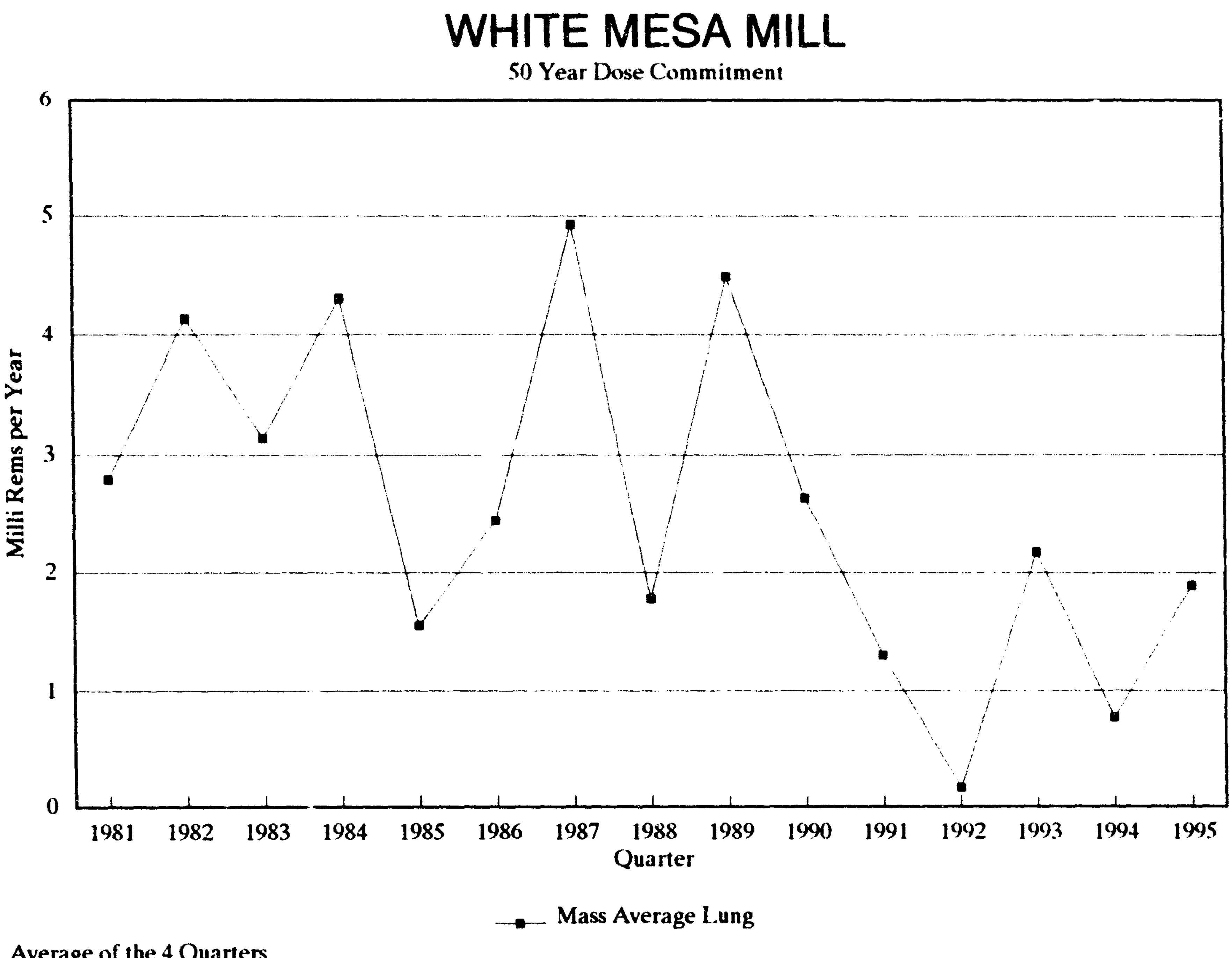
WHITE MESA MILL

50 Year Dose Commitment



Average of the 4 Quarters

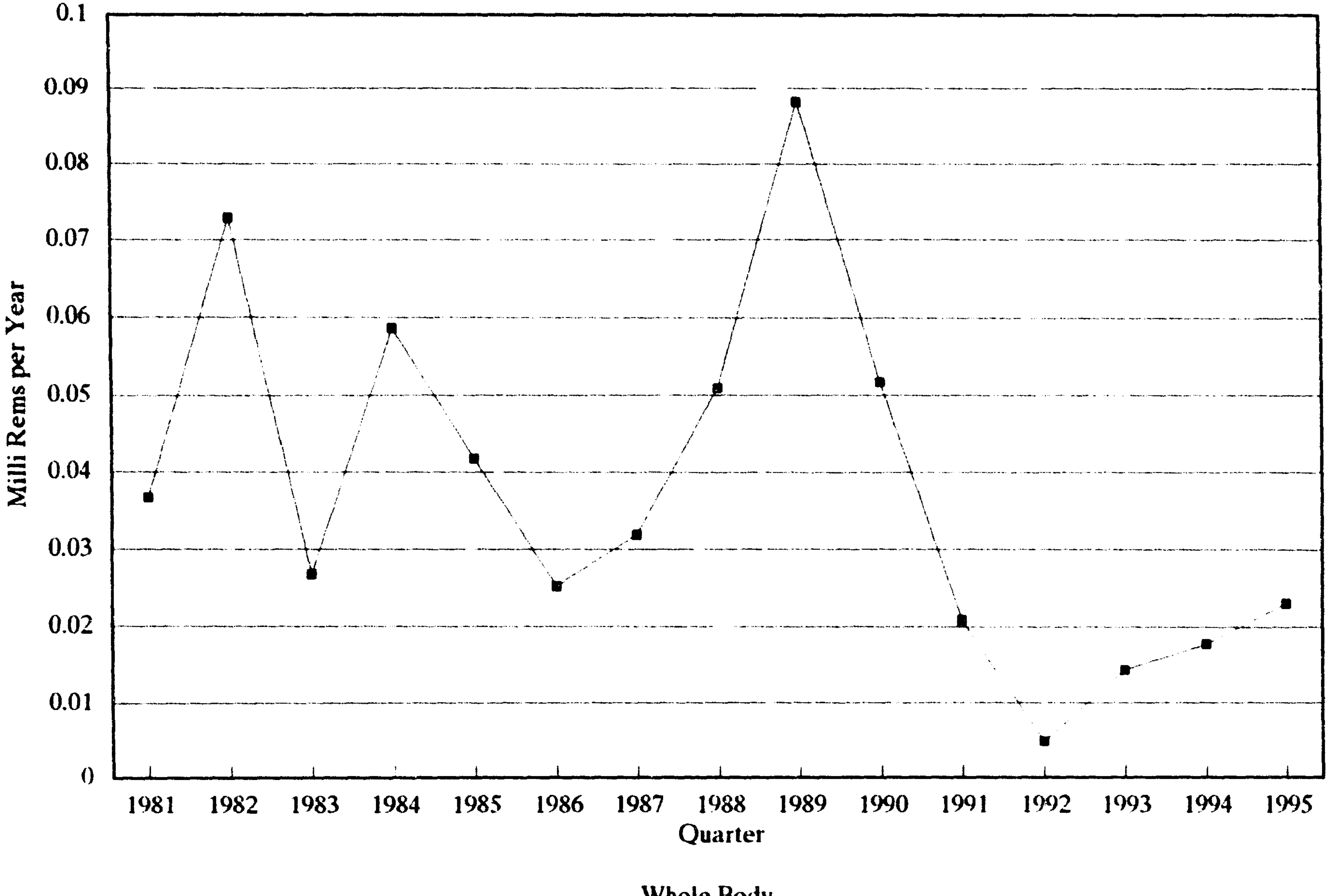
GRAPH 21


WHITE MESA MILL
50 Year Dose Commitment
Milli Rems per Year
0
1
2
3
4
5
6
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
Quarter
Mass Average Lung
Average of the 4 Quarters

GRAPH 22

WHITE MESA MILL

50 Year Dose Commitment



Average of the 4 Quarters

GRAPH 23

TABLE 19

ENERGY FUELS NUCLEAR, INC.
WHITE MESA URANIUM MILL

MONITOR WELLS
WATER QUALITY ANALYSIS
THIRD QUARTER
GROUNDWATER

PARAMETER DATE OF SAMPLE	MW#1 9/14/95	MW#2 9/14/95	MW#3 9/14/95	MW#4 9/14/95	MW#5 9/14/95	MW#11 9/14/95	MW#12 9/14/95	MW#14 9/14/95	MW#15 9/14/95	CULINARY 9/14/95
CASING ELEVATION, feet	5648.22	5613.49	5555.32	5622.57	5609.33	5611.08	5609.45	5596.39	5598.62	N/A
PHREATIC ELEVATION, feet	5572.62	5503.51	5471.67	5535.68	5501.27	5510.31	5500.17	5491.31	5491.33	N/A
pH FIELD	7.32	7.38	7.11	7.13	7.87	8.06	7.33	7.02	7.21	7.59
FIELD SP. COND. (µmhos@T)	1720	3670	5690	3720	2670	2670	4140	3900	4310	429
TDS, (mg/l)	1251	2808	5089	2935	1849	1740	3544	3155	3333	219
CHLORIDE (mg/l)	13.7	7.6	73.0	55.9	49.0	33.0	64.0	21.0	40.0	1.7
SULFATES (mg/l)	682	1951	3237	2110	1057	1012	2388	2220	2365	34
U-NAT. (µCi/ml)	2.6E-09	7.9E-09	2.6E-08	3.5E-09	3.2E-09	9.5E-10	1.2E-08	4.1E-08	2.8E-08	6.8E-10
U-NAT. LLD. (µCi/ml)	2.0E-10	2.0E-10	2.0E-10	2.0E-10	2.0E-10	2.0E-10	2.0E-10	2.0E-10	2.0E-10	2.0E-10
POTASSIUM(mg/l)	6.37	10.4	22.3	10	7.41	5.78	12.7	11.5	9.8	3.4
NICKEL (mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

TABLE 20

ENERGY FUELS NUCLEAR, INC.
WHITE MESA URANIUM MILL

MONITOR WELLS
WATER QUALITY ANALYSIS
FOURTH QUARTER
GROUNDWATER

PARAMETER DATE OF SAMPLE	MW#1 12/07/95	MW#2 12/07/95	MW#3 12/07/95	MW#4 12/07/95	MW#5 12/07/95	MW#11 12/07/95	MW#12 12/07/95	MW#14 12/07/95	MW#15 12/07/95	CULINARY 12/07/95
CASING ELEVATION, feet	5648.22	5613.49	5555.32	5622.57	5609.33	5611.08	5609.45	5596.39	5598.62	N/A
PHREATIC ELEVATION, feet	5572.66	5503.76	5471.62	5537.40	5501.41	5510.64	5500.29	5491.39	5491.42	N/A
pH FIELD	7.43	7.32	6.79	7.12	7.74	7.98	7.15	6.93	7.05	7.58
FIELD SP. COND. (µmhos@T)	1725	3730	5830	3840	2690	2700	4120	3910	4430	434
SODIUM (mg/l)	178	498	765	302	455	576	300	345	495	8.8
POTASSIUM (mg/l)	6.4	10.3	22	10.1	7.2	5.7	12.3	12	9.5	3.2
ARSENIC (mg/l)	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.019
NICKEL (mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
SELENIUM (mg/l)	<0.001	0.01	0.017	0.006	<0.001	<0.001	0.004	<0.001	0.106	<0.001
U-NAT. (µCi/ml)	8.1E-10	8.1E-09	1.8E-08	3.7E-09	6.8E-10	2.0E-10	1.0E-08	3.9E-08	3.0E-08	2.0E-10
U-NAT. LLD. (µCi/ml)	2.0E-10	2.0E-10	2.0E-10	2.0E-10	2.0E-10	2.0E-10	2.0E-10	2.0E-10	2.0E-10	2.0E-10
Ra-226 (pCi/l)	4.0E-13	9.0E-13	5.0E-13	7.0E-13	3.0E-13	<.2E-12	5.0E-13	2.0E-13	<.2E-12	4.0E-13
Ra-226 LLD (pCi/l)	2.0E-13	2.0E-13	2.0E-13	2.0E-13	2.0E-13	2.0E-13	2.0E-13	2.0E-13	2.0E-13	2.0E-13
Th-230 (pCi/l)	3.0E-13	5.0E-13	5.0E-13	5.0E-13	4.0E-13	5.0E-13	4.0E-13	2.0E-13	5.0E-13	7.0E-13
Th-230 LLD (pCi/l)	2.0E-13	2.0E-13	2.0E-13	2.0E-13	2.0E-13	2.0E-13	2.0E-13	2.0E-13	2.0E-13	2.0E-13
Pb-210 (pCi/l)	<1E-12	<1E-12	<1E-12	<1E-12	<1E-12	<1E-12	1.8E-12	<1E-12	<1E-12	<1E-12
Pb-210 LLD (pCi/l)	1.0E-12	1.0E-12	1.0E-12	1.0E-12	1.0E-12	1.0E-12	1.0E-12	1.0E-12	1.0E-12	1.0E-12

TABLE 21

ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL

QUALITY CONTROL DUPLICATE SAMPLES

THIRD QUARTER 1995

	Monitor Well 2	Blind Duplicate	Per Cent Difference	Monitor Culinary	Blind Duplicate	Per Cent Difference
Chloride	7.6	7.5	1.32%	1.7	1.1	35.29%
Nickel	0.05	0.05	0.00%	0.05	0.05	0.00%
Potassium	10.4	10.5	0.95%	3.4	3.33	2.06%
Sulfate	1951	1983	1.61%	34	33	2.94%
TDS	2808	2699	3.88%	219	211	3.65%
U	7.9E-09	7.4E-09	6.33%	6.8E-10	1.6E-09	57.69%

	Monitor** Well 13	Monitor** Well 13A	Monitor** Well 16	SPIKED SAMPLE	SPIKE VALUE	Per Cent Difference
Chloride	1.5	1.7	1.2	1.1	1.9	42.11%
Nickel	<0.05	<0.05	<0.05	0.08	0.096	16.67%
Potassium	<0.1	0.3	<0.1	100	100	0.00%
Sulfate	<1	48	<1	1	1	0.00%
TDS	<1	99	31	1	4.66	78.54%
U	9.5E-10	1.5E-09	1.20E-09	7.7E-08	6.8E-08	11.69%

FOURTH QUARTER 1995

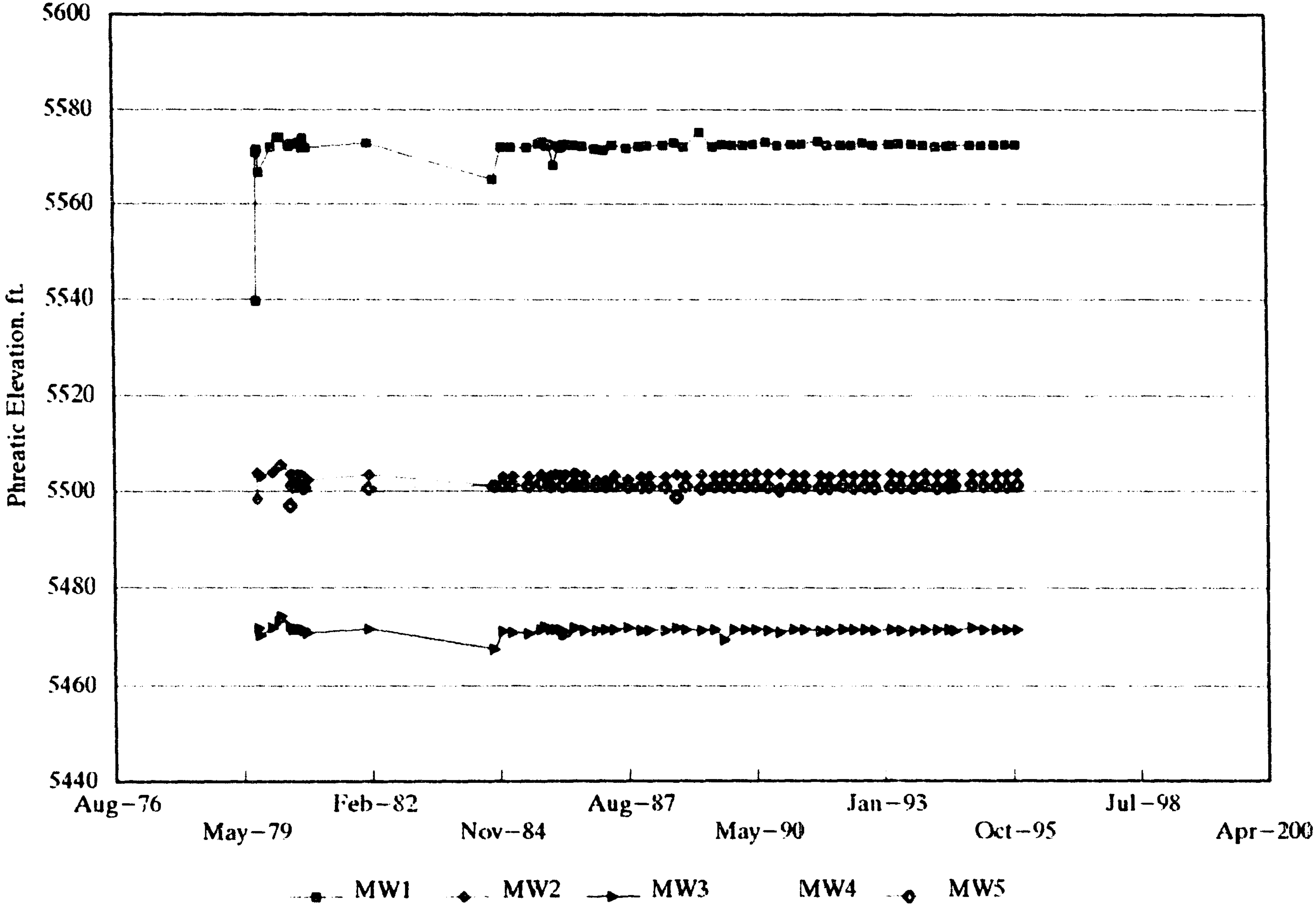
	Monitor Well 4	Blind Duplicate	Per Cent Difference	Monitor Well 5	Blind Duplicate	Per Cent Difference
Sodium	302	300	0.66%	455	450	1.10%
Potassium	10.1	9.8	2.97%	7.2	7	2.78%
Arsenic	<0.001	<0.001	0.00%	<0.001	<0.001	0.00%
Nickel	<0.05	<0.05	0.00%	<0.05	<0.05	0.00%
Selenium	0.006	0.005	16.67%	<0.001	<0.001	0.00%
U-Natural	3.7E-09	3.7E-09	0.00%	6.8E-10	2.2E-09	69.09%
Ra-226	7.0E-13	7.0E-13	0.00%	3.0E-13	2.0E-12	85.00%
Th-230	5.0E-13	5.0E-13	0.00%	4.0E-13	8.0E-13	50.00%
Pb-210	<1E-12	<1E-12	0.00%	<1E-12	<1E-12	0.00%

	Monitor** Well 13	Monitor** Well 13A	Monitor** Well 16	SPIKED SAMPLE	SPIKED VALUE	Per Cent Difference
Sodium	<1	<1	<1	234	240	2.50%
Potassium	<1	<1	<1	34.5	36.5	5.48%
Arsenic	<0.001	<0.001	<0.001	<0.001		
Nickel	<0.05	<0.05	<0.05	<0.05		
Selenium	<0.001	<0.001	0.003	<0.001		
U-Natural	<2E-10	<2E-10	1.20E-09	<2E-10		
Ra-226	<2E-13	<2E-13	2.00E-13	<2E-13		
Th-230	5.0E-13	6.0E-13	<2E-13	<2E-13		
Pb-210	<1E-12	2.2E-12	<1E-12	6.80E-12		

** Actual flushing of hose reel with a blank of de-ionized water, recirculated for 30 minutes

ENERGY FUELS NUCLEAR, INC.

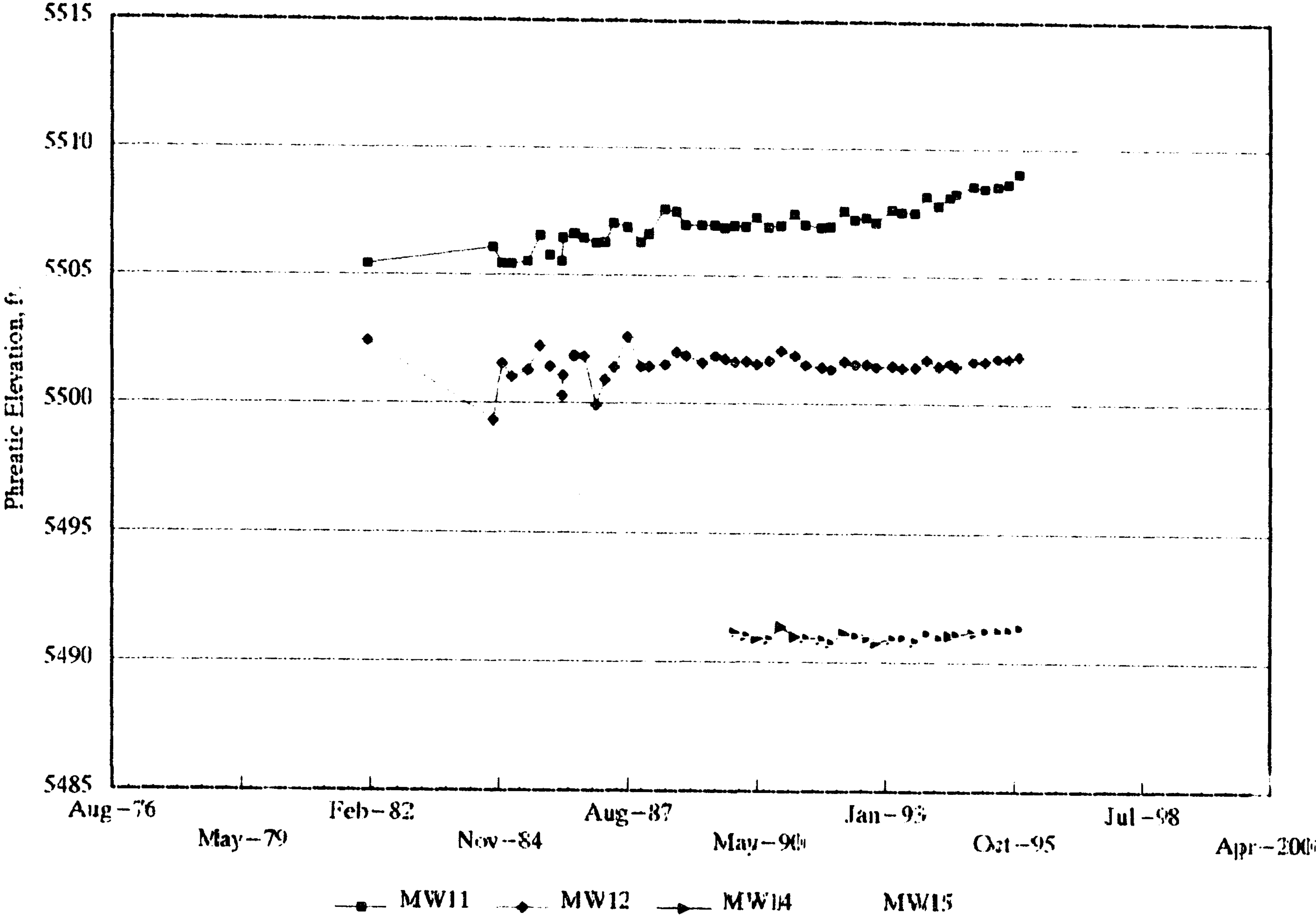
WHITE MESA MILL



GRAPH 24

ENERGY FUELS NUCLEAR, INC.

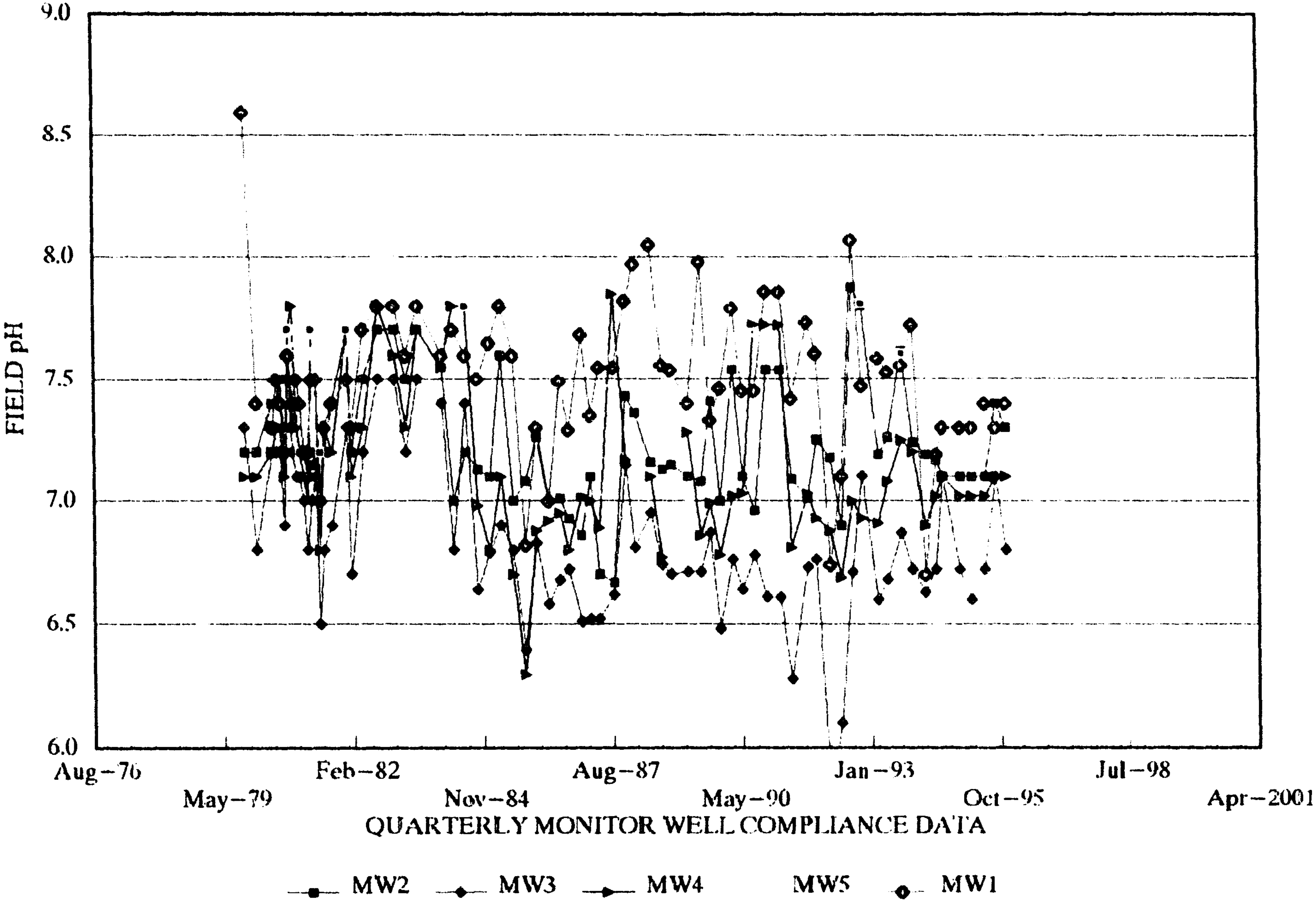
WHITE MESA MILL



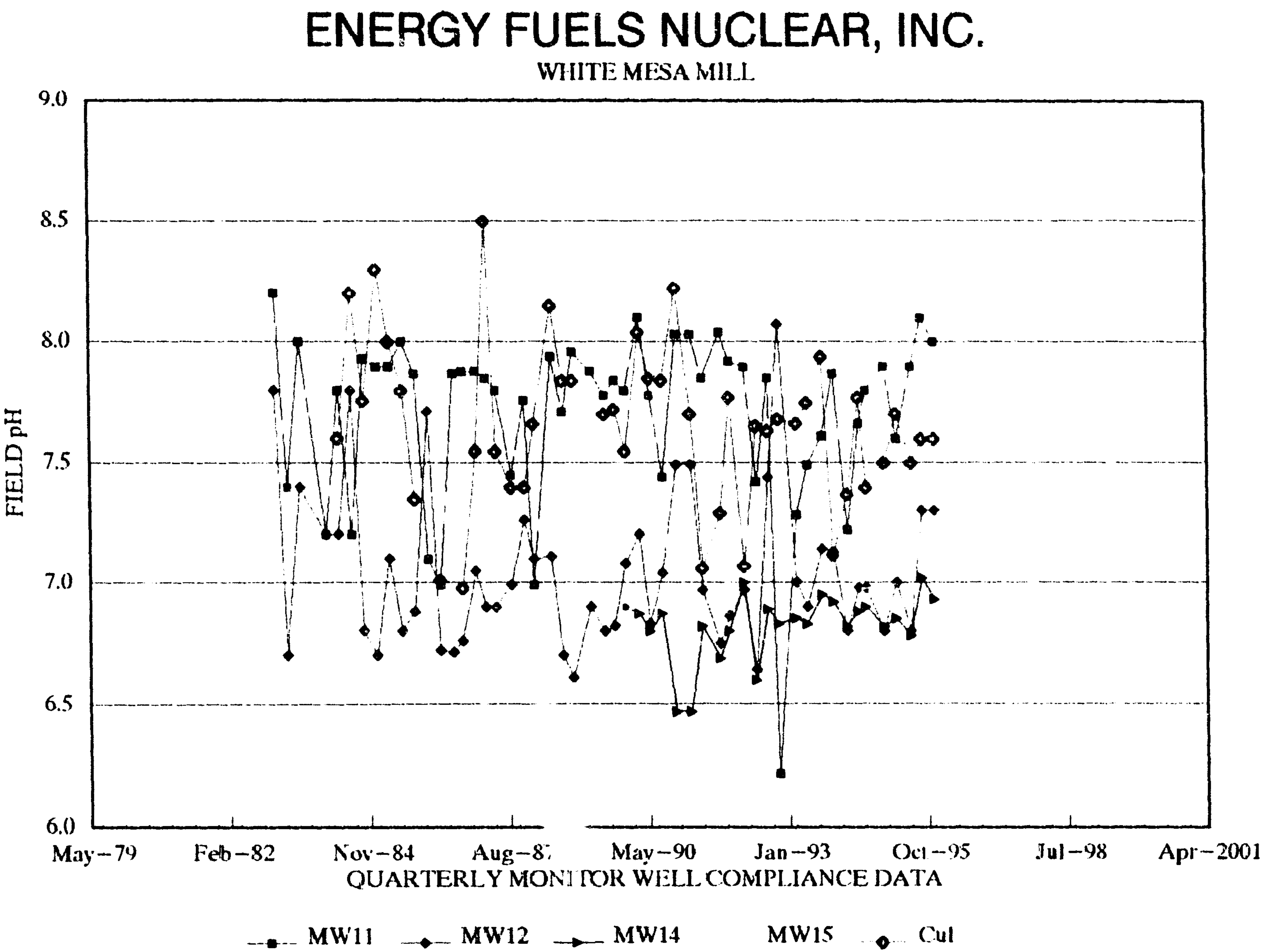
GRAPH 25

ENERGY FUELS NUCLEAR, INC.

WHITE MESA MILL



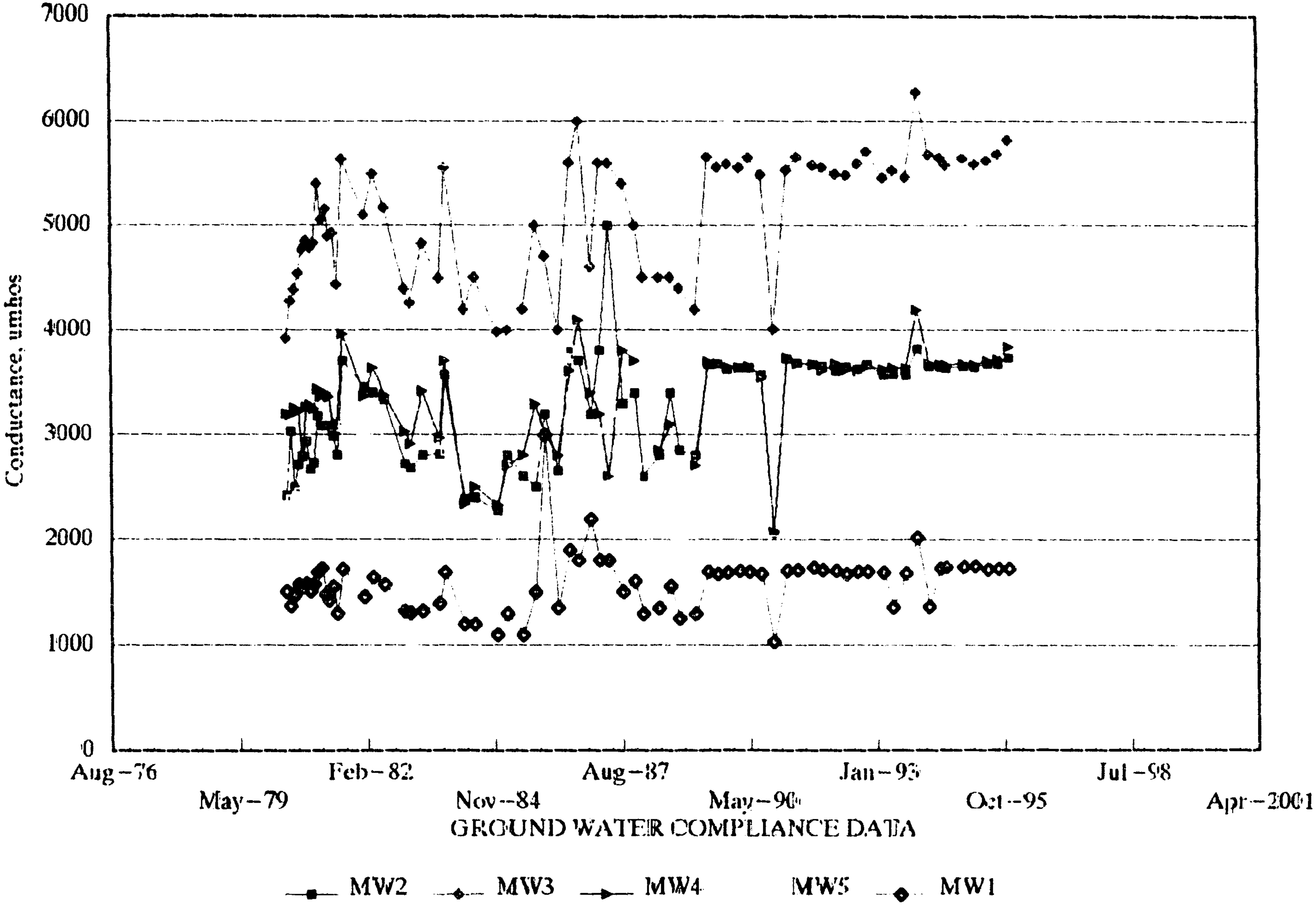
GRAPH 26


ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
9.0
8.5
8.0
7.5
7.0
6.5
6.0
FIELD pH
May−79
Feb−82
Nov−84
Aug−87
May−90
Jan−93
Oct−95
Jul−98
Apr−2001
QUARTERLY MONITOR WELL COMPLIANCE DATA
MW11
MW12
MW14
MW15
Cul

GRAPH 27

ENERGY FUELS NUCLEAR, INC.

WHITE MESA MILL



GRAPH 28

APPENDIX A

HOURLY DATA - SAROADS

HOURLY AVERAGED WIND SPEED
DATA RECORDED IN JULY 1995
BLANDING - UTAH
UNITS ARE TENTHS OF A METER PER SECOND

HOUR OF THE DAY

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG
1	56	52	41	37	38	28	32	50	30	31	34	38	43	54	77	49	49	65	58	55	43	44	30	40	45
2	41	38	53	51	36	33	22	27	26	31	29	40	54	57	78	73	65	56	65	58	27	34	49	46	45
3	30	17	23	35	18	41	32	15	31	49	63	73	36	99	35	47	48	63	59	17	13	19	19	27	38
4	20	22	10	24	36	20	16	18	14	29	41	30	54	53	56	49	58	58	42	43	49	44	48	49	37
5	47	59	51	42	51	21	19	22	19	24	20	23	26	30	31	33	35	36	35	17	25	38	36	41	33
6	39	43	35	34	11	25	14	27	21	29	25	24	24	34	30	29	22	33	10	17	39	43	44	53	29
7	45	30	29	30	29	37	22	20	34	40	33	36	40	33	30	26	28	20	22	24	42	41	43	49	33
8	47	38	34	34	40	21	24	27	38	52	41	36	29	33	32	34	29	27	47	30	50	38	34	51	36
9	48	28	25	16	33	29	21	40	67	56	48	46	46	41	48	63	83	41	33	27	36	44	43	48	42
10	45	34	40	37	39	28	25	24	27	29	40	45	43	51	51	43	54	43	19	15	29	35	35	26	36
11	37	35	31	42	44	36	24	22	31	37	47	55	53	79	63	56	52	33	59	38	10	17	28	46	41
12	39	35	20	30	33	34	30	21	50	54	44	49	48	84	85	79	72	95	73	50	59	33	31	25	49
13	34	27	25	18	28	44	20	22	25	29	27	25	37	81	100	104	86	74	54	53	53	41	31	13	44
14	32	27	25	24	30	14	10	13	20	20	24	25	41	40	47	48	51	40	30	30	55	39	45	42	32
15	22	18	22	26	25	27	22	23	20	15	18	32	60	51	47	46	44	49	49	52	53	56	43	48	36
16	38	43	38	36	49	49	32	21	12	17	32	32	31	34	34	35	30	39	34	85	55	55	56	41	39
17	38	39	37	18	19	13	10	37	66	18	36	30	33	44	38	27	39	48	31	38	57	54	58	57	37
18	57	63	57	18	34	53	53	52	45	42	56	60	54	44	53	52	45	52	43	50	54	31	28	43	47
19	38	46	33	20	24	27	18	13	28	32	28	25	24	27	25	29	32	22	20	13	38	41	24	27	27
20	35	38	43	30	37	41	33	16	22	41	48	36	36	44	39	51	104	84	31	13	35	28	27	34	39
21	27	29	34	28	23	22	24	15	25	21	27	27	23	32	35	34	43	46	39	25	31	42	45	37	31
22	36	17	22	11	29	33	27	19	13	17	26	28	27	37	41	43	41	34	29	55	37	48	35	32	31
23	34	30	25	25	19	27	18	23	33	42	42	37	38	41	38	35	37	41	74	98	80	60	23	18	39
24	38	39	37	18	19	13	10	37	66	18	36	30	33	44	38	27	39	48	31	38	57	54	58	57	37
25	35	28	46	35	29	25	30	27	19	61	64	54	45	47	68	54	44	57	64	113	86	77	34	25	49
26	21	28	33	29	32	27	32	24	21	31	28	33	33	44	55	44	58	55	62	56	41	29	22	45	37
27	70	39	35	22	16	10	10	14	16	16	28	32	36	36	48	72	50	38	36	37	41	34	39	35	34
28	12	15	19	19	26	32	34	28	22	17	22	29	36	37	31	57	31	24	22	18	55	35	24	29	28
29	24	25	27	32	33	27	26	29	30	22	24	21	26	36	79	30	33	36	34	33	37	40	40	25	32
30	19	28	23	24	23	30	30	17	22	17	20	17	25	34	28	33	30	29	31	29	24	25	25	41	26
31	42	37	18	22	12	13	20	19	19	25	37	22	33	52	54	69	75	78	73	60	39	55	58	55	41
AVERAGE	37	34	32	28	30	28	24	25	29	31	35	35	38	47	49	47	49	47	42	42	44	41	37	39	37

* Indicates calibration of sensors
** Indicates invalid data

ENECOTECH INC.
SAROAD(V1.0) 02/01/96

HOURLY AVERAGED WIND DIRECTION
DATA RECORDED IN JULY 1995
BLANDING - UTAH
UNITS ARE DEGREES AZIMUTH

HOUR OF THE DAY

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	356	3	22	39	25	14	297	342	15	126	140	154	186	228	258	347	283	287	169	152	82	80	30	14
2	12	47	53	43	27	14	39	134	156	171	192	207	215	238	252	247	258	261	265	263	299	322	333	319
3	340	40	29	17	104	325	316	323	168	159	207	260	60	314	21	49	77	61	58	138	26	12	338	353
4	355	347	347	17	14	356	291	266	198	227	240	242	286	321	319	305	318	313	6	14	13	10	7	353
5	331	340	338	354	335	70	52	156	147	157	213	233	227	213	263	221	197	192	182	160	19	11	9	4
6	357	1	14	345	19	21	62	126	134	163	152	149	159	267	251	284	236	221	360	59	20	12	14	15
7	11	358	348	320	23	19	309	285	158	144	165	160	189	211	257	296	220	246	273	354	4	358	16	16
8	12	5	8	16	16	17	23	145	165	163	158	127	121	126	159	111	89	114	100	63	76	61	27	23
9	37	25	34	316	48	27	31	111	137	145	163	177	157	195	182	166	144	173	174	314	355	345	16	19
10	38	10	37	29	29	30	22	60	161	184	197	192	187	186	144	163	190	178	150	113	76	211	188	55
11	31	346	351	4	16	30	35	148	139	160	183	202	186	179	157	160	158	174	201	204	134	43	317	334
12	297	265	269	24	22	23	31	117	151	152	161	180	172	176	179	175	169	239	300	314	291	317	7	36
13	13	8	26	318	4	351	14	107	160	154	169	203	159	248	314	272	272	271	328	356	25	67	17	359
14	348	317	314	2	7	8	266	126	109	183	230	197	205	216	223	231	247	57	22	17	3	34	47	10
15	353	38	0	0	358	17	41	64	134	271	80	65	42	49	46	35	40	24	347	342	345	350	358	4
16	9	356	347	40	20	22	25	52	39	52	76	79	50	37	30	21	29	14	35	141	190	197	147	308
17	302	302	300	306	329	294	254	208	157	333	174	205	222	230	194	175	318	305	305	341	346	339	338	342
18	342	336	332	333	345	350	344	337	333	310	292	313	310	309	329	321	323	324	358	349	339	338	308	345
19	342	2	343	20	72	44	19	81	131	133	141	142	154	134	83	172	159	140	174	184	4	4	301	8
20	32	24	13	29	19	11	4	8	108	141	148	156	157	187	220	156	118	129	81	5	19	3	346	346
21	347	344	35	258	353	2	357	344	347	354	164	177	193	198	229	213	354	348	259	274	11	5	357	31
22	360	28	18	228	329	336	338	319	192	179	280	352	351	188	180	168	196	352	353	352	352	358	352	351
23	358	16	15	4	357	352	352	296	353	352	354	259	323	339	333	353	348	332	344	352	332	357	335	236
24	302	302	300	306	329	294	254	208	157	333	174	205	222	230	194	175	318	305	305	341	346	339	338	342
25	19	24	21	23	20	41	21	17	140	143	157	165	173	205	193	209	173	187	166	235	335	356	327	337
26	35	7	17	24	29	36	31	21	93	141	161	179	216	212	238	275	250	260	293	343	6	43	145	208
27	190	224	259	292	310	310	310	347	277	180	184	203	203	198	207	18	25	38	199	230	223	220	238	240
28	108	31	59	36	23	26	21	33	88	147	166	183	212	222	64	58	43	67	97	356	196	230	259	24
29	39	20	26	19	15	39	63	13	46	184	184	174	186	258	356	316	50	23	36	61	23	3	3	48
30	35	24	22	22	24	5	349	346	290	201	199	194	192	205	197	247	244	244	243	236*	242	219	1	352
31	360	7	215	359	30	51	40	38	118	155	159	173	130	355	345	346	4	354	350	351	5	12	7	4

* Indicates calibration of sensors
** Indicates invalid data

ENECOTECH INC.
SAROAD(V1.0) 02/01/96

HOURLY HORIZONTAL WIND DIRECTION STANDARD DEVIATION
DATA RECORDED IN JULY 1995
BLANDING - UTAH
UNITS ARE TENTHS OF A DEGREE

HOUR OF THE DAY

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG
1	363	92	167	64	86	79	151	130	439	371	311	372	401	339	202	516	282	153	414	284	94	91	163	51	234
2	76	144	77	83	147	90	196	315	224	316	327	279	321	281	183	171	132	196	117	97	319	80	69	51	179
3	170	132	107	146	733	211	249	383	344	145	317	213	495	215	290	267	442	35[illegible]	92	624	247	162	339	151	284
4	202	162	718	137	69	417	230	310	365	276	255	470	236	282	303	319	189	21[illegible]	206	123	55	69	63	132	242
5	89	44	94	171	125	242	218	175	200	293	526	545	492	426	449	397	287	183	101	198	256	74	163	165	246
6	88	185	174	287	320	153	307	204	209	249	253	383	481	378	525	504	538	334	675	107	102	51	22	33	273
7	43	318	286	376	188	109	300	405	262	225	291	362	283	289	486	453	426	599	126	401	74	128	235	24	279
8	37	99	203	79	95	130	107	509	180	183	227	314	439	495	520	588	323	242	172	130	295	381	95	51	246
9	97	417	183	501	171	134	177	250	129	216	258	276	290	455	314	271	151	172	216	410	358	198	73	72	241
10	92	87	59	87	88	104	85	370	315	281	264	316	319	284	270	241	241	163	132	411	505	377	270	459	243
11	136	294	304	83	52	96	117	365	162	286	216	186	304	326	200	238	230	215	124	98	316	323	446	223	223
12	125	125	311	78	53	59	85	468	158	157	279	269	346	276	198	193	191	428	168	177	95	183	212	171	200
13	114	175	94	446	189	116	343	242	307	315	472	533	458	395	121	169	123	190	151	120	186	117	558	571	271
14	165	156	446	287	200	492	739	461	447	611	432	489	367	301	290	265	211	774	516	171	114	201	125	125	349
15	361	191	200	205	150	185	157	138	443	544	719	406	148	244	248	187	202	107	128	50	39	55	118	87	221
16	119	95	110	345	76	46	82	182	517	421	300	429	462	437	420	358	303	140	360	313	711	586	336	107	302
17	127	109	210	254	638	615	253	680	129	532	199	367	285	256	227	515	377	187	98	146	55	72	54	50	268
18	66	76	95	532	107	96	94	101	159	216	189	207	213	239	246	261	279	141	156	106	44	125	182	95	168
19	99	119	191	592	215	161	139	373	231	197	260	327	607	583	647	388	273	233	96	184	184	151	367	336	290
20	89	57	71	51	70	43	114	177	516	184	183	278	287	311	403	379	136	122	535	363	175	186	17	113	203
21	93	721	505	718	534	304	62	459	29	308	376	320	521	531	661	346	6	308	488	508	152	104	95	275	351
22	148	354	384	743	114	44	54	401	644	428	775	23	17	434	207	214	584	6	4	4	68	71	115	92	247
23	195	170	266	252	231	0	261	494	9	8	722	651	372	233	156	11	402	351	271	153	154	155	607	553	278
24	127	109	210	254	638	615	253	680	129	532	199	367	285	256	227	515	377	187	98	146	55	72	54	50	268
25	127	169	75	69	109	171	99	83	516	204	152	230	346	314	235	238	256	240	135	173	238	72	324	674	219
26	284	117	119	53	107	89	87	78	487	265	291	310	387	266	310	319	232	186	182	297	79	491	270	166	228
27	117	448	151	124	400	376	236	326	521	419	400	306	406	332	250	382	111	134	565	126	90	78	64	139	271
28	262	529	292	223	96	97	65	100	276	365	476	470	334	398	405	116	241	485	398	683	249	150	367	175	302
29	281	215	181	127	113	164	333	181	275	391	455	428	502	327	251	664	146	385	207	155	76	85	129	535	275
30	87	96	93	78	115	104	81	355	220	394	352	482	402	272	333	486	481	484	407	103	83	202	307	49	253
31	103	117	700	408	160	220	67	107	347	175	109	415	739	367	338	216	151	166	144	146	147	65	78	71	232
AVERAGE	145	197	228	253	206	186	185	307	296	307	341	356	372	340	320	329	268	261	241	226	181	166	204	189	254

* Indicates calibration of sensors
** Indicates invalid data

ENECOTECH INC.
SAROAD(V1.0) 02/01/96

HOURLY AVERAGED WIND SPEED
DATA RECORDED IN AUGUST 1995
BLANDING - UTAH
UNITS ARE TENTHS OF A METER PER SECOND

HOUR OF THE DAY

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG
1	56	52	41	37	38	28	32	50	30	31	34	38	43	54	77	49	49	65	58	55	43	44	30	40	45
2	41	38	53	51	36	33	22	27	26	31	29	40	54	57	78	73	65	56	65	58	27	34	49	46	45
3	30	17	23	35	18	41	32	15	31	49	63	73	36	99	35	47	48	63	59	17	13	19	19	27	38
4	20	22	10	24	36	20	16	18	14	29	41	30	54	53	56	49	58	58	42	43	49	44	48	49	37
5	47	59	51	42	51	21	19	22	19	24	20	23	26	30	31	33	35	36	35	17	25	38	36	41	33
6	39	43	35	34	11	25	14	27	21	29	25	24	24	34	30	29	22	33	10	17	39	43	44	53	29
7	45	30	29	30	29	37	22	20	34	40	33	36	40	33	30	26	28	20	22	24	42	41	43	49	33
8	47	38	34	34	40	21	24	27	38	52	41	36	29	33	32	34	29	27	47	30	50	38	34	51	36
9	48	28	25	16	33	29	21	40	67	56	48	46	46	41	48	63	83	41	33	27	36	44	43	48	42
10	45	34	40	37	39	28	25	24	27	29	40	45	43	51	51	43	54	43	19	15	29	35	35	26	36
11	37	35	31	42	44	36	24	22	31	37	47	55	53	79	63	56	52	33	59	38	10	17	28	46	41
12	39	35	20	30	33	34	30	21	50	54	44	49	48	84	85	79	72	95	73	50	59	33	31	25	49
13	34	27	25	18	28	44	20	22	25	29	27	25	37	81	100	104	86	74	54	53	53	41	31	13	44
14	32	27	25	24	30	14	10	13	20	20	24	25	41	40	47	48	51	40	30	30	55	39	45	42	32
15	22	18	22	26	25	27	22	23	20	15	18	32	60	51	47	46	44	49	49	52	53	56	43	48	36
16	38	43	38	36	49	49	32	21	12	17	32	32	31	34	34	35	30	39	34	85	55	55	56	41	39
17	38	39	37	18	19	13	10	37	66	18	36	30	33	44	38	27	39	48	31	38	57	54	58	57	37
18	57	63	57	18	34	53	53	52	45	42	56	60	54	44	53	52	45	52	43	50	54	31	28	43	47
19	38	46	33	20	24	27	18	13	28	32	28	25	24	27	25	29	32	22	20	13	38	41	24	27	27
20	35	38	43	30	37	41	33	16	22	41	48	36	36	44	39	51	104	84	31	13	35	28	27	34	39
21	27	29	34	28	23	22	24	15	25	21	27	27	23	32	35	34	43	46	39	25	31	42	45	37	31
22	36	17	22	11	29	33	27	19	13	17	26	28	27	37	41	43	41	34	29	55	37	48	35	32	31
23	34	30	25	25	19	27	18	23	33	42	42	37	38	41	38	35	37	41	74	98	80	60	23	18	39
24	38	39	37	18	19	13	10	37	66	18	36	30	33	44	38	27	39	48	31	38	57	54	58	57	37
25	35	28	46	35	29	25	30	27	19	61	64	54	45	47	68	54	44	57	64	113	86	77	34	25	49
26	21	28	33	29	32	27	32	24	21	31	28	33	33	44	55	44	58	55	62	56	41	29	22	45	37
27	70	39	35	22	16	10	10	14	16	16	28	32	36	36	48	72	50	38	36	37	41	34	39	35	34
28	12	15	19	19	26	32	34	28	22	17	22	29	36	37	31	57	31	24	22	18	55	35	24	29	28
29	24	25	27	32	33	27	26	29	30	22	24	21	26	36	79	30	33	36	34	33	37	40	40	25	32
30	19	28	23	24	23	30	30	17	22	17	20	17	25	34	28	33	30	29	31	29	24	25	25	41	26
31	42	37	18	22	12	13	20	19	19	25	37	22	33	52	54	69	75	78	73	60	39	55	58	55	41
AVERAGE	37	34	32	28	30	28	24	25	29	31	35	35	38	47	49	47	49	47	42	42	44	41	37	39	37

* Indicates calibration of sensors
** Indicates invalid data

ENECOTECH INC.
SAROAD(V1.0) 02/01/96

HOURLY AVERAGED WIND DIRECTION
DATA RECORDED IN AUGUST 1995
BLANDING - UTAH
UNITS ARE DEGREES AZIMUTH

HOUR OF THE DAY

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	356	3	22	39	25	14	297	342	15	126	140	154	186	228	258	347	283	287	169	152	82	80	30	14
2	12	47	53	43	27	14	39	134	156	171	192	207	215	238	252	247	258	261	265	263	299	322	333	319
3	340	40	29	17	104	325	316	323	168	159	207	260	60	314	21	49	77	61	58	138	26	12	338	353
4	355	347	347	17	14	356	291	266	198	227	240	242	286	321	319	305	318	313	6	14	13	10	7	353
5	331	340	338	354	335	70	52	156	147	157	213	233	227	213	263	221	197	192	182	160	19	11	9	4
6	357	1	14	345	19	21	62	126	134	163	152	149	159	267	251	284	236	221	360	59	20	12	14	15
7	11	358	348	320	23	19	309	285	158	144	165	160	189	211	257	296	220	246	273	354	4	358	16	16
8	12	5	8	16	16	17	23	145	165	163	158	127	121	126	159	111	89	114	100	63	76	61	27	23
9	37	25	34	316	48	27	31	111	137	145	163	177	157	195	182	166	144	173	174	314	355	345	16	19
10	38	30	37	29	29	30	22	60	161	184	197	192	187	186	144	163	190	178	150	113	76	211	188	55
11	31	346	351	4	16	30	35	148	139	160	183	202	186	179	157	160	158	174	201	204	134	43	317	334
12	297	265	269	24	22	23	31	117	151	152	161	180	172	176	179	175	169	239	300	314	291	317	7	36
13	13	8	26	318	4	351	14	107	160	154	169	203	159	248	314	272	272	271	328	356	25	67	17	359
14	348	317	314	2	7	8	266	126	109	183	230	197	205	216	223	231	247	57	22	17	3	34	47	10
15	353	38	0	0	358	17	41	64	134	271	80	65	42	49	46	35	40	24	347	342	345	350	358	4
16	9	356	347	40	20	22	25	52	39	52	76	79	50	37	30	21	29	14	35	141	190	197	147	308
17	302	302	300	306	329	294	254	208	157	333	174	205	222	230	194	175	318	305	305	341	346	339	338	342
18	342	336	332	333	345	350	346	337	333	310	292	313	310	309	329	321	323	324	358	349	339	338	308	345
19	342	2	343	20	72	44	19	81	131	133	141	142	154	134	83	172	159	140	174	184	4	4	301	8
20	32	24	13	29	19	11	4	8	108	141	148	156	157	187	220	156	118	129	81	5	19	3	346	346
21	347	344	35	258	353	2	357	344	347	354	164	177	193	198	229	213	354	348	259	274	11	5	357	31
22	360	28	18	228	329	336	338	319	192	179	280	352	351	188	180	168	196	352	353	352	352	358	352	351
23	358	16	15	4	357	352	352	296	353	352	354	259	323	339	333	353	348	332	344	352	332	357	335	236
24	302	302	300	306	329	294	254	208	157	333	174	205	222	230	194	175	318	305	305	341	346	339	338	342
25	19	24	21	23	20	41	21	17	140	143	157	165	173	205	193	209	173	187	166	235	335	356	327	337
26	35	7	17	24	29	36	31	21	93	141	161	179	216	212	238	275	250	260	293	343	6	43	145	208
27	190	224	259	292	310	310	310	347	277	180	184	203	203	198	207	18	25	38	199	230	223	220	238	240
28	108	31	59	36	23	26	21	33	88	147	166	183	212	222	64	58	43	67	97	356	196	230	259	24
29	39	20	26	19	15	39	63	13	46	184	184	174	186	258	356	316	50	23	36	61	23	3	3	48
30	35	24	22	22	24	5	349	346	290	201	199	194	192	205	197	247	244	244	243	236	242	219	1	352
31	360	7	215	359	30	51	40	38	118	155	159	173	130	355	345	346	4	354	350	351	5	12	7	4

* Indicates calibration of sensors
** Indicates invalid data

ENECOTECH INC.
SAROAD(V1.0) 02/01/96

HOURLY HORIZONTAL WIND DIRECTION STANDARD DEVIATION
DATA RECORDED IN AUGUST 1995
BLANDING - UTAH
UNITS ARE TENTHS OF A DEGREE

HOUR OF THE DAY

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG
1	363	92	167	64	86	79	151	130	439	371	311	372	401	339	202	516	282	153	414	284	94	91	163	51	234
2	76	144	77	83	147	90	196	315	224	316	327	279	321	281	183	171	132	196	117	97	319	80	69	51	179
3	170	132	107	146	733	211	249	383	344	145	317	213	495	215	290	267	442	351	92	624	247	162	339	151	284
4	202	162	718	137	69	417	230	310	365	276	255	470	236	282	303	319	189	219	206	123	55	69	63	132	242
5	89	44	94	171	125	242	218	175	200	293	526	545	492	426	449	397	287	183	101	198	256	74	163	165	246
6	88	185	174	287	320	153	307	204	209	249	253	383	481	378	525	504	538	334	675	107	102	51	22	33	273
7	43	318	286	376	188	109	300	405	262	225	291	362	283	289	486	453	426	599	126	401	74	128	235	24	279
8	37	99	203	79	95	130	107	509	180	183	227	314	439	495	520	588	323	242	172	130	295	381	95	51	246
9	97	417	183	501	171	134	177	250	129	216	258	276	290	455	314	271	151	172	216	410	358	198	73	72	241
10	92	87	59	87	88	104	85	370	315	281	264	316	319	284	270	241	241	163	132	411	505	377	270	459	243
11	136	294	304	83	52	96	117	365	162	286	216	186	304	326	200	238	230	215	124	98	316	323	446	223	223
12	125	125	311	78	53	59	85	468	158	157	279	269	346	276	198	193	191	428	168	177	95	183	212	171	200
13	114	175	94	446	189	116	343	242	307	315	472	533	458	395	121	169	123	190	151	120	186	117	558	571	271
14	165	156	446	287	200	492	739	461	447	611	432	489	367	301	290	265	211	774	516	171	114	201	125	125	349
15	361	191	200	205	150	185	157	138	443	544	719	406	148	244	248	187	202	107	128	50	39	55	118	87	221
16	119	95	110	345	76	46	82	182	517	421	300	429	462	437	420	356	303	140	360	313	711	586	336	107	302
17	127	109	210	254	638	615	253	680	129	532	199	367	285	256	227	515	377	187	98	146	55	72	54	50	268
18	66	76	95	532	107	96	94	101	159	216	189	207	213	239	246	261	279	141	156	106	44	125	182	95	168
19	99	119	191	592	215	161	139	373	231	197	260	327	607	583	647	388	273	233	96	184	184	151	367	336	290
20	89	57	71	51	70	43	114	177	516	184	183	278	287	311	403	379	136	122	535	363	175	186	17	113	203
21	93	721	505	718	534	304	62	459	[illegible]	308	376	320	521	531	661	346	6	308	488	508	152	104	95	275	351
22	148	354	384	743	114	44	54	401	644	428	775	23	17	434	207	214	584	6	4	4	68	71	115	92	247
23	195	170	266	252	231	0	261	494	9	8	722	651	372	233	156	11	402	351	271	153	154	155	607	553	278
24	127	109	210	254	638	615	253	680	129	532	199	367	285	256	227	515	377	187	98	146	55	72	54	50	268
25	127	169	75	69	109	171	99	83	516	204	152	230	346	314	235	238	256	240	135	173	238	72	324	674	219
26	284	117	119	53	107	89	87	78	487	265	291	310	387	266	310	319	232	186	182	297	79	491	270	166	228
27	117	448	151	124	400	376	236	326	521	419	400	306	406	332	250	382	111	134	565	126	90	78	64	139	271
28	262	529	292	223	96	97	65	100	276	365	476	470	334	398	405	116	241	485	398	683	249	150	367	175	302
29	281	215	181	127	113	164	333	181	275	391	455	428	502	327	251	664	146	385	207	155	76	85	129	535	275
30	87	96	93	78	115	104	81	355	220	394	352	482	402	272	333	486	481	484	407	103	83	202	307	49	253
31	103	117	700	408	160	220	67	107	347	175	109	415	739	367	338	216	151	166	144	146	147	65	78	71	232
AVERAGE	145	197	228	253	206	186	185	307	296	307	341	356	372	340	320	329	268	261	241	226	181	166	204	189	254

* Indicates calibration of sensors
** Indicates invalid data

ENECOTECH INC.
SAROAD(V1.0) 02/01/96

HOURLY AVERAGED WIND SPEED
DATA RECORDED IN SEPTEMBER 1995
BLANDING - UTAH
UNITS ARE TENTHS OF A METER PER SECOND

HOUR OF THE DAY

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG
1	56	52	41	37	38	28	32	50	30	31	34	38	43	54	77	49	49	65	58	55	43	44	30	40	45
2	41	38	53	51	36	33	22	27	26	31	29	40	54	57	78	73	65	56	65	58	27	34	49	46	45
3	30	17	23	35	18	41	32	15	31	49	63	73	36	99	35	47	48	63	59	17	13	19	19	27	38
4	20	22	10	24	36	20	16	18	14	29	41	30	54	53	56	49	58	58	42	43	49	44	48	49	37
5	47	59	51	42	51	21	19	22	19	24	20	23	26	30	31	33	35	36	35	17	25	38	36	41	33
6	39	43	35	34	11	25	14	27	21	29	25	24	24	34	30	29	22	33	10	17	39	43	44	53	29
7	45	30	29	30	29	37	22	20	34	40	33	36	40	33	30	26	28	20	22	24	42	41	43	49	33
8	47	38	34	34	40	21	24	27	38	52	41	36	29	33	32	34	29	27	47	30	50	38	34	51	36
9	48	28	25	16	33	29	21	40	67	56	48	46	46	41	48	63	83	41	33	27	36	44	43	48	42
10	45	34	40	37	39	28	25	24	27	29	40	45	43	51	51	43	54	43	19	15	29	35	35	26	36
11	37	35	31	42	44	36	24	22	31	37	47	55	53	79	63	56	52	33	59	38	10	17	28	46	41
12	39	35	20	30	33	34	30	21	50	54	44	49	48	84	85	79	72	95	73	50	59	33	31	25	49
13	34	27	25	18	28	44	20	22	25	29	27	25	37	81	100	104	86	74	54	53	53	41	31	13	44
14	32	27	25	24	30	14	10	13	20	20	24	25	41	40	47	48	51	40	30	30	55	39	45	42	32
15	22	18	22	26	25	27	22	23	20	15	18	32	60	51	47	46	44	49	49	52	53	56	43	48	36
16	38	43	38	36	49	49	32	21	12	17	32	32	31	34	34	35	30	39	34	85	55	55	56	41	39
17	38	39	37	18	19	13	10	37	66	18	36	30	33	44	38	27	39	48	31	38	57	54	58	57	37
18	57	63	57	18	34	53	53	52	45	42	56	60	54	44	53	52	45	52	43	50	54	31	28	43	47
19	38	46	33	20	24	27	18	13	28	32	28	25	24	27	25	29	32	22	20	13	38	41	24	27	27
20	35	38	43	30	37	41	33	16	22	41	48	36	36	44	39	51	104	84	31	13	35	28	27	34	39
21	27	29	34	28	23	22	24	15	25	21	27	27	23	32	35	34	43	46	39	25	31	42	45	37	31
22	36	17	22	11	29	33	27	19	13	17	26	28	27	37	41	43	41	34	29	55	37	48	35	32	31
23	34	30	25	25	19	27	18	23	33	42	42	37	38	41	38	35	37	41	74	98	80	60	23	18	39
24	38	39	37	18	19	13	10	37	66	18	36	30	33	44	38	27	39	48	31	38	57	54	58	57	37
25	35	28	46	35	29	25	30	27	19	61	64	54	45	47	68	54	44	57	64	113	86	77	34	25	49
26	21	28	33	29	32	27	32	24	21	31	28	33	33	44	55	44	58	55	62	56	41	29	22	45	37
27	70	39	35	22	16	10	10	14	16	16	28	32	36	36	48	72	50	38	36	37	41	34	39	35	34
28	12	15	19	19	26	32	34	28	22	17	22	29	36	37	31	57	31	24	22	18	55	35	24	29	28
29	24	25	27	32	33	27	26	29	[illegible]	22	24	21	26	36	79	30	33	36	34	33	37	40	40	25	32
30	19	28	23	24	23	30	30	17	22	17	20	17	25	34	28	33	30	29	31	29	24	25	25	41	26
AVERAGE	37	34	32	28	30	29	24	25	30	31	35	36	38	47	49	47	48	46	41	41	44	41	37	38	37

* Indicates calibration of sensors
** Indicates invalid data

ENECOTECH INC.
SAROAD(V1.0) 02/01/96

HOURLY AVERAGED WIND DIRECTION
DATA RECORDED IN SEPTEMBER 1995
BLANDING - UTAH
UNITS ARE DEGREES AZIMUTH

HOUR OF THE DAY

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	356	3	22	39	25	14	297	342	15	126	140	154	186	228	258	347	283	287	169	152	82	80	30	14
2	12	47	53	43	27	14	39	134	156	171	192	207	215	238	252	247	258	261	265	263	299	322	333	319
3	340	40	29	17	104	325	316	323	168	159	207	260	60	314	21	49	77	61	58	138	26	12	338	353
4	355	347	347	17	14	356	291	266	198	227	240	242	286	321	319	305	318	313	6	14	13	10	7	353
5	331	340	338	354	335	70	52	156	147	157	213	233	227	213	263	221	197	192	182	160	19	11	9	4
6	357	1	14	345	19	21	62	126	134	163	152	149	159	267	251	284	236	221	360	59	20	12	14	15
7	11	358	348	320	23	19	309	285	158	144	165	160	189	211	257	296	220	246	273	354	4	358	16	16
8	12	5	8	16	16	17	23	145	165	163	158	127	121	126	159	111	89	114	100	63	76	61	27	23
9	37	25	34	316	48	27	31	111	137	145	163	177	157	195	182	166	144	173	174	314	355	345	16	19
10	38	30	37	29	29	30	22	60	161	184	197	192	187	186	144	163	190	178	150	113	76	211	188	55
11	31	346	351	4	16	30	35	148	139	160	183	202	186	179	157	160	158	174	201	204	134	43	317	334
12	297	265	269	24	22	23	31	117	151	152	161	180	172	176	179	175	169	239	300	314	291	317	7	36
13	13	8	26	318	4	351	14	107	160	154	169	203	159	248	314	272	272	271	328	356	25	67	17	359
14	348	317	314	2	7	8	266	126	109	183	230	197	205	216	223	231	247	57	22	17	3	34	47	10
15	353	38	0	0	358	17	41	64	134	271	80	65	42	49	46	35	40	24	347	342	345	350	358	4
16	9	356	347	40	20	22	25	52	39	52	76	79	50	37	30	21	29	14	35	141	190	197	147	308
17	302	302	300	306	329	294	254	208	157	333	174	205	222	230	194	175	318	305	305	341	346	339	338	342
18	342	336	332	333	345	350	344	337	333	310	292	313	310	309	329	321	323	324	358	349	339	338	308	345
19	342	2	343	20	72	44	19	81	131	133	141	142	154	134	83	172	159	140	174	184	4	4	301	8
20	32	24	13	29	19	11	4	8	108	141	148	156	157	187	220	156	118	129	81	5	19	3	346	346
21	347	344	35	258	353	2	357	344	347	354	164	177	193	198	229	213	354	348	259	274	11	5	357	31
22	360	28	18	228	329	336	338	319	192	179	280	352	351	188	180	168	196	352	353	352	352	358	352	351
23	358	16	15	4	357	352	352	296	353	352	354	259	323	339	333	353	348	332	344	352	332	357	335	236
24	302	302	300	306	329	294	254	208	157	333	174	205	222	230	194	175	318	305	305	341	346	339	338	342
25	19	24	21	23	20	41	21	17	140	143	157	165	173	205	193	209	173	187	166	235	335	356	327	337
26	35	7	17	24	29	36	31	21	93	141	161	179	216	212	238	275	250	260	293	343	6	43	145	208
27	190	224	259	292	310	310	310	347	277	180	184	203	203	198	207	18	25	38	199	230	223	220	238	240
28	108	31	59	36	23	26	21	33	88	147	166	183	212	222	64	58	43	67	97	356	196	230	259	24
29	39	20	26	19	15	39	63	13	46	184	184	174	186	258	356	316	50	23	36	61	23	3	3	48
30	35	24	22	22	24	5	349	346	290	201	199	194	192	205	197	247	244	244	243	236	242	219	1	352

* Indicates calibration of sensors
** Indicates invalid data

ENECOTECH INC.
SAROAD(V1.0) 02/01/96

HOURLY HORIZONTAL WIND DIRECTION STANDARD DEVIATION
DATA RECORDED IN SEPTEMBER 1995
BLANDING - UTAH
UNITS ARE TENTHS OF A DEGREE

HOUR OF THE DAY

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG
1	363	92	167	64	86	79	15[illegible]	130	439	371	311	372	401	339	202	516	282	153	414	284	94	91	163	51	234
2	76	144	77	83	147	90	196	315	224	316	327	279	321	281	183	171	132	196	117	97	319	80	69	51	179
3	170	132	107	146	733	211	249	383	344	145	317	213	495	215	290	267	442	351	92	624	247	162	339	151	284
4	202	162	718	137	69	417	230	310	365	276	255	470	236	282	303	319	189	219	206	123	55	69	63	132	242
5	89	44	94	171	125	242	218	175	200	293	526	545	492	426	449	397	287	183	101	198	256	74	163	165	246
6	88	185	174	287	320	153	307	204	209	249	253	383	481	378	525	504	538	334	675	107	102	51	22	33	273
7	43	318	286	376	188	109	300	405	262	225	291	362	283	289	486	453	426	599	126	401	74	128	235	24	279
8	37	99	203	79	95	130	107	509	180	183	227	314	439	495	520	588	323	242	172	130	295	381	95	51	246
9	97	417	183	501	171	134	177	250	129	216	258	276	290	455	314	271	151	172	216	410	358	198	73	72	241
10	92	87	59	87	88	104	85	370	315	281	264	316	319	284	270	241	241	163	132	411	505	377	270	459	243
11	136	294	304	83	52	96	117	365	162	286	216	186	304	326	200	238	230	215	124	98	316	323	446	223	223
12	125	125	311	78	53	59	85	468	158	157	279	269	346	276	198	193	191	428	168	177	95	183	212	171	200
13	114	175	94	446	189	116	343	242	307	315	472	533	458	395	121	169	123	190	151	120	186	117	558	571	271
14	165	156	446	287	200	492	739	461	447	611	432	4[illegible]9	367	301	290	265	211	774	516	171	114	201	125	125	349
15	361	191	200	205	150	185	157	138	443	544	719	4[illegible]6	148	244	248	187	202	107	128	50	39	55	118	87	221
16	119	95	110	345	76	46	82	182	517	421	300	429	462	437	420	358	303	140	360	313	711	586	336	107	302
17	127	109	210	254	638	615	253	680	129	532	199	367	285	256	227	515	377	187	98	146	55	72	54	50	268
18	66	76	95	532	107	96	94	101	159	216	189	207	213	239	246	261	279	141	156	106	44	125	182	95	168
19	99	119	191	592	215	161	139	373	231	197	260	327	607	583	647	388	273	233	96	184	184	151	367	336	290
20	89	57	71	51	70	43	114	177	516	184	183	278	287	311	403	379	136	122	535	363	175	186	17	113	203
21	93	721	505	718	534	304	62	459	29	308	376	320	521	531	661	346	6	308	488	508	152	104	95	275	351
22	148	354	384	743	114	44	54	401	644	428	775	23	17	434	207	214	584	6	4	4	68	71	115	92	247
23	195	170	266	252	231	0	261	494	9	8	722	651	372	233	156	11	402	351	271	153	154	155	607	553	278
24	127	109	210	254	638	615	253	680	129	532	199	367	285	256	227	515	377	187	98	146	55	72	54	50	268
25	127	169	75	69	109	171	99	83	516	204	152	230	346	314	235	238	256	240	135	173	238	72	324	674	219
26	284	117	119	53	107	89	87	78	487	265	291	310	387	266	310	319	232	186	182	297	79	491	270	166	228
27	117	448	151	124	400	376	236	326	521	419	400	306	406	332	250	382	111	134	565	126	90	78	64	139	271
28	262	529	292	223	96	97	65	100	276	365	476	470	334	398	405	116	241	485	398	683	249	150	367	175	302
29	281	215	181	127	113	164	333	181	275	391	455	428	502	327	251	664	146	385	207	155	76	85	129	535	275
30	87	96	93	78	115	104	81	355	220	394	352	482	402	272	333	486	481	484	407	103	83	202	307	49	253
AVERAGE	146	200	213	248	208	185	189	313	295	311	349	354	360	339	319	332	272	264	245	229	182	170	208	193	255

* Indicates calibration of sensors
** Indicates invalid data

ENECOTECH INC.
SAROAD(V1.0) 02/01/96

HOURLY A[illegible]ERAGED WIND SPEED
DATA RECORDED IN OCTOBER 1995
BLANDING - UTAH
UNITS ARE TENTHS OF A M[illegible]TER PER SECOND

HOUR OF THE DAY

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG
1	56	52	41	37	38	28	32	50	30	31	34	38	43	54	77	49	49	65	58	55	43	44	30	40	45
2	41	38	53	51	36	33	22	27	26	31	29	40	54	57	78	73	65	56	65	58	27	34	49	46	45
3	30	17	23	35	18	41	32	15	31	49	63	73	36	99	35	47	48	63	59	17	13	19	19	27	38
4	20	22	10	24	36	20	16	18	14	29	41	30	54	53	56	[illegible]	58	58	42	[illegible]	49	44	48	49	37
5	47	59	51	42	51	21	19	22	19	24	20	23	26	30	31	33	35	36	35	17	25	38	36	41	33
6	39	43	35	34	11	25	14	27	21	29	25	24	24	34	30	29	22	33	10	17	39	43	44	53	29
7	45	30	29	[illegible]	29	37	22	20	[illegible]	40	33	36	40	33	30	26	28	20	22	24	42	41	43	49	33
8	47	38	34	34	40	21	24	27	[illegible]	52	41	36	29	33	32	34	29	27	47	30	50	38	34	51	36
9	48	28	25	16	33	29	21	40	[illegible]	56	48	46	46	41	48	63	83	41	33	27	36	44	43	48	42
10	45	34	40	37	39	28	25	24	27	29	40	45	43	51	51	43	54	43	19	15	29	35	35	26	36
11	37	35	31	42	44	36	24	22	31	37	47	55	53	79	63	56	52	33	59	38	10	17	28	46	41
12	39	35	20	30	33	34	30	21	50	54	44	49	48	84	85	79	72	95	73	50	59	33	31	25	49
13	34	27	25	18	28	44	20	22	25	29	27	25	37	81	100	104	86	74	54	53	53	41	31	13	44
14	32	27	25	24	30	14	10	13	20	20	24	25	41	40	47	48	51	40	30	30	55	39	45	42	32
15	22	18	22	26	25	27	22	23	20	15	18	32	60	51	47	46	44	49	49	52	53	56	43	48	36
16	38	43	38	36	49	49	32	21	12	17	32	32	31	34	34	35	30	39	34	85	55	55	56	41	39
17	38	39	37	18	19	13	10	37	66	18	36	30	33	44	38	27	39	48	31	38	57	54	58	57	37
18	57	63	57	18	34	53	53	52	45	42	56	60	54	44	53	52	45	52	43	50	54	31	28	43	47
19	38	46	33	20	24	[illegible]	18	13	28	32	28	25	24	27	25	29	32	22	20	13	38	41	24	27	27
20	35	38	43	30	37	41	33	16	22	41	48	36	36	44	39	51	104	84	31	13	35	28	27	34	39
21	27	29	34	28	23	22	24	15	25	21	27	27	23	32	35	34	43	46	39	25	31	42	45	37	31
22	36	17	22	11	29	33	27	19	13	17	26	28	27	37	41	43	41	34	29	55	37	48	35	32	31
23	34	30	25	25	19	27	18	23	33	42	42	37	38	41	38	35	37	41	74	98	80	60	23	18	39
24	38	39	37	18	19	13	10	37	66	18	36	30	33	44	38	27	39	48	31	38	57	54	58	57	37
25	35	28	46	35	29	25	30	27	19	61	64	54	45	47	68	54	44	57	64	113	86	77	34	25	49
26	21	28	33	29	32	27	32	24	21	31	28	33	33	44	55	44	58	55	62	56	41	29	22	45	37
27	70	39	35	22	16	10	10	14	16	16	28	32	36	36	48	72	50	38	36	37	41	34	39	35	34
28	12	15	19	19	26	32	34	28	22	17	22	29	36	37	31	57	31	24	22	18	55	35	24	29	28
29	24	25	27	32	33	27	26	29	30	22	24	21	26	36	79	30	33	36	34	33	37	40	40	25	32
30	19	28	23	24	23	30	30	17	22	17	20	17	25	34	28	33	30	29	31	29	24	25	25	41	26
31	42	37	18	22	12	13	20	19	19	25	37	22	33	52	54	69	75	78	73	60	39	55	58	55	41
AVERAGE	37	34	32	28	30	28	24	25	29	31	35	35	38	47	49	47	49	47	42	42	44	41	37	39	37

* Indicates calibration of sensors
** Indicates invalid data

ENECOTECH INC.
SAROAD(V1.0) 02/01/96

HOURLY AVERAGED WIND DIRECTION
DATA RECORDED IN OCTOBER 1995
BLANDING - UTAH
UNITS ARE DEGREES AZIMUTH

HOUR OF THE DAY

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	356	3	22	39	25	14	297	342	15	126	140	154	186	228	258	347	283	287	169	152	82	80	30	14
2	12	47	53	43	27	14	39	134	156	171	192	207	215	238	252	247	258	261	265	263	299	322	333	319
3	340	40	29	17	104	325	316	323	168	159	207	260	60	314	21	49	77	61	58	138	26	12	338	353
4	355	347	347	17	14	356	291	266	198	227	240	242	286	321	319	305	318	313	6	14	13	10	7	353
5	331	340	338	354	335	70	52	156	147	157	213	233	227	213	263	221	197	192	182	160	19	11	9	4
6	357	1	14	345	19	21	62	126	134	163	152	149	159	267	251	284	236	221	360	59	20	12	14	15
7	11	358	348	320	23	19	309	285	158	144	165	160	189	211	257	296	220	246	273	354	4	358	16	16
8	12	5	6	16	16	17	23	145	165	163	158	127	121	126	159	111	89	114	100	63	76	61	27	23
9	37	25	34	316	48	27	31	111	137	145	163	177	157	195	182	166	144	173	174	314	355	345	16	19
10	38	30	37	29	29	30	22	60	161	184	197	192	187	186	144	163	190	178	150	113	76	211	188	55
11	31	346	351	4	16	30	35	148	139	160	183	202	186	179	157	160	158	174	201	204	134	43	317	334
12	297	265	269	24	22	23	31	117	151	152	161	180	172	176	179	175	169	239	300	314	291	317	7	36
13	13	8	26	318	4	351	14	107	160	154	169	203	159	248	314	272	272	271	328	356	25	67	17	359
14	348	317	314	2	7	8	266	126	109	183	230	197	205	216	223	231	247	57	22	17	3	34	47	10
15	353	38	0	0	358	17	41	64	134	271	80	65	42	49	46	35	40	24	347	342	345	350	358	4
16	9	356	347	40	20	22	25	52	39	52	76	79	50	37	30	21	29	14	35	141	190	197	147	308
17	302	302	300	306	329	294	254	208	157	333	174	205	222	230	194	175	318	305	305	341	346	339	338	342
18	342	336	332	333	345	350	344	337	333	310	292	313	310	309	329	321	323	324	358	349	339	338	308	345
19	342	2	343	20	72	44	19	81	131	133	141	142	154	134	83	172	159	140	174	184	4	4	301	8
20	32	24	13	29	19	11	4	8	108	141	148	156	157	187	220	156	118	129	81	5	19	3	346	346
21	347	344	35	258	353	2	357	344	347	354	164	177	193	198	229	213	354	348	259	274	11	5	357	31
22	360	28	18	228	329	336	338	319	192	179	280	352	351	188	180	168	196	352	353	352	352	358	352	351
23	358	16	15	4	357	352	352	296	353	352	354	259	323	339	333	353	348	332	344	352	332	357	335	236
24	302	302	300	306	329	294	254	208	157	333	174	205	222	230	194	175	318	305	305	341	346	339	338	342
25	19	24	21	23	20	41	21	17	140	143	157	165	173	205	193	209	173	187	166	235	335	356	327	337
26	35	7	17	24	29	36	31	21	93	141	161	179	216	212	238	275	250	260	293	343	6	43	145	208
27	190	224	259	292	310	310	310	347	277	180	184	203	203	198	207	18	25	38	199	230	223	220	238	240
28	108	31	59	36	23	26	21	33	88	147	166	183	212	222	64	58	43	67	97	356	196	230	259	24
29	39	20	26	19	15	39	63	13	46	184	184	174	186	258	356	316	50	23	36	61	23	3	3	48
30	35	24	22	22	24	5	349	346	290	201	199	194	192	205	197	247	244	244	243	236	242	219	1	352
31	360	7	215	359	30	51	40	38	118	155	159	173	130	355	345	346	4	354	350	351	5	12	7	4

* Indicates calibration of sensors
** Indicates invalid data

ENECOTECH INC.
SAROAD(V1.0) 02/01/96

HOURLY HORIZONTAL WIND DIRECTION STANDARD DEVIATION
DATA RECORDED IN OCTOBER 1995
BLANDING - UTAH
UNITS ARE TENTHS OF A DEGREE

HOUR OF THE DAY

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG
1	363	92	167	64	86	79	151	130	439	371	311	372	401	339	202	516	282	153	414	284	94	91	163	51	234
2	76	144	77	83	147	90	196	315	224	316	327	279	321	281	183	171	132	196	117	97	319	80	69	51	179
3	170	132	107	146	733	211	249	383	344	145	317	213	495	215	290	267	442	351	92	624	247	162	339	151	284
4	202	162	718	137	69	417	230	310	365	276	255	470	236	282	303	319	189	219	206	123	55	69	63	132	242
5	89	44	94	171	125	242	218	175	200	293	526	545	492	426	449	397	287	183	101	198	256	74	163	165	246
6	88	185	174	287	320	153	307	204	209	249	253	383	481	378	525	504	538	334	675	107	102	51	22	33	273
7	43	318	286	376	188	109	300	405	262	225	291	362	283	289	486	453	426	599	126	401	74	128	235	24	279
8	37	99	203	79	95	130	107	509	180	183	227	314	439	495	520	588	323	242	172	130	295	381	95	51	246
9	97	417	183	501	171	134	177	250	129	216	258	276	290	455	314	271	151	172	216	410	358	198	73	72	241
10	92	87	59	87	88	104	85	370	315	281	264	316	319	284	270	241	241	163	132	411	505	377	270	459	243
11	136	294	304	83	52	96	117	365	162	286	216	186	304	326	200	238	230	215	124	98	316	323	446	223	223
12	125	125	311	78	53	59	85	468	158	157	279	269	346	276	198	193	191	428	168	177	95	183	212	171	200
13	114	175	94	446	189	116	343	242	307	315	472	533	458	395	121	169	123	190	151	120	186	117	558	571	271
14	165	156	446	287	200	492	739	461	447	611	432	489	367	301	290	265	211	774	516	171	114	201	125	125	349
15	361	191	200	205	150	185	157	138	443	544	719	406	148	244	248	187	202	107	128	50	39	55	118	87	221
16	119	95	110	345	76	46	82	182	517	421	300	429	462	437	420	358	303	140	360	313	711	586	336	107	302
17	127	109	210	254	638	615	253	680	129	532	199	367	285	256	227	515	377	187	98	146	55	72	54	50	268
18	66	76	95	532	107	96	94	101	159	216	189	207	213	239	246	261	279	141	156	106	44	125	182	95	168
19	99	119	191	592	215	161	139	373	231	197	260	327	607	583	647	388	273	233	96	184	184	151	367	336	290
20	89	57	71	51	70	43	114	177	516	184	183	278	287	311	403	379	136	122	535	363	175	186	17	113	203
21	93	721	505	718	534	304	62	459	29	308	376	320	521	531	661	346	6	308	488	508	152	104	95	275	351
22	148	354	384	743	114	44	54	401	644	428	775	23	17	434	207	214	584	6	4	4	68	71	115	92	247
23	195	170	266	252	231	0	261	494	9	8	722	651	372	233	156	11	402	351	271	153	154	155	607	553	278
24	127	109	210	254	638	615	253	680	129	532	199	367	285	256	227	515	377	187	98	146	55	72	54	50	268
25	127	169	75	69	109	171	99	83	516	204	152	230	346	314	235	238	256	240	135	173	238	72	324	674	219
26	284	117	119	53	107	89	87	78	487	265	291	310	387	266	310	319	232	186	182	297	79	491	270	166	228
27	117	448	151	124	400	376	236	326	521	419	400	306	406	332	250	382	111	134	565	126	90	78	64	139	271
28	262	529	292	223	96	97	65	100	276	365	476	470	334	398	405	116	241	485	398	683	249	150	367	175	302
29	281	215	181	127	113	164	333	181	275	391	455	428	502	327	251	664	146	385	207	155	76	85	129	535	275
30	87	96	93	78	115	104	81	355	220	394	352	482	402	272	333	486	481	484	407	[illegible]	83	202	307	49	253
31	103	117	700	408	160	220	67	107	347	175	109	415	739	367	338	216	151	166	144	146	147	65	78	71	232
AVERAGE	145	197	228	253	206	186	185	307	296	307	341	356	372	340	320	329	268	261	241	226	181	166	204	189	254

* Indicates calibration of sensors
** Indicates invalid data

ENECOTECH INC.
SAROAD(V1.0) 02/01/96

HOURLY HORIZONTAL WIND DIRECTION STANDARD DEVIATION
DATA RECORDED IN OCTOBER 1995
BLANDING - [illegible]
UNITS ARE TENTHS OF A DEGREE

HOUR OF THE DAY

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG
1	363	92	167	64	86	79	151	130	439	371	311	372	401	339	202	516	282	153	414	284	94	91	163	51	234
2	76	144	77	83	147	90	196	315	224	316	327	279	321	281	183	171	132	196	117	97	319	80	69	51	179
3	170	132	107	146	733	211	249	383	344	145	317	213	495	215	290	267	442	351	92	624	247	162	339	151	284
4	202	162	718	137	69	417	230	310	365	276	255	470	236	282	303	319	189	219	206	123	55	69	63	132	242
5	89	44	94	171	125	242	218	175	200	293	526	545	492	426	449	397	287	183	101	198	256	74	163	165	246
6	88	185	174	287	320	153	307	204	209	249	253	383	481	378	525	504	538	334	675	107	102	51	22	33	273
7	43	318	286	376	188	109	300	405	262	225	291	362	283	289	486	453	426	599	126	401	74	128	235	24	279
8	37	99	203	79	95	130	107	509	180	183	227	314	439	495	520	588	323	242	172	130	295	381	95	51	246
9	97	417	183	501	171	134	177	250	129	216	258	276	290	455	314	271	151	172	216	410	358	198	73	72	241
10	92	87	59	87	88	104	85	370	315	281	264	316	319	284	270	241	241	163	132	411	505	377	270	459	243
11	136	294	304	83	52	96	117	365	162	286	216	186	304	326	200	238	230	215	124	98	316	323	446	223	223
12	125	125	311	78	53	59	85	468	158	157	279	269	346	276	198	193	191	428	168	177	95	183	212	171	200
13	114	175	94	446	189	116	343	242	307	315	472	533	458	395	121	169	123	190	151	120	186	117	558	571	271
14	165	156	446	287	200	492	739	461	447	611	432	489	367	301	290	265	211	774	516	171	114	201	125	125	349
15	361	191	200	205	150	185	157	138	443	544	719	406	148	244	248	187	202	107	128	50	39	55	118	87	221
16	119	95	110	345	76	46	82	182	517	421	300	429	462	437	420	358	303	140	360	313	711	586	336	107	302
17	127	109	210	254	638	615	253	680	129	532	199	367	285	256	227	515	377	187	98	146	55	72	54	50	268
18	66	76	95	532	107	96	94	101	159	216	189	207	213	239	246	261	279	141	156	106	44	125	182	95	168
19	99	119	191	592	215	161	139	373	231	197	260	327	607	583	647	388	273	233	96	184	184	151	367	336	290
20	89	57	71	51	70	43	114	177	516	184	183	278	287	311	403	379	136	122	535	363	175	186	17	113	203
21	93	721	505	718	534	304	62	459	29	308	376	320	521	531	661	346	6	308	488	508	152	104	95	275	351
22	148	354	384	743	114	44	54	401	644	428	775	23	17	434	207	214	584	6	4	4	68	71	115	92	247
23	195	170	266	252	231	0	261	494	9	8	722	651	372	233	156	11	402	351	271	153	154	155	607	553	278
24	127	109	210	254	638	615	253	680	129	532	199	367	285	256	227	515	377	187	98	146	55	72	54	50	268
25	127	169	75	69	109	171	99	83	516	204	152	230	346	314	235	238	256	240	135	173	238	72	324	674	219
26	284	117	119	53	107	89	87	78	487	265	291	310	387	266	310	319	232	186	182	297	79	491	270	166	228
27	117	448	151	124	400	376	236	326	521	419	400	306	406	332	250	382	111	134	565	126	90	78	64	139	271
28	262	529	292	223	96	97	65	100	276	365	476	470	334	398	405	116	241	485	398	683	249	150	367	175	302
29	281	215	181	127	113	164	333	181	275	391	455	428	502	327	251	664	146	385	207	155	76	85	129	535	275
30	87	96	93	78	115	104	81	355	220	394	352	482	402	272	333	486	481	484	407	103	83	202	307	49	253
31	103	117	700	408	160	220	67	107	347	175	109	415	739	367	338	216	151	166	144	146	147	65	78	71	232
AVERAGE	145	197	228	253	206	186	185	307	296	307	341	356	372	340	320	329	268	261	241	226	181	166	204	189	254

* Indicates calibration of sensors
** Indicates invalid data

ENECOTECH INC.
SAROAD(V1.0) 02/01/96

HOURLY AVERAGED WIND SPEED
DATA RECORDED IN NOVEMBER 1995
BLANDING - UTAH
UNITS ARE TENTHS OF A METER PER SECOND

HOUR OF THE DAY

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG
1	56	52	41	37	38	28	32	50	30	31	34	38	43	54	77	49	49	65	58	55	43	44	30	40	45
2	41	38	53	51	36	33	22	27	26	31	29	40	54	57	78	73	65	56	65	58	27	34	49	46	45
3	30	17	23	35	18	41	32	15	31	49	63	73	36	99	35	47	48	63	59	17	13	19	19	27	38
4	20	22	10	24	36	20	16	18	14	29	41	30	54	53	56	49	58	58	42	43	49	44	48	49	37
5	47	59	51	42	51	21	19	22	19	24	20	23	26	30	31	33	35	36	35	17	25	38	36	41	33
6	39	43	35	34	11	25	14	27	21	29	25	24	24	34	30	29	22	33	10	17	39	43	44	53	29
7	45	30	29	30	29	37	22	20	34	40	33	36	40	33	30	26	28	20	22	24	42	41	43	49	33
8	47	38	34	34	40	21	24	27	38	52	41	36	29	33	32	34	29	27	47	30	50	38	34	51	36
9	48	28	25	16	33	29	21	40	67	56	48	46	46	41	48	63	83	41	33	27	36	44	43	48	42
10	45	34	40	37	39	28	25	24	27	29	40	45	43	51	51	43	54	43	19	15	29	35	35	26	36
11	37	35	31	42	44	36	24	22	31	37	47	55	53	79	63	56	52	33	59	38	10	17	28	46	41
12	39	35	20	30	33	34	30	21	50	54	44	49	48	84	85	79	72	95	73	50	59	33	31	25	49
13	34	27	25	18	28	44	20	22	25	29	27	25	37	81	100	104	86	74	54	53	53	41	31	13	44
14	32	27	25	24	30	14	10	13	20	20	24	25	41	40	47	48	51	40	30	30	55	39	45	42	32
15	22	18	22	26	25	27	22	23	20	15	18	32	60	51	47	46	44	49	49	52	53	56	43	48	36
16	38	43	38	36	49	49	32	21	12	17	32	32	31	34	34	35	30	39	34	85	55	55	56	41	39
17	38	39	37	18	19	13	10	37	66	18	36	30	33	44	38	27	39	48	31	38	57	54	58	57	37
18	57	63	57	18	34	53	53	52	45	42	56	60	54	44	53	52	45	52	43	50	54	31	28	43	47
19	38	46	33	20	24	27	18	13	28	32	28	25	24	27	25	29	32	22	20	13	38	41	24	27	27
20	35	38	43	30	37	41	33	16	22	41	48	36	36	44	39	51	104	84	31	13	35	28	27	34	39
21	27	29	34	28	23	22	24	15	25	21	27	27	23	32	35	34	43	46	39	25	31	42	45	37	31
22	36	17	22	[illegible]	29	33	27	19	13	17	26	28	27	37	41	43	41	34	29	55	37	48	35	32	31
23	34	30	25	25	19	27	18	23	33	42	42	37	38	41	38	35	37	41	74	98	80	60	23	18	39
24	38	39	37	18	19	13	10	37	66	18	36	30	33	44	38	27	39	48	31	38	57	54	58	57	37
25	35	28	46	35	29	25	30	27	19	61	64	54	45	47	68	54	44	57	64	113	86	77	34	25	49
26	21	28	33	29	32	27	32	24	21	31	28	33	33	44	55	44	58	55	62	56	41	29	22	45	37
27	70	39	35	22	16	10	10	14	16	16	28	32	36	36	48	72	50	38	36	37	41	34	39	35	34
28	12	15	19	19	26	32	34	28	22	17	22	29	36	37	31	57	31	24	22	18	55	35	24	29	28
29	24	25	27	32	33	27	26	29	30	22	24	21	26	36	79	30	33	36	34	33	37	40	40	25	32
30	19	28	23	24	23	30	30	17	22	17	20	17	25	34	28	33	30	29	31	29	24	25	25	41	26
AVERAGE	37	34	32	28	30	29	24	25	30	31	35	36	38	47	49	47	48	46	41	41	44	41	37	38	37

* Indicates calibration of sensors
** Indicates invalid data

ENECOTECH INC.
SAROAD(V1.0) 02/01/96

HOURLY AVERAGED WIND DIRECTION
DATA RECORDED IN NOVEMBER 1995
BLANDING - UTAH
UNITS ARE DEGREES AZIMUTH

HOUR OF THE DAY

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	356	3	22	39	25	14	297	342	15	126	140	154	186	228	258	347	283	287	169	152	82	80	30	14
2	12	47	53	43	27	14	39	134	156	171	192	207	215	238	252	247	258	261	265	263	299	322	333	319
3	340	40	29	17	104	325	316	323	168	159	207	260	60	314	21	49	77	61	58	138	26	12	338	353
4	355	347	347	17	14	356	291	266	198	227	240	242	286	321	319	305	318	313	6	14	13	10	7	353
5	331	340	338	354	335	70	52	156	147	157	213	233	227	213	263	221	197	192	182	160	19	11	9	4
6	357	1	14	345	19	21	62	126	134	163	152	149	159	267	251	284	236	221	360	59	20	12	14	15
7	11	358	348	320	23	19	309	285	158	144	165	160	189	211	257	296	220	246	273	354	4	358	16	16
8	12	5	8	16	16	17	23	145	165	163	158	127	121	126	159	111	89	114	100	63	76	61	27	23
9	37	25	34	316	48	27	31	111	137	145	163	177	157	195	182	[illegible]	144	173	174	314	355	345	16	19
10	38	30	37	29	29	30	22	60	161	184	197	192	187	186	144	163	190	178	150	113	76	211	188	55
11	31	346	351	4	16	30	35	148	139	160	183	202	186	179	157	160	158	174	201	204	[illegible]	43	317	334
12	297	265	269	24	22	23	31	117	151	152	161	180	172	176	179	175	169	[illegible]	300	314	291	317	7	36
13	13	8	26	318	4	351	14	107	160	154	169	203	159	248	314	272	272	271		356	25	67	17	359
14	348	317	314	2	7	8	266	126	109	183	230	197	205	216	223	231	247	57		17	3	34	47	10
15	353	38	0	0	358	17	41	64	134	271	80	65	42	49	46	35	40	24		342	345	350	358	4
16	9	356	347	40	20	22	25	52	39	52	76	79	50	37	30	21	29	14		141	190	197	147	308
17	302	302	300	306	329	294	254	208	157	333	174	205	222	230	194	175	318	305	[illegible]	341	346	339	338	342
18	342	336	332	333	345	350	344	337	333	310	292	313	310	309	329	321	323	324	358	349	339	338	308	345
19	342	2	343	20	72	44	19	81	131	133	141	142	154	134	83	172	159	140	174	184	4	4	301	8
20	32	24	13	29	19	11	4	8	108	141	148	156	157	187	220	156	118	129	81	5	19	3	346	346
21	347	344	35	258	353	2	357	344	347	354	164	177	193	198	229	213	354	348	259	274	11	5	357	31
22	360	28	18	228	329	336	338	319	192	179	280	352	351	188	180	168	196	352	353	352	352	358	352	351
23	358	16	15	4	357	352	352	296	353	352	354	259	323	339	333	353	348	332	344	352	332	357	335	236
24	302	302	300	306	329	294	254	208	157	333	174	205	222	230	194	175	318	305	305	341	346	339	338	342
25	19	24	21	23	20	41	21	17	140	143	157	165	173	205	193	209	173	187	166	235	335	356	327	337
26	35	7	17	24	29	36	31	21	93	141	161	179	216	212	238	275	250	260	293	343	6	43	145	208
27	190	224	259	292	310	310	310	347	277	180	184	203	203	198	207	18	25	38	199	230	223	220	238	240
28	108	31	59	36	23	26	21	33	88	147	166	183	212	222	64	58	43	67	97	356	156	230	259	24
29	39	20	26	19	15	39	63	13	46	184	184	174	186	258	356	[illegible]	50	23	36	61	23	3	3	48
30	35	24	22	22	24	5	349	346	290	201	199	194	192	205	197	247	244	244	243	236	242	219	1	352

* Indicates calibration of sensors
** Indicates invalid data

ENECOTECH INC.
SAROAD(V1.0) 02/01/96

HOURLY HORIZONTAL WIND DIRECTION STANDARD DEVIATION
DATA RECORDED IN NOVEMBER 1995
BLANDING - UTAH
UNITS ARE TENTHS OF A DEGREE

HOUR OF THE DAY

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG
1	363	92	167	64	86	79	151	130	439	371	311	372	401	339	202	516	282	153	414	284	94	91	163	51	234
2	76	144	77	83	147	90	196	315	224	316	327	279	321	281	183	171	132	196	117	97	319	80	69	51	179
3	170	132	107	146	733	211	249	383	344	145	317	213	495	215	290	267	442	351	92	624	247	162	339	151	284
4	202	162	718	137	69	417	230	310	365	276	255	470	236	282	303	319	189	219	206	123	55	69	63	132	242
5	89	44	94	171	125	242	218	175	200	293	526	545	492	426	449	397	287	183	101	198	256	74	163	165	246
6	88	185	174	287	320	153	307	204	209	249	253	383	481	378	525	504	538	334	675	107	102	51	22	33	273
7	43	318	286	376	188	105	300	405	262	225	291	362	283	289	486	453	426	599	126	401	74	128	235	24	279
8	37	99	203	79	95	130	107	509	180	183	227	314	439	495	520	588	323	242	172	130	295	381	95	51	246
9	97	417	183	501	171	134	177	250	129	216	258	276	290	455	314	271	151	172	216	410	358	198	73	72	241
10	92	87	59	87	88	104	85	370	315	281	264	316	319	284	270	241	241	163	132	411	505	377	270	459	243
11	136	294	304	83	52	96	117	365	162	286	216	186	304	326	200	238	230	215	124	98	316	323	446	223	223
12	125	125	311	78	53	59	85	468	158	157	279	269	346	276	198	193	191	428	168	177	95	183	212	171	200
13	114	175	94	446	189	116	343	242	307	315	472	533	458	395	121	169	123	190	151	120	186	117	558	571	271
14	165	156	446	287	200	492	739	461	447	611	432	489	367	301	290	265	211	774	516	171	114	201	125	125	349
15	361	191	200	205	150	185	157	138	443	544	719	406	148	244	248	187	202	107	128	50	39	55	118	87	221
16	119	95	110	345	76	46	82	182	517	421	300	429	462	437	420	358	303	140	360	313	711	586	336	107	302
17	127	109	210	254	638	615	253	680	129	532	199	367	285	256	227	515	377	187	98	146	55	72	54	50	268
18	66	76	95	532	107	96	94	101	159	216	189	207	213	239	246	261	279	141	156	106	44	125	182	95	168
19	99	119	191	592	215	161	139	373	231	197	260	327	607	583	647	388	273	233	96	184	184	151	367	336	290
20	89	57	71	51	70	43	114	177	516	184	183	278	287	311	403	379	136	122	535	363	175	186	17	113	203
21	93	721	505	718	534	304	62	459	29	308	376	320	521	531	661	346	6	308	488	508	152	104	95	275	351
22	148	354	384	743	114	44	54	401	644	428	775	23	17	434	207	214	584	6	14	4	68	71	115	92	247
23	195	170	266	252	231	10	261	494	9	8	722	651	372	233	156	11	402	351	271	153	154	155	607	553	278
24	127	109	210	254	638	615	253	680	129	532	199	367	285	256	227	515	377	187	98	146	55	72	54	50	268
25	127	169	75	69	109	171	99	83	516	204	152	230	346	314	235	238	256	240	135	173	238	72	324	674	219
26	284	117	119	53	107	89	87	78	487	265	291	310	387	266	310	319	232	186	182	297	79	491	270	166	228
27	117	448	151	124	400	376	236	326	521	419	400	306	406	332	250	382	111	134	565	126	90	78	64	139	271
28	262	529	292	223	96	97	65	100	276	365	476	470	334	398	405	116	241	485	398	683	249	150	367	175	302
29	281	215	181	127	113	164	[illegible]	181	275	391	455	428	502	327	251	664	146	385	207	155	76	85	129	535	275
30	87	96	93	78	115	104	81	355	220	394	352	482	402	272	333	486	481	484	407	103	83	202	307	49	253
AVERAGE	146	200	213	248	208	185	189	313	295	311	349	354	360	339	319	332	272	264	245	229	182	170	208	193	255

* Indicates calibration of sensors
** Indicates invalid data

ENECOTECH INC.
SAROAD(V1.0) 02/01/96

HOURLY AVERAGED WIND SPEED
DATA RECORDED IN DECEMBER 1995
BLANDING - UTAH
UNITS ARE TENTHS OF A METER PER SECOND

HOUR OF THE DAY

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG
1	56	52	41	37	38	28	32	50	30	31	34	38	43	54	77	49	49	65	58	55	43	44	30	40	45
2	41	38	53	51	36	33	22	27	26	31	29	40	54	57	78	73	65	56	65	58	27	34	49	46	45
3	30	17	23	35	18	41	32	15	31	49	63	73	36	99	35	47	48	63	59	17	13	19	19	27	38
4	20	22	10	24	36	20	16	18	14	29	41	30	54	53	56	49	58	58	42	43	49	44	48	49	37
5	47	59	51	42	51	21	19	22	19	24	20	23	26	30	31	33	35	36	35	17	25	38	36	41	33
6	39	43	35	34	11	25	14	27	21	29	25	24	24	34	30	29	22	33	10	17	39	43	44	53	29
7	45	30	29	30	29	37	22	20	34	40	33	36	40	33	30	26	28	20	22	24	42	41	43	49	33
8	47	38	34	34	40	21	24	27	38	52	41	36	29	33	32	34	29	27	47	30	50	38	34	51	36
9	48	28	25	16	33	29	21	40	67	56	48	46	46	41	48	63	83	41	33	27	36	44	43	48	42
10	45	34	40	37	39	28	25	24	27	29	40	45	43	51	51	43	54	43	19	15	29	35	35	26	36
11	37	35	31	42	44	36	24	22	31	37	47	55	53	79	63	56	52	33	59	38	10	17	28	46	41
12	39	35	20	30	33	34	30	21	50	54	44	49	48	84	85	79	72	95	73	50	59	33	31	25	49
13	34	27	25	18	28	44	20	22	25	29	27	25	37	81	100	104	86	74	54	53	53	41	31	13	44
14	32	27	25	24	30	14	10	13	20	20	24	25	41	40	47	48	51	40	30	30	55	39	45	42	32
15	22	18	22	26	25	27	22	23	20	15	18	32	60	51	47	46	44	49	49	52	53	56	43	48	36
16	38	43	38	36	49	49	32	21	12	17	32	32	31	34	34	35	30	39	34	85	55	55	56	41	39
17	38	39	37	18	19	13	10	37	66	18	36	30	33	44	38	27	39	48	31	38	57	54	58	57	37
18	57	63	57	18	34	53	53	52	45	42	56	60	54	44	53	52	45	52	43	50	54	31	28	43	47
19	38	46	33	20	24	27	18	13	28	32	28	25	24	27	25	29	32	22	20	13	38	41	24	27	27
20	35	38	43	30	37	41	33	16	22	41	48	36	36	44	39	51	104	84	31	13	35	28	27	34	39
21	27	29	34	28	23	22	24	15	25	21	27	27	23	32	35	34	43	46	39	25	31	42	45	37	31
22	36	17	22	11	29	33	27	19	13	17	26	28	27	37	41	43	41	34	29	55	37	48	3[illegible]	32	31
23	34	30	25	25	19	27	18	23	33	42	42	37	38	41	38	35	37	41	74	98	80	60	23	18	39
24	38	39	37	18	19	13	10	37	66	18	36	30	33	44	38	27	39	48	31	38	57	54	58	57	37
25	35	28	46	35	29	25	30	27	19	61	64	54	45	47	68	54	44	57	64	113	86	77	34	25	49
26	21	28	33	29	32	27	32	24	21	31	28	33	33	44	55	44	58	55	62	56	41	29	22	45	37
27	70	39	35	22	16	10	10	14	16	16	28	32	36	36	48	72	50	38	36	37	41	34	39	35	34
28	12	15	19	19	26	32	34	28	22	17	22	29	36	37	31	57	31	24	22	18	55	35	24	29	28
29	24	25	27	32	33	27	26	29	30	22	24	21	26	36	79	30	33	36	34	33	37	40	40	25	32
30	19	28	23	24	23	30	30	17	22	17	20	17	25	34	28	33	30	29	31	29	24	25	25	41	26
31	42	37	18	22	12	13	20	19	19	25	37	22	33	52	54	69	75	78	73	60	39	55	58	55	41
AVERAGE	37	34	32	28	30	28	24	25	29	31	35	35	38	47	49	47	49	47	42	42	44	41	37	39	37

* Indicates calibration of sensors
** Indicates invalid data

ENECOTECH INC.
SAROAD(V1.0) 02/01/96

HOURLY AVERAGED WIND DIRECTION
DATA RECORDED IN DECEMBER 1995
BLANDING - UTAH
UNITS ARE DEGREES AZIMUTH

HOUR OF THE DAY

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	356	3	22	39	25	14	297	342	15	126	140	154	186	228	258	347	283	287	169	152	82	80	30	14
2	12	47	53	43	27	14	39	134	156	171	192	207	215	238	252	247	258	261	265	263	299	322	333	319
3	340	40	29	17	104	325	316	323	168	159	207	260	60	314	21	49	77	61	58	138	26	12	338	353
4	355	347	347	17	14	356	291	266	198	227	240	242	286	321	319	305	318	313	6	14	13	10	7	353
5	331	340	338	354	335	70	52	156	147	157	213	233	227	213	263	221	197	192	182	160	19	11	9	4
6	357	1	14	345	19	21	62	126	134	163	152	149	159	267	251	284	236	221	360	59	20	12	14	15
7	11	358	348	320	23	19	309	285	158	144	165	160	189	211	257	296	220	246	273	354	4	358	16	16
8	12	5	8	16	16	17	23	145	165	163	158	127	121	126	159	111	89	114	100	63	76	61	27	23
9	37	25	34	316	48	27	31	111	137	145	163	177	157	195	182	166	144	173	174	314	355	345	16	19
10	38	30	37	29	29	30	22	60	161	184	197	192	187	186	144	163	190	178	150	113	76	211	188	55
11	31	346	351	4	16	30	35	148	139	160	183	202	186	179	157	160	158	174	201	204	134	43	317	334
12	297	265	269	24	22	23	31	117	151	152	161	180	172	176	179	175	169	239	300	314	291	317	7	36
13	13	8	26	318	4	351	14	107	160	154	169	203	159	248	314	272	272	271	328	356	25	67	17	359
14	348	317	314	2	7	8	266	126	109	183	230	197	205	216	223	231	247	57	22	17	3	34	47	10
15	353	38	0	0	[illegible]	17	41	64	134	271	80	65	42	49	46	35	40	24	347	342	345	350	358	4
16	9	356	347	40	20	22	25	52	39	52	76	79	50	37	30	21	29	14	35	141	190	197	147	308
17	302	302	300	306	329	294	254	208	157	333	174	205	222	230	194	175	318	305	305	341	346	339	338	342
18	342	336	332	333	345	350	344	337	333	310	292	313	310	309	329	321	323	324	358	349	339	338	308	345
19	342	2	343	20	72	44	19	81	131	133	141	142	154	134	83	172	159	140	174	184	4	4	301	8
20	32	24	13	29	19	11	4	8	108	141	148	156	157	187	220	156	118	129	81	5	19	3	346	346
21	347	344	35	258	353	2	357	344	347	354	164	177	193	198	229	213	354	348	259	274	11	5	357	31
22	360	28	18	228	329	336	338	319	192	179	280	352	351	188	180	168	196	352	353	352	352	358	352	351
23	358	16	15	4	357	352	352	296	353	352	354	259	323	339	333	353	348	332	344	352	332	357	335	236
24	302	302	300	306	329	294	254	208	157	333	174	205	222	230	194	175	318	305	305	341	346	339	338	342
25	19	24	21	23	20	41	21	17	140	143	157	165	173	205	193	209	173	187	166	235	335	356	327	337
26	35	7	17	24	29	36	31	21	93	141	161	179	216	212	238	275	250	260	293	343	6	43	145	208
27	190	224	259	292	310	310	310	347	277	180	184	203	203	198	207	18	25	38	199	230	223	220	238	240
28	108	31	59	36	23	26	21	33	88	147	166	183	212	222	64	58	43	67	97	356	196	230	259	24
29	39	20	26	19	15	39	63	13	46	184	184	174	186	258	356	316	50	23	36	61	23	3	3	48
30	35	24	22	22	24	5	349	346	290	201	199	194	192	205	197	247	244	244	243	236	242	219	1	352
31	360	7	215	359	30	51	40	38	118	155	159	173	130	355	345	346	4	354	350	351	5	12	7	4

* Indicates calibration of sensors
** Indicates invalid data

ENECOTECH INC.
SAROAD(V1.0) 02/01/96

HOURLY HORIZONTAL WIND DIRECTION STANDARD DEVIATION
DATA RECORDED IN DECEMBER 1995
BLANDING - UTAH
UNITS ARE TENTHS OF A DEGREE

HOUR OF THE DAY

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG
1	363	92	167	64	86	79	151	130	439	371	311	372	401	339	202	516	282	153	414	284	94	91	163	51	234
2	76	144	77	83	147	90	196	315	224	316	327	279	321	281	183	171	132	196	117	97	319	80	69	51	179
3	170	132	107	146	733	211	249	383	344	145	317	213	495	215	290	267	442	351	92	624	247	162	339	151	284
4	202	162	718	137	69	417	230	310	365	276	255	470	236	282	303	319	189	219	206	123	55	69	63	132	242
5	89	44	94	171	125	242	218	175	200	293	526	545	492	426	449	397	287	183	101	196	256	74	163	165	246
6	88	185	174	287	320	153	307	204	209	249	253	383	481	378	525	504	538	334	675	107	102	51	22	33	273
7	43	318	286	376	188	109	300	405	262	225	291	362	283	289	486	453	426	599	126	401	74	128	235	24	279
8	37	99	203	79	95	130	107	509	180	183	227	314	439	495	520	588	323	242	172	130	295	381	95	51	246
9	97	417	183	501	171	134	177	250	129	216	258	276	290	455	314	271	151	172	216	410	358	198	73	72	241
10	92	87	59	87	88	104	85	370	315	281	264	316	319	284	270	241	241	163	132	411	505	377	270	459	243
11	136	294	304	83	52	96	117	365	162	286	216	186	304	326	200	238	230	215	124	98	316	323	446	223	223
12	125	125	311	78	53	59	85	468	158	157	279	269	346	276	198	193	191	428	168	177	95	183	212	171	200
13	114	175	94	446	189	116	343	242	307	315	472	533	458	395	121	169	123	190	151	120	186	117	558	571	271
14	165	156	446	287	200	492	739	461	447	611	432	489	367	301	290	265	211	774	516	171	114	201	125	125	349
15	361	191	200	205	150	185	157	138	443	544	719	406	148	244	248	187	202	107	128	50	39	55	118	87	221
16	119	95	110	345	76	46	82	182	517	421	300	429	462	437	420	358	303	140	360	313	711	586	336	107	302
17	127	109	210	254	638	615	253	680	129	532	199	367	285	256	227	515	377	187	98	146	55	72	54	50	268
18	66	76	95	532	107	96	94	101	159	216	189	207	213	239	246	261	279	141	156	106	44	125	182	95	168
19	99	119	191	592	215	161	139	373	231	197	260	327	607	583	647	388	273	233	96	184	184	151	367	336	290
20	89	57	71	51	70	43	114	177	516	184	183	278	287	311	403	379	136	122	535	363	175	186	17	113	203
21	93	721	505	718	534	304	62	459	29	308	376	320	521	531	661	346	6	308	488	508	152	104	95	275	351
22	148	354	384	743	114	44	54	401	644	428	775	23	17	434	207	214	584	6	4	4	68	71	115	92	247
23	195	170	266	252	231	0	261	494	9	8	722	651	372	233	156	11	402	351	271	153	154	155	607	553	278
24	127	109	210	254	638	615	253	680	129	532	199	367	285	256	227	515	377	187	98	146	55	72	54	50	268
25	127	169	75	69	109	171	99	83	516	204	152	230	346	314	235	238	256	240	135	173	238	72	324	674	219
26	284	117	119	53	107	89	87	78	487	265	291	310	387	266	310	319	232	186	182	297	79	491	270	166	228
27	117	448	151	124	400	376	236	326	521	419	400	306	406	332	250	382	111	134	565	126	90	78	64	139	271
28	262	529	292	223	96	97	65	100	276	365	476	470	334	398	405	116	241	485	398	683	249	150	367	175	302
29	281	215	181	127	113	164	333	181	275	391	455	428	502	327	251	664	146	385	207	155	76	85	129	535	275
30	87	96	93	78	115	104	81	355	220	394	352	482	402	272	333	486	481	484	407	103	83	202	307	49	253
31	103	117	700	408	160	220	67	107	347	175	109	415	739	367	338	216	151	166	144	146	147	65	78	71	232
AVERAGE	145	197	228	253	206	186	185	307	296	307	341	356	372	340	320	329	268	261	241	226	181	166	204	189	254

* Indicates calibration of sensors
** Indicates invalid data

ENECOTECH INC.
SAROAD(V1.0) 02/01/96

APPENDIX B

JOINT FREQUENCY DISTRIBUTIONS OF WIND DIRECTION BY WIND SPEED FOR HOURS OF THE DAY

LIST OF TABLES

TABLE B-1
FREQUENCY OF WINDS BY DIRECTION AND SPEED
FOR
JULY THROUGH DECEMBER 1995
ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
TIME (MST): 0000-0400

Speed Class Interval (m/s)

Direction	1<1.5	1.5< 3	3< 5	5< 8	8<11	>11	All	Mean Speed
N	1.09	11.68	12.09	0.82	0.00	0.14	25.82	3.1
NNE	0.82	15.22	14.81	0.14	0.00	0.00	30.98	2.9
NE	1.22	8.02	2.99	0.41	0.00	0.00	12.64	2.5
ENE	0.27	2.04	0.27	0.00	0.00	0.00	2.58	2.1
E	0.41	1.22	0.27	0.00	0.00	0.00	1.90	2.2
ESE	0.54	0.54	0.14	0.00	0.00	0.00	1.22	1.8
SE	0.00	1.36	0.00	0.00	0.00	0.00	1.36	2.0
SSE	0.00	0.41	0.41	0.00	0.00	0.00	0.82	3.1
S	0.14	0.27	0.27	0.27	0.00	0.00	0.95	3.8
SSW	0.00	0.14	0.41	0.41	0.00	0.00	0.95	4.7
SW	0.27	0.41	0.41	0.27	0.00	0.00	1.36	3.1
WSW	0.00	0.68	0.14	0.00	0.00	0.00	0.82	2.5
W	0.00	0.54	0.68	0.00	0.14	0.00	1.36	3.3
WNW	0.14	0.27	1.36	0.00	0.00	0.00	1.77	3.4
NW	0.27	1.90	2.31	0.41	0.00	0.00	4.89	3.2
NNW	0.54	3.26	3.26	1.90	0.41	0.14	9.51	3.9
All	5.71	47.96	39.81	4.62	0.54	0.27	98.91	3.0

Calm (less than 1.0 m/s) = 1.1
Period mean wind speed = 3.0 m/s

TABLE B-2
FREQUENCY OF WINDS BY DIRECTION AND SPEED
FOR
JULY THROUGH DECEMBER 1995
ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
TIME (MST): 0400-0800

Speed Class Interval (m/s)

Direction	1<1.5	1.5< 3	3< 5	5< 8	8<11	>11	All	Mean Speed
N	1.77	10.19	5.30	0.27	0.00	0.00	17.53	2.5
NNE	2.31	16.98	13.86	0.00	0.00	0.00	33.15	2.7
NE	2.31	9.51	1.49	0.00	0.00	0.00	13.32	2.1
ENE	1.09	2.99	0.14	0.00	0.00	0.00	4.21	2.0
E	0.54	0.68	0.00	0.00	0.00	0.00	1.22	1.7
ESE	0.14	0.68	0.27	0.00	0.00	0.00	1.09	2.2
SE	0.27	0.41	0.00	0.00	0.00	0.00	0.68	2.2
SSE	0.00	0.68	0.00	0.00	0.00	0.00	0.68	2.2
S	0.14	0.27	0.14	0.27	0.00	0.00	0.82	4.1
SSW	0.00	0.41	0.27	0.00	0.00	0.00	0.68	2.7
SW	0.14	0.82	0.68	0.00	0.00	0.00	1.63	2.6
WSW	0.27	0.27	0.00	0.00	0.00	0.00	0.54	1.5
W	0.27	0.68	0.27	0.00	0.00	0.00	1.22	2.1
WNW	0.27	1.49	0.41	0.00	0.00	0.00	2.17	2.3
NW	0.14	2.04	1.77	0.54	0.14	0.27	4.89	3.8
NNW	1.63	5.03	1.77	1.90	0.68	0.27	11.28	3.6
All	11.28	53.13	26.36	2.99	0.82	0.54	95.11	2.7

Calm (less than 1.0 m/s) = 4.9
Period mean wind speed = 2.6 m/s

TABLE B-3
FREQUENCY OF WINDS BY DIRECTION AND SPEED
FOR
JULY THROUGH DECEMBER 1995
ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
TIME (MST): 0800-1200

Speed Class Interval (m/s)

Direction	1<1.5	1.5< 3	3< 5	5< 8	8<11	>11	All	Mean Speed
N	0.27	1.22	0.81	0.00	0.00	0.00	2.31	2.8
NNE	0.27	1.90	0.41	0.27	0.00	0.00	2.85	2.6
NE	0.81	1.76	0.54	0.27	0.00	0.00	3.39	2.4
ENE	1.09	1.36	0.68	0.14	0.00	0.00	3.26	2.1
E	0.81	2.44	0.41	0.00	0.00	0.00	3.66	2.0
ESE	0.68	2.44	0.68	0.00	0.00	0.00	3.80	2.2
SE	1.22	6.24	4.75	0.54	0.00	0.00	12.75	2.9
SSE	0.54	12.62	8.55	1.22	0.00	0.00	22.93	2.9
S	0.95	7.73	7.33	0.14	0.00	0.00	16.15	2.8
SSW	0.68	5.83	3.26	0.68	0.00	0.00	10.45	2.8
SW	0.14	1.63	0.68	0.27	0.00	0.00	2.71	2.8
WSW	0.27	0.54	0.81	0.00	0.27	0.00	1.90	3.5
W	0.14	1.49	0.27	0.14	0.00	0.00	2.04	2.4
WNW	0.27	0.81	0.41	0.41	0.00	0.00	1.90	3.2
NW	0.14	0.68	0.68	0.54	0.41	0.27	2.71	5.4
NNW	0.68	1.35	0.68	0.27	0.68	0.27	3.93	4.6
All	8.96	50.07	30.94	4.88	1.36	0.54	96.74	2.9

Calm (less than 1.0 m/s) = 3.3
Period mean wind speed = 2.8 m/s

TABLE B-4
FREQUENCY OF WINDS BY DIRECTION AND SPEED
FOR
JULY THROUGH DECEMBER 1995
ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
TIME (MST): 1200-1600

Speed Class Interval (m/s)

Direction	1<1.5	1.5< 3	3< 5	5< 8	8<11	>11	All	Mean Speed
N	0.00	0.82	0.41	0.68	0.00	0.00	1.90	4.3
NNE	0.00	0.27	0.41	0.41	0.00	0.00	1.09	4.4
NE	0.00	0.27	0.95	0.41	0.00	0.00	1.63	4.3
ENE	0.00	0.27	0.68	0.41	0.00	0.00	1.36	4.0
E	0.27	0.95	0.00	0.00	0.00	0.00	1.22	2.1
ESE	0.00	0.68	0.41	0.00	0.00	0.00	1.09	2.8
SE	0.27	1.49	1.09	0.41	0.00	0.00	3.26	3.0
SSE	0.27	4.89	3.40	0.68	0.00	0.00	9.24	3.1
S	0.14	9.51	12.09	1.22	0.27	0.00	23.23	3.3
SSW	0.00	6.93	12.09	3.67	0.00	0.00	22.69	3.7
SW	0.14	2.04	7.07	2.72	0.14	0.00	12.09	4.1
WSW	0.00	0.82	1.63	2.17	0.54	0.00	5.16	5.1
W	0.14	0.27	0.82	0.68	0.54	0.14	2.58	5.7
WNW	0.00	0.68	0.27	0.54	0.00	0.27	1.77	5.3
NW	0.00	0.54	2.31	2.17	1.09	0.54	6.66	6.3
NNW	0.14	0.14	1.49	2.31	0.54	0.14	4.76	5.9
All	1.36	30.57	45.11	18.48	3.13	1.09	99.73	4.0

Calm (less than 1.0 m/s) = 0.3
Period mean wind speed = 4.0 m/s

TABLE B-5
FREQUENCY OF WINDS BY DIRECTION AND SPEED
FOR
JULY THROUGH DECEMBER 1995
ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
TIME (MST): 1600-2000

Speed Class Interval (m/s)

Direction	1<1.5	1.5< 3	3< 5	5< 8	8<11	>11	All	Mean Speed
N	0.82	2.99	6.93	1.90	0.41	0.00	13.04	3.8
NNE	0.27	3.40	4.89	0.68	0.00	0.00	9.24	3.2
NE	0.54	1.49	1.90	0.14	0.00	0.00	4.08	2.8
ENE	0.54	1.09	0.95	0.54	0.00	0.00	3.13	3.0
E	0.54	0.82	0.54	0.41	0.00	0.00	2.31	2.9
ESE	0.41	1.22	0.14	0.00	0.27	0.00	2.04	3.1
SE	0.68	1.22	0.41	0.14	0.54	0.00	2.99	3.5
SSE	0.41	2.31	0.95	0.54	0.00	0.00	4.21	2.7
S	1.22	3.80	2.99	0.95	0.00	0.00	8.97	3.0
SSW	0.82	2.04	3.53	1.36	0.00	0.00	7.74	3.5
SW	0.27	2.17	3.53	1.22	0.00	0.27	7.47	3.9
WSW	0.27	1.36	2.72	2.58	0.14	0.00	7.07	4.4
W	0.00	1.36	2.17	1.77	0.14	0.00	5.43	4.2
WNW	0.00	0.68	0.68	0.82	0.00	0.00	2.17	4.2
NW	0.00	1.36	3.53	2.17	0.27	0.14	7.47	4.7
NNW	0.00	1.09	4.76	3.67	0.82	0.14	10.46	5.0
All	6.79	28.40	40.63	18.89	2.58	0.54	97.83	3.8

Calm (less than 1.0 m/s) = 2.2
Period mean wind speed = 3.7 m/s

TABLE B-6
FREQUENCY OF WINDS BY DIRECTION AND SPEED
FOR
JULY THROUGH DECEMBER 1995
ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
TIME (MST): 2000-2400

Speed Class Interval (m/s)

Direction	1<1.5	1.5< 3	3< 5	5< 8	8<11	>11	All	Mean Speed
N	0.54	8.15	24.73	1.49	0.14	0.00	35.05	3.5
NNE	0.68	6.52	14.67	1.22	0.00	0.00	23.10	3.3
NE	0.14	3.67	0.68	0.27	0.00	0.00	4.76	2.6
ENE	0.27	1.09	0.27	0.14	0.00	0.00	1.77	2.6
E	0.14	0.68	0.41	0.14	0.00	0.00	1.36	3.0
ESE	0.00	0.82	0.14	0.00	0.00	0.00	0.95	2.6
SE	0.14	0.95	0.27	0.00	0.00	0.00	1.36	2.3
SSE	0.14	0.68	0.00	0.14	0.00	0.00	0.95	2.7
S	0.14	0.27	0.14	0.27	0.00	0.00	0.82	3.6
SSW	0.00	0.68	0.54	0.68	0.00	0.00	1.90	4.0
SW	0.00	0.82	1.36	0.41	0.00	0.00	2.58	3.7
WSW	0.14	0.82	0.82	0.41	0.27	0.00	2.45	4.2
W	0.00	0.54	0.54	0.00	0.14	0.00	1.22	3.6
WNW	0.14	1.09	0.41	0.14	0.00	0.00	1.77	2.8
NW	0.00	1.90	2.45	0.95	0.00	0.00	5.30	3.8
NNW	0.00	3.67	5.84	3.80	0.95	0.00	14.27	4.3
All	2.45	32.34	53.26	10.05	1.49	0.00	99.59	3.5

Calm (less than 1.0 m/s) = 0.4
Period mean wind speed = 3.5 m/s

APPENDIX C

JOINT FREQUENCY DISTRIBUTION OF WIND DIRECTION BY WIND SPEED FOR EACH STABILITY CLASSES

LIST OF TABLES

TABLE C-1
FREQUENCY OF WINDS BY DIRECTION AND SPEED
FOR STABILITY CLASS A
JULY THROUGH DECEMBER 1995
ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL

Speed Class Interval (m/s)

Direction	1,<1.5	1.5,<3	3,<5	5,<8	8,<11	>11	All	Mean Speed
N	0.00	0.56	0.00	0.00	0.00	0.00	0.56	2.3
NNE	0.00	1.67	0.00	0.00	0.00	0.00	1.67	2.1
NE	0.00	0.84	0.56	0.00	0.00	0.00	1.39	2.4
ENE	0.28	0.56	0.00	0.00	0.00	0.00	0.84	1.7
E	0.84	2.23	0.00	0.00	0.00	0.00	3.06	2.0
ESE	0.00	1.95	0.00	0.00	0.00	0.00	1.95	2.3
SE	0.28	7.52	0.00	0.00	0.00	0.00	7.80	2.4
SSE	0.00	22.01	1.39	0.00	0.00	0.00	23.40	2.4
S	1.11	23.40	0.00	0.00	0.00	0.00	24.51	2.3
SSW	0.56	18.94	0.84	0.00	0.00	0.00	20.33	2.4
SW	0.00	6.41	0.00	0.00	0.00	0.00	6.41	2.4
WSW	0.00	1.67	0.56	0.00	0.00	0.00	2.23	2.5
W	0.28	1.39	0.00	0.00	0.00	0.00	1.67	2.1
WNW	0.00	1.95	0.00	0.00	0.00	0.00	1.95	2.5
NW	0.00	0.84	0.28	0.00	0.00	0.00	1.11	2.5
NNW	0.28	0.00	0.00	0.00	0.00	0.00	0.28	1.1
All	3.62	91.92	3.62	0.00	0.00	0.00	99.16	2.3

Calm (less than 1.0 m/s) = 0.8%
Period mean wind speed = 2.3 m/s
Percent occurrence for A stability class 8.1%

TABLE C-2
FREQUENCY OF WINDS BY DIRECTION AND SPEED
FOR STABILITY CLASS B
JULY THROUGH DECEMBER 1995
ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL

Speed Class Interval (m/s)

Direction	1,<1.5	1.5,<3	3,<5	5,<8	8,<11	>11	All	Mean Speed
N	0.34	0.51	0.00	0.00	0.00	0.00	0.85	2.1
NNE	0.17	1.02	0.85	0.00	0:00	0.00	2.04	2.7
NE	0.51	1.19	1.02	0.00	0.00	0.00	2.72	2.4
ENE	0.17	0.68	1.19	0.00	0.00	0.00	2.04	2.8
E	0.17	1.36	0.68	0.00	0.00	0.00	2.21	2.5
ESE	0.17	1.87	1.19	0.00	0.00	0.00	3.23	2.5
SE	1.02	3.90	5.09	0.00	0.00	0.00	10.02	2.7
SSE	0.51	6.62	10.53	0.00	0.00	0.00	17.66	2.9
S	0.34	5.43	16.47	0.00	0.00	0.00	22.24	3.1
SSW	0.34	3.06	13.41	0.00	0.00	0.00	16.81	3.2
SW	0.17	1.02	5.94	0.17	0.00	0.00	7.30	3.3
WSW	0.34	0.34	2.72	0.00	0.00	0.00	3.40	3.1
W	0.00	0.51	1.19	0.00	0.00	0.00	1.70	2.9
WNW	0.00	0.51	0.68	0.00	0.00	0.00	1.19	2.9
NW	0.17	0.68	2.72	0.00	0.00	0.00	3.57	3.3
NNW	0.17	0.68	0.51	0.17	0.00	0.00	1.53	2.9
All	4.58	29.37	64.18	0.34	0.00	0.00	98.47	3.0

Calm (less than 1.0 m/s) = 1.5%
Period mean wind speed = 3.0 m/s
Percent occurrence for B stability class 13.3%

TABLE C-3
FREQUENCY OF WINDS BY DIRECTION AND SPEED
FOR STABILITY CLASS C
JULY THROUGH DECEMBER 1995
ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL

Speed Class Interval (m/s)

Direction	1,<1.5	1.5,<3	3,<5	5,<8	8,<11	>11	All	Mean Speed
N	0.33	2.99	1.00	1.00	0.00	0.00	5.32	3.3
NNE	0.33	2.49	1.16	0.50	0.00	0.00	4.49	2.8
NE	0.66	[illegible].66	1.83	0.33	0.00	0.00	5.48	2.8
ENE	0.83	2.49	1.16	0.66	0.00	0.00	5.15	2.8
E	0.66	1.99	0.00	0.17	0.00	0.00	2.82	2.1
ESE	0.66	1.50	0.33	0.00	0.00	0.00	2.49	2.2
SE	0.50	1.83	2.49	0.50	0.00	0.00	5.32	3.3
SSE	0.83	2.99	4.15	1.50	0.00	0.00	9.47	3.4
S	0.33	2.99	9.30	1.50	0.00	0.00	14.12	3.8
SSW	0.17	2.66	6.31	3.99	0.00	0.00	13.12	4.2
SW	0.33	1.66	4.65	2.49	0.00	0.00	9.14	4.2
WSW	0.00	0.66	0.66	1.50	0.17	0.00	2.99	4.7
W	0.17	1.16	0.50	0.83	0.00	0.00	2.66	3.4
WNW	0.33	0.50	0.50	0.83	0.00	0.00	2.16	3.8
NW	0.00	0.83	3.49	2.82	0.17	0.00	7.31	4.6
NNW	0.00	1.16	2.49	1.66	0.17	0.00	5.48	4.3
All	6.15	30.56	40.03	20.27	0.50	0.00	97.51	3.7

Calm (less than 1.0 m/s) = 2.5%
Period mean wind speed = 3.6 m/s
Percent occurrence for C stability class 13.6%

TABLE C-4
FREQUENCY OF WINDS BY DIRECTION AND SPEED
FOR STABILITY CLASS D
JULY THROUGH DECEMBER 1995
ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL

Speed Class Interval (m/s)

Direction	1,<1.5	1.5,<3	3,<5	5,<8	8,<11	>11	All	Mean Speed
N	0.33	4.07	16.02	2.10	0.26	0.07	22.85	3.8
NNE	0.26	8.34	11.49	1.05	0.00	0.00	21.14	3.2
NE	0.39	3.22	2.23	0.59	0.00	0.00	6.43	3.0
ENE	0.26	0.33	0.53	0.33	0.00	0.00	1.44	3.4
E	0.26	0.39	0.33	0.20	0.00	0.00	1.18	3.1
ESE	0.13	0.20	0.13	0.00	0.13	0.00	0.59	4.2
SE	0.33	0.39	0.07	0.33	0.26	0.00	1.38	4.2
SSE	0.07	0.53	0.33	0.66	0.00	0.00	1.58	4.1
S	0.33	1.12	0.85	0.92	0.13	0.00	3.35	3.9
SSW	0.20	0.59	1.51	1.64	0.00	0.00	3.94	4.3
SW	0.00	0.33	2.04	1.31	0.07	0.13	3.87	4.8
WSW	0.20	0.66	1.05	1.84	0.53	0.00	4.27	5.3
W	0.07	0.13	1.12	0.92	0.46	0.07	2.76	5.5
WNW	0.00	0.59	1.05	0.59	0.00	0.13	2.36	4.5
NW	0.00	0.66	2.30	2.17	0.85	0.59	6.57	6.1
NNW	0.39	1.44	5.38	5.91	1.90	0.46	15.50	5.4
All	3.22	22.98	46.42	20.55	4.60	1.44	99.21	4.2

Calm (less than 1.0 m/s) = 0.8%
Period mean wind speed = 4.2 m/s
Percent occurrence for D stability class 34.5%

TABLE C-5
FREQUENCY OF WINDS BY DIRECTION AND SPEED
FOR STABILITY CLASS E
JULY THROUGH DECEMBER 1995
ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL

Speed Class Interval (m/s)

Direction	1,<1.5	1.5,<3	3,<5	5,<8	8,<11	>11	All	Mean Speed
N	0.63	11.41	12.57	0.00	0.00	0.00	24.61	3.0
NNE	1.57	13.40	18.12	0.10	0.00	0.00	33.19	3.0
NE	0.84	6.91	1.05	0.00	0.00	0.00	8.80	2.3
ENE	0.63	1.78	0.00	0.00	0.00	0.00	2.41	1.9
E	0.21	0.63	0.31	0.00	0.00	0.00	1.15	2.3
ESE	0.42	1.05	0.21	0.00	0.00	0.00	1.68	1.9
SE	0.42	1.15	0.21	0.00	0.00	0.00	1.78	2.1
SSE	0.00	0.94	0.10	0.00	0.00	0.00	1.05	2.5
S	0.63	0.94	0.31	0.00	0.00	0.00	1.88	2.2
SSW	0.21	0.31	0.52	0.10	0.00	0.00	1.15	3.4
SW	0.21	0.84	0.73	0.00	0.00	0.00	1.78	2.7
WSW	0.10	0.31	0.73	0.10	0.00	0.00	1.26	3.2
W	0.10	1.57	0.84	0.00	0.00	0.00	2.51	2.5
WNW	0.10	1.05	0.31	0.00	0.00	0.00	1.47	2.5
NW	0.21	2.62	2.41	0.00	0.00	0.00	5.24	2.9
NNW	0.42	3.87	3.25	0.10	0.00	0.00	7.64	2.9
All	6.70	48.80	41.68	0.42	0.00	0.00	97.59	2.8

Calm (less than 1.0 m/s) = 2.4%
Period mean wind speed = 2.8 m/s
Percent occurrence for E stability class 21.6%

TABLE C-6
FREQUENCY OF WINDS BY DIRECTION AND SPEED
FOR STABILITY CLASS F
JULY THROUGH DECEMBER 1995
ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL

Speed Class Interval (m/s)

Direction	1,<1.5	1.5,<3	3,<5	5,<8	8,<11	>11	All	Mean Speed
N	4.63	16.45	0.00	0.00	0.00	0.00	21.08	2.0
NNE	2.57	11.31	0.26	0.00	0.00	0.00	14.14	1.9
NE	4.11	10.54	0.00	0.00	0.00	0.00	14.65	1.7
ENE	1.80	5.66	0.00	0.00	0.00	0.00	7.46	1.8
E	1.54	2.57	0.00	0.00	0.00	0.00	4.11	1.6
ESE	0.51	1.80	0.00	0.00	0.00	0.00	2.31	1.9
SE	0.00	2.06	0.00	0.00	0.00	0.00	2.06	2.0
SSE	0.26	1.54	0.00	0.00	0.00	0.00	1.80	1.9
S	0.26	0.26	0.00	0.00	0.00	0.00	0.51	1.8
SSW	0.26	1.03	0.00	0.00	0.00	0.00	1.29	2.1
SW	0.51	1.54	0.00	0.00	0.00	0.00	2.06	1.6
WSW	0.26	2.06	0.00	0.00	0.00	0.00	2.31	2.1
W	0.00	1.03	0.00	0.00	0.00	0.00	1.03	2.0
WNW	0.77	1.29	0.00	0.00	0.00	0.00	2.06	1.7
NW	0.26	3.86	0.00	0.00	0.00	0.00	4.11	2.0
NNW	2.57	9.51	0.00	0.00	0.00	0.00	12.08	2.0
All	20.31	72.49	0.26	0.00	0.00	0.00	93.06	1.9

Calm (less than 1.0 m/s) = 6.9%
Period mean wind speed = 1.8 m/s
Percent occurrence for F stability class 8.8%

TABLE C-7
FREQUENCY OF WINDS BY DIRECTION AND SPEED
FOR STABILITY CLASS ALL
JULY THROUGH DECEMBER 1995
ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL

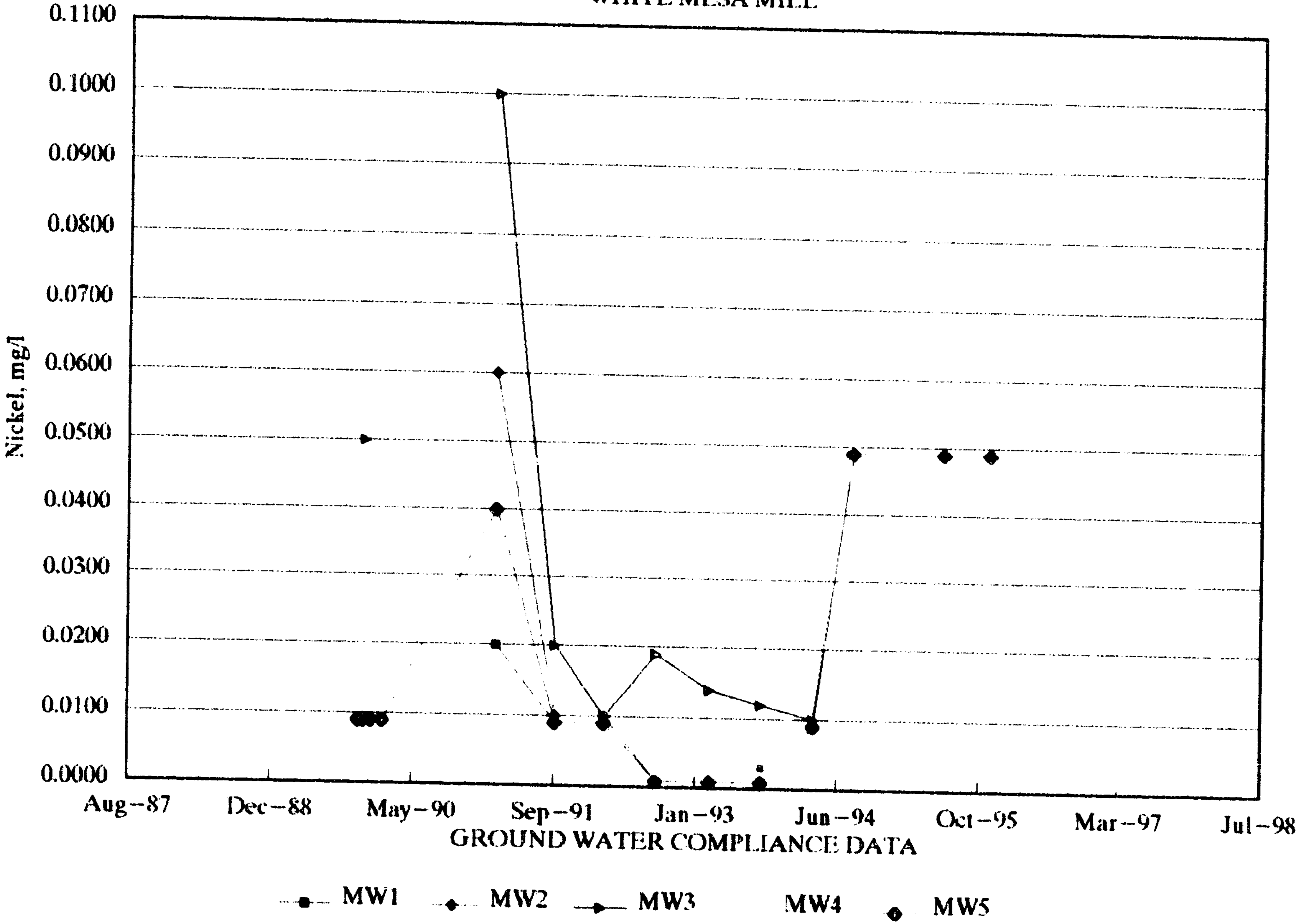
Speed Class Interval (m/s)

Direction	1,<1.5	1.5,<3	3,<5	5,<8	8,<11	>11	All	Mean Speed
N	0.75	5.84	8.37	0.86	0.09	0.02	15.93	3.3
NNE	0.72	7.38	8.17	0.45	0.00	0.00	16.73	3.0
NE	0.84	4.12	1.43	0.25	0.00	0.00	6.63	2.5
ENE	0.54	1.47	0.50	0.20	0.00	0.00	2.72	2.5
E	0.45	1.13	0.27	0.09	0.00	0.00	1.95	2.3
ESE	0.29	1.06	0.29	0.00	0.05	0.00	1.70	2.4
SE	0.43	1.95	1.09	0.18	0.09	0.00	3.73	2.9
SSE	0.23	3.60	2.22	0.43	0.00	0.00	6.47	2.9
S	0.45	3.64	3.83	0.52	0.05	0.00	8.49	3.1
SSW	0.25	2.67	3.35	1.13	0.00	0.00	7.40	3.5
SW	0.16	1.31	2.29	0.81	0.02	0.05	4.64	3.8
WSW	0.16	0.75	1.02	0.86	0.20	0.00	2.99	4.3
W	0.09	0.81	0.79	0.43	0.16	0.02	2.31	3.9
WNW	0.14	0.84	0.59	0.32	0.00	0.05	1.92	3.5
NW	0.09	1.40	2.17	1.13	0.32	0.20	5.32	4.5
NNW	0.50	2.42	2.97	2.31	0.68	0.16	9.03	4.4
All	6.09	40.40	39.34	9.98	1.65	0.50	97.96	3.3

Calm (less than 1.0 m/s) = 2.1%
Period mean wind speed = 3.3 m/s
Percent occurrence for All stability classes 100.0%

ENERGY FUELS NUCLEAR, INC.

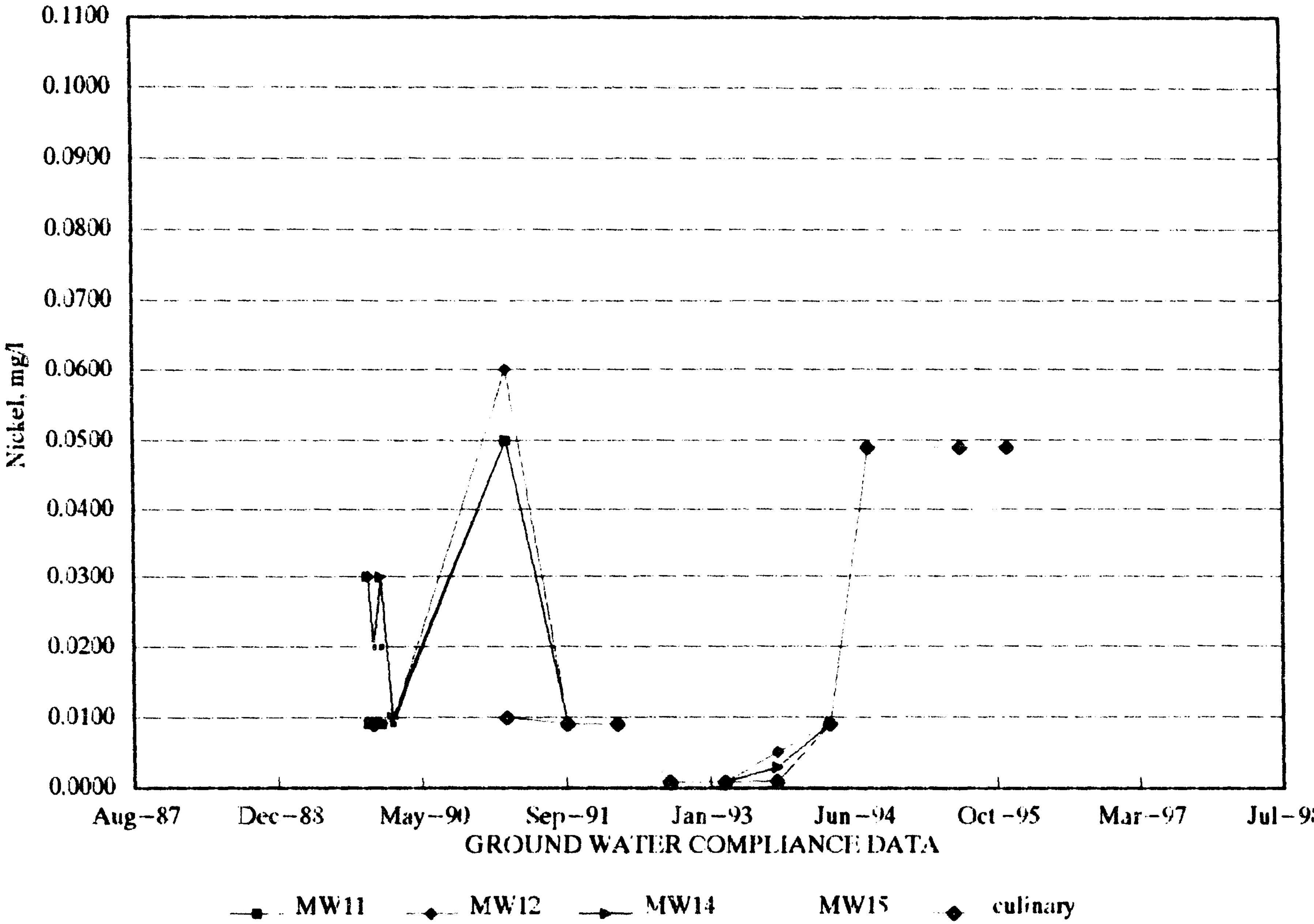
WHITE MESA MILL



GRAPH 40

ENERGY FUELS NUCLEAR, INC.

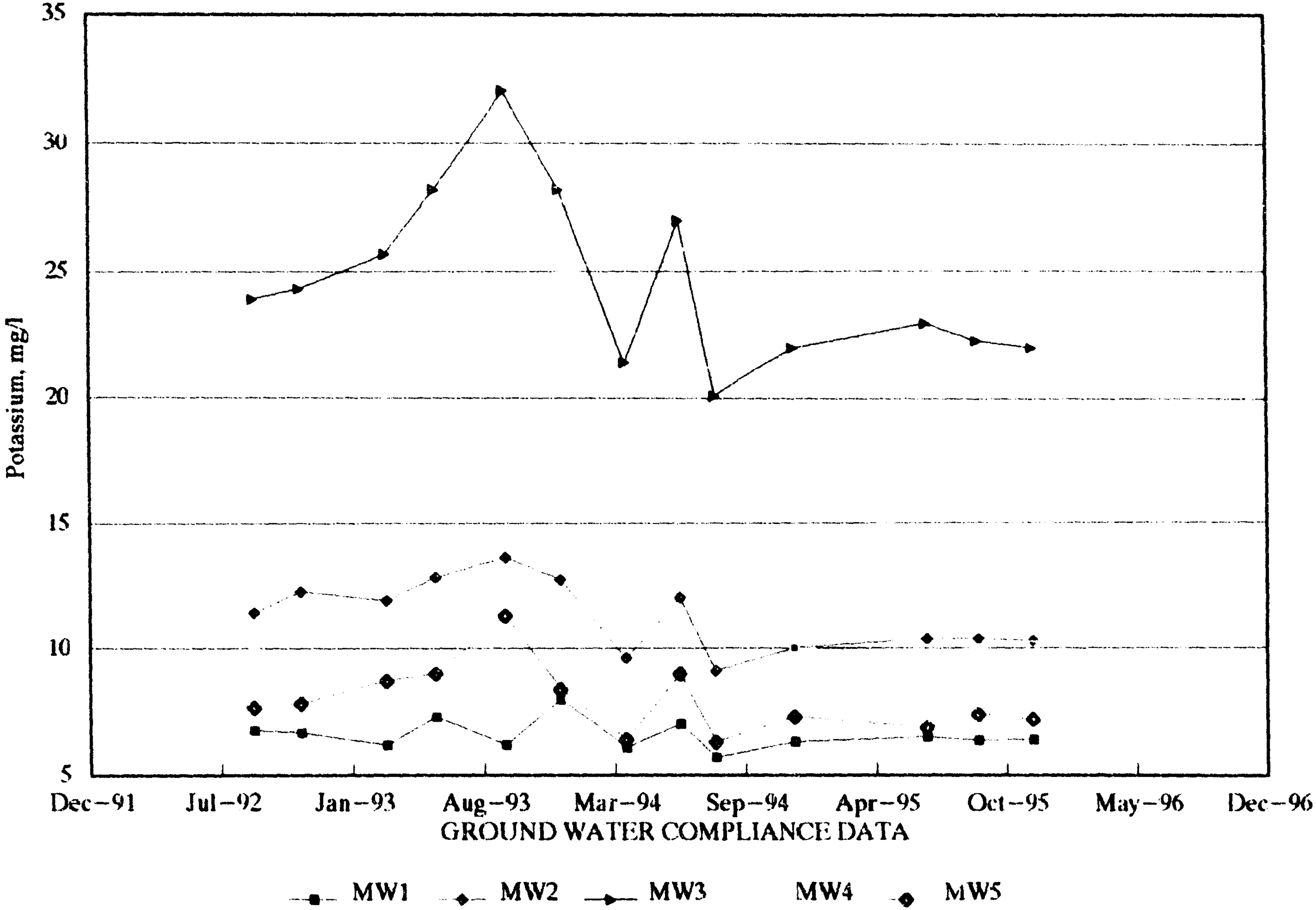
WHITE MESA MILL



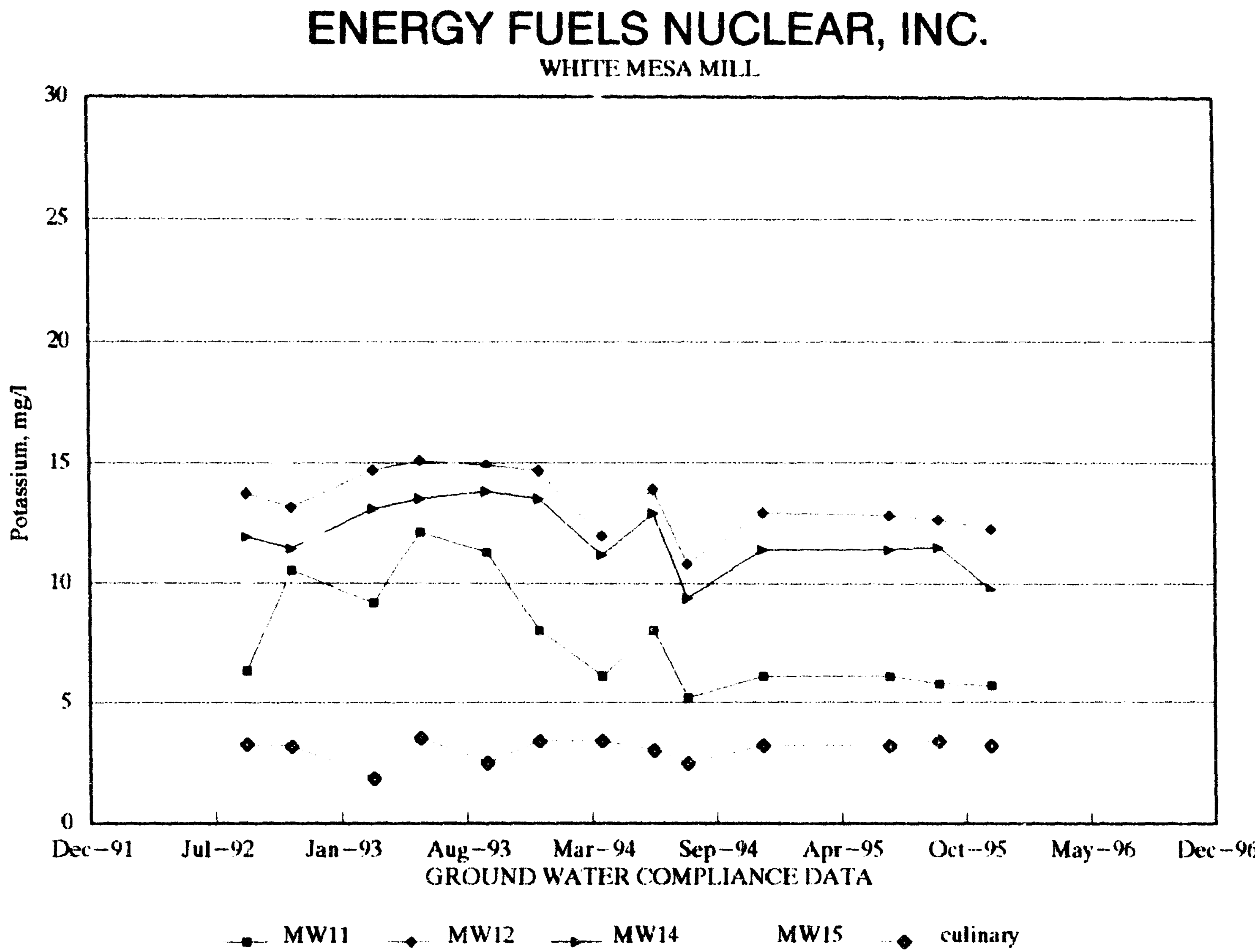
GRAPH 41

ENERGY FUELS NUCLEAR, INC.

WHITE MESA MILL



GRAPH 42

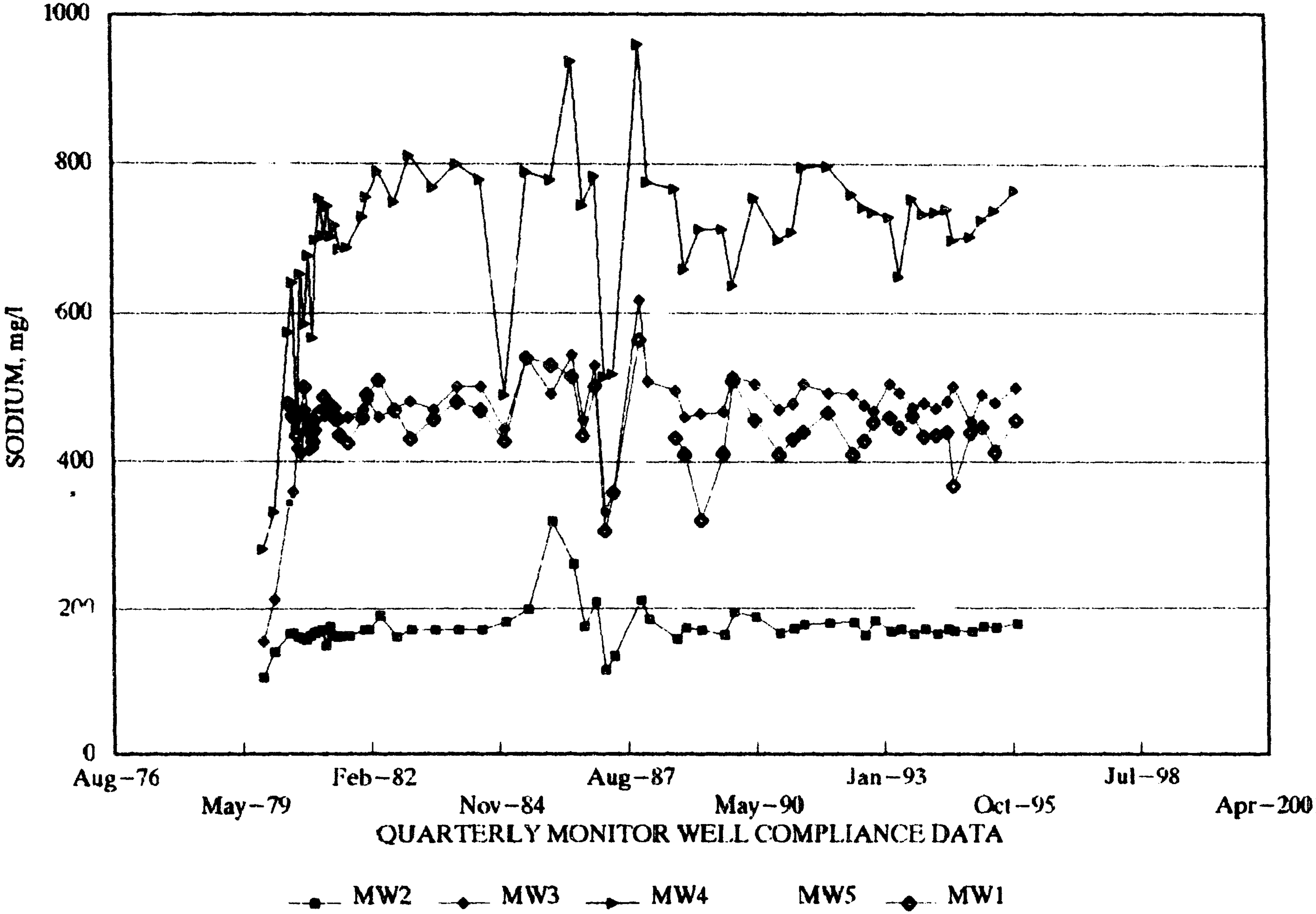


ENERGY FUELS NUCLEAR, INC.
WHITE MESA MILL
Potassium, mg/l
30
25
20
15
10
5
0
Dec-91
Jul-92
Jan-93
Aug-93
Mar-94
Sep-94
Apr-95
Oct-95
May-96
Dec-96
GROUND WATER COMPLIANCE DATA
MW11
MW12
MW14
MW15
culinary

GRAPH 43

ENERGY FUELS NUCLEAR, INC.

WHITE MESA MILL



GRAPH 44

HYDROGEOLOGIC EVALUATION OF WHITE MESA URANIUM MILL, JULY 1994

FOR

RECLAMATION

OF

WHITE MESA FACILITIES

BLANDING, UTAH

PREPARED BY

TITAN ENVIRONMENTAL

7939 EAST ARAPAHOE ROAD, SUITE 230

ENGLEWOOD, COLORADO 80112

Hydrogeologic Evaluation of White Mesa Uranium Mill

Prepared For:

Energy Fuels Nuclear, Inc.
One Tabor Center, Suite 2500
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July 1994

By:

TITAN Environmental Corporation
5690 DTC Boulevard, Suite 260
Englewood, CO 80111

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HYDROGEOLOGIC EVALUATION OF WHITE MESA URANIUM MILL

1.0 INTRODUCTION

This report presents a hydrogeologic evaluation for the White Mesa Uranium Mill. The evaluation focuses on description and definition of the site hydrostratigraphy, and occurrence of ground water as it relates to the natural and manmade safeguards which protect ground water resources from potential leakage of tailings cells at the site.

The findings of this evaluation indicate that the tailings located in the existing disposal cells are not impacting ground water at the site. In addition, it does not appear that future impacts to ground water would be expected as a result of continuing operations. These conclusions are based on chemical and hydrogeologic data which show that:

1. The chemistry of perched ground water encountered below the site does not show concentrations or increasing trends in concentrations of constituents that would indicate seepage from the existing disposal cells;

2. The useable aquifer at the site is separated from the facility by about 1,200 feet of unsaturated, low-permeability rock;

3. The useable aquifer is under artesian pressure and, therefore, has an upward pressure gradient which would preclude downward migration of constituents into the aquifer; and

4. The facility has operated for a period of 15 years and has caused no discernible impacts to ground water during this period.

Continued and expanded monitoring of subsurface conditions at the site will be performed to verify that past, current and future operations will not impact ground water.

Numerous technical studies were used in the preparation of this document. Regional geologic and geohydrologic data were obtained primarily from U.S. Geological Survey and State of Utah publications. Site-specific information was obtained from the 1978 Environmental Report

prepared by Dames and Moore, the 1988 Reclamation Plan submitted by Umetco, a 1992 ground water study report submitted by Umetco, and a 1991 ground water hydrology report on White Mesa prepared by Hydro-Engineering. Additional references consulted during preparation of this report include site-specific reports by D'Appolonia (1981, 1982 and 1984).

1.1 Site Description

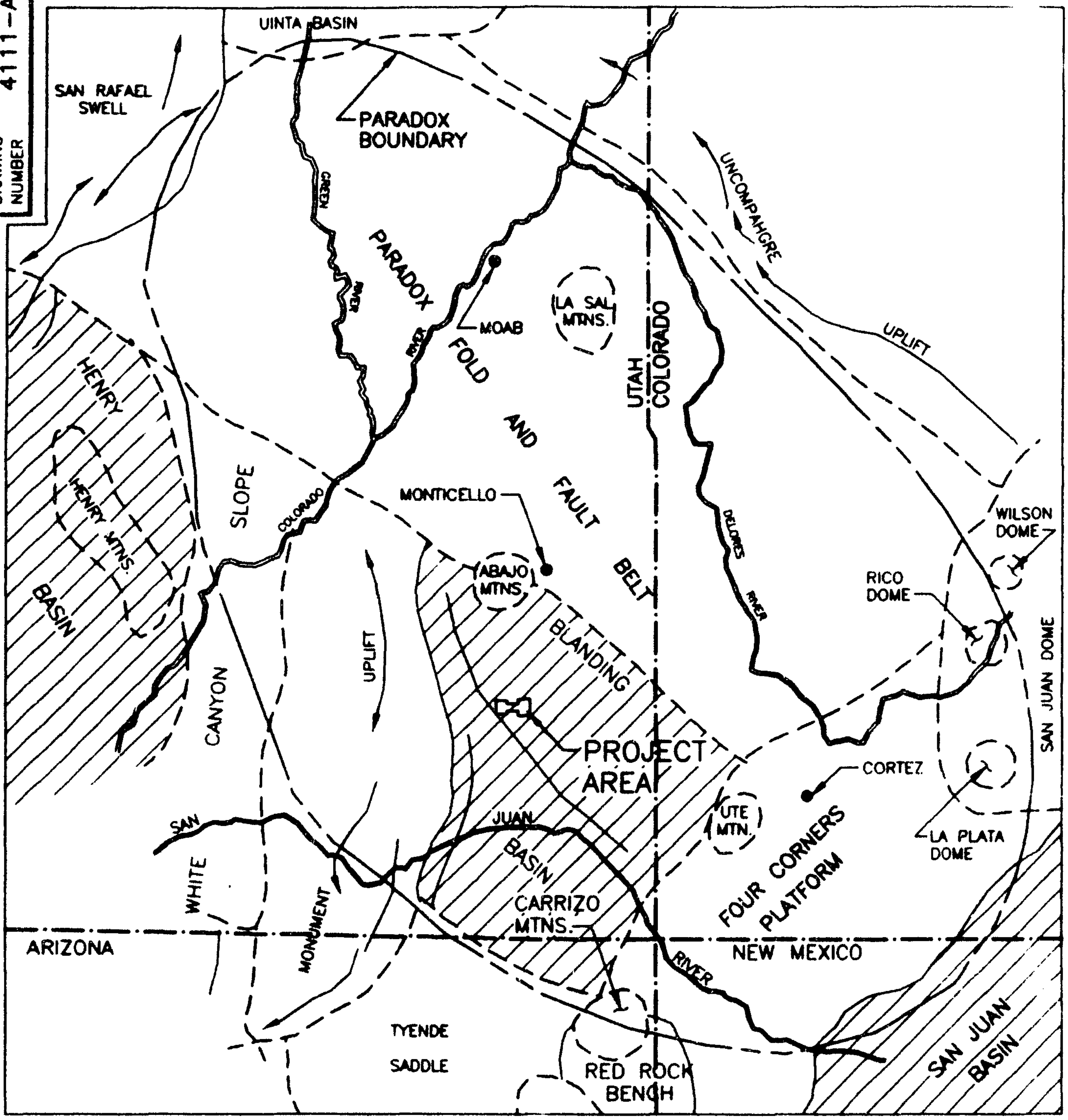
The White Mesa Uranium Mill is located in southeastern Utah, approximately 6 miles south of the town of Blanding. It is situated on White Mesa, a flat area bounded on the east by Corral Canyon, to the west by Westwater Creek, and to the south by Cottonwood Canyon. The site consists of the uranium processing mill, and four engineered lined tailings disposal cells.

1.2 Geologic Setting

The White Mesa Uranium Mill site is located near the western edge of the Blanding Basin within the Canyon lands section of the Colorado Plateau physiographic province (Figure 1.1). The Canyon lands have undergone broad, fairly horizontal uplift and subsequent erosion which have produced the region's characteristic topography represented by high plateaus, mesas, buttes and deep canyons incised into relatively flat lying sedimentary r ks of pre-Tertiary age. Elevations range from approximately 3,000 feet in the bottoms of th .eep canyons along the southwestern margins of the region to more than 11,000 feet in the Hen bajo and La Sal mountains located to the northwest and northeast of the facility. With the .ception of the deep canyons and isolated mountain peaks, an average elevation slightly in excess of 5,000 feet persists over most of the Canyon lands. The average elevation at the White Mesa Uranium Mill is 5,600 feet mean sea level (MSL).

1.2.1 Stratigraphy

Rocks of Upper Jurassic and Cretaceous age are exposed in the canyon walls in the vicinity of the White Mesa Uranium Mill site. These rock units (Figure 1.2) include, in descending order, the following: Eolian sand of Quaternary Age and varying thickness overlies the Dakota



DRAWING NUMBER 4111-A4

COLORADO PLATEAU GEOLOGIC MAP

PREPARED FOR

ENERGY FUELS NUCLEAR
DENVER, COLORADO

TITAN Environmental

REFERENCE:
AFTER SHOEMAKER, 1956, KELLEY, 1958)

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
1		ISSUED FOR DRAFT SUBMITTAL	T.M.G.		

DATE: 7-20-94
SCALE: N.T.S.

FIGURE 1.1

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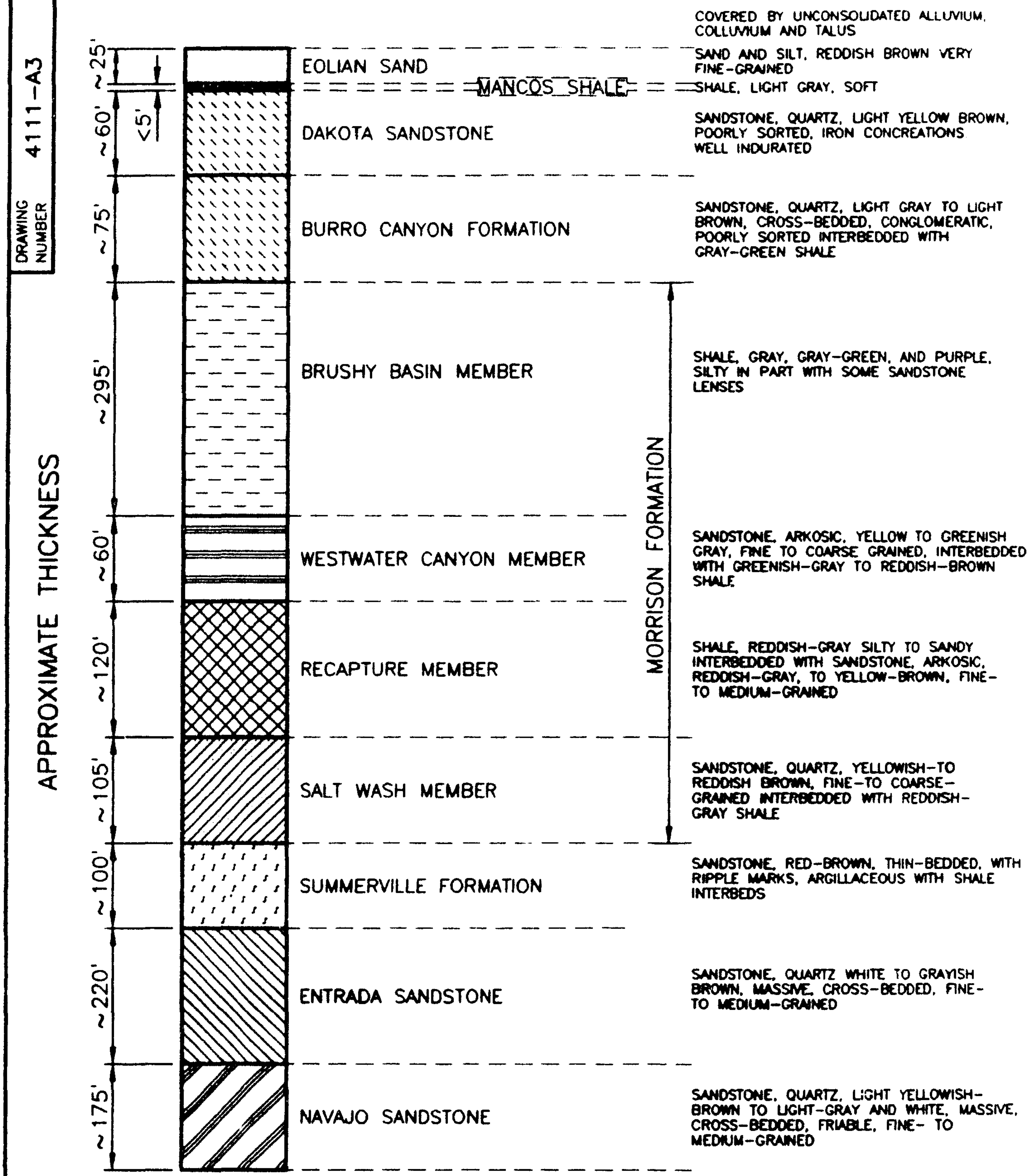
1



DRAWING NUMBER 4111-A3

NOTE:

1. THIS DRAWING IS NOT TO SCALE.
2. ALL THICKNESSES ARE APPROXIMATE.

REFERENCE:
DAMES & MOORE 1978

STRATIGRAPHY OF WHITE MESA

PREPARED FOR

ENERGY FUELS NUCLEAR
DENVER, COLORADO

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No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
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DATE: 7-19-94
SCALE: N.T.S.

FIGURE 1.2

DRAWING NUMBER 4111-A3

1

sandstone and Mancos shale on the mesa. A thin deposit of talus derived from rock falls of Dakota sandstone and Burro Canyon Formation mantles the lower valley flanks. Underlying these units are the Cretaceous Age erosional remnants of Mancos shale, Dakota Sandstone, and Burro Canyon Formation. Erosional remnants of Mancos shale are only found north of the Mill site. The Brushy Basin, Westwater Canyon, Recapture and Salt Wash Members of the upper Jurassic Age Morrison Formation are encountered below the Burro Canyon Formation. The Summerville Formation, Entrada Sandstone and Navajo Sandstone are the deepest units of concern encountered at the site.

1.2.2 Local Geologic Structure

In general, the rock formations of the region are flat-lying with dips of 1 to 3 degrees. The rock formations are incised by streams that have formed canyons between intervening areas of broad mesas and buttes. An intricate system of deep canyons along and across hog-backs and cuestas has resulted from faulting, upwarping and dislocation of rocks around the intrusive rock masses, such as the Abajo Mountains. Thus the region is divided up into numerous hydrological areas controlled by structural features.

The strata underlying White Mesa have a regional dip of 1/2 to 1 degrees to the south; however, local dips of 5 degrees have been measured. Haynes, et al (1972) includes a map showing the structure at the base of the Dakota Formation. Approximately 25 miles to the north, the Abajo Mountains, formed by igneous intrusions, have caused local faulting, upwarping, and displacement of the sedimentary section. However, no faults have been mapped in the immediate vicinity of White Mesa.

1.3 Hydrogeologic Setting

On a regional basis, the formations that are recognized as aquifers are: Cretaceous-age Dakota Sandstone and the upper part of the Morrison Formation of late Jurassic age; the Entrada Sandstone, and the Navajo Sandstone of Jurassic age; the Wingate Sandstone and the Shinarump

Member of the Chinle Formation of Triassic age; and the DeChelle Member of the Cutler Formation of Permian age.

Recharge to aquifers in the region occurs by infiltration of precipitation into the aquifers along the flanks of the Abajo, Henry and La Sal Mountains and along the flanks of folds, such as Comb Ridge Monocline and the San Rafael Swell, where the permeable formations are exposed at the surface (Figure 1.1).

Seventy-four ground water appropriation applications, within a five-mile radius of the Mill site, are on file with the Utah State Engineer's office. A summary of the applications is presented in Table 1.1 and shown on Figure 1.3. The majority of the applications is by private individuals and for wells drawing small, intermittent quantities of water, less than 8 gallons per minute (gpm), from the Burro Canyon Formation. For the most part, these wells are located upgradient (north) of the White Mesa Uranium Mill site. Stockwatering and irrigation are listed as primary uses of the majority of the wells. It is important to note that no wells exist downgradient of the site within the 5-mile radius.

The productivity of the Burro Canyon Formation within the White Mesa site is substantially different from the productivity of this formation upgradient of the site. For the most part, the documented pumping rates from on-site wells completed in the Burro Canyon Formation are less than 0.5 gpm. Even at this low rate, the on-site wells are typically pumped dry within a couple of hours. This low productivity stems from the fact that the White Mesa Uranium Mill is located over a peripheral fringe of perched water; saturated thickness decreases under the site and permeability of the formation is very low.

These observations have been verified by studies performed for the U.S. Department of Energy's disposal site at Slick Rock which noted that the Dakota Sandstone, Burro Canyon Formation and upper claystone of the Brushy Basin Member are not considered aquifers due to the low permeability, discontinuous nature and limited thickness of these units (DOE, 1993).

Table 1.1

Wells Located Within A 5-Mile Radius of The White Mesa Uranium Mill

Map Numbers	Water Right	SEC	TWP	RNG	CFS	USE	Depth (ft.)
1	Nielson, Norman and Richard C.	11	37S	22E	0.015	IDS	150-200
2	Guymon, Willard M.	10	37S	22E	0.015	S	82
3	Nielson, J. Rex	10	37S	22E	0.015	IDS	160
4	Nielson, J. Rex	10	37S	22E	0.013	S	165
5	Lyman, Fred S.	10	37S	22E	0.022	IDS	120
6	Plateau Resources	15	37S	22E	0.015	O	740
7	Plateau Resources	15	37S	22E	0.015	O	135
8	Nielson, Norman and Richard C.	14	37S	22E	0.015	IS	150-200
9	Lyman, George F.	15	37S	22E	0.015	S	135
10	Holt, N.E., McLaws, W.	15	37S	22E	0.007	S	195
11	Perkins, Dorothy	21	37S	22E	0.015	S	150
12	Energy Fuels Nuclear, Inc.	21	37S	22E	0.6	O	1600
13	Energy Fuels Nuclear, Inc.	22	37S	22E	1.11	O	1820
14	Utah Launch Complex	27	37S	22E	0.015	D	650
15	Energy Fuels Nuclear, Inc.	28	37S	22E	1.11	O	1885
16	Energy Fuels Nuclear, Inc.	28	37S	22E	1.11	O	1850
17	Energy Fuels Nuclear, Inc.	28	37S	22E	0.015	DSO	1800
18	Energy Fuels Nuclear, Inc.	28	37S	22E	0.6	O	1600
19	Jones, Alma U.	33	37S	22E	0.015	S	200
20	Energy Fuels Nuclear, Inc.	33	37S	22E	0.6	O	1600
21	BLM	8	37S	22E	0.01	S	170
22	Halliday, Fred L.	11	37S	22E	0.015	IS	180
23	Perking, Paul	2	37S	22E	0.015	ID	180
24	Redd, James D.	2	37S	22E	0.1	ID	200
25	Brown, Aroe G.	1	37S	22E	0.015	IS	210
26	Brown, George	1	37S	22E	0.015	IDS	140
27	Brown, Llo M.	1	37S	22E	0.004	IDS	141
28	Rentz, Alyce M.	1	37S	22E	0.015	ID	180
29	Rogers, Clarence	2	37S	22E	0.015	S	142
30	Perkins, Dorothy	2	37S	22E	0.015	S	100-200
31	Brandt J.R. & C.J.	1	37S	22E	0.015	IDS	160
32	Montella, Frank A.	3	37S	22E	0.015	IDO	190
33	Snyder, Bertha	1	37S	22E	0.1	IDS	196
34	Martineau, Stanley D.	1	37S	22E	0.015	ID	160
35	Kirk, Ronald D. & Catherine A.	1	37S	22E	0.015	IDS	160
36	Palmer, Ned J. and Marilyn	1	37S	22E	0.015	IDS	0
37	Grover, Jess M.	1	37S	22E	0.015	S	160
38	Monson, Larry	1	37S	22E	0.015	IDS	140
39	Neilson, Norman and Richard	1	37S	22E	0.015	IS	132
40	Watkins, Henry Clyde	1	37S	22E	0.015	IS	150
41	Shumway, Glen & Eve	15	37S	22E	0.015	IS	60
42	Energy Fuels Nuclear, Inc. (not drilled)	21	37S	22E	0.600	O	1600

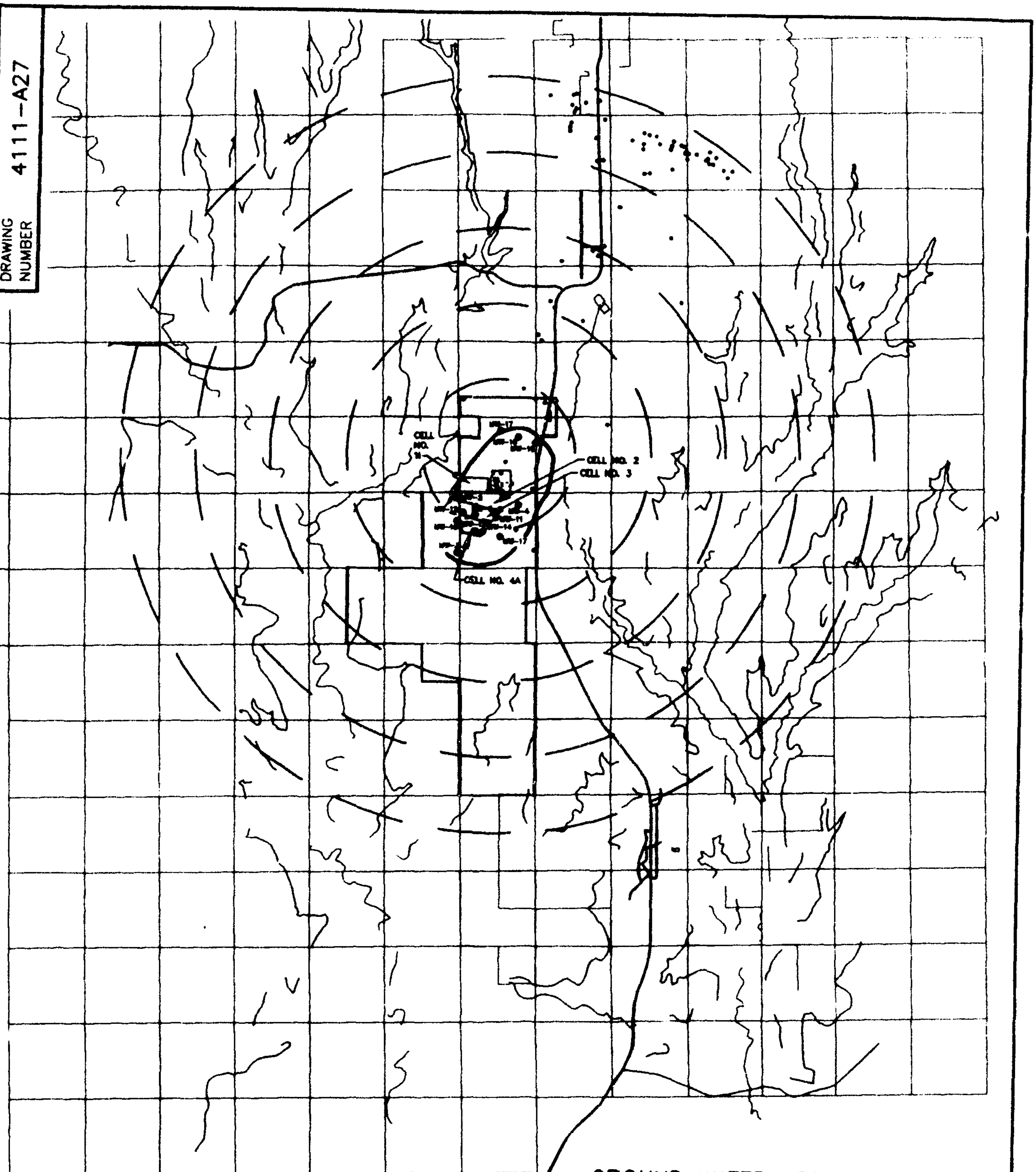
Table 1.1

Wells Located Within A 5-Mile Radius of
The White Mesa Uranium Mill
(Continued)

Map Numbers	Water Right	SEC	TWP	RNG	CFS	USE	Depth (ft.)
43	Energy Fuels Nuclear, Inc. (#1)	28	37S	22E	1.100	O	1860
44	Watkins, Ivan R.	1	37S	22E	0.200	S	185
45	Waukesha of Utah	3	37S	22E	0.015	D	226
46	Simpson, William	3	37S	22E	0.030	ID	180
47	Guyman, Willard M.	2	37S	22E	0.030	S	164
48	Harrieson, Lynda	2	37S	22E	0.012	IDS	---
49	Hurst, Reed	2	37S	22E	0.015	D	100-300
50	Kaer, Alvin	2	37S	22E	0.015	IDS	100-300
51	Heiner, Gerald B.	2	37S	22E	0.015	ID	75
52	Laws, James A.	2	37S	22E	0.015	IDS	100-300
53	Laws, J. Parley	2	37S	22E	0.015	IDS	
54	Anderson, Dennis & Edith	2	37S	22E	0.015	IDS	160
55	Guymon, Eugene	2	37S	22E	0.100	IDS	130
56	Guymon, Eugene	2	37S	22E	0.015	S	130
57	Guymon, Dennis & Doris	2	37S	22E	0.030	IDS	210
58	Guymon, Eugene	2	37S	22E	0.115	IDS	100-200
59	Guymon, Eugene	2	37S	22E	0.115	IDS	100-200
60	Perkins, Dorothy	2	37S	22E	0.015	IDS	140
61	Watkins, Ivan R.	1	37S	22E	0.015	IDS	145
62	Roper, Lloyd	34	36S	22E	0.015	ID	180
63	Smith, Lee & Marylynn	34	36S	22E	0.060	IDS	170
64	McDonald, Kenneth P.	34	36S	22E	0.015	IDS	734
65	Brake, John	34	36S	22E	0.015	ID	250
66	Brake, John	34	36S	22E	0.015	IS	150
67	Redd, Parley V. & Reva V.	34	36S	22E	0.015	IS	200
68	C & C Construction	34	26S	22E	0.015	IS	190
69	Guymon, Dean W.	3	37S	22E	0.015	IDS	180
70	Phillips, Elizabeth Ann Hurst	34	36S	22E	0.015	I	165
71	Howe, Leonard R.	3	37S	22E	0.015	O	160
72	Shumway, Mark Eugene	3	37S	22E	0.015	ID	
73	Shumway, Mark Eugene	3	37S	22E	0.015	IDS	150
74	Lyman, Henry M.	3	37S	22E	0.100	IDS	200

Notes:
D - Domestic
I - Irrigation
S- Stockwatering
O - Industrial

SEC - Section
TWP - Township
RNG - Range
CFS - Cubic Feet Per Second



DRAWING NUMBER 4111-A27

GROUND WATER APPROPRIATION APPLICATIONS WITHIN A FIVE MILE RADIUS OF THE WHITE MESA MILL

PREPARED FOR

ENERGY FUELS NUCLEAR
DENVER, COLORADO

SCALE

2000 0 2000 FEET

TITAN Environmental

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
1		ISSUED FOR DRAFT SUBMITTAL	T.M.G.		

DATE: 7-27-94
SCALE: N.T.S.

FIGURE 1.3

DRAWING NUMBER 4111-A27

1

Two water wells exist approximately 4.5 miles southeast of the site on the Ute Indian Reservation. These wells supply domestic water for the village on the mesa along Highway 191. Both wells are completed in the Entrada sandstone which is 1,200 feet below the ground surface.

1.4 Climatological Setting

The climate of southeastern Utah is classified as dry to arid continental. The region is generally typified by warm summer and cold winter temperatures, with precipitation averaging less than 11.8 inches annually and evapotranspiration in the range of 61.5 inches annually (Dames and Moore, 1978).

Precipitation in southeastern Utah is characterized by wide variations in seasonal and annual rainfall and by long periods of no rainfall. Short duration summer storms furnish rain in small areas of a few square miles and this is frequently the total rainfall for an entire month within a given area. The average annual precipitation in the region ranges from less than 8 inches at Bluff to more than 16 inches on the eastern flank of the Abajo Mountains, as recorded at Monticello. The mountain peaks in the Henry, La Sal and Abajo Mountains may receive more than 30 inches of precipitation, but these areas are very small in comparison to the vast area of much lower precipitation in the region.

2.0 EVALUATION OF GROUND WATER OCCURRENCE

The site stratigraphy is briefly described in Section 1.2.1. The detailed site stratigraphic column with descriptions of each geologic unit is provided on Figure 1.2. The following discussion focuses on those geologic units at or in the vicinity of the site which have or may have ground water present.

2.1 Hydrostratigraphy

The presence of ground water within and in proximity to the site has been documented in three strata: the Dakota Sandstone, the Burro Canyon Formation, and the Entrada/Navajo Sandstone. The Burro Canyon Formation hosts perched ground water over the Brushy Basin Member of the Morrison Formation at the site.

The Entrada/Navajo Sandstones form one of the most permeable aquifers in the region. This aquifer is separated from the Burro Canyon Formation by the Morrison Formation and Summerville Formation. Water in this aquifer is under artesian pressure and is used by the site's operator for industrial needs and consumption. The artesian conditions present in this aquifer are discussed in Section 3.4.1.

Geologic cross sections which illustrate the stratigraphic position of the Entrada/Navajo Sandstone aquifer and intervening strata are shown on Figures 2.1, 2.2, and 2.3. The summary of the borehole information supporting the site's stratigraphy, description of the drilling information and boring logs are presented in Appendix A. With the exception of six deep water supply wells installed at various locations around the site and completed in Entrada/Navajo Sandstone, all of the boring data are from wells drilled through the Dakota/Burro Canyon Sandstones and terminated in the Brushy Basin Member. The drilling and logging data indicate that the physical characteristics of the bedrock vary considerably, both vertically and laterally. The following sections discuss the relevance of those strata and their physical characteristics to the site's hydrogeology.

2.1.1 Dakota Sandstone

The Dakota Sandstone is a low- to moderately-permeable formation that produces acceptable quality water at low production rates. Water from this formation is typically used for stock water and/or irrigation.

The Dakota Sandstone is the uppermost strata in which the tailings disposal cells are sited. At the ground surface, the Dakota Sandstone is overlain by a veneer of reddish-brown clayey or sandy silts with a thickness of up to 10 feet and extends to depths of 43 to 66 feet below the surface (D'Appolonia, 1982). The Dakota Sandstone at this site is typically composed of moderately hard to hard sandstones with random discontinuous shale (claystone) and siltstone layers. The sandstones are moderately cemented (upper part of formation) to well cemented with kaolinitic clays. The claystones and siltstones are typically 2 to 3 feet thick, although boring WMMW-19 encountered a siltstone layer having a thickness of 8 feet at 33 to 41 feet below the ground surface.

Porosity of the Dakota Sandstone is predominately intergranular. Laboratory tests performed (see Table 2.1) show the total porosity of the sandstone varies from 13.4 to 26.0 percent with an average value of 19.9 percent. The formation is very dry to dry with volumetric water contents varying from 0.6 to 7.1 percent with an average value of 3.0 percent. Saturation values for the Dakota Sandstone vary from 3.7 to 27.2 percent. The hydraulic conductivity values as determined from packer tests range from 9.12E-04 centimeters per second (cm/sec) to 2.71E-06 cm/sec with a geometric mean of 3.89E-05 cm/sec (Dames & Moore, 1978; Umetco, 1992). A summary of hydraulic properties of the Dakota Sandstone is presented in Table 2.2.

2.1.2 Burro Canyon Sandstone

Directly below the Dakota Sandstone, the borings encountered sandstones and random discontinuous shale layers of the Burro Canyon Formation to depths of 91 to 141 feet below the site. The importance of this stratum to the site's hydrogeology is that it hosts perched water beneath the site. The composition of the Brushy Basin Member is of variegated bentonitic

Table 2.1

Properties of the Dakota/Burro Canyon Formations
White Mesa Uranium Mill

Formation	Well No. and Sample Interval		Moisture Content (Percent)	Moisture Content Volumetric	Dry Unit Weight (lbs/cu ft)	Porosity (Percent)	Particle Sp. Gr.	Saturation (Percent)	Retained Moisture (Percent)	Liquid Limit (Percent)	Plastic Limit (Percent)	Plasticity Index (Percent)	Rock Type
Dakota	WMMW-16	26.4' - 38.4'	1.5	3.3	135.2	17.9	2.64	18.2	5.1				Sandstone
	WMMW-16	37.8' - 38.4'	0.4	0.8	127.4	22.4	2.63	3.7	6.3				Sandstone
	WMMW-17	27.0' - 27.5'	0.3	0.6	138.8	13.4	2.57	4.8	5.1				Sandstone
	WMMW-17	49.0' - 49.5	3.6	7.1	121.9	26.0	2.64	27.2	9.6				Sandstone
Burro Canyon	WMMW-16	45.0' - 45.5'	5.6	12.6	140.9	16.4	2.70	77.2		29.6	15.4	14.2	Sandy Mudstone
	WMMW-16	47.5' - 48.0'	2.6	5.9	142.8	12.0	2.60	48.9	4.4				Sandstone
	WMMW-16	53.5' - 54.1'	0.7	1.4	129.0	19.9	2.58	7.1	6.4				Sandstone
	WMMW-16	60.5' - 61.0'	0.1	0.2	117.9	27.3	2.61	0.8	9.9				Sandstone
	WMMW-16	65.5' - 66.0'	2.6	5.5	131.5	19.3	2.62	28.2	7.1				Sandstone
	WMMW-16	73.0' - 73.5'	0.1	0.3	130.3	20.6	2.63	1.3	5.5				Sandstone
	WMMW-16	82.0' - 82.4'	0.1	0.1	134.3	18.5	2.64	0.6	4.8				Sandstone
	WMMW-16	90.0' - 90.7	0.1	0.3	161.5	2.0	2.64	12.8	0.9				Sandstone
	WMMW-16	91.1' - 91.4'	5.2	9.8	118.1	29.1	2.67	33.8		33.7	16.2	17.5	Claystone
	WMMW-17	104.0' - 104.5'	0.2	0.4	161.4	1.7	2.67	26.6	0.8				Sandstone
Average:			**1.65**	**3.4**	**135**	**17.6**	**2.63**	**21**	**5.5**				

Table 2.2

Summary of Hydraulic Properties
White Mesa Uranium Mill

Boring/Well Location	Test Type	Interval (ft-ft)	Document Referenced	Hydraulic Conductivity (ft/yr)	Hydraulic Conductivity (cm/sec)
Soils					
6	Laboratory Test	9	D&M	1.2E+01	1.2E-05
7	Laboratory Test	4.5	D&M	1.0E+01	1.[illegible]E-05
10	Laboratory Test	4	D&M	1.2E+01	1.2E-05
12	Laboratory Test	9	D&M	1.4E+02	1.4E-04
16	Laboratory Test	4.5	D&M	2.2E+01	2.1E-05
17	Laboratory Test	4.5	D&M	9.3E+01	9.0E-05
19	Laboratory Test	4	D&M	7.0E+01	6.8E-05
22	Laboratory Test	4	D&M	3.9E+00	3.8E-06
			Geometric Mean	2.45E+01	2.37E-05
Dakota Sandstone					
No. 3	Injection Test	28-33	D&M (1)	5.68E+02	5.49E-04
No. 3	Injection Test	33-42.5	D&M	2.80E+00	2.71E-06
No. 12	Injection Test	16-22.5	D&M	5.10E+00	4.93E-06
No. 12	Injection Test	22.5-37.5	D&M	7.92E+01	7.66E-05
No. 19	Injection Test	26-37.5	D&M	7.00E+00	6.77E-06
No. 19	Injection Test	37.5-52.5	D&M	9.44E+02	9.12E-04
			Geometric Mean	4.03E+01	3.89E-05
Burro Canyon Formation					
No. 3	Injection Test	42.5-52.5	D&M	5.80E+00	5.61E-06
No. 3	Injection Test	52.5-63	D&M	1.62E+01	1.57E-05
No. 3	Injection Test	63-72.5	D&M	5.30E+00	5.13E-06
No. 3	Injection Test	72.5-92.5	D&M	3.20E+00	3.09E-06
No. 3	Injection Test	92.5-107.5	D&M	4.90E+00	4.74E-06
No. 3	Injection Test	122.5-142	D&M	6.00E-01	5.80E-07
No. 9	Injection Test	27.5-42.5	D&M	2.70E+00	2.61E-06
No. 9	Injection Test	42.5-59	D&M	2.00E+00	1.93E-06
No. 9	Injection Test	59-82.5	D&M	7.00E-01	6.77E-07
No. 9	Injection Test	82.5-107.5	D&M	1.10E+00	1.06E-06
No. 9	Injection Test	107.5-132	D&M	3.00E-01	2.90E-07
No. 12	Injection Test	37.5-57.5	D&M	9.01E-01	8.70E-07
No. 12	Injection Test	57.5-82.5	D&M	1.40E+00	1.35E-06
No. 12	Injection Test	82.5-102.5	D&M	1.07E+01	1.03E-05
No. 28	Injection Test	76-87.5	D&M	4.30E+00	4.16E-06
No. 28	Injection Test	87.5-107.5	D&M	3.00E-01	2.90E-07
No. 28	Injection Test	107.5-132.5	D&M	2.00E-01	1.93E-07
WMMW1	(7) Recovery	92-112	Peel (2)	3.00E+00	2.90E-06
WMMW3	(7) Recovery	67-87	Peel	2.97E+00	2.87E-06
WMMW5	(7) Recovery	95.5-133.5	H-E	1.31E+01	1.27E-05
WMMW5	(7) Recovery	95.5-133.5	Peel	2.10E+01	2.03E-05
WMMW11	(7) Recovery	90.7-130.4	H-E (3)	1.23E+03	1.19E-03
WMMW11	(7) Single well drawdown	90.7-130.4	Peel	1.63E+03	1.58E-03
WMMW12	(7) Recovery	84-124	H-E	6.84E+01	6.61E-05
WMMW12	(7) Recovery	84-124	Peel	6.84E+01	6.61E-05
WMMW14	Single well drawdown	90-120 (5)	H-E	1.21E+03	1.16E-03
WMMW14	Single well drawdown	90-120 (6)	H-E	4.02E+02	3.88E-04
WMMW15	Single well drawdown	99-129	H-E	3.65E+01	3.53E-05
WMMW15	(7) Recovery	99-129	Peel	2.58E+01	2.49E-05

Table 2.2

Summary of Hydraulic Properties
White Mesa Uranium Mill
(Continued)

Boring/Well Location	Test Type	Interval (ft-ft)	Document Referenced	Hydraulic Conductivity (ft/yr)	Hydraulic Conductivity (cm/sec)
WMMW16	Injection Test	28.5-31.5	Peel	9.42E+02	9.10E-04
WMMW16	Injection Test	45.5-51.5	Peel	5.28E+01	5.10E-05
WMMW16	Injection Test	65.5-71.5	Peel	8.07E+01	7.80E-05
WMMW16	Injection Test	85.5-91.5	Peel	3.00E+01	2.90E-05
WMMW17	Injection Test	45-50	Peel	3.10E+00	3.00E-06
WMMW17	Injection Test	90-95	Peel	3.62E+00	3.50E-06
WMMW17	Injection Test	100-105	Peel	5.69E+00	5.50E-06
WMMW18	Injection Test	27-32	Peel	1.14E+02	1.10E-04
WMMW18	Injection Test	85-90	Peel	2.59E+01	2.50E-05
WMMW18	Injection Test	85-90	Peel	2.69E+01	2.60E-05
WMMW18	Injection Test	120-125	Peel	4.66E+00	4.50E-06
WMMW19	Injection Test	55-60	Peel	8.69E+00	8.40E-06
WMMW19	Injection Test	95-100	Peel	1.45E+00	1.40E-06
			Geometric mean	1.05E+01	1.01E-05
Entrada/Navajo Sandstones					
WW-1	Recovery		D'Appolonia (4)	3.80E+02	3.67E-04
WW-1	Multi-well drawdown		D'Appolonia	4.66E+02	4.50E-04
WW-1,2,3	Multi-well drawdown		D'Appolonia	4.24E+02	4.10E-04
			Geometric Mean	4.22E+02	4.08E-04

Notes:
(1) D&M = Dames & Moore, Environmental Report, White Mesa Uranium Project, January, 1978.
(2) Peel = Peel Environmental Services, UMETCO Minerals Corp., Ground Water Study, White Mesa Facility, June, 1994.
(3) H-E = Hydro-Engineering, Ground-Water Hydrology at the White Mesa Tailings Facility, July, 1991.
(4) D'Appolonia, Assessment of the Water Supply System, White Mesa Project, Feb. 1981
(5) Early test data.
(6) Late test data.
(7) Test data reanalyzed by TEC.

mudstone and siltstone; its permeability is lower than the overlying Burro Canyon Formation and prevents downward percolation of ground water (Haynes, et al, 1972). Observed plasticity of claystones (Umetco, 1992) forming the Brushy Basin Member indicates low potential for open fractures which could increase permeability.

Previous investigators have seldom made a distinction between the Dakota and Burro Canyon Sandstones. However, examination of borehole cuttings, cores and geophysical logging methods has allowed separation of the two formations. Although similar to the Dakota, the Burro Canyon Formation varies from a very fine- to coarse-grained sandstone. The sand grains are generally poorly sorted. The coarse-grained layers also tend to be conglomeratic. The grains are cemented with both silica and kaolin, but silica cemented sandstones are dominant. The formation becomes argillaceous near the contact with the Brushy Basin Member.

The saturated thickness in the Burro Canyon Formation varies across the project area from 55 feet in the northern section to less than 5 feet in the southern area. Saturation ceases or is marginal along the western and southern section of the project. The extent toward the east is not defined, but its maximum extent is certainly not beyond the walls of Westwater Creek and Corral Canyons where the Burro Canyon Formation crops out. Perched ground water elevations and saturated thickness of this formation are shown on Figures 2.4 and 2.5, respectively.

Hydraulic properties of this stratum have been determined from 12 single, well-pumping/recovery tests and from 30 packer tests. A summary of the hydraulic properties is given in Table 2.2. These tests indicate the hydraulic conductivity geometric mean to be 1.0E-05 cm/sec. The physical properties of the Burro Canyon Sandstone are summarized in Table 2.1. Based on the core samples tested, the sandstones of the Burro Canyon Formation vary in total porosity from 1.7 to 27.6 percent, the average being 16.0 percent. Volumetric water content in these sandstones ranges from 0.1 to 7.1 percent, averaging 2.2 percent, with the fine-grained materials having the higher moisture content. Porosities in the claystone layers vary from 16.4 to 29.1 percent with saturation values ranging from 33.8 to 77.2 percent.

2.1.3 Brushy Basin Member

The Brushy Basin Member of the Morrison Formation is the first aquitard isolating perched water in the Burro Canyon Formation from the productive Entrada/Navajo Sandstones. The Brushy Basin Member, in contrast to the overlying Dakota Sandstone, is composed of bentonitic mudstone and claystone. Site-specific hydraulic property data are not available for the Brushy Basin Member.

The thickness of the Brushy Basin Member in this region reportedly varies from 200-450 feet (Dames & Moore, 1978). This stratum was penetrated by six water supply wells (see Figure 2.1 and Appendix A) and its thickness was estimated at 275 feet. During the site investigation, borings which terminated in the Brushy Basin Member, encountered moderately plastic dark green to dark reddish-brown mudstones. Plastic bentonitic mudstone is not prone to develop fracturing. Hence, competency of this strata, as on aquitard, is very likely.

2.1.4 Entrada/Navajo Aquifer

Within and in proximity to the site, the Entrada/Navajo Sandstones are both prolific aquifers. Since site water wells are screened in both aquifers, they are, from a hydrogeologic standpoint, treated as a single aquifer. The Entrada/Navajo Sandstone is the first useable aquifer of significance documented within the project area. This aquifer is present at depths between 1200 and 1800 feet below the surface and is capable of delivering from 150 to 225 gpm of water per well (D'Appolonia, 1981).

Water is present under artesian pressure and is documented to rise by about 800 to 900 feet above the top of Entrada/Navajo Sandstone contact with the overlying Summerville Formation. The static water level is about 400 to 500 feet below the surface (Figures 2.2 and 2.3). Section 3.4.1 provides a more detailed discussion regarding the artesian conditions of this formation.

The thickness of the strata separating this aquifer from water present in the Burro Canyon Formation is about 1,200 feet. This confining layer is competent enough to maintain pressure

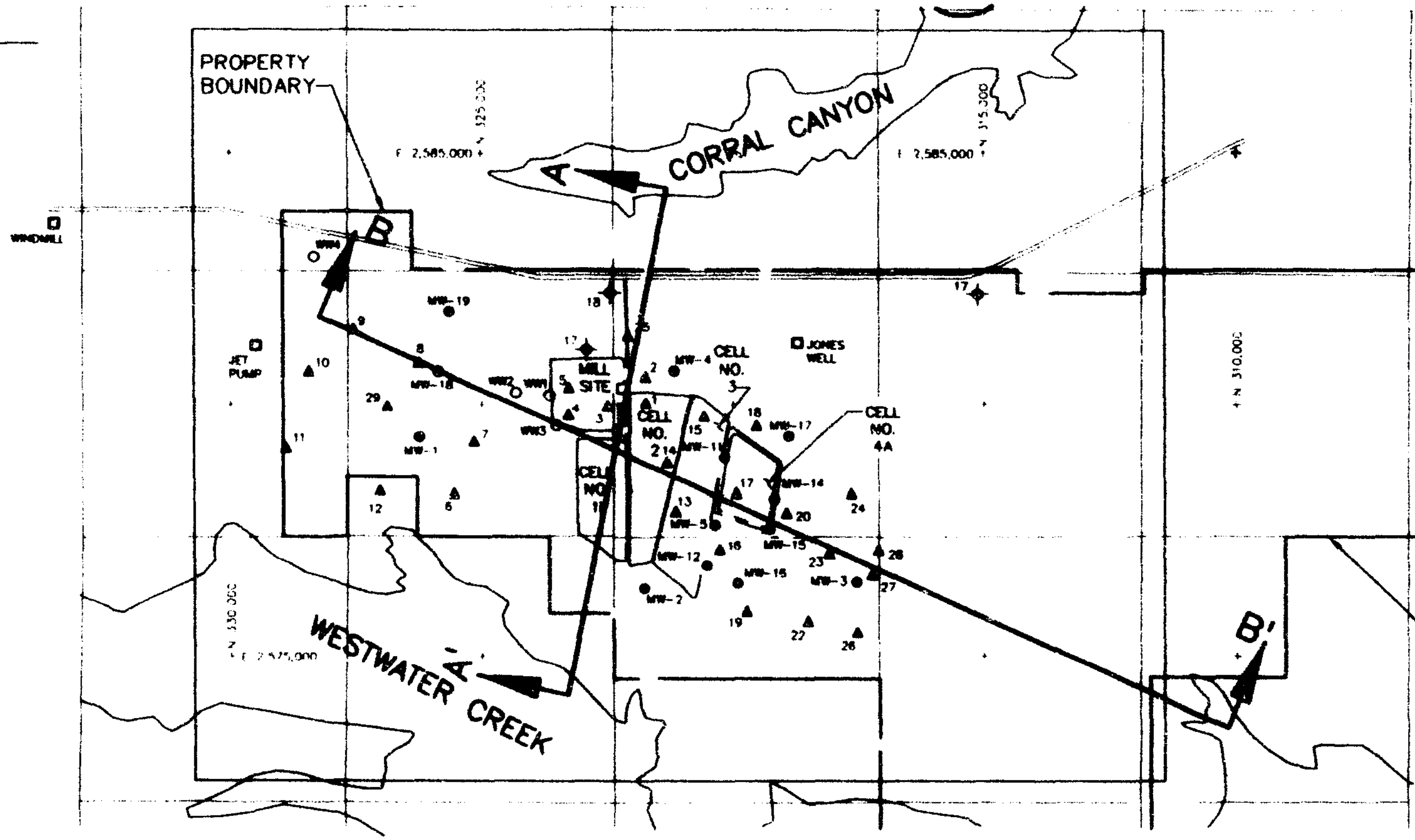
of 900 feet of water or 390 pounds per square inch (psi) within the Entrada/Navajo Aquifer. The positioning of this aquifer and its hydraulic head versus other strata is shown on Figures 2.2 and 2.3. In-situ hydraulic pressure of ground water in the Entrada/Navajo Aquifer is strong evidence of the "aquitard" properties of the overlying sedimentary section. Due to the presence of significant artesian pressure in this aquifer, any future hydraulic communication between perched water in the Burro Canyon Formation and the Entrada/Navajo Aquifer is unlikely.

2.2 Perched Ground Water Characteristics

The perched water in the Burro Canyon Formation originates in the areas north of the site as shown by the direction of ground water flow from north to south (see Figure 2.4). The thickness of saturation is greatest in the northern and central sections of the site and reduces toward the south. The configuration of the perched water table and map of saturated thicknesses are provided on Figures 2.4 and 2.5, respectively. The topography of the Brushy Basin Member which defines the bottom of the perched water is shown on Figure 2.6.

The ground water from the Burro Canyon Formation discharges into the adjacent canyons (Westwater Creek and Corral Canyon) as evidenced by springs and productive vegetation patterns. Some part of the ground water flow may enter the Brushy Basin Member via relief fractures which occur in close proximity to the canyons. The location of the canyons which bound the White Mesa on the west, east and south are shown on Figure 2.1.

The geometric mean of the hydraulic conductivity of the saturated part of Burro Canyon Formation is 1.0E-05 cm/sec. The water yield per well is very low, as documented by 9 pumping tests, and is typically below 0.5 gpm. In contrast to the very low pumping rates observed in 8 wells, Well WMMW-11 produced a higher yield on the order of 2 gpm. This higher yield may be attributable to the presence of localized high-permeability material, such as a lense of coarser material acting as a drainage gallery. Localized fracturing could also cause a similar effect, but few fractures have been documented during drilling of this or other wells (Umetco, 1992; Dames & Moore, 1978).



LEGEND:

- DAMES AND MOORE 1978 BORINGS
- WATER SUPPLY WELLS D'APPOLONIA (1981)
- EXISTING MONITORING WELLS
- EXISTING WATER SUPPLY WELLS
- STOCK WELLS
- CROSS SECTION LOCATIONS

SCALE

2000 0 2000 4000 FEET

SITE PLAN MAP
WHITE MESA MILL
BLANDING, UTAH

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

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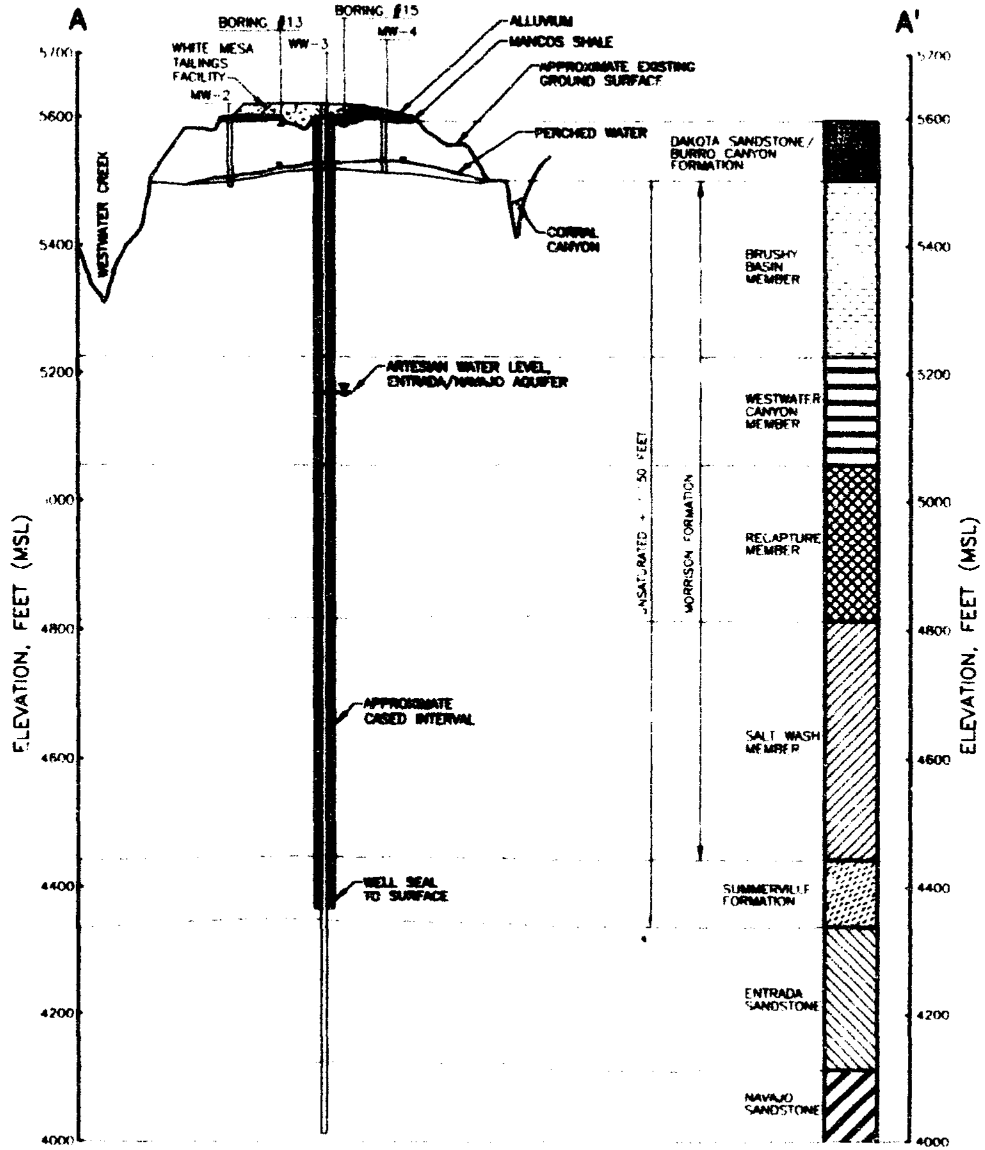
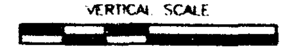
FIGURE 2.1

DRAWING NUMBER 4111-B5

DRAWING NUMBER 4111-B2





NOTES:

1. CONTACTS ARE APPROXIMATE BASED ON DRILLERS LOGS
2. BORINGS HAVE BEEN PROJECTED

No	DATE	ISSUE / REVISION			
△		ISSUED FOR DRAFT SUBMITTAL			

CROSS SECTION A–A'
WEST TO EAST THROUGH WHITE MESA
WESTWATER CREEK
TO CORRAL CANYON

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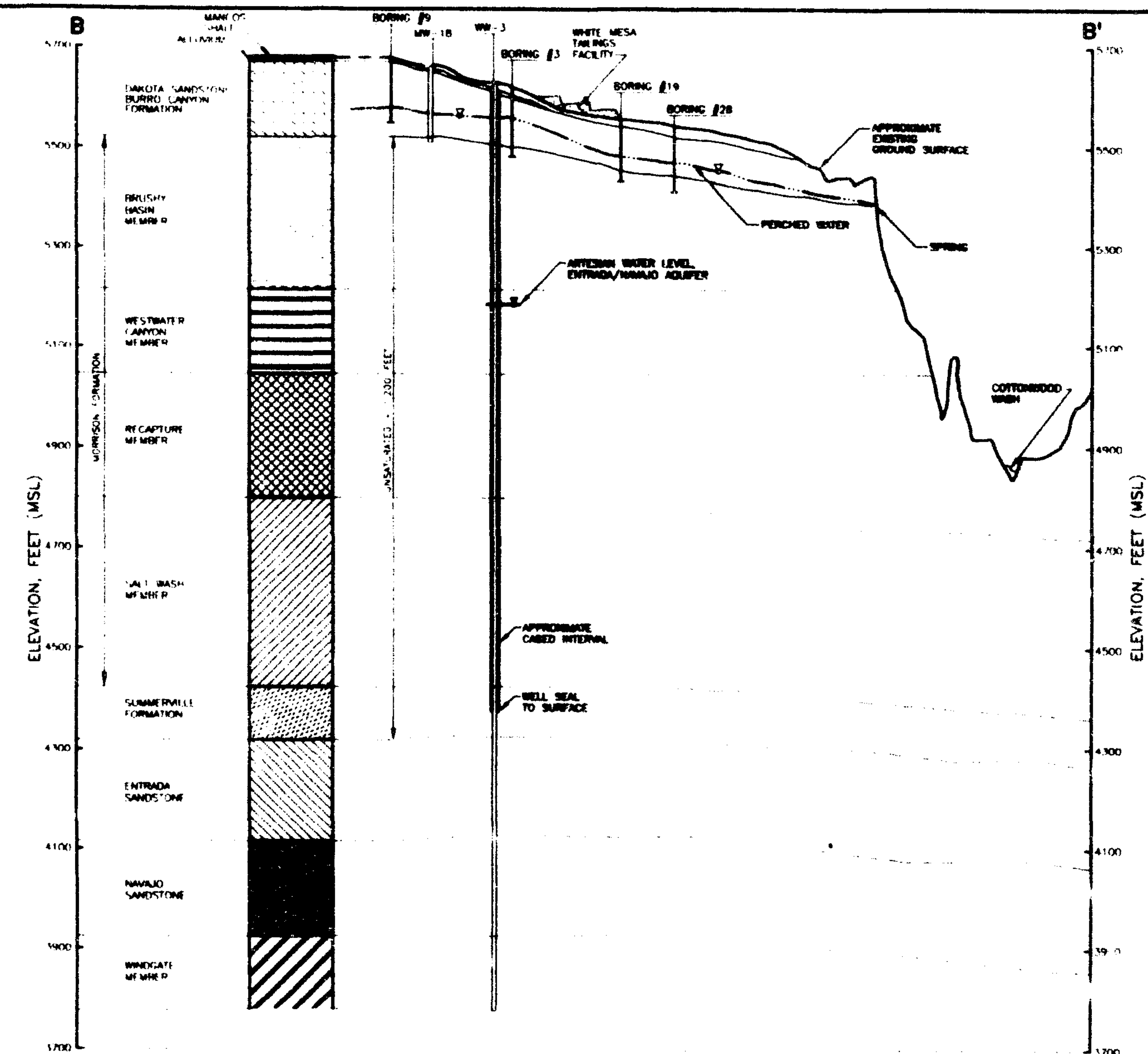
FIGURE 2.2

DRAWING NUMBER 4111-B2



NOTES:

1. CONTACTS ARE APPROXIMATE BASED ON DRILLERS LOGS
2. BORINGS HAVE BEEN PROJECTED

VERTICAL SCALE

200 0 200 FEET

CROSS SECTION B-B'
NORTH TO SOUTH THROUGH WHITE MESA
NORTH OF FACILITY
TO COTTONWOOD WASH

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FIGURE 2.3

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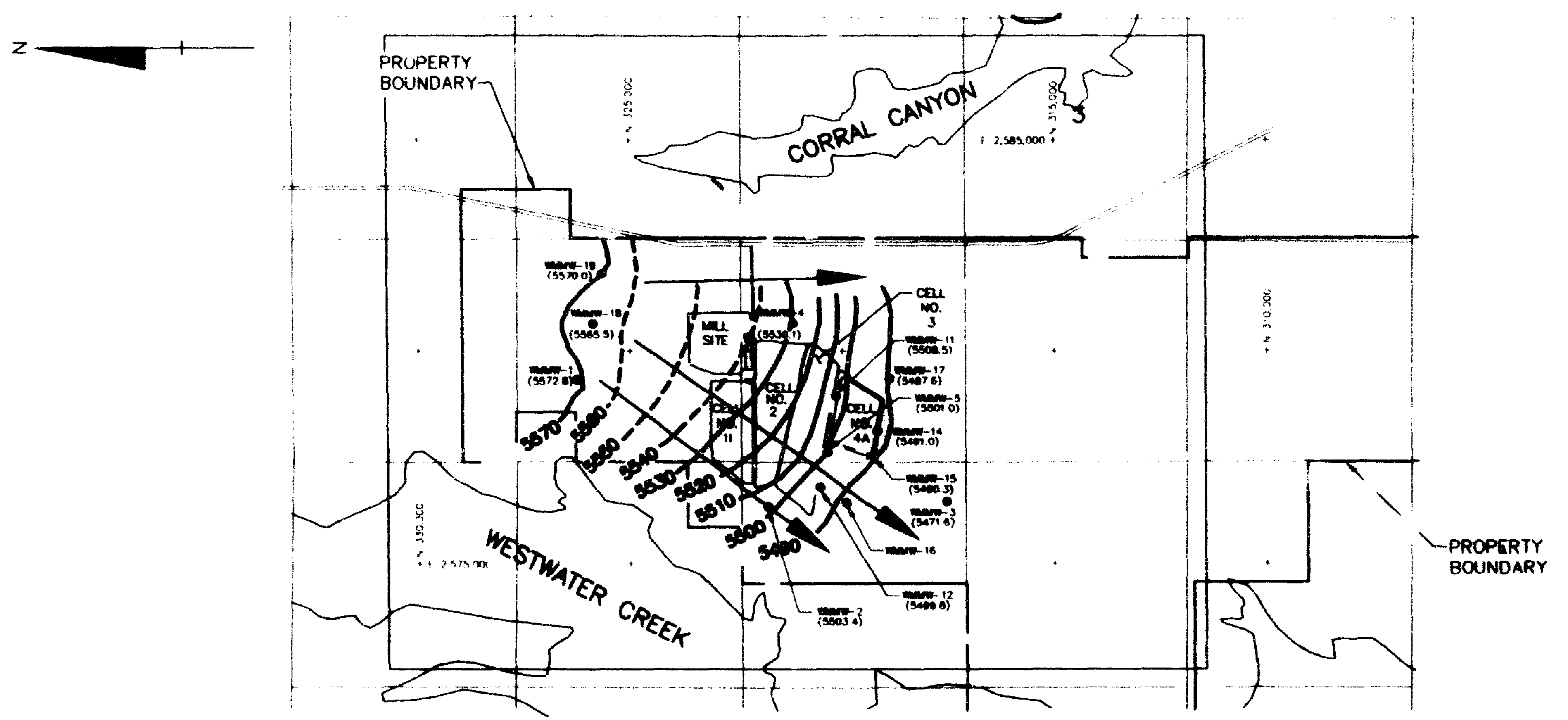
DRAWING NUMBER 4111-B9



LEGEND:

- - 5560 CONTOUR IN FEET ABOVE MEAN SEA LEVEL

——▶ GROUND WATER FLOW DIRECTION

SCALE

2000 0 2000 4000 FEET

PERCHED GROUND WATER LEVELS
FALL 1992
WHITE MESA MILL
BLANDING, UTAH

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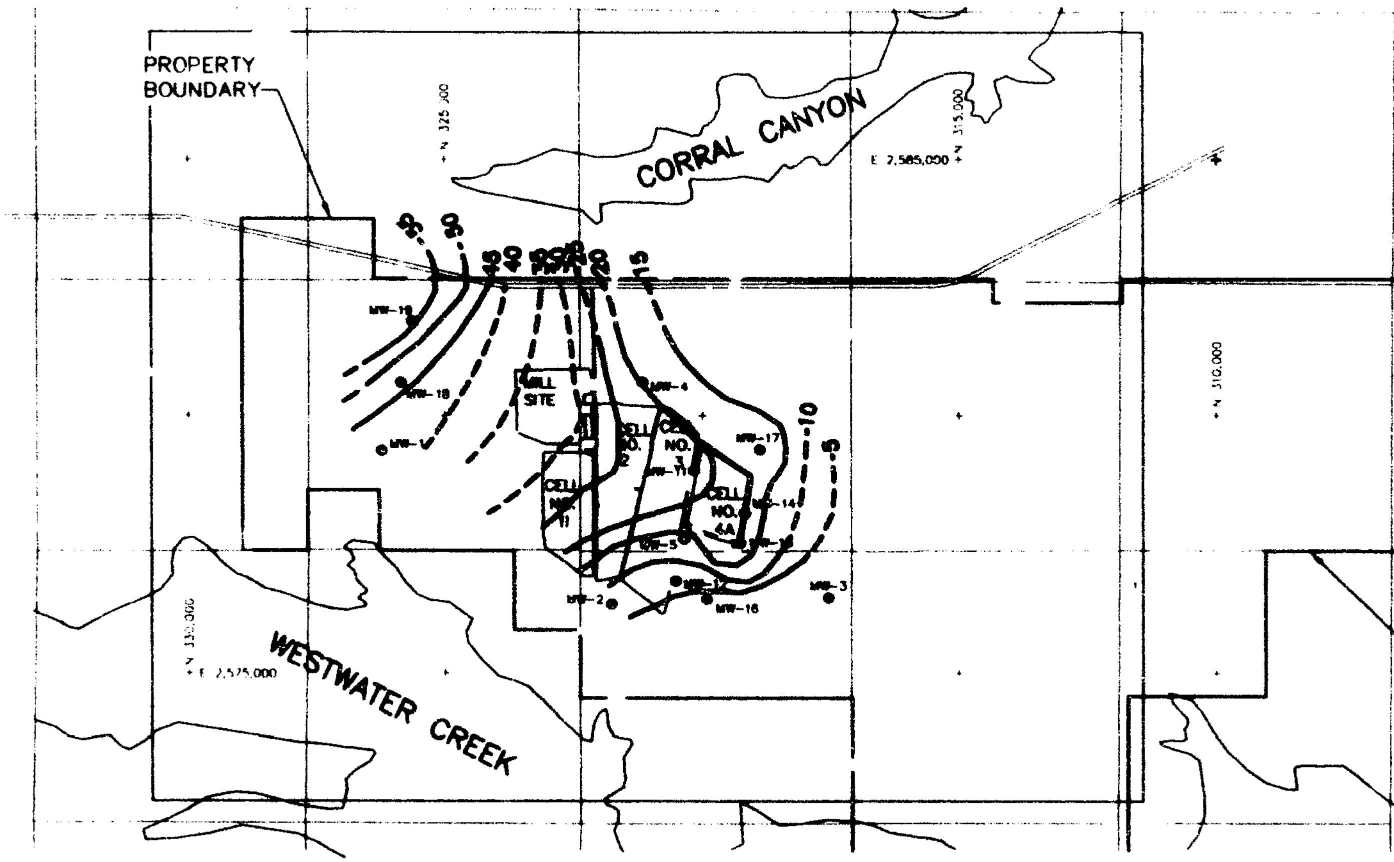
DATE 7-18-94 SCALE AS SHOWN	FIGURE 2.4	DRAWING NUMBER 4111-B9



SCALE

2000 0 2000 4000 FEET

LEGEND:

—5 SATURATED THICKNESS IN FEET

SATURATED THICKNESS FALL 1992
BURRO CANYON FORMATION
WHITE MESA MILL
BLANDING, UTAH

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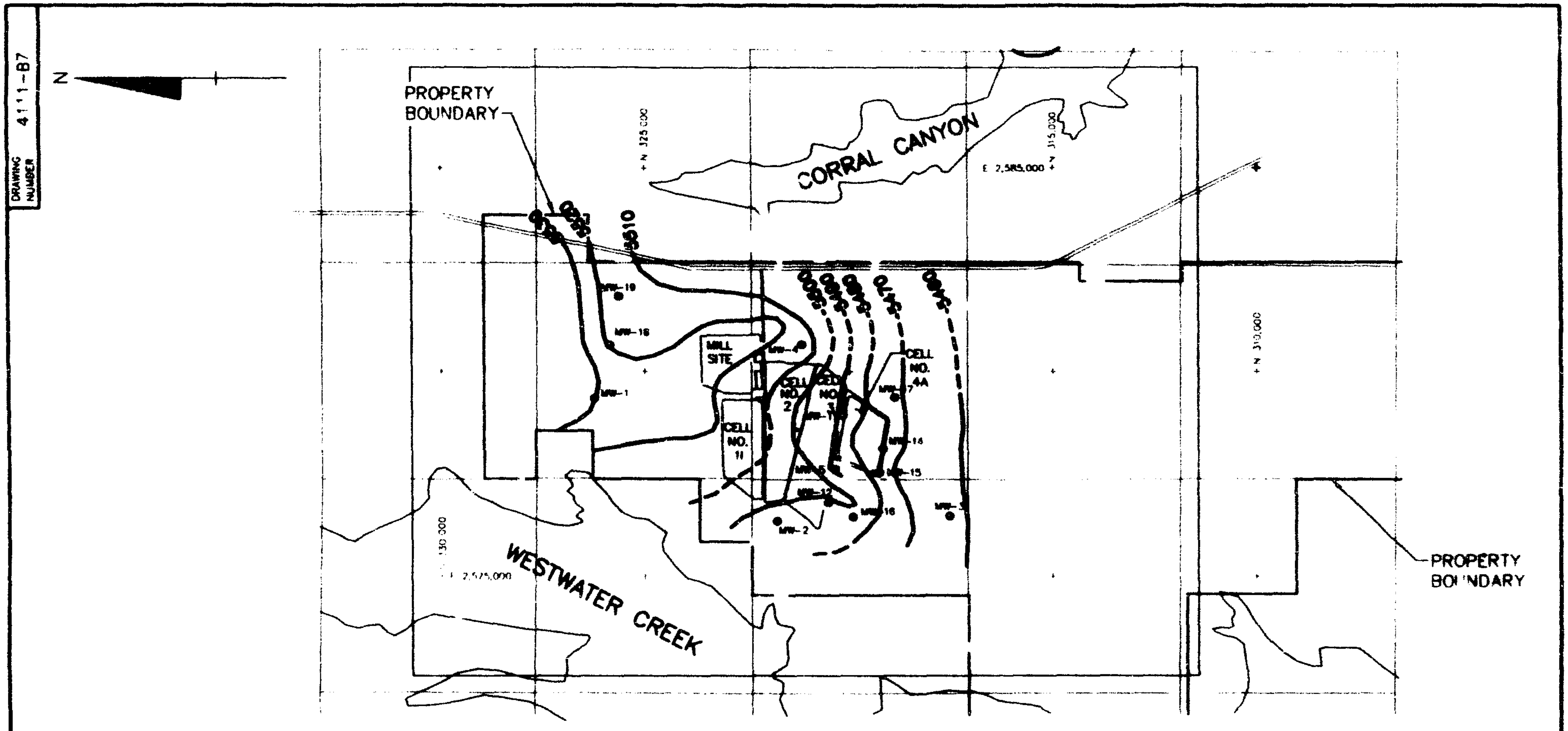
SCALE AS SHOWN

FIGURE 2.5

DRAWING NUMBER 4111-B8



LEGEND:

--- 5620 CONTOUR IN FEET ABOVE MEAN SEA LEVEL

ELEVATION OF TOP OF BRUSHY BASIN
WHITE MESA MILL
BLANDING, UTAH

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DATE: 7-18-94	FIGURE 2.6	DRAWING NUMBER 4111-B
SCALE: AS SHOWN		

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2.2.1 Perched Water Quality

Ground water monitoring of the Burro Canyon Formation saturated zone has been conducted at the White Mesa facility since 1979. Table 2.3 provides a list of wells that have been constructed for monitoring purposes at the facility. Figure 2.1 indicates the locations of these wells. The water quality data obtained from these wells are provided both in tabular and graphical form in Appendix B.

Examination of the spatial distribution and temporal trends (or lack thereof) in concentrations of analyzed constituents provides three significant conclusions:

1. The quality of perched water throughout the site shows no discernible pattern in variation,

2. The water qu. .y is generally of poor quality [moderately high values of chloride, sulfate, and totally dissolved solids (TDS)], and

3. Analytical results show that operations at the White Mesa Uranium Mill have not impacted the quality of the perched water of the Burro Canyon Formation.

To arrive a these conclusions, comparisons of the water chemistries from the various wells were analyzed by graphical techniques. The purpose of the comparisons was to determine if trends in chloride, which would be associated with water from the tailings ponds, were increasing in the perched water of the Burro Canyon Formation. The trilinear plot and the Stiff diagram were used to conduct a preliminary evaluation of differences or similarities in water quality data between wells.

2.2.1.1 Temporal and Spatial Variations

Figure 2.7 is a trilinear plot for the water sampled in wells in the immediate vicinity of the Mill site during the fall of 1992. Figures 2.8 through 2.10 are Stiff diagrams presenting the same data. These plots show that the water from all wells is of the sulfate (anion) type. The cation

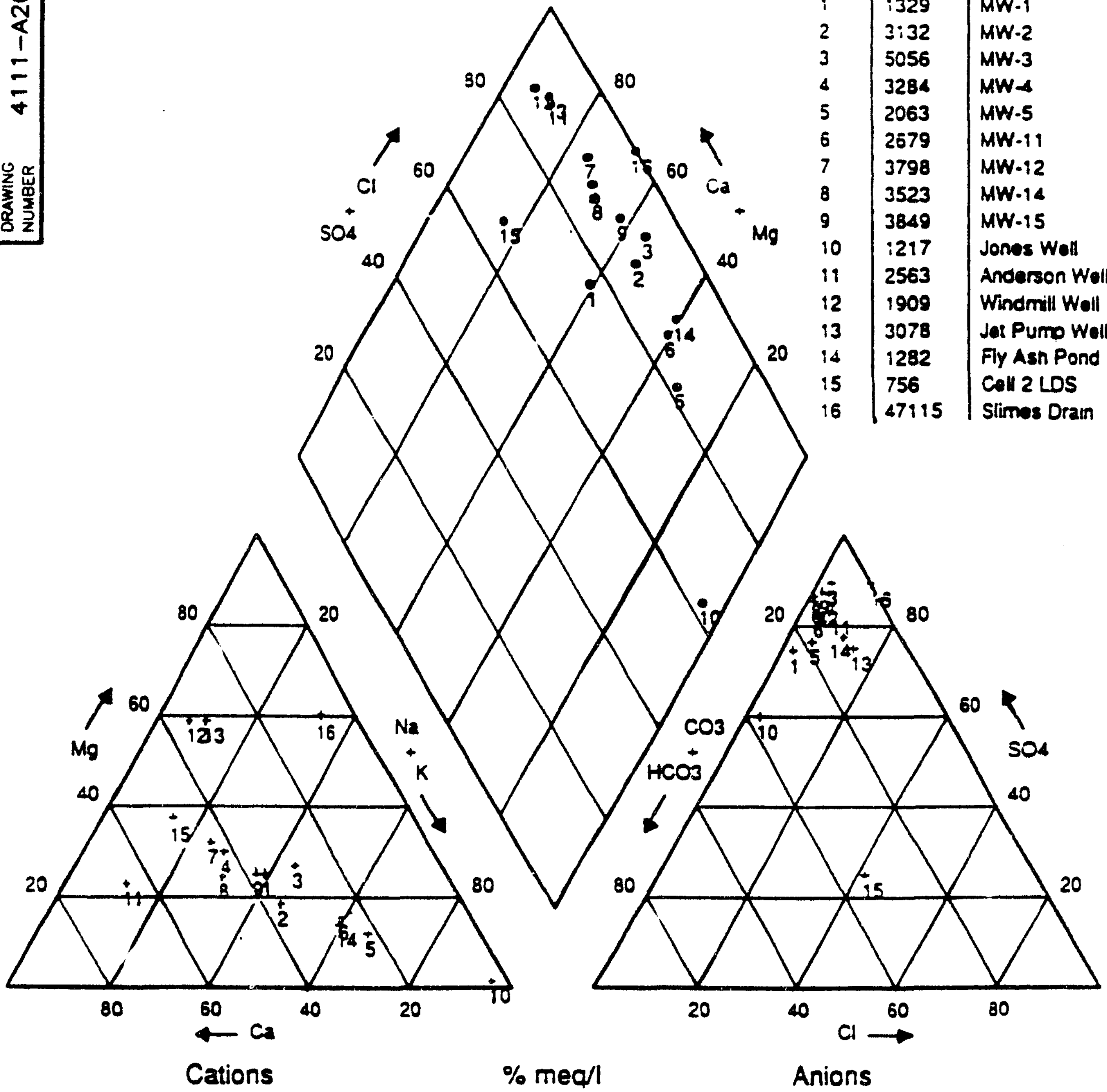
Table 2.3

Monitoring Well and Ground Water Elevation Data
White Mesa Uranium Mill

Well Name	Date Installed	Total Depth	Perforations	Water Level Date	Water Level Depth (ft)	Water Level Elevation (ft-MSL)	Measuring Point Above LDS (ft)	Measuring Point Elevation (ft-MSL)
WMMW-1	Sep-79	117'	92'-112'	11/19/92	75.45	5572.77	2.0	5648.22
WMMW-2	Sep-79	128.8'	85'-125'	11/19/92	110.06	5503.43	1.8	5613.49
WMMW-3	Sep-79	98'	67'-87'	11/19/92	83.74	5471.58	2.0	5555.32
WMMW-4	Sep-79	123.6'	92'-12'	11/19/92	92.42	5530.15	1.6	5622.57
WMMW-5	May-80	136'	95.5'-133-5'	11/19/92	108.32		0.6	5609.33
WMMW-6	May-80	This well was destroyed in March 1993 during construction of Cell 3.						
WMMW-7	May-80	This well was destroyed in March 1993 during construction of Cell 3.						
WMMW-8	May-80	This well was destroyed in March 1993 during construction of Cell 3.						
WMMW-11	Oct-82	135'	90.7-130.4'	11/19/92	102.53	5508.55	2.4	5611.08
WMMW-12	Oct-82	130.3'	84'-124'	11/19/92	109.68	5499.77	0.9	5609.45
WMMW-13	Oct-82	118.5'	This well was destroyed during construction of Cell 4A					
WMMW-14	Sep-89	129.1'	90'-120'	11/19/92	105.34	5491.05	0.0	5596.39
WMMW-15	Sep-89	138'	99'-129'	11/19/92	108.28	5490.34	0.8	5598.62
WMMW-16	Dec-92	91.5'	78.5'-88.5'	7/12/92	Dry		1.5	
WMMW-17	Dec-92	110'	90'-100'	11/30/92	87.56		1.5	
WMMW-18	Dec-92	148.5'	103.5'-133.5'	11/30/92	92.11		1.5	
WMMW-19	Dec-92	149'	101'-131'	10/12/92	85.00		1.5	
#9-1	May-80	33.5'	10'-30'	3/4/91	Dry		1.8	5622.83
#9-2	May-80	62.7'	39.7''-59 7''	3/4/91	Dry		2	5622.58
#10-2	May-80	33.5'	11.3'-31.3'	3/4/91	Dry		2	5633.58
#10-2	May-80	62.2'	39.2'-59.2'	3/4/91	Dry		2.1	5633.39

Notes:
1. Well locations provided on Figure 2.1.
2. LDS = leak detection system
3. ft.-MSL = feet - mean sea level

No.	TDS	Well Name
1	1329	MW-1
2	3132	MW-2
3	5056	MW-3
4	3284	MW-4
5	2063	MW-5
6	2679	MW-11
7	3798	MW-12
8	3523	MW-14
9	3849	MW-15
10	1217	Jones Well
11	2563	Anderson Well
12	1909	Windmill Well
13	3078	Jet Pump Well
14	1282	Fly Ash Pond
15	756	Cell 2 LDS
16	47115	Slimes Drain



TRILINEAR PLOT OF WATER FROM WHITE MESA MILL MONITOR WELLS, FLY ASH POND, SLIMES DRAIN AND SURROUNDING STOCK WELLS

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Umetco 1992

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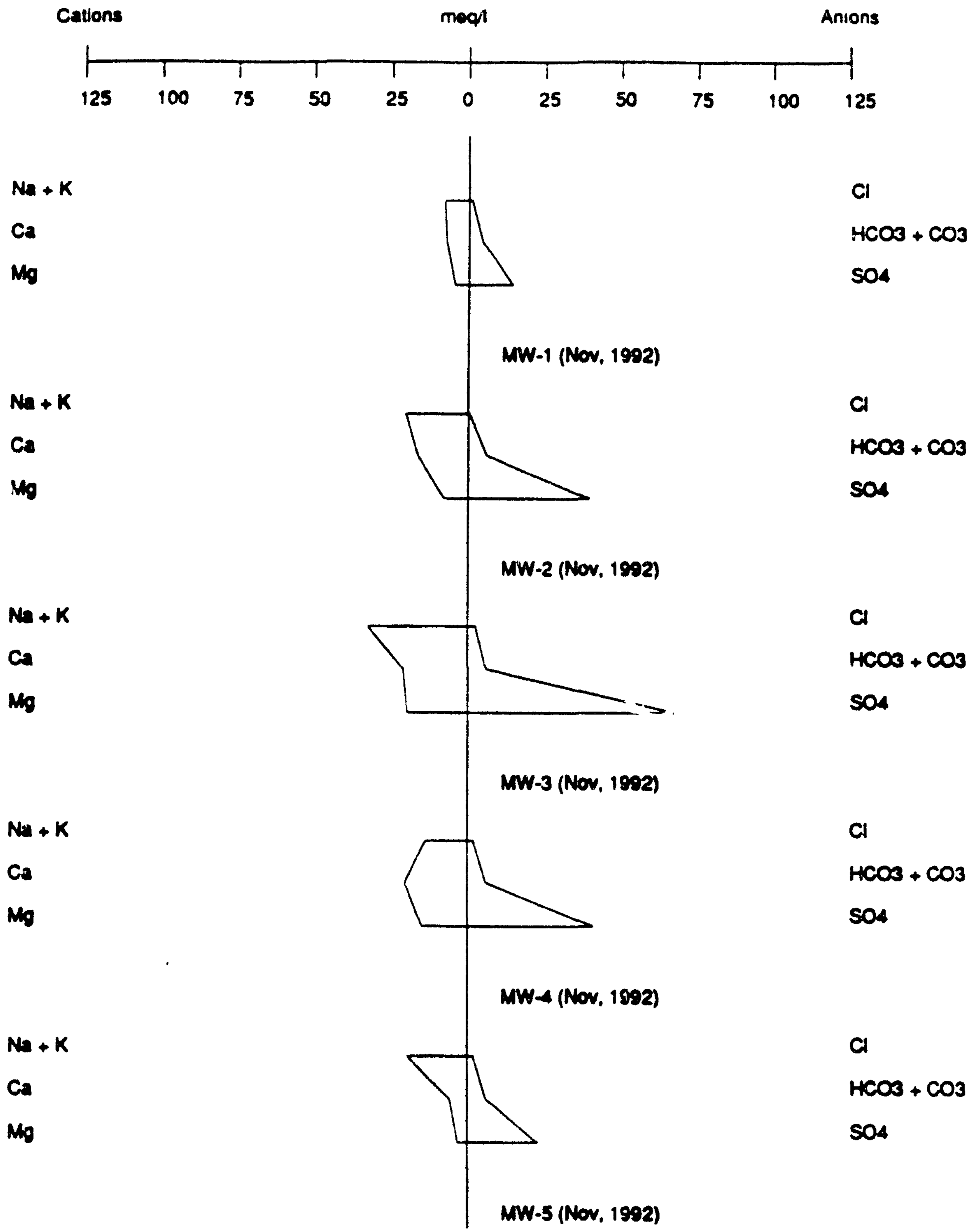
FIGURE 2.7

DRAWING NUMBER 4111-A20

⚠1



DRAWING NUMBER 4111-A14

STIFF DIAGRAMS OF
WATER FROM MONITOR WELLS

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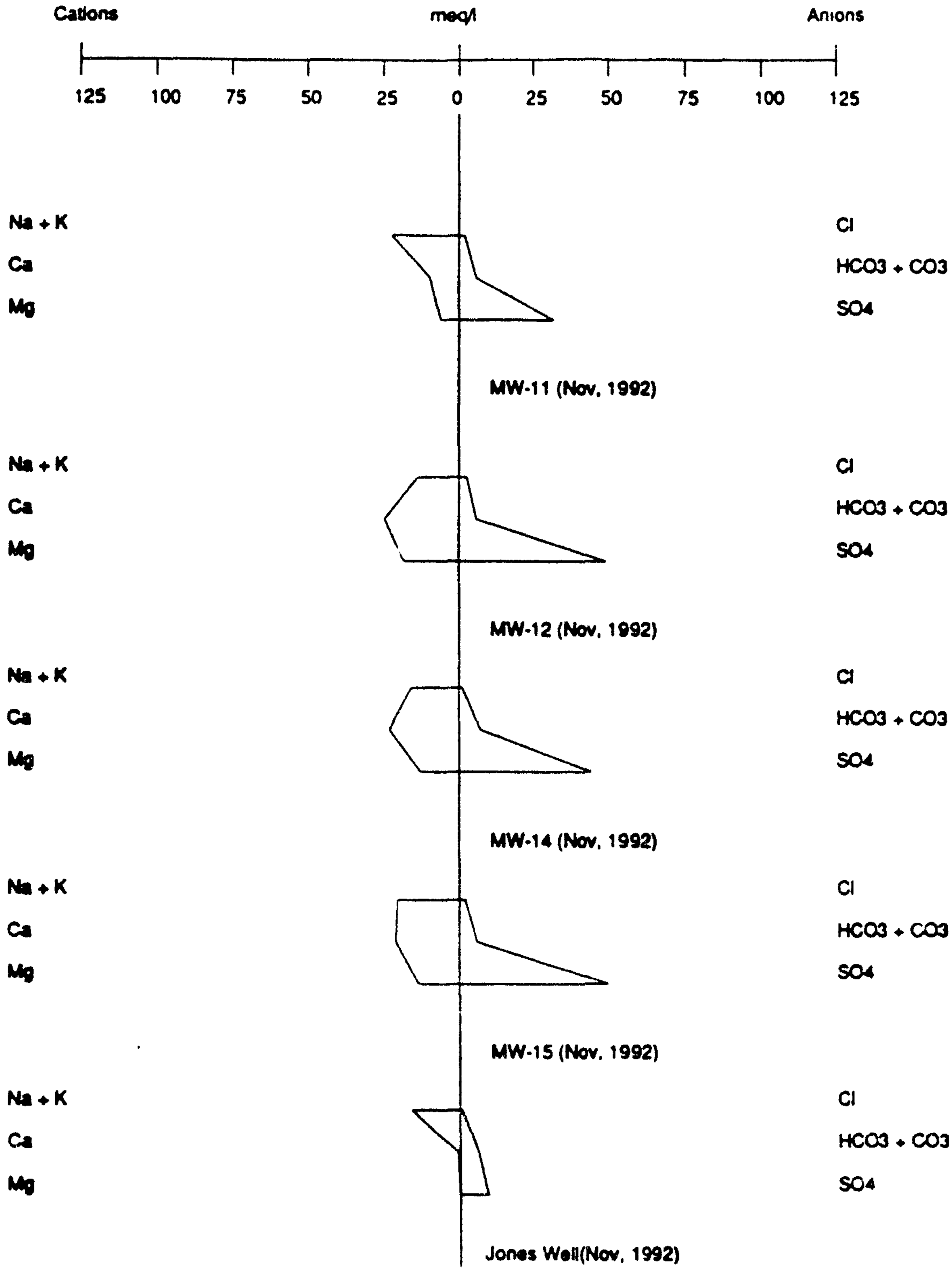
FIGURE 2.8

DRAWING NUMBER
4111-A14

1

DRAWING NUMBER 4111-A15



STIFF DIAGRAMS OF
WATER FROM MONITOR WELLS
AND STOCK WELL

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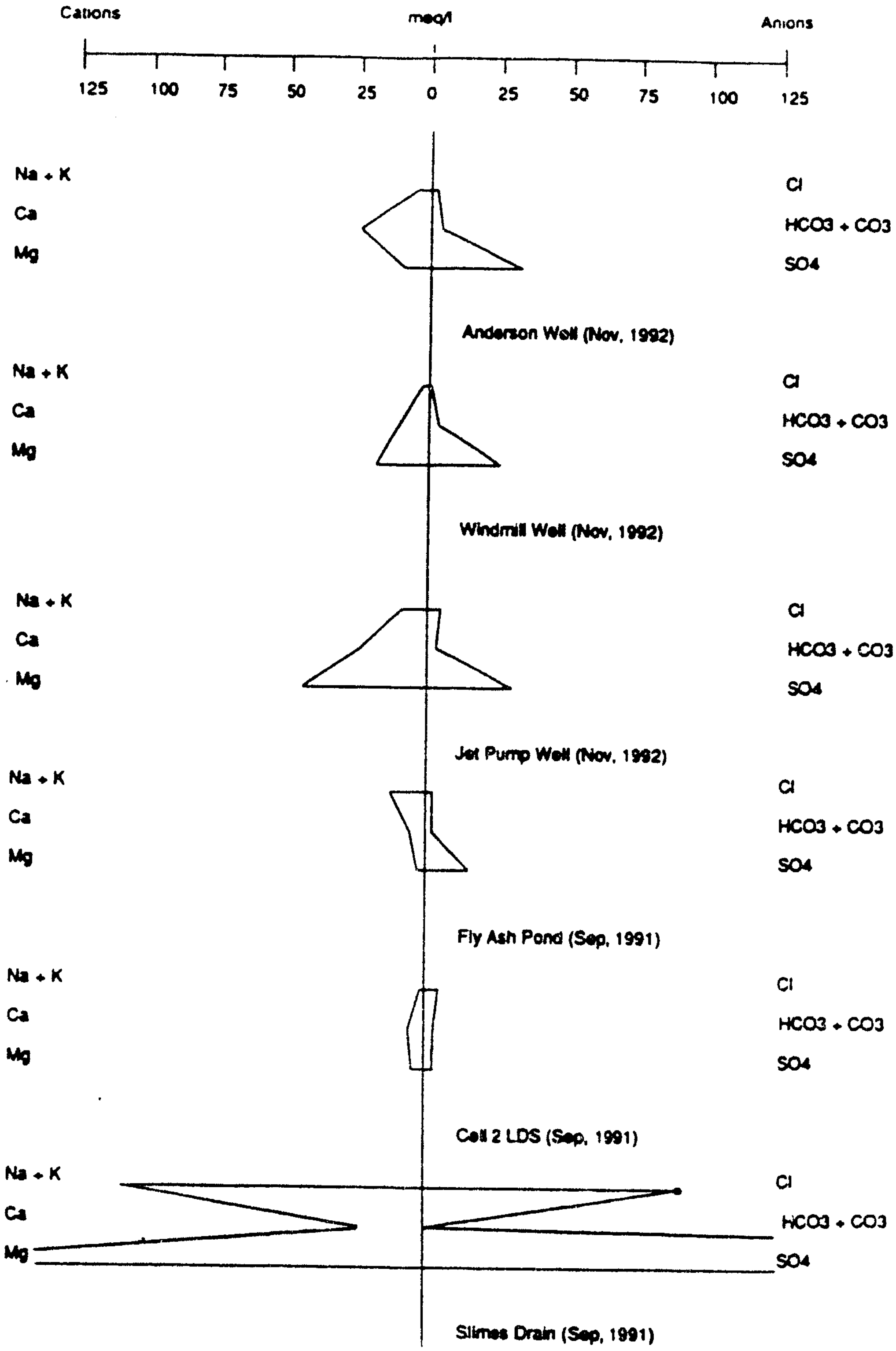
SCALE: N.T.S.

FIGURE 2.9

DRAWING NUMBER
4111-A15

⚠1

DRAWING NUMBER 4111-A16



STIFF DIAGRAMS OF SLIMES DRAIN, FLY ASH POND AND SURROUNDING STOCK WELLS

PREPARED FOR

ENERGY FUELS NUCLEAR
DENVER, COLORADO

REFERENCE:
Umetco 1992

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FIGURE 2.10

DRAWING NUMBER 4111-A16

1

definition of the water type is variable. Of the 13 wells analyzed for water chemistry, 4 fall in the calcium-sulfate type category, 4 fall in the (sodium plus potassium)-sulfate type, 2 samples classify as the magnesium-sulfate type. Five samples have no dominant cation type. However, these 5 samples tend to classify more closely to the (sodium plus potassium)-sulfate and calcium-sulfate types.

A temporal change of water chemistries may be suggested from four sampling periods for wells WMMW-1, WMMW-3 and WMMW-4 using the trilinear plotting technique shown on Figures 2.11 through 2.13. These figures suggest changes in water chemistries from October, 1979 through February 1991.

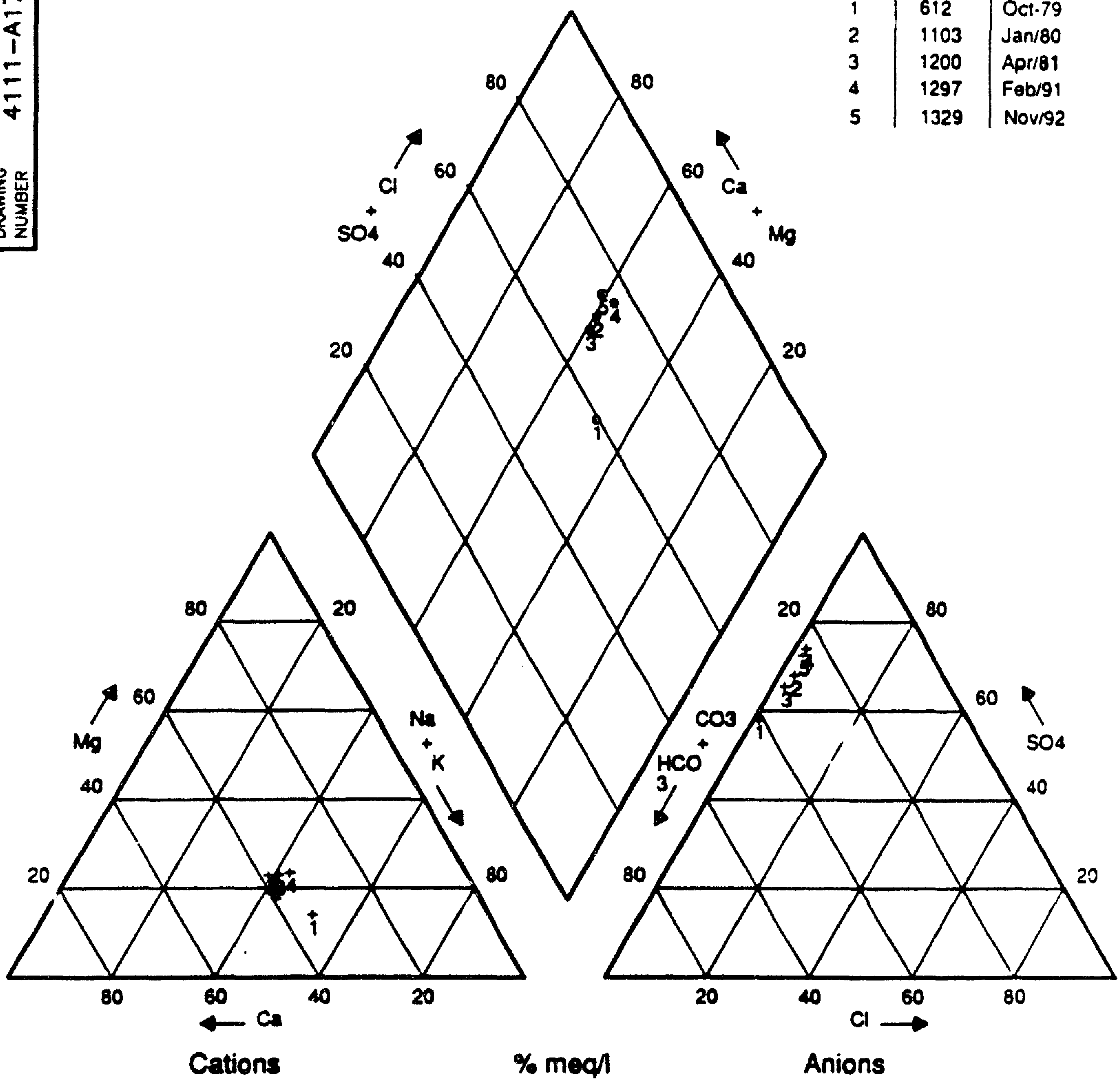
The spatial variability of water quality data within the Burro Canyon Formation is illustrated on Figures 2.7 through 2.13 and the data presented in Appendix B. Upgradient Monitoring Wells WMMW-1, WMMW-18, and WMMW-19 varied in sulfate concentrations from 676 to 1736 milligrams per liter (mg/l). Likewise, chloride concentrations in these wells varied from 12 to 92 mg/l. Across the site, sulfate and chloride concentrations vary with no discernible pattern to the variations. Details regarding chemistry of the Burro Canyon Formation water can be found in Appendix B, including the results of 1993 sampling for Wells WMMW-17, 18 and 19.

Variability of water within the Burro Canyon Formation is the result of slow moving to nearly stagnant ground water flow beneath the site. These conditions are likely leading to dissolution of minerals from the Brushy Basin Member and the formation of sulfate-dominated waters.

2.2.1.2 Statistical Analysis

Because of the variable ground water chemistry in the Burro Canyon Formation baseline data, comparison of individual well ground water chemistries to a single background ground water well may not be an appropriate method of monitoring potential disposal cell leakage or ground water impacts. Water quality baseline and comparisons to that baseline established on a well-by-well basis may be required to provide a meaningful representation of changes in ground water chemistry. Using this concept, the statistical "t" test was performed on samples from chloride

No.	TDS	Sample Date
1	612	Oct-79
2	1103	Jan/80
3	1200	Apr/81
4	1297	Feb/91
5	1329	Nov/92



Ref: Umetco, 1982.

TIME-SEQUENCE
TRILINEAR PLOT OF WMMW-1
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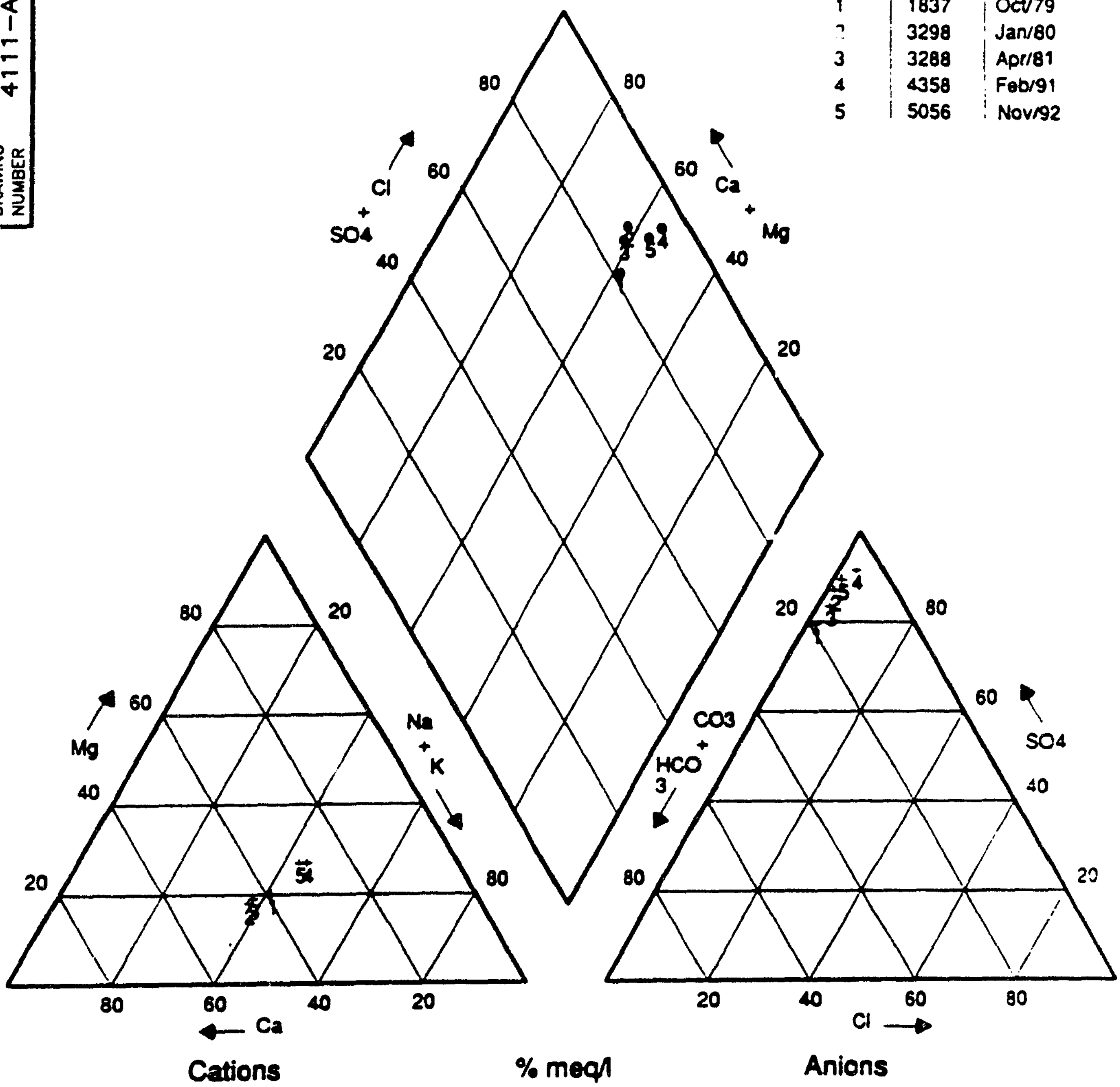
FIGURE 2.11

DRAWING NUMBER 4111-A17

No.	TDS	Sample Date
1	1837	Oct/79
2	3298	Jan/80
3	3288	Apr/81
4	4358	Feb/91
5	5056	Nov/92



TIME-SEQUENCE
TRILINEAR PLOT OF WMMW-3
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Umetco 1992

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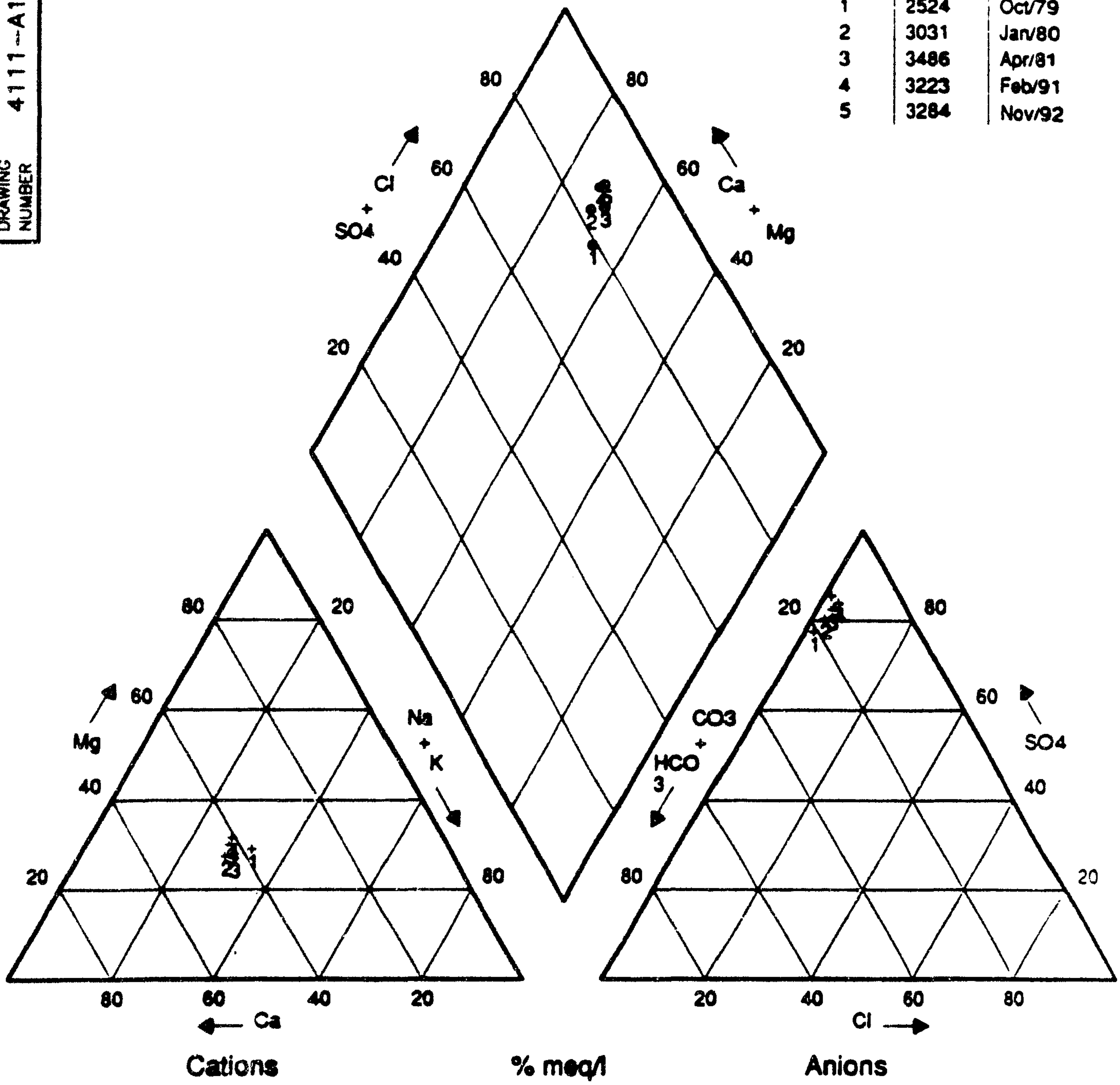
1		ISSUED FOR DRAFT SUBMITTAL	T.M.G.			DATE: 7-19-94 SCALE: N.T.S.	FIGURE 2.12	DRAWING NUMBER 4111-A18

No.	TDS	Sample Date
1	2524	Oct/79
2	3031	Jan/80
3	3486	Apr/81
4	3223	Feb/91
5	3284	Nov/92



TIME SEQUENCE
TRILINEAR PLOT OF WMMW-4

PREPARED FOR

ENERGY FUELS NUCLEAR
DENVER, COLORADO

REFERENCE:
Umetco 1992

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DATE: 7-19-94
SCALE: N.T.S.

FIGURE 2.13

DRAWING NUMBER 4111-A19

DRAWING NUMBER 4111-A19

1

populations within specific wells over time (see Appendix B). Because chlorides are a conservative species and are concentrated in the tailings solutions, this or other similar mobile constituents may be selected as an initial method of detecting impacts to the ground water.

Disposal Cell No. 2 leak detection system (LDS) water chemistry provides a useful picture of the water chemistry directly below Disposal Cell No. 2. The water analyzed in the Disposal Cell No. 2 LDS contains the lowest TDS content (756 mg/l) of any water sampled in the area (Appendix B) with the exception of the Jones well. The Jones well also contains the highest percentage of carbonate and bicarbonate when compared to the other monitoring wells. The slimes drain contains a TDS value of 47,115 mg/l and no carbonates due to its extremely low pH (typically 1.5 to 3). Any significant leakage of tailings solution into the LDS would react with the carbonates and raise the TDS levels. This has not occurred to date.

Well WMMW-1 (installed September 1979) was originally considered as a potential background well for the site. Chlorides in this well have been relatively low (varying from 11 to 53.2 mg/l) since 1980. A "t" test was performed on sample populations from 1980-81 and 1990-92 for Well WMMW-1. The test indicates that there is a significant difference in the mean of the populations at the 0.05 level of significance. The analysis indicates chloride levels decreased significantly. Tests performed on a sulfate population from the period 1980-81 to a population from 1990-92 show the sulfates in this well have increased significantly. Such changes in water chemistry in this potential background well suggest that water chemistry in the Brushy Basin Member is variable.

Well WMMW-3 (installed September 1979) was originally constructed to serve as the point of compliance well. Statistical testing ("t" test) on a chloride population from 1980-81 compared to a chloride population from 1990-92 shows that there is no significant difference in the two chloride populations. Sulfate samples taken 1980-81 compared to samples taken 1988-91 show there is a significant increase in sulfates.

For Well WMMW-5 (installed May 1980), the statistical "t" test performed on a sample from the chloride population of 1981-83 to a sample from a chloride population of 1990-92 shows there

is a significant difference in the means of the chloride populations and that the chloride content has decreased.

For Well WMMW-12 (installed October 1982), the statistical "t" test performed on a sample from the chloride population from 1982-85 compared to the chloride population from 1990-91 shows there is a significant difference in the means of the chloride populations of these two sampling periods and that the chloride content has decreased.

Wells WMMW-14 and 15 (installed September 1989) were installed in the south embankment of Disposal Cell No. 4A in 1989. Wells WMMW-14 and 15 have a similar water chemistry to Monitor Well WMMW-12 which was installed in 1982. A statistical "t" test chloride value indicates the mean chloride value in Well WMMW-15 is significantly higher than Well WMMW-14. Statistical tests also show that the chloride values are decreasing in both wells. Similar testing on Well WMMW-12 likewise shows a decrease in chlorides. Any contamination from the tailings solution would probably show an increase in the chloride values in these wells over time, which has not happened.

Considering the apparent variability of chemical composition of perched water and the absence of any impact from operations, it may be appropriate to determine background concentrations for a number of selected wells.

3.0 OPERATIONAL EFFECTS

This section addresses the potential operational effects of the tailings disposal cells on the vadose zone, perched ground water, and the Entrada/Navajo Aquifer. It is important to note that in the 15 years of operation, no operational effects to the vadose zone, perched ground water, or the underlying aquifers have been documented, as demonstrated by the water chemistry discussions in Section 2.2.

3.1 Infiltration Evaluation

Operational effects of the tailings disposal cells are concerned with the potential for liquids from the cells to migrate into and through the vadose zone at the site.

The EPA Hydrologic Evaluation of Landfill Performance (HELP) Model Version 2.0 (Schroeder, et al, 1989) was used to estimate the potential seepage from the tailings disposal cells. The HELP model uses water balance methods to quantify water movement out of the bottom of the disposal cells. The model accounts for the combined effects of hydrologic processes including precipitation, surface disposal, runoff, infiltration, percolation, evapotranspiration, changes in soil moisture, and lateral drainage.

The HELP model uses site-specific climatological, cover/liner material, and design data. Climatological data include: monthly temperature, precipitation, and solar radiation values. Cover/liner property data include: soil type, hydraulic conductivity, porosity, field capacity, and wilting point. Design data include: number of soil layers, thicknesses of layers, type of soil layer (barrier to flow, lateral drainage, or percolation layer), and drainage slopes. The specific input and output data used in the HELP model evaluation for the facility are presented in Appendix C. Properties of tailings, disposal cell design, and properties of disposal cell cover materials were obtained from the reclamation plan for the site (Umetco, 1988).

The tailings disposal cells at the White Mesa Uranium Mill store slurried tailings from the mill's operations. These cells are termed wet cells. Tailings imported from outside sources will be void of drainable liquid and will be placed in impoundments free of liquids. These cells are termed dry cells. Dry tailings disposal consists of placing low-moisture-content tailings in a lined, engineered disposal cell. Hence, dry tailings have no capacity to drain liquid into underlying strata. An engineered cap is placed over the tailings to limit precipitation infiltration.

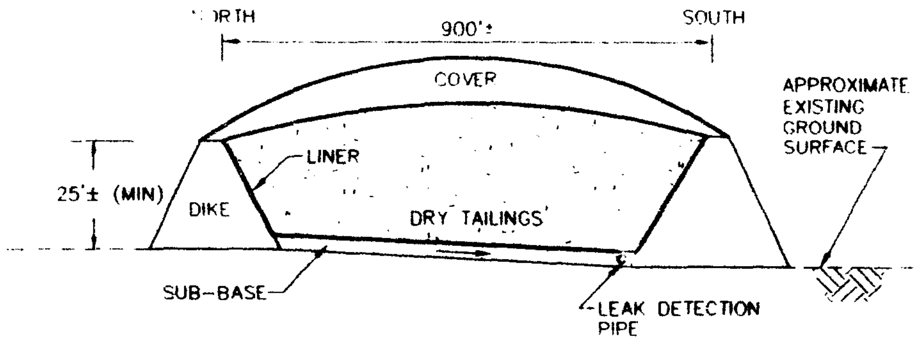
Wet tailings disposal consists of placement of slurried tailings into a lined, engineered disposal cell. With this type of disposal, the tailings are completely saturated. Due to their wet condition, these tailings have the potential to release seepage into the vadose zone. Wet cells are also capped to limit precipitation infiltration.

Both the dry and wet tailings cells were evaluated using the HELP model. For this evaluation, climatological data from Blanding, Utah and Grand Junction, Colorado were utilized. The cells were conservatively evaluated assuming partially- and fully-leaking liners.

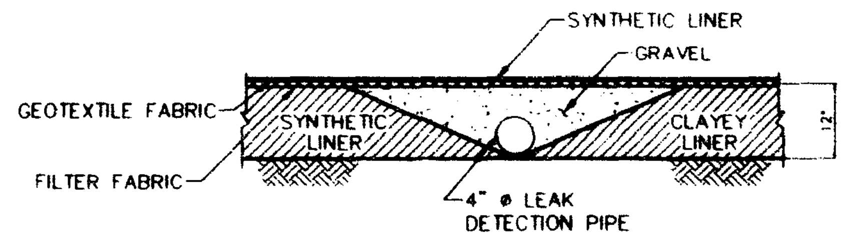
3.1.1 Dry Tailings Disposal Cell

A schematic fo. a typical dry tailings disposal cell is shown on Figure 3.1. As shown, the bottom of the cell has a 1-foot clay layer base which is overlain with a synthetic liner. Dry tailings are placed within the cell over the liner. The dry cell cap consists of a 4-foot-thick random-fill base layer overlain by 1 foot of clay, 1 foot of filter material (capillary break), 3.5 feet of random fill (protective layer), and 0.5 foot of vegetative cover.

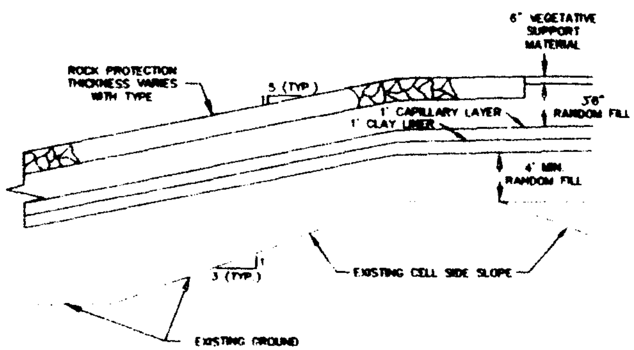
The EPA HELP model was used to evaluate the infiltration that may occur through the typical dry tailings disposal cell configuration. The specific input and output data used for the HELP model evaluation for dry tailings disposal are presented in Appendix C. Based on site data, the HELP model evaluation for the dry tailings disposal cell configuration indicated that zero net infiltration is expected to reach the vadose zone through the operational life of the cell.



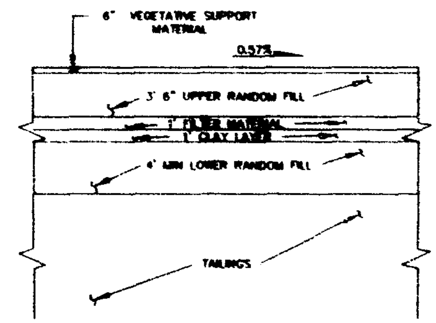
DRY TAILINGS CELL SCHEMATIC



LEAK DETECTION DETAIL



TYPICAL SIDE SLOPE RECLAMATION COVER



TYPICAL DRY CELL RECLAMATION COVER

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△		ISSUED FOR DRAFT SUBMITTAL	TMC		

REFERENCE
Umetco, 1992 AND 1988

DRY TAILINGS CELL SCHEMATIC
PREPARED FOR
ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

TITAN Environmental

DATE: 7-18-94
SCALE: N.T.S.

FIGURE 3.1

DRAWING NUMBER 4111-B12

3.1.2 Wet Tailings Disposal Cell

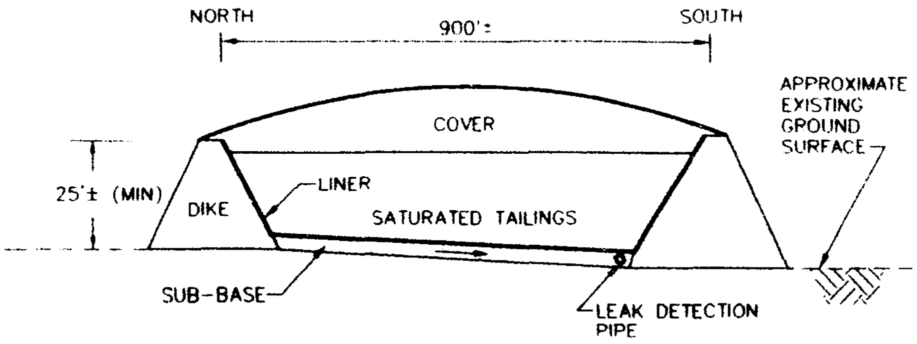
A schematic for a typical wet tailings disposal cell is shown on Figure 3.2. The wet tailings disposal cell has a six-inch base/drainage layer of crushed rock and sand overlain by a synthetic liner. Under operational conditions, the tailings are placed within the cell as a slurry; therefore, the tailings are completely saturated. The maximum depth of the tailings within the cell is three feet below the top of the cell dike (freeboard limit). The cap for the wet tailings disposal cell is identical to that for the dry tailings disposal cell.

The EPA HELP model was used to evaluate the infiltration that may occur through the typical wet tailings disposal cell configuration. The specific input and output data used for the HELP model evaluation are presented in Appendix C. Based on site data, the HELP model evaluation for the wet tailings disposal cell configuration indicates the potential for .04 to .12 feet per year of net infiltration into the vadose zone. The estimated infiltration for the wet tailings disposal cell is higher than for the dry tailings disposal cell because of: 1) the saturated condition of the tailings provides additional water for gravity drainage into the vadose zone; and 2) the conservative assumption that the bottom liner of the disposal cell would leak.

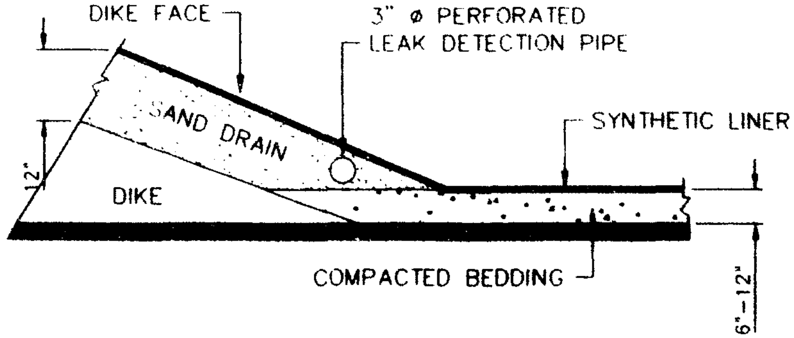
3.2 Potential Vadose Zone Impacts

Moisture infiltrating the vadose zone will first be taken up into storage within the formation until enough moisture is available to allow gravity drainage. This storage is referred to as residual moisture or moisture retention. Moisture retention tests on the Dakota and Burro Canyon Sandstones are summarized in Table 2.1. These data indicate that the unsaturated portions of the Dakota and Burro Canyon Sandstones, on the average, may retain up to 5.5 percent of moisture under gravity drainage conditions. Using an average unsaturated zone thickness of 109.5 feet, the available volume of "retained" moisture beneath a typical cell is approximately 18,902,000 cubic feet. Assuming continued infiltration from the wet tailings cell, it would take 50 years for a fully-leaking lined cell and 150 years for a partially-leaking lined cell to accumulate this volume. Therefore, migration of infiltrated moisture from the wet tailings disposal cell is

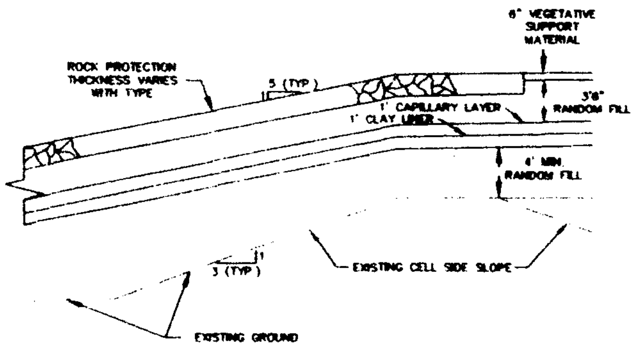
DRAWING NUMBER 4111-B13



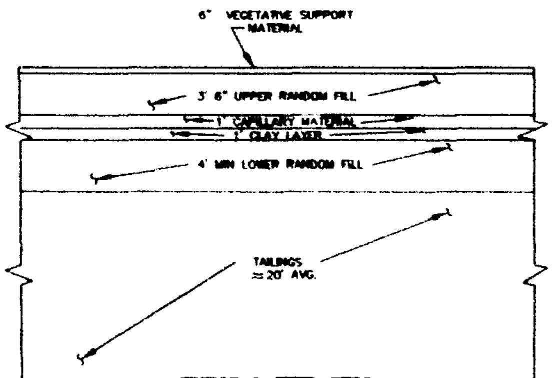
DRY TAILINGS CELL SCHEMATIC



LEAK DETECTION DETAIL
NTS



TYPICAL SIDE SLOPE RECLAMATION COVER



TYPICAL WET CELL RECLAMATION COVER

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Umetco 1992 AND 1988

WET TAILINGS CELL SCHEMATIC
PREPARED FOR
ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO
TITAN Environmental

DATE 7-18-94 / SCALE N.T.S.	FIGURE 3.2	DRAWING NUMBER 4111-B13

estimated to take 50 to 150 years to travel through the vadose zone at the site. This estimate is conservative as it assumes only vertical migration from the cells and does not account for lateral migration.

It could be postulated that a hypothetical fracture beneath a wet tailings disposal cell would reduce the time of infiltration through the vadose zone. However, no significant fractures/joints have been documented in the subsurface in the approximately 45 wells and borings at the site. In addition, Disposal Cell No. 2 has been in operation for over 14 years with no evidence of constituents migrating through the vadose zone.

3.3 Potential Perched Ground Water Zone Impacts

As discussed in Section 2.0, the perched ground water zone beneath the site thins toward the edges of the mesa. Both the Dakota and Burro Canyon Sandstones outcrop at the edge of the mesa, and this is also the discharge zone for the perched ground water. Discharge takes place at the rim along the contact between the Burro Canyon Formation and underlying Brushy Basin Member as evidenced by the springs and productive vegetative pattern. Part of the discharge may also enter the Brushy Basin Member along documented fractures at the canyon rim.

Constituents that may have entered the perched water zone via infiltration through the vadose zone would be expected to migrate southward within the perched water zone and ultimately be discharged at the edge of the mesa. Vertical migration to any significant depth is highly unlikely due to the low permeability and unsaturated thickness of the underlying strata.

The ground water seepage velocity in the saturated Burro Canyon Formation can be used to estimate the minimum travel time for constituents to migrate from under the site to the edge of the mesa. This is a conservative approach, as this method does not account for adsorption of the constituents which may retard migration and lengthen the transport time. Specific calculations of ground water travel time are presented in Appendix D.

The ground water seepage velocity may be estimated using Darcy's law. Seepage velocity is a function of hydraulic conductivity, hydraulic gradient, and effective porosity. The measured hydraulic conductivities for the Burro Canyon Sandstone via pump/recovery and injection tests are summarized in Table 2.2. The measured values range from 1.58E-03 to 1.93E-07 cm/sec with a geometric mean of the measured values of 1.01E-05 cm/sec (10.5 ft/yr).

An average hydraulic gradient from the site to the edge of the mesa can be estimated utilizing the perched water elevation map shown on Figure 2.4. The hydraulic gradient from the center of the site to the edge of the site is estimated to be 0.015 feet/foot. Using an average porosity of 17.6 percent for both the Dakota and Burro Canyon Sandstones (Table 2.1), the seepage velocity within the perched water zone is estimated at approximately 0.89 ft/yr.

The downgradient distance from the White Mesa Facility to the Dakota/Burro Canyon Sandstones outcrop on the southern rim of the mesa is approximately 8,000 feet. Using the ground water seepage velocity of 0.89 ft/yr, it would take a minimum of 8,900 years for a constituent entering the perched water zone to reach the discharge point at the rim of the canyon. Therefore, even if leakage did occur, the possibility of constituents entering the local surface drainage system via seepage from the Burro Canyon Formation is not likely.

3.4 Potential Entrada/Navajo Aquifer Impacts

This section addresses the natural hydraulic and physical barriers that are present at the site that protect the Entrada/Navajo Aquifer from operational effects of the facility. The primary barriers are the artesian conditions present in the Entrada/Navajo Aquifer and the presence of the Brushy Basin aquitard and other intervening low-permeability layers within the Morrison and Summerville Formations which separate the perched water from the Entrada/Navajo Aquifer. In the presence of both of these natural barriers, it is unlikely constituents present in the tailings disposal cells would migrate into the Entrada/Navajo Aquifer.

3.4.1 Artesian Conditions

As described in Section 2.1.4, the Entrada/Navajo Aquifer is regionally used for irrigation and domestic consumption (Dames and Moore, 1978). Figures 2.2 and 2.3 show the relative location of the Entrada/Navajo Aquifer with respect to the White Mesa Uranium Facility and the perched water in the Burro Canyon Sandstone. The elevation of the Entrada/Navajo Aquifer beneath White Mesa is approximately 4,340 feet MSL, or 1,200 feet below the mesa ground surface.

Well logs from four water supply wells completed at the facility indicate that the ground water levels in the Entrada/Navajo are at an average elevation of 5,180 feet MSL, or 450 feet below the mesa ground surface (D'Appolonia, 1981) (Appendix A). This is equivalent to 850 feet of artesian head. The artesian pressure heads measured in these wells are summarized in Table 3.1.

Artesian conditions in the Entrada/Navajo Aquifer were also noted in a water well drilled at the Hanksville ore-buying station 84 miles from the site (Dames and Moore, 1978). Therefore, the presence of artesian pressure in this aquifer is laterally extensive and can be assumed to be continuous throughout this site.

The artesian conditions in the Entrada/Navajo Aquifer can be explained by the topographic location of primary aquifer recharge. According to the Dames and Moore (1978) Environmental Report, recharge to the Entrada/Navajo Aquifer is from the outcrop area of these sandstones along the length of the north-south trending Comb Ridge Monocline located approximately 8 miles west of the site (Dames and Moore, 1978).

In terms of operational effects, the presence of artesian pressures in the Entrada/Navajo provides a positive safeguard against potential migration of constituents into the aquifer. In order for constituents to enter the aquifer, the pressure within the aquifer would have to be exceeded. Therefore, migration of constituents into the Entrada/Navajo Aquifer in the presence of artesian conditions is unlikely.

Table 3.1

Ground Water Levels in Entrada/Navajo Aquifer
White Mesa Uranium Mill

Well Designation	Estimated Ground Surface Elevation (ft-MSL)	Estimated Casing Elevation (ft-MSL)	Total Well Depth (ft)	Estimated Original Static Water Elevation (ft-MSL)	Estimated Top Elevation of Entrada Aquifer (ft-MSL)	Artesian Pressure Head (ft)	Completion Details
WW1	5622	4582	1860	5175	4326	849	Gravel pack and slotted casing installed at depth of 1700 ft. Well decommissioned.
WW2	5630	4380	1885	5180	4340	840	Barren below the casing. Casing not sealed at the bottom.
WW3	5622	4372	1820	5172	4322	850	Barren below the casing. Casing cemented at bottom.
WW4	5670	4420	1820	5210	4370	840	Barren below the casing.

Notes: ft-MSL = feet - mean sea level

3.4.2 Brushy Basin Aquitard

As shown on Figures 2.2 and 2.3, the Brushy Basin, Westwater Canyon, Recapture, and Salt Wash Members of the Morrison Formation are stratigraphically situated between the facility and Entrada/Navajo Aquifer. All of these members are unsaturated as indicated on drillers logs for wells that have penetrated the Morrison Formation (Appendix A) and are described as being low permeability. The Brushy Basin Member is described as consisting of bentonitic mudstones and siltstones and is generally considered impermeable (Dames and Moore, 1978).

Site-specific data on the hydraulic properties of the Brushy Basin or other members of the Morrison Formation are not available. However, the relative permeability of the Morrison Formation can be inferred from the presence of the high artesian pressures present in the Entrada/Navajo Aquifer. If this formation were moderately permeable, then leaky, confined conditions would exist and the overlying strata would be saturated to some degree. The absence of saturated conditions in the Morrison Formation implies layers of very low permeability.

The presence of low permeability, unsaturated strata between the Burro Canyon Formation and the Entrada/Navajo Aquifer provides a positive natural physical barrier that will protect the quality of the Entrada/Navajo Aquifer. In order to impact the quality of the Entrada/Navajo Aquifer, constituents generated from tailings storage would have to migrate through over 1,200 feet of unsaturated, low-permeability strata between the Burro Canyon Member and top of the Entrada/Navajo Aquifer. This, combined with the artesian pressures in the Entrada/Navajo Aquifer indicate migration of constituents from the facility to the aquifer is unlikely.

4.0 ADDITIONAL INVESTIGATIONS AND MONITORING

4.1 Additional Investigations

This section presents proposed additional investigations to comply with the requirements of the U.S. Nuclear Regulatory Commission (NRC). Proposed investigations include the following tasks:

- Investigate subsurface joint sets,
- Verify the hydraulic properties of the Brushy Basin Member, and
- Define the extent of the perched ground water zone.

The proposed investigations will be conducted in the following phases: 1) subsurface joint identification program, 2) Brushy Basin Member investigations, and 3) extent of the perched ground water zone.

4.2 Subsurface Joint Sets

Observational data presented in the Environmental Report (Dames and Moore, 1978) indicate that jointing is common in the exposed Dakota/Burro Canyon Formations along the mesa's rim with primary joints parallel to the cliff faces and secondary joints almost perpendicular to the primary joints. Umetco (1992) also mapped surface fractures along the canyon rim and found a primary joint vector with a strike of N11E, and a secondary joint vector with a strike of N47W.

Investigations are proposed to determine whether or not the surficially mapped joint sets are present in the subsurface Dakota/Burro Canyon Formations beneath Tailings Disposal Cells No. 3 and No. 4A at the site and whether or not their presence, if any, is causing an increase in the rock mass permeability.

The scope of investigations to identify subsurface joint sets consists of advancing four angled borings into the Dakota/Burro Canyon Formations and at least 25 feet into the Brushy Basin

Member beneath Tailings Disposal Cells No. 3 and No. 4A. Figure 4.1 presents the proposed locations of the angled borings. At each location shown on Figure 4.1, one angled boring will be advanced parallel to the strike of the primary joints mapped on the surface. A second boring will be advanced perpendicular to the strike of the primary joints. This method should intersect the maximum number of potential subsurface fractures, if present. Each boring will be fully cored with an NX or NWQL double-core barrel. Cores will be logged with particular attention given to fractures, specifically, their orientation, spacing, aperture, and any evidence of flow (e.g., staining, mineral redeposition or presence of clay).

Permeability pressure (packer) tests will be conducted in each borehole in five- or ten-foot increments throughout the entire length of the borehole. Upon completion, borings will be grouted with cement/bentonite grout from the bottom up.

4.3 Brushy Basin Member Investigations

The primary objective of the Brushy Basin Member investigation is to quantify the hydraulic properties of the unit and evaluate its effectiveness as an aquitard. For the sake of expediting the investigations, borings from which the hydraulic information is obtained will be converted into observation wells to further define the extent of saturation in the Burro Canyon Formation.

The proposed Brushy Basin Member investigation includes:

- Drilling three exploratory borings into the Brushy Basin Member. Each boring will penetrate 20 feet into the unit. The boring data will also be used to define the Brushy Basin-Burro Canyon Member contact. The proposed locations of the borings are presented on Figure 4.1.
- From each boring, collecting two 5-foot sections of the core from the Brushy Basin Member.

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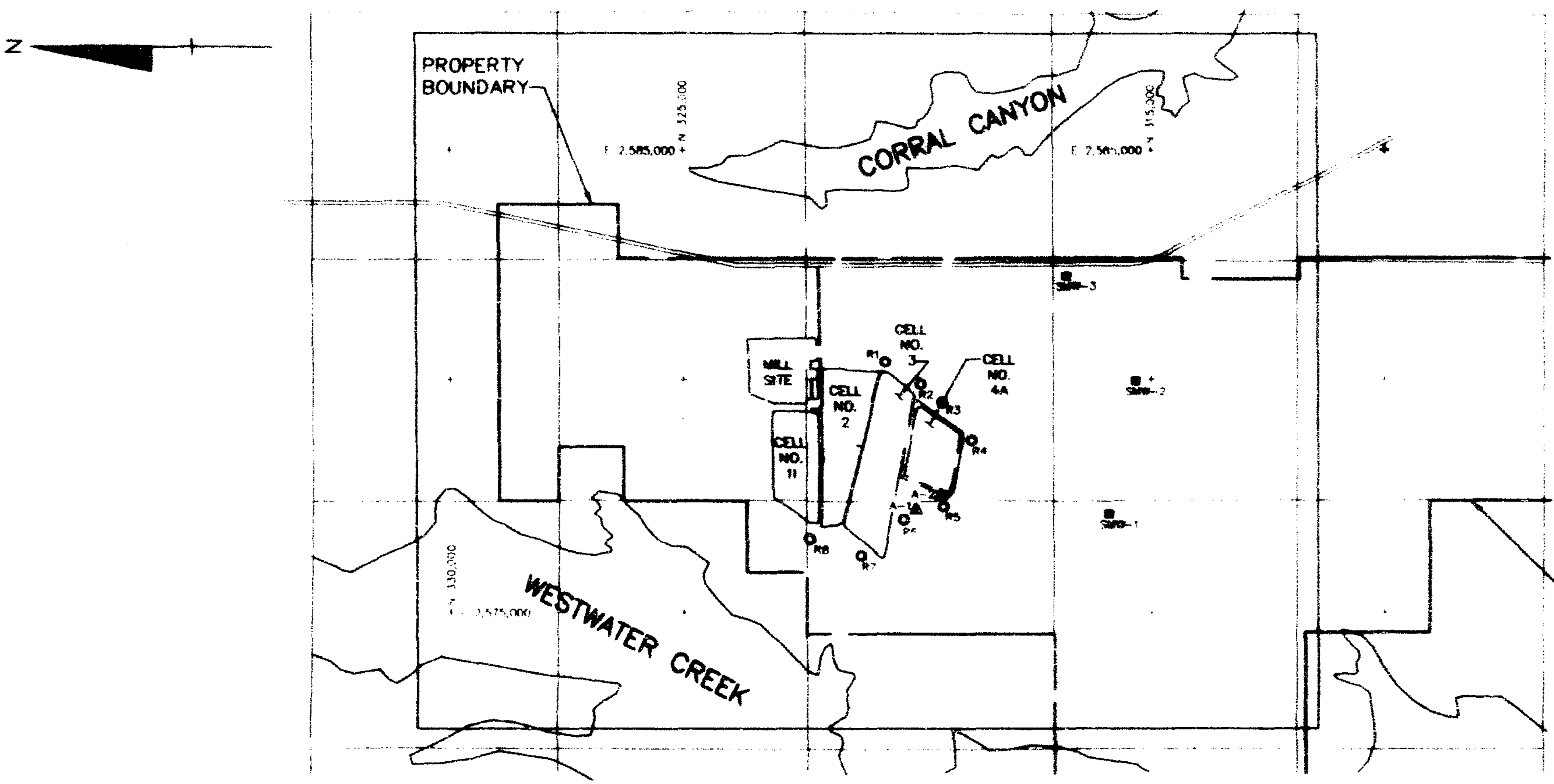

SCALE

2000 0 2000 4000 FEET

PROPOSED LOCATIONS FOR ADDITIONAL BORINGS AND MONITORING WELLS
WHITE MESA MILL
BLANDING, UTAH

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

TITAN Environmental

LEGEND:

A-1 ▲ NESTED ANGLE BORINGS

SMW-1 ■ SHALLOW MONITORING WELL AND BRUSHY BASIN TEST HOLE

R4 O RESISTIVITY SURVEY POINT

NOTE:

1. ALL LOCATIONS ARE APPROXIMATE

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⚠		ISSUED FOR DRAFT SUBMITTAL	TMG		

DATE: 7-18-94	FIGURE 4.1	DRAWING NUMBER 4111-B10
SCALE: AS SHOWN		

- Conducting packer permeability tests in each boring within the section of the hole in the Brushy Basin Member.

- Conducting laboratory liquid permeability tests on vertically-oriented cores from the Brushy Basin Member. These tests will be necessary to quantify the vertical permeability which is expected to be orders of magnitude lower than the horizontal permeabilities from the field packer tests (horizontal permeability will be calculated from packer tests).

All borings advanced within the Brushy Basin Member will be converted into the observation wells screened in the Burro Canyon Formation.

4.4 Perched Ground Water Zone Extent

Based on the available site data, the perched ground water zone thickness in the Dakota/Burro Canyon sandstones thins southward and the water discharges along the rim of White Mesa. The lateral extent and saturated thickness of the perched ground water zone between the site and the edge of the mesa are currently unknown. It is known, however, that the extent of perched ground water does not extend beyond the canyon walls, as the Dakota/Burro Canyon sandstones outcrop along the rim of the canyon.

To further define the extent of the perched ground water zone between the site and the edge of the mesa, three shallow observation wells will be completed in the borings advanced for the investigation of the Brushy Basin Member. The proposed locations of these wells are presented on Figure 4.1. Each well will be fully screened within the Burro Canyon Formation. Well construction will be the same as that for Well WMMW-16, as shown in Appendix A.

4.5 Vadose Zone Monitoring

Energy Fuels believes that the existing monitoring wells which are completed in the perched water zone above the Brushy Basin Formation are suitable for the timely detection of leaks from the tailings disposal cells at the site when considering that the first aquifer to protect is in the

Entrada/Navajo Sandstones and that about 1,200 feet of unsaturated, tight formations separate this aquifer from perched water. The NRC, however, has asked that other methods be investigated that would provide an earlier warning that excursions are taking place from the tailings disposal cells.

To be responsive to NRC requests, Energy Fuels has investigated several methods of monitoring existing tailings disposal cells and has evaluated their potential application at the White Mesa Uranium Mill. The methods reviewed are presented in Appendix E. A summary of the proposed monitoring method is provided in the following paragraphs.

Energy Fuels wishes to stress that the TEM method will not allow for collection of alleged seepage samples for laboratory analysis. Therefore, information obtained by this method will be of a qualitative nature only. It appears possible that elevated moisture from atmospheric infiltration and likely dissolution of salts known to be present in Mancos Shale overlying the Dakota Sandstone may cause readings similar to those expected to be caused by leakage from cells. Therefore, Energy Fuels will exercise utmost care in collection and interpretation of TEM surveys.

4.5.1 Proposed Vadose Zone Monitoring Plan

Energy Fuels proposes to perform Transient Electromagnetic (TEM) geophysical surveys from approximately eight locations around the tailings cell as shown in Figure 4.1. Precise locations will depend on field-specific conditions prior to field implementation, and may vary slightly from those shown in Figure 4.1.

Initial survey information will be evaluated to establish baseline moisture conditions with depth from readings taken at specific locations. Two initial surveys will be performed at 6-month intervals, with annual surveys performed thereafter. The survey information will be evaluated to determine if a wetting front exists downgradient of the tailings ponds and to evaluate potential movement of this front downward through the unsaturated zone. The data and yearly evaluation

will be presented in the Annual Technical Evaluation of the White Mesa Mill Tailings Management System.

4.5.1.1 General Description

Based on current usage in the field of geophysics, the TEM survey is the preferred method of choice in the industry for detection and monitoring of plumes. The method, using a survey pattern similar to that being proposed in this section for the White Mesa Mill, is now being employed at Kennecott's Bingham Pit. Much of the recent work has included saltwater encroachment in the southeast.

The underlying premise for using geophysics is that the property being evaluated has substantially different properties from those of the host rock. The physical properties that are generally of most interest are magnetic susceptibility, resistivity, and induced polarization effect.

TEM surveys are conducted using a large transmitter (T_x) loop on the ground, and a small loop connected to a receiver. The transmitter loop will vary from 100 feet on side to several thousand feet on a side. Equipment for TEM surveys is built by several manufacturers, Geonics, Crone, UTEM, and Zonge Engineering.

4.5.1.2 Basic Operation

To collect data, the transmitter loop is connected to the transmitter, and a large current, typically 15-20 amps, is then transmitted for a short time, 17 milliseconds. When the current is turned off, eddy currents are generated in the ground which decay over time. The receiver, which is connected to the small coil, then makes many measurements starting at 0.089 milliseconds until 20 milliseconds. In most case three measurements are made at each station, vertical (z), north and east. North and east are often called X and Y to confuse the geologists.

4.5.1.3 General Description of Survey Procedures

Three types of set-ups are commonly used for TEM surveys. One of these will be applied for White Mesa Mill. They are fixed transmitter-moving receiver (profiling), in-loop (sounding), and slingram.

The fixed transmitter-moving receiver generally uses a large loop of wire, typically 1,000 feet by 1,500 feet. The loop is not moved during a survey, only the receiver is moved along the survey lines. The fixed transmitter-moving receiver method is the most common method used for exploration.

The in-loop method is the most common in environmental and engineering applications. A small transmitter loop, between 100-400 feet on a side, and the receiver are both moved for every reading. The receiver is in the center of the loop. The in-loop method is good for determining the depth to different layers, often for engineering surveys. Station separation between transmitter loops is dependant upon the target, for environmental monitoring this separation can vary between 0 and a thousand feet.

The slingram method is similar to the in-loop method. However, both the receiver and transmitter are moved for each reading, with the receiver always a fixed distance outside of the transmitter loop. Many of the initial TEM surveys in Canada used the slingram method, however, it is the least popular method.

Appendix E includes a description of the principals of TEM.

REFERENCES

REFERENCES

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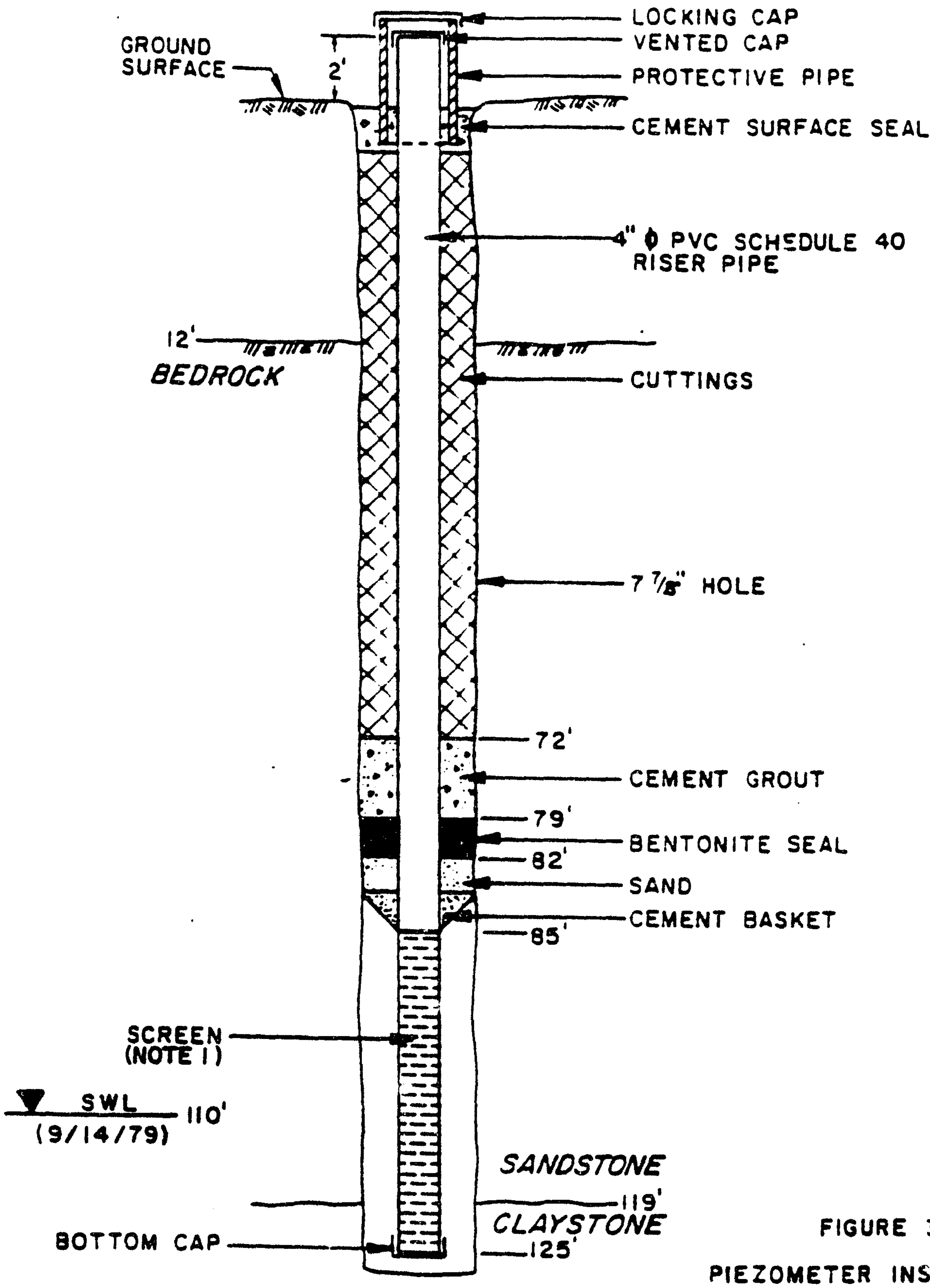
APPENDIX A

WELL/BORING LOGS



NOT TO SCALE

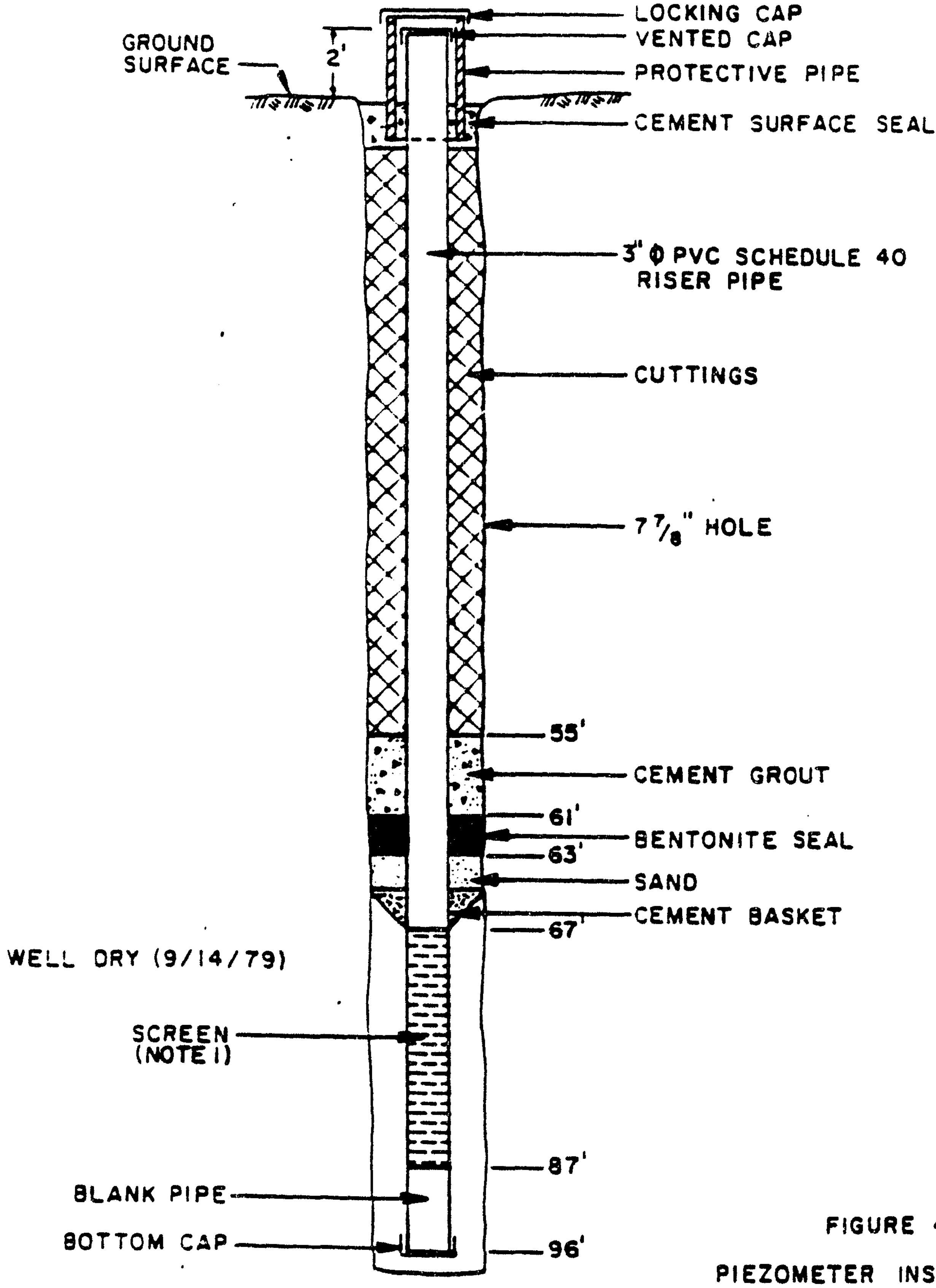
NOTE 1: SCREEN CONSISTS OF COMMERCIALLY SLOTTED PIPE WITH 0.045 IN. WIDE SLOTS, 3 ROWS AND 40-42/SLOTS/ROW/FT. PIPE.

FIGURE 3

PIEZOMETER INSTALLATION
WELL NO. 2
CONSTRUCTION DETAILS

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO



NOT TO SCALE

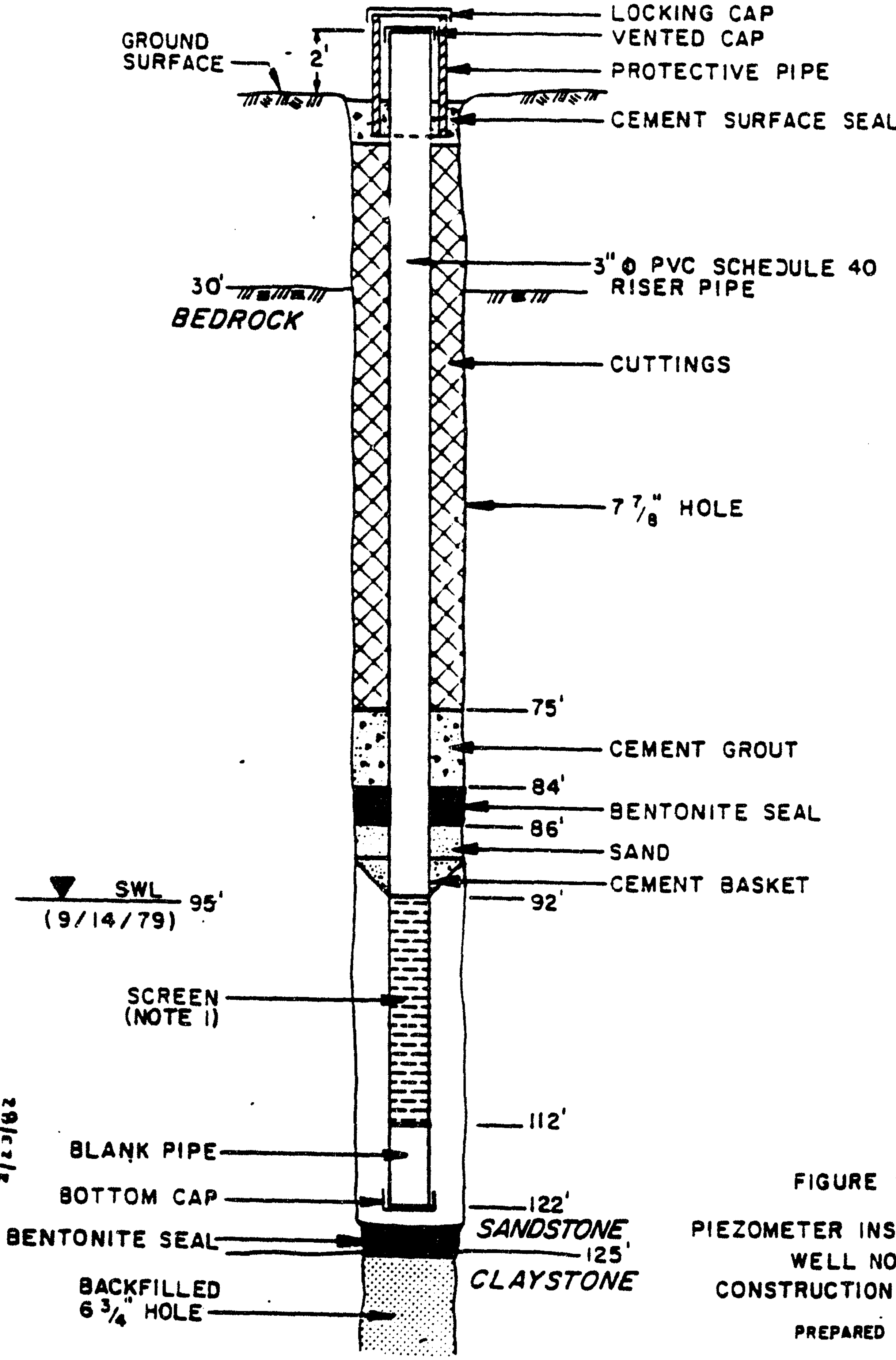
FIGURE 4

PIEZOMETER INSTALLATION
WELL NO. 3
CONSTRUCTION DETAILS

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

NOTE 1: SCREEN CONSISTS OF COMMERCIALLY SLOTTED PIPE WITH 0.045 IN. WIDE SLOTS, 3 ROWS AND 40-42 /SLOTS/ ROW/FT. PIPE.



NOT TO SCALE

FIGURE 5

PIEZOMETER INSTALLATION
WELL NO. 4
CONSTRUCTION DETAILS

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

NOTE 1: SCREEN CONSISTS OF COMMERCIALLY SLOTTED PIPE WITH 0.045 IN. WIDE SLOTS, 3 ROWS AND 40-42/SLOTS/ROW/FT PIPE

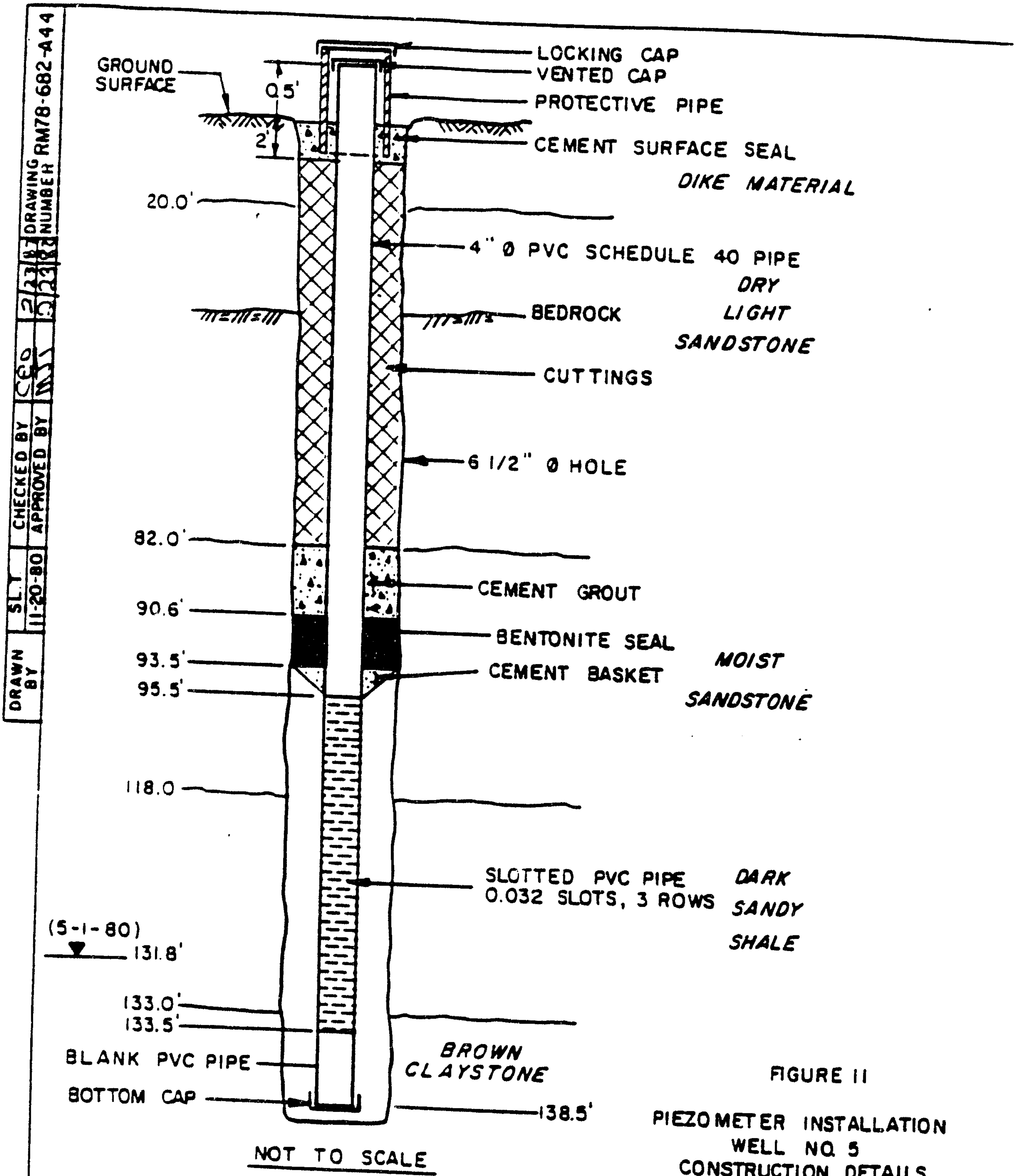


FIGURE 11

PIEZOMETER INSTALLATION
WELL NO. 5
CONSTRUCTION DETAILS

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

D'APPOLONIA

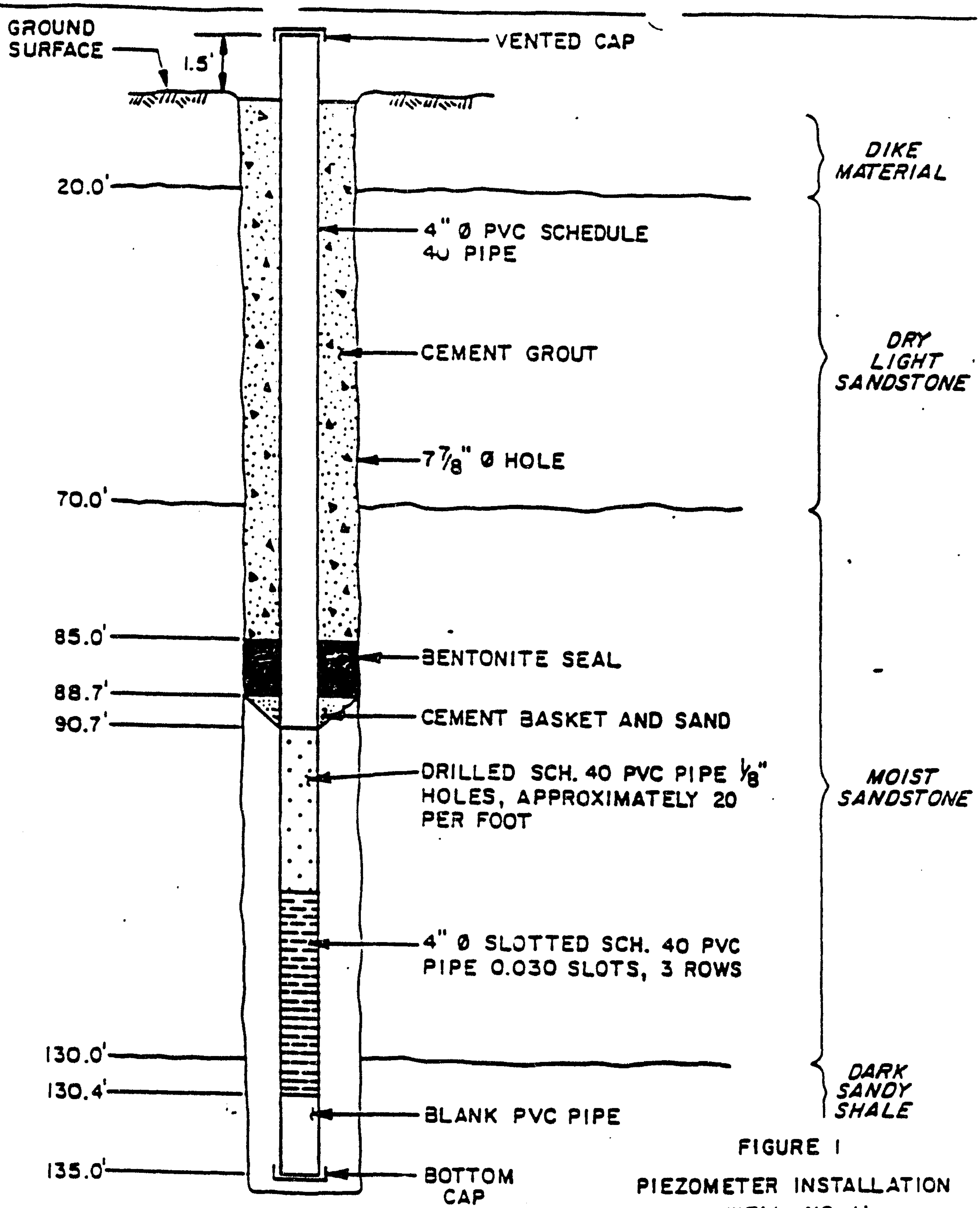


FIGURE 1

PIEZOMETER INSTALLATION
WELL NO. 11
CONSTRUCTION DETAILS

PREPARED FOR

ENERGY FUELS NUCLEAR, INC
DENVER, COLORADO

DRAWING NUMBER 2-2039-A1

APPROVED BY

10-28-82

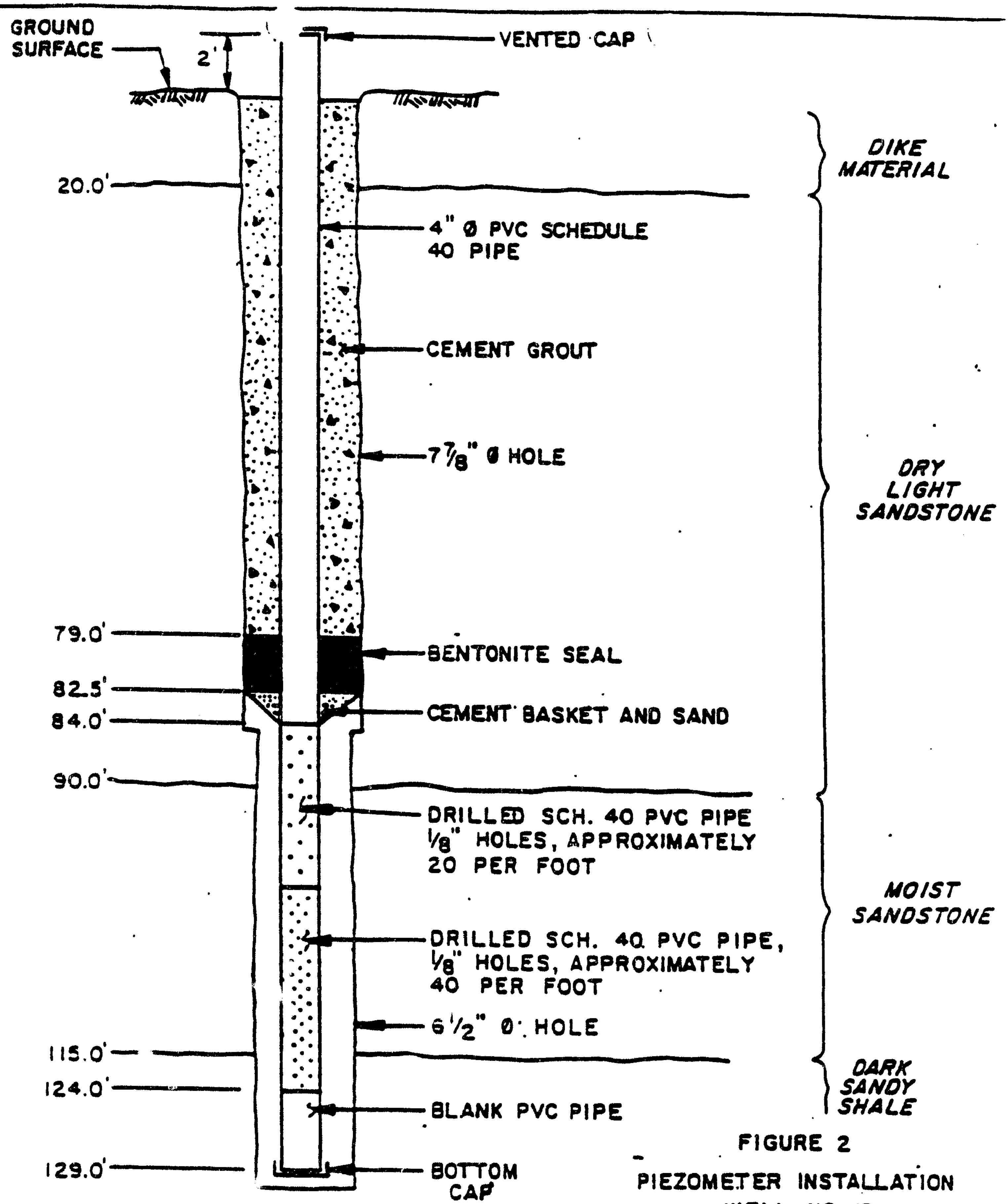


FIGURE 2

PIEZOMETER INSTALLATION
WELL NO. 12
CONSTRUCTION DETAILS

PREPARED FOR

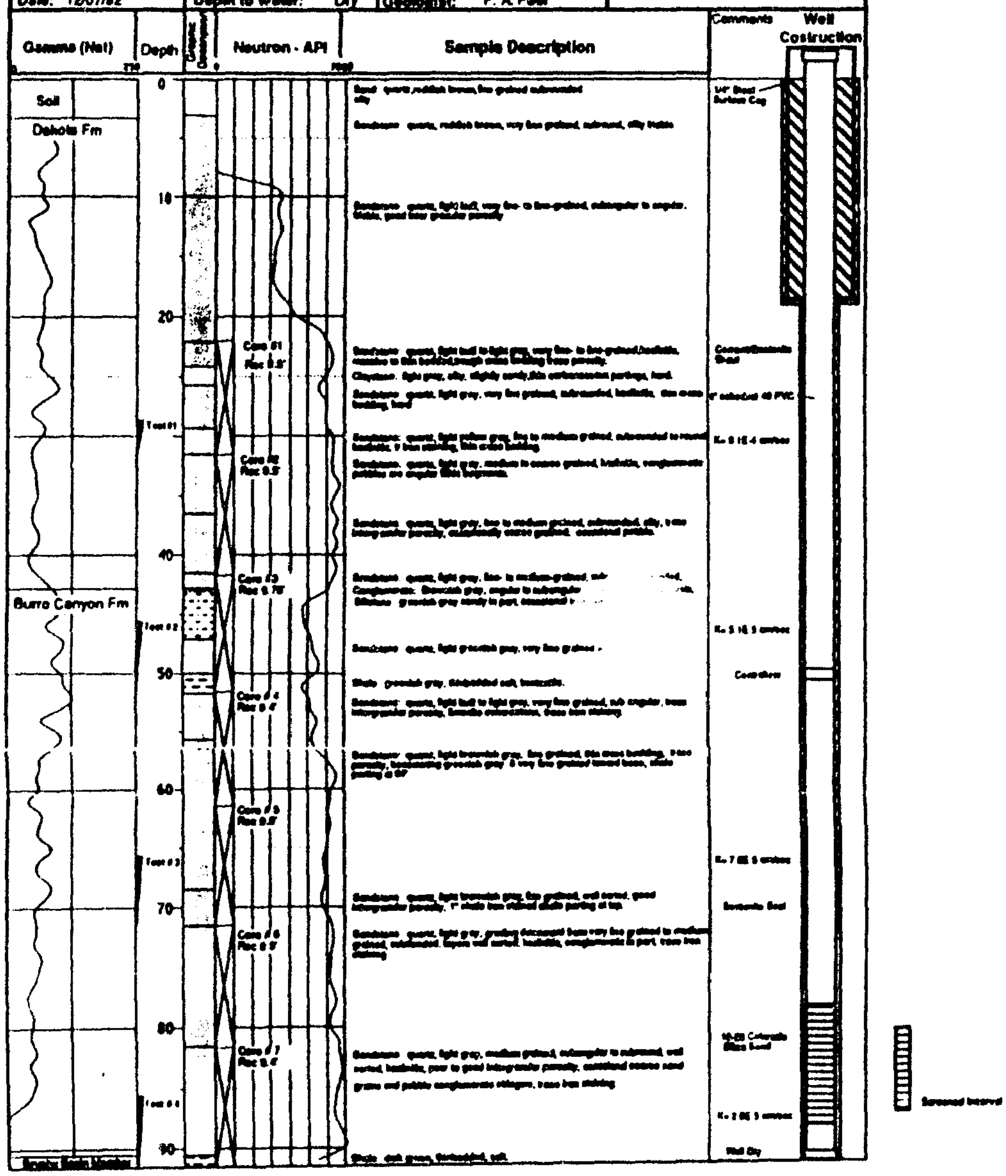
ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

PEEL Environmental Services
Arvada, CO (303)420-8116

Bore Hole No.: WMMW-16

UMETCO Minerals Corporation

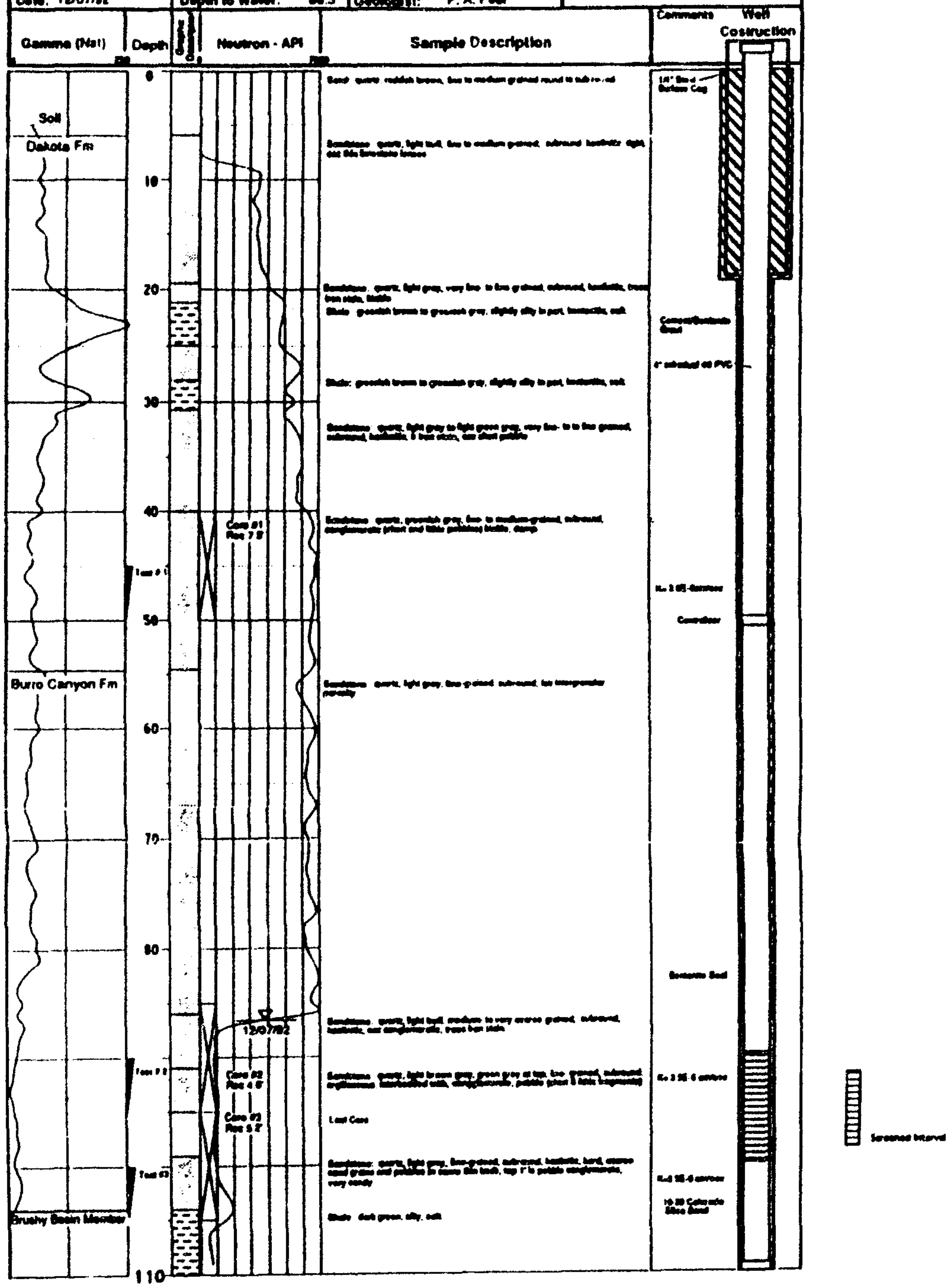
Project: White Mesa	Surface Elev. 5586.18	T.D. = 91.5
Date: 12/07/92	Depth to Water: Dry	Geologist: F. A. Peel



PEEL Environmental Services
Arvada, CO

Bore Hole No.: WMMW-17

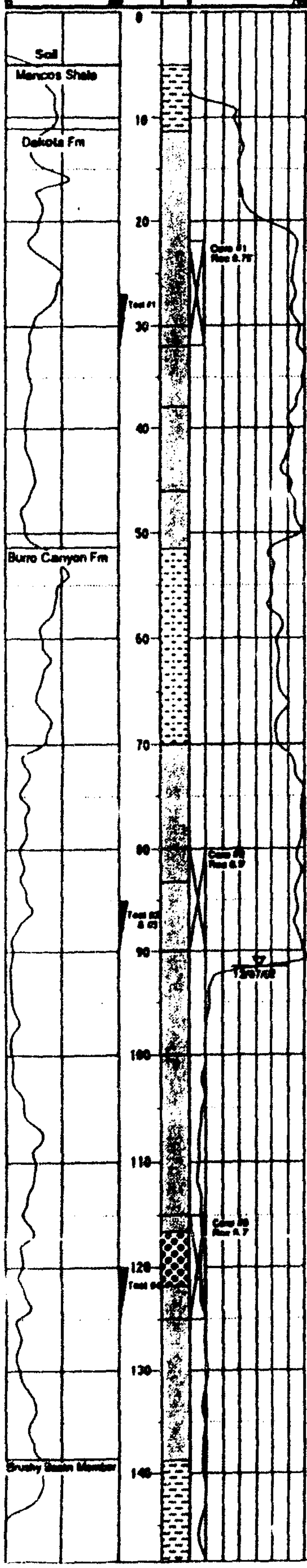
Project: White Mesa	Surface Elev. 5575.06	T. D.: 110'	UMETCO Minerals Corporation
Date: 12/07/92	Depth to Water: 86.5'	Geologist: F. A. Peel	



PEEL Environmental Services
Arvada, CO

Project: White Mesa	Surface Elev. 5657.58	T. D. = 148.5	Bore Hole No.: WMMW-18
Date: 12/07/92	Depth to Water: 92'	Geologist: F. A. Peel	UMETCO Minerals Corporation

Gamma (Net) | Neutron - API | Sample Description | Comments | Well Costruction



Sample Description

Sand: quartz, red brown, silty

Shale: black, platy, hard

Sandstone: quartz, light buff to light gray, subround, kaolinitic, trace iron staining >>> less toward base, Occ lithic pebble, occ thin shale parting.

Sandstone: as above >>> very conglomeratic in part, pebble size chert and lithic fragments.
Sandstone: quartz, buff, fine-grained, subrounded, slightly argillaceous, kaolinitic, trace iron staining.

Sandstone: quartz, light yellow gray, fine-grained, subangular, iron staining.

Sandstone: as above >>> very fine-grained.

Siltstone: light greenish gray, argillaceous, platy

Sandstone: quartz, light gray, very fine grained, subangular, trace kaolinite.

Sandstone: quartz, light gray, very fine- to medium-grained, subangular, occ pebble.

Sandstone: as above interbedded with Conglomerate, pebble (lithic), light gray, sandy in part.

Sandstone: as above.

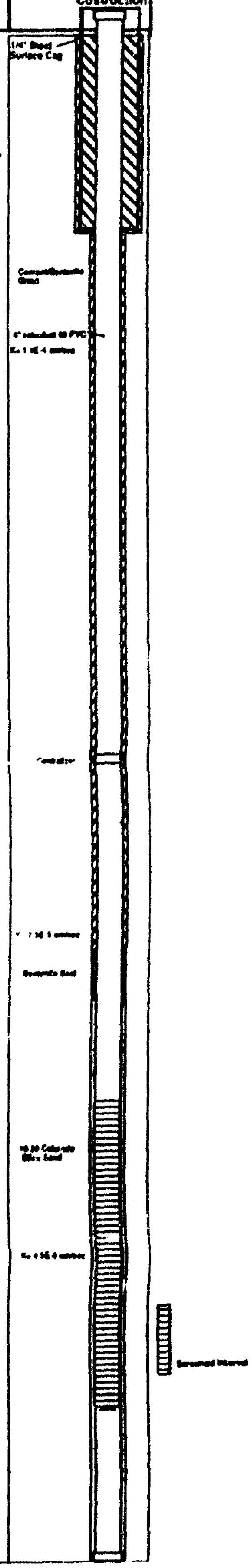
Sandstone: quartz, greenish gray, fine-grained, subangular to subround, kaolinitic, friable, interbedded with occasional thin shale layer reddish brown, soft.

Sandstone: quartz, light green to greenish gray, very fine- to fine-grained, subround, argillaceous.
Conglomerate: pebble, lithic fragments, very friable, sandy to very sandy in part.

Sandstone: quartz, light green, very fine-grained, argillaceous with thin red and green shale stringers.

Sandstone: as above.

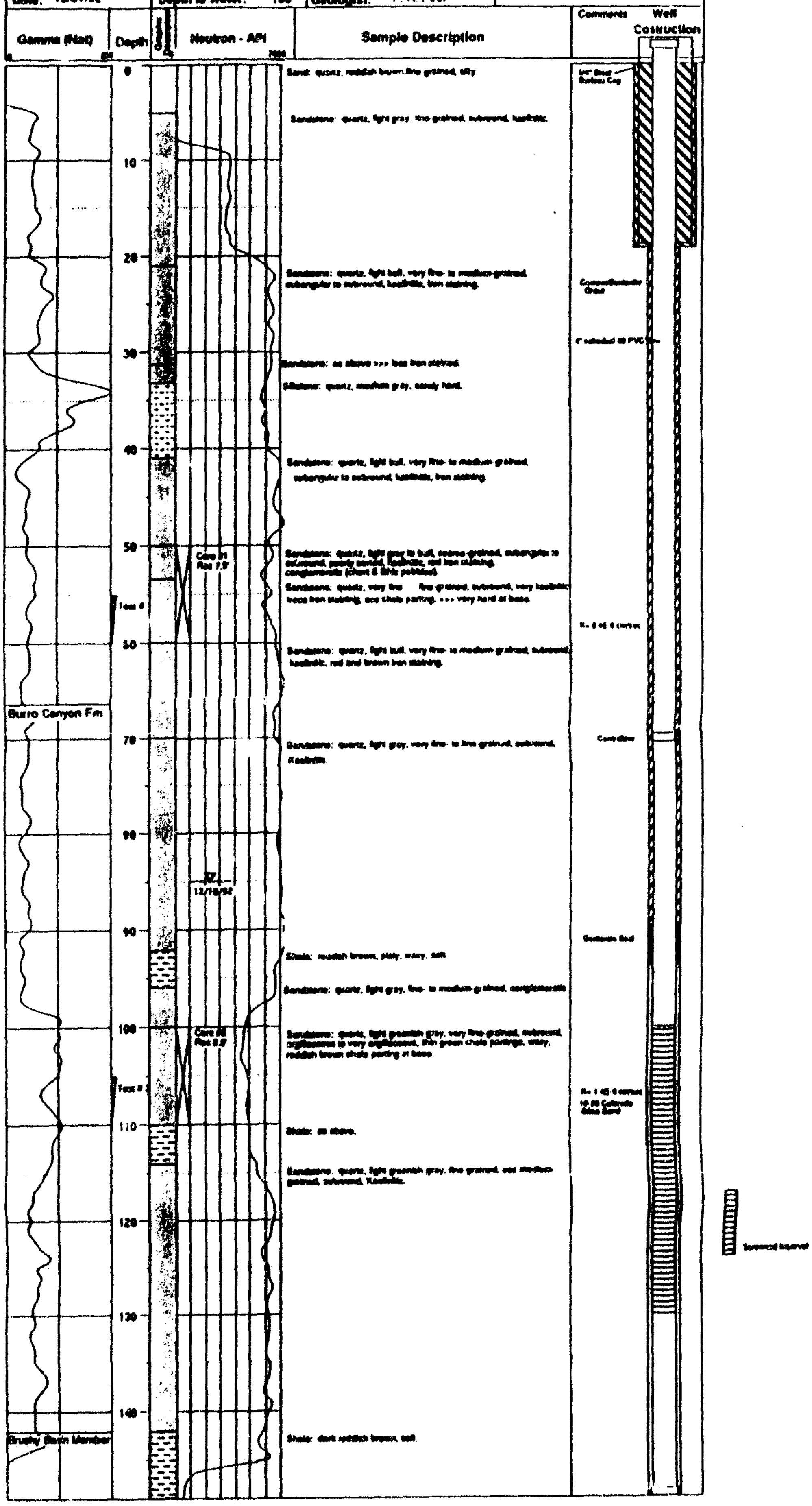
Shale: reddish brown platy, soft.



PEEL Environmental Services

Bore Hole No. : WMMW-19

Project: White Mesa	Surface Elev. 5655.05	T. D. = 149	UMETCO Minerals Corporation
Date: 12/07/92	Depth to Water: 150	Geologist: F. A. Peel	



Water well was logged before the well recharged

WW 1

REPORT OF WELL DRILLER
STATE OF UTAH

GENERAL STATEMENT: Report of well driller is hereby made and filed with the State Engineer, in accordance with the laws of Utah. (This report shall be filed with the State Engineer within 30 days after the completion or abandonment of the well. Failure to file such reports constitutes a misdemeanor.)

(1) WELL OWNER:
Name: Energy Fuels Nuclear, Inc.
Address: Blanding, Utah

(2) LOCATION OF WELL:
County: San Juan — Ground Water Basin: (leave blank)
North 1300 feet, East 2400 feet from SE Corner
of Section 29 T. 37 S R. 22 E SLBM

(3) NATURE OF WORK (check): New Well ☒ Replacement Well ☐ Deepening ☐ Repair ☐ Abandon ☐

(4) NATURE OF USE (check): Domestic ☐ Industrial ☐ Municipal ☐ Stockwater ☐ Irrigation ☐ Mining ☐ Other ☐ Test Well ☐

(5) TYPE OF CONSTRUCTION (check): Rotary ☐ Dug ☐ Jetted ☐ Cable ☐ Driven ☐ Bored ☐

(6) CASING SCHEDULE: Threaded ☐ Welded ☐
10 " Diam. from 0 feet to 1020 feet Gage 250
6 " Diam. from 332 feet to 1700 feet Gage 180
" Diam. from feet to feet Gage
New ☐ Used ☐

(7) PERFORATIONS: Perforated? Yes ☒ No ☐
Size of perforations: 3/16 inches by 3 inches
[illegible] perforations from [illegible] feet to 1300 feet

(8) SCREENS: Well screen installed? Yes ☐ No ☒

(9) CONSTRUCTION:
Was well gravel packed? Yes ☐ No ☒
Was a surface seal provided? Yes ☒ No ☐
To what depth? 120 feet
Material used in seal: Cement
Did any strata contain unusable water? Yes ☐ No ☒
Was surface casing used? Yes No ☐
Was it cemented in place? Yes No ☐

(10) WATER LEVELS:
Static level 127 feet below land surface Date
Artesian pressure feet above land surface Date

LOG RECEIVED: (11) FLOWING WELL:
Controlled by (check): Valve ☐ Cap ☐ Plug ☐ No Control ☐
Does well leak around casing? Yes ☐ No ☐

(12) WELL TESTS: Drawdown is the distance in feet the water level is lowered below static level.
Was a pump test made? Yes ☒ No ☐ If so, by whom: Energy Fuels Nuclear
Yield: 223 gal./min. with 353 feet drawdown after 1.6 hours
Bailer test: gal./min. with feet drawdown after hours
Artesian flow: g.p.m. Date
Temperature of water: Was a chemical analysis made? No ☐ Yes ☐

(13) WELL LOG: Diameter of well 12¼ inches
Depth drilled 1870 feet. Depth of completed well 1870 feet

NOTE: Place an "X" in the space or combination of spaces needed to designate the material or combination of materials encountered in each depth interval. Under REMARKS make any desirable notes as to occurrence of water and the color, size, nature, etc., of material encountered in each depth interval. Use additional sheets if needed.

DEPTH From	DEPTH To	Clay	Silt	Sand	Gravel	Cobbles	Boulders	Hardpan	Conglomerate	Bedrock	Other	REMARKS
0	8	x										Red
3	25										x	Sandstone Green
25	50										x	Yellow
50	78	x									x	White Clay Lenses
78	88											Shale Blue Gray
[illegible]	131											Mud Stone
131	360										x	Blue Gray
360	486											Lime
486	501		x								x	Gray Dark SS
501	580	x										Blue Gray
580	625	x										Red Mud Stone
625	705										x	White Sandstone
705	732											[illegible] Shale
[illegible]	750											[illegible]
750	825	x									x	White SS/White [illegible]
825	857											[illegible] Shale
857	909	x										Shale Red
909	939		x									Silt Stone W/B
939	1039	x	x									Red
1038	1060	x									x	Red SS/B/W/R Clay
1060	1090	x										Mud Stone
1090	1200	x										Red Mud Stone
1200	1250	x										Red White Blue Mud Stone
1250	1296											Red Mud Stone
1296	1840	x									x	White SS / Clay Lenses
1340	1260	x										Red Shale

Work started August 3 1979 Completed September 26 1979

(14) PUMP:
Manufacturer's Name:
Type: H. P.
Depth to pump or bowls: feet

Well Driller's Statement:
This well was drilled under my supervision, and this report is true to the best of my knowledge and belief.
Name GRIMSHAW DRILLING INC. (Person, firm, or corporation) (Type or print)
Address 2222 North 800 East - Cedar City, Utah 847[illegible]
(Signed) [signature] (Well Driller)
License No. 240 Date , 19

WW-2

REPORT OF WELL DRILLER

STATE OF UTAH

Examined ____
Recorded: B. C. ____ T. B. ____
Inspection Sheet ____
Coded ____

Application No. [illegible]
Claim No. ____
Coordinate No. ____

GENERAL STATEMENT: Report of well driller is hereby made and filed with the State Engineer, in accordance with the laws of Utah. (This report shall be filed with the State Engineer within 30 days after the completion or abandonment of the well. Failure to file such reports constitutes a misdemeanor.)

(1) WELL OWNER:

Name: Energy Fuels Nuclear
Address: Blanding, Utah

(2) LOCATION OF WELL:

County: San Juan
Ground Water Basin (leave blank) ____

North 2100 feet, East 2200 feet from SE Corner
of Section 28 T. 37 S, R. 22 E SLBM (strike out words not needed)

(3) NATURE OF WORK (check):

New Well ☐ Replacement Well ☐ Deepening ☐ Repair ☐ Abandon ☐

If abandonment, describe material and procedure: ____

(4) NATURE OF USE (check):

Domestic ☐ Industrial ☒ Municipal ☐ Stockwater ☐
Irrigation ☐ Mining ☐ Other ☐ Test Well ☐

(5) TYPE OF CONSTRUCTION (check):

Rotary ☒ Dug ☐ Jetted ☐
Cable ☐ Driven ☐ Bored ☐

(6) CASING SCHEDULE:

Threaded ☐ Welded ☐

10" Diam. from 0 feet to 1250 feet Gage 250
____" Diam. from ____ feet to ____ feet Gage ____
____" Diam. from ____ feet to ____ feet Gage ____

New ☑ Reject ☐ Used ☐

(7) PERFORATIONS:

Perforated? Yes ☐ No ☐

Type of perforator used ____
Size of perforations ____ inches by ____ inches
____ perforations from ____ feet to ____ feet
____ perforations from ____ feet to ____ feet
____ perforations from ____ feet to ____ feet
____ perforations from ____ feet to ____ feet
____ perforations from ____ feet to ____ feet

(8) SCREENS:

Well screen installed? Yes ☐ No ☐

Manufacturer's Name ____
Type ____ Model No. ____
Diam. ____ Slot size ____ Set from ____ ft. to ____
Diam. ____ Slot size ____ Set from ____ ft. to ____

(9) CONSTRUCTION:

Was well gravel packed? Yes ☒ No ☐ Size of gravel 3/8 to 3/4
Gravel placed from 100 feet to 1250 feet
Was a surface seal provided? Yes ☑ No ☐
To what depth? 100 feet
Material used in seal: Cement
Did any strata contain unusable water? Yes ☐ No ☐
Type of water: ____ Depth of strata ____
Method of sealing strata off: ____

Was surface casing used? Yes ☐ No ☒
Was it cemented in place? Yes ☐ No ☐

(10) WATER LEVELS:

Static level 480 feet below land surface Date ____
Artesian pressure ____ feet above land surface Date ____

LOG RECEIVED ____

(11) FLOWING WELL:

Controlled by (check) Valve ☐
Cap ☐ Plug ☐ No control ☐
Does well leak around casing? Yes ☐
No ☐

(12) WELL TESTS:

Drawdown is the distance in feet the water level is lowered below static level.

Was a pump test made? Yes ☐ No ☐ If so, by whom? ____

Yield: ____ gal./min. with ____ feet drawdown after ____ hours
" ____ " ____ " ____ "
" ____ " ____ " ____ "

Bailer test ____ gal./min. with ____ feet drawdown after ____ hours
Artesian flow ____ g.p.m. Date ____
Temperature of water ____ Was a chemical analysis made? No ☐ Yes ☐

(13) WELL LOG:

Diameter of well 15 inches
Depth drilled 1885 feet. Depth of completed well 1885 feet.

NOTE: Place an "X" in the space or combination of spaces needed to designate the material or combination of materials encountered in each depth interval. Under REMARKS make any desirable notes as to occurrence of water and the color, size, nature, etc., of material encountered in each depth interval. Use additional sheet if needed.

DEPTH From	DEPTH To	Clay	Silt	Sand	Gravel	Cobbles	Boulders	Hardpan	Conglomerate	Bedrock	Other Sandstone	REMARKS
0	25	X									X	Red & Green
25	80	X									X	White Grey-Blue Green
80	150	X									X	Mud Stone-Blue Grey
150	400										X	Blue Grey Sandstone
400	580	X									X	Blue Green Limestone/cl
580	650	X										
			5% Limestone-Shale - Red mudstone									
650	750	X									X	Blue Green Limestone
			Sandstone with Red Clay Lenses									
750	900										X	Mud Stone - Brown
900	1200	X									X	80% clay 15% Sandstone
			5% shale									
1200	1250	X									X	50% Red Clay-50% White Sandstone
1250	1290	X									X	Red Clay-Red Sandstone
1290	1885										X	White Sandstone
Note		0' to 1250' is 15 inch hole										
		Casing set to 1250'										
9-7/8	Open hole from 1250' to 1885'											

Work started Oct. 10, 1979 completed Jan 19, 1980

(14) PUMP:

Manufacturer's Name ____
Type: ____ H. P. [illegible]
Depth to pump or bowls ____ feet

Well Driller's Statement:

This well was drilled under my supervision, and this report is true to the best of my knowledge and belief.

Name [illegible] (Person, firm, or corporation) (Type or print)
Address [illegible]
(Signed) [illegible] (Well Driller)
License No. [illegible] Date [illegible], 19[illegible]

(USE OTHER SIDE FOR ADDITIONAL REMARKS)

WW3

Form 113-104-1240

REPORT OF WELL DRILLER

STATE OF UTAH

Application No. 47073 (09-589)

Claim No.

Cooperative No.

Checked ______ T. D.

Record. No. ______

Inspection sheet

Card

GENERAL STATEMENT: Report of well driller is hereby made and filed with the State Engineer, in accordance with the laws of Utah. (This report shall be filed with the State Engineer within 30 days after the completion or abandonment of the well. Failure to file such reports constitutes a misdemeanor.)

(1) WELL OWNER:

Name Energy Fuels Nuclear, Inc.

Address Blanding, UT 84511

(2) LOCATION OF WELL:

County San Juan Ground Water Basin (leave blank)

North 1400 feet, West 3000 feet from SE Corner of Section 28 T. 37 S, R. 22 E SLBM (strike out words not needed)

(3) NATURE OF WORK (check): New Well X

Replacement Well ☐ Deepening ☐ Repair ☐ Abandon ☐

If abandonment, describe material and procedure:

(4) NATURE OF USE (check):

Domestic ☐ Industrial X Municipal ☐ Stockwater ☐

Irrigation ☐ Mining ☐ Other ☐ Test Well ☐

(5) TYPE OF CONSTRUCTION (check):

Rotary X Dug ☐ Jetted ☐

Cable ☐ Driven ☐ Bored ☐

(6) CASING SCHEDULE: Threaded ☐ Welded X

8" Diam. from 0 feet to 1250 feet Gage .337

" Diam. from ______ feet to ______ feet Gage

" Diam. from ______ feet to ______ feet Gage

New ☐ Second ☐ Used ☐

(7) PERFORATIONS: Perforated? Yes ☐ No X

Type of perforator used

Size of perforations ______ inches by ______ inches

______ perforations from ______ feet to ______ feet

______ perforations from ______ feet to ______ feet

______ perforations from ______ feet to ______ feet

______ perforations from ______ feet to ______ feet

______ perforations from ______ feet to ______ feet

(8) SCREENS: Well screen installed? Yes ☐ No X

Manufacturer's Name

Type ______ Model No.

Diam. ______ Slot size ______ Set from ______ ft. to

Diam. ______ Slot size ______ Set from ______ ft. to

(9) CONSTRUCTION:

Was well gravel packed? Yes ☐ No X Size of gravel:

Gravel placed from ______ feet to ______ feet

Was a surface seal provided? Yes X No ☐

To what depth? 1250 feet

Material used in seal: Cement

Did any strata contain unusable water? Yes ☐ No X

Type of water: ______ Depth of strata

Method of sealing strata off:

Was surface casing used? Yes ☐ No X

Was it cemented in place? Yes ☐ No ☐

(10) WATER LEVELS:

Static level [illegible] feet below land surface Date 8-3-80

Artesian pressure ______ feet above land surface Date

LOG RECEIVED

(11) FLOWING WELL:

Controlled by (check) Valve ☐

Cap ☐ Plug ☐ No Control ☐

Does well leak around casing? Yes ☐

No X

(12) WELL TESTS: Drawdown is the distance in feet the water level is lowered below static level.

Was a pump test made? Yes X No ☐ If so, by whom? Energy Fuels

Yield: 245 gal./min. with 315 feet drawdown after 2 hours

Bailer test ______ gal./min. with ______ feet drawdown after ______ hours

Artesian flow ______ g.p.m. Date

Temperature of water ______ Was a chemical analysis made? No ☐ Yes ☐

(13) WELL LOG: Diameter of well 12¼" to 1250' & 6" to 1850' inches

Depth drilled 1850 feet. Depth of completed well 1850 feet.

NOTE: Place an "X" in the space or combination of spaces needed to designate the material or combination of materials encountered in each depth interval. Under REMARKS make any desirable notes as to occurrence of water and the color, size, nature, etc., of material encountered in each depth interval. Use additional sheet if needed.

Depth From	Depth To	Clay	Silt	Sand	Gravel	Cobbles	Boulders	Hardpan	Conglomerate	Bedrock	Other	REMARKS
0	25	X										Brown Shale
25	70										X	Sandstone
70	100										X	Shale & Sandstone
100	350										X	Shale & Mudstone
350	470										X	Limestone
470	570		X									Gray Sandstone
570	600	X										Red Shale
600	710										X	Sandstone
710	750	X										Red Shale
750	830										X	Sandstone & Shale
830	920	X										Red & Gray Shale
920	1040										X	Red & White Sandstone
1040	1200	X										Red Mudstone
1200	1300										X	Red & Blue Shale
1300	1850										X	Red &White Sandstone

Work started June 24, 19 80 Completed July 28, 19 80

(14) PUMP:

Manufacturer's Name

Type: ______ H. P.

Depth to pump or bowl ______ feet

Well Driller's Statement:

This well was drilled under my supervision, and this report is true to the best of my knowledge and belief.

Name [illegible] Drilling Co., Inc. (Person, firm, or corporation) (Type or print)

Address 4251 Graham St., Boulder, CO [illegible]

(Signed) ______ (Well Driller)

License No. 524 (Colo) Date August 7, 19 80

USE OTHER SIDE FOR ADDITIONAL REMARKS

WELL # 4

WW4

Form 113-184-12-83

Examined ______
Recorded: S.C. ______ T.S. ______
Inspection Sheet ______
Field ______

REPORT OF WELL DRILLER

STATE OF UTAH

Application No. A12626 (09-699)
Claim No. ______
Coordinate No. ______

GENERAL STATEMENT: Report of well driller is hereby made and filed with the State Engineer, in accordance with the laws of Utah. (This report shall be filed with the State Engineer within 30 days after the completion or abandonment of the well. Failure to file such reports constitutes a misdemeanor.)

(1) WELL OWNER:

Name Energy Fuels Nuclear, Inc.
Address Blanding, UT 84511

(2) LOCATION OF WELL:

County San Juan Ground Water Basin ______ (leave blank)

North 1000 feet, East 650 feet from SW Corner

Section 22 T. 37 S, R. 22 E SLBM (strike words not needed)

(3) NATURE OF WORK (check):

New Well ☒ Replacement Well ☐ Deepening ☐ Repair ☐ Abandon ☐

If abandonment, describe material and procedure: ______

(4) NATURE OF USE (check):

Domestic ☐ Industrial ☒ Municipal ☐ Stockwater ☐
Irrigation ☐ Mining ☐ Other ☐ Test Well ☐

(5) TYPE OF CONSTRUCTION (check):

Rotary ☒ Dug ☐ Jetted ☐
Cable ☐ Driven ☐ Bored ☐

(6) CASING SCHEDULE: Threaded ☐ Welded ☒

__" Diam. from ____ feet to 1250 feet Gage ____
__" Diam. from ____ feet to ____ feet Gage ____
__" Diam. from ____ feet to ____ feet Gage ____
New ☐ Reject ☐ Used ☐

(7) PERFORATIONS: Perforated? Yes ☐ No ☒

Type of perforator used ______
Size of perforations ____ inches by ____ inches
____ perforations from ____ feet to ____ feet
____ perforations from ____ feet to ____ feet
____ perforations from ____ feet to ____ feet
____ perforations from ____ feet to ____ feet
____ perforations from ____ feet to ____ feet

(8) SCREENS: Well screen installed? Yes ☐ No ☒

Manufacturer's Name ______
Type ______ Model No. ______
Diam. ____ Slot size ____ Set from ____ ft. to ____ ft.
Diam. ____ Slot size ____ Set from ____ ft. to ____ ft.

(9) CONSTRUCTION:

Was well gravel packed? Yes ☐ No ☒ Size of gravel: ______
Gravel placed from ____ feet to ____ feet
Was a surface seal provided? Yes ☒ No ☐
To what depth? 125 feet
Material used in seal: Concrete
Did any strata contain unusable water? Yes ☐ No ☐
Type of water ______ Depth of strata ______
Method of sealing strata off ______

Was surface casing used? Yes ☐ No ☒
Was it cemented in place? Yes ☐ No ☐

(10) WATER LEVELS:

____ feet below land surface Date ______
____ feet above land surface Date ______

(11) FLOWING WELL:

Controlled by: Valve ☐
Cap ☐ Plug ☐ No Control ☐
Does well leak around casing? Yes ☐
No ☐

(12) WELL TESTS:

Drawdown is the distance in feet the water level is lowered below static level.

Was a pump test made? Yes ☒ No ☐ If so, by whom? Energy Fuels

Yield: 238 gal/min. with 890 feet drawdown after 48 hours

Bailer test ____ gal/min. with ____ feet drawdown after ____ hours
Artesian flow ____ g.p.m. Date ______
Temperature of water ______ Was a chemical analysis made? No ☐ Yes ☐

(13) WELL LOG: 12¼" to 1250' & 6" to 1820'

Depth drilled 1820 feet. Depth of completed well 1820 feet.

NOTE: Place an "X" in the space or combination of spaces needed to designate the material or combination of materials encountered in each depth interval. Under REMARKS make any desirable notes as to occurrence of water and the color, size, nature, etc., of material encountered in each depth interval. Use additional sheet if needed.

Depth From	Depth To	Clay	Silt STONE	Sand STONE	Gravel	Cobbles	Boulders	Hardpan	Conglomerate	Bedrock	MUDSTONE	REMARKS
0	120			X								Dakota Formation
120	740		X								X	Brushy Basin
740	900			X							X	Brushy Basin & Salt Wash
900	940			X								Salt Wash
940	980										X	" "
980	1020		X	X								" "
1020	1050		X								X	" "
1050	1100			X								" "
1100	1240										X	" "
1240	1300		X									Summerville
1300	1490			X								Entrada
1490	1720			X								Navajo
1720	1820			X								Wingate

Work started Sept. 24, 1980 19__ Completed Oct. 24, 19 80

(11) PUMP:

Manufacturer's Name ______
Type ______ H.P. ______
Depth to pump or bowl ____ feet

Well Driller's Statement:

This well was drilled under my supervision, and this report is true to the best of my knowledge and belief.

Name [illegible] (Person, firm, or corporation) (Type or print)

Address [illegible]

(Signed) [illegible] (Well Driller)

License No. 558 Colo. Date Nov. ____ 19__

USE OTHER SIDE FOR ADDITIONAL REMARKS

Form 113-104-12

WW5

Examined ______
Recorded: B. C. ______ T. B. ______
Inspection Sheet ______
Copied ______

REPORT OF WELL DRILLER
STATE OF UTAH

Application No. A 2198
Claim No. ______
Cooperate No. ______

GENERAL STATEMENT: Report of well driller is hereby made and filed with the State Engineer, in accordance with the laws of Utah. (This report shall be filed with the State Engineer within 30 days after the completion or abandonment of the well. Failure to file such reports constitutes a misdemeanor.)

(1) WELL OWNER:
Name Energy Fuels Ltd.
Address Denver , Colorado

(2) LOCATION OF WELL:
County San Juan Ground Water Basin (leave blank) Second
North 6040 feet, East 2000 feet from S W Corner
of Section 27 T. 37 S, R. 22 E SLBM (strike out words not needed)

(3) NATURE OF WORK (check): New Well X
Replacement Well ☐ Deepening ☐ Repair ☐ Abandon ☐
If abandonment, describe material and procedure: ______

(4) NATURE OF USE (check):
Domestic ☐ Industrial X Municipal ☐ Stockwater ☐
Irrigation ☐ Mining ☐ Other ☐ Test Well X

(5) TYPE OF CONSTRUCTION (check):
Rotary X Dug ☐ Jetted ☐
Cable ☐ Driven ☐ Bored ☐

(6) CASING SCHEDULE: Threaded ☐ Welded ☐
6 " Diam. from 0 feet to 1250 feet Gage 1/4"
______ " Diam. from ______ feet to ______ feet Gage ______
______ " Diam. from ______ feet to ______ feet Gage ______
New ☐ Reject ☐ Used ☐

(7) PERFORATIONS: Perforated? Yes ☐ No X
Type of perforator used ______
Size of perforations ______ inches by ______ inches
______ perforations from ______ feet to ______ feet
______ perforations from ______ feet to ______ feet
______ perforations from ______ feet to ______ feet
______ perforations from ______ feet to ______ feet
______ perforations from ______ feet to ______ feet

(8) SCREENS: Well screen installed? Yes ☐ No X
Manufacturer's Name ______
Type ______ Model No. ______
Diam. ______ Slot size ______ Set from ______ ft. to ______
Diam. ______ Slot size ______ Set from ______ ft. to ______

(9) CONSTRUCTION:
Was well gravel packed? Yes ☐ No X Size of gravel: ______
Gravel placed from ______ feet to ______ feet
Was a surface seal provided? Yes X No ☐
To what depth? 18' feet
Material used in seal: Concrete
Did any strata contain unusable water? Yes ☐ No X
Type of water: ______ Depth of strata ______
Method of sealing strata off: ______
Was surface casing used? Yes ☐ No X
Was it cemented in place? Yes ☐ No ☐

(10) WATER LEVELS:
Static level 387 feet below land surface Date 1-19-77
Artesian pressure ______ feet above land surface Date ______

LOG RECEIVED:

(11) FLOWING WELL:
Controlled by (check) Valve ☐
Cap ☐ Plug ☐ No Control ☐
Does well leak around casing? Yes ☐ No ☐

(12) WELL TESTS: Drawdown is the distance in feet the water level is lowered below static level.
Was a pump test made? Yes X No ☐ If so, by whom? W. E. Hoggard Jr.
Yield: 120 gal./min. with 377 feet drawdown after 1½ hours
Bailer test ______ gal./min. with ______ feet drawdown after ______ hours
Artesian flow ______ g.p.m. Date ______
Temperature of water 70 Was a chemical analysis made? No X Yes ☐

(13) WELL LOG: Diameter of well 8" to 1260 6" to 1800' inches
Depth drilled 1800 feet. Depth of completed well 1800 feet.

NOTE: Place an "X" in the space or combination of spaces needed to designate the material or combination of materials encountered in each depth interval. Under REMARKS make any desirable notes as to occurrence of water and the color, size, nature, etc. of material encountered in each depth interval. Use additional sheet if needed.

From	To	Clay	Silt	Sand	Gravel	Cobbles	Boulders	Hardpan	Conglomerate	Bedrock	Other	Remarks
0	5											Soil
6	27	X										Green Shale
28	230			X						X		Br. SS Dakota Formation
230	325	X										Green Shale with Lime very hard
326	760										X	Red & Green Shale with SS lenses med. hard
761	817			X								White SS Westwater Sand some water
818	890	X										Summerville shale& SS
891	910			X								Pink SS & Shale Curtis formation
911	1217			X								Red SS Entrada Formatio
1218	1247			X								White SS top of NavajoS
1250												Set 6 5/8" OD casing to 1250'
1251	1300			X								White SS. Navajo SS. (water)

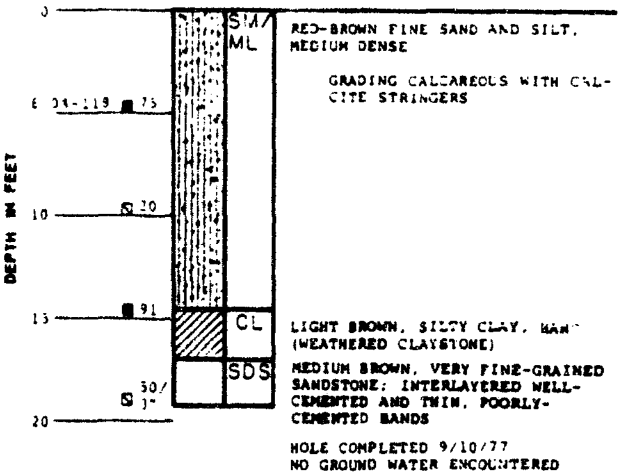
Work started Dec. 6 1976 Completed Jan 19 1977

(14) PUMP:
Manufacturer's Name Reda
Type: Submergible H. P. 40
Depth to pump or bowls 790 feet

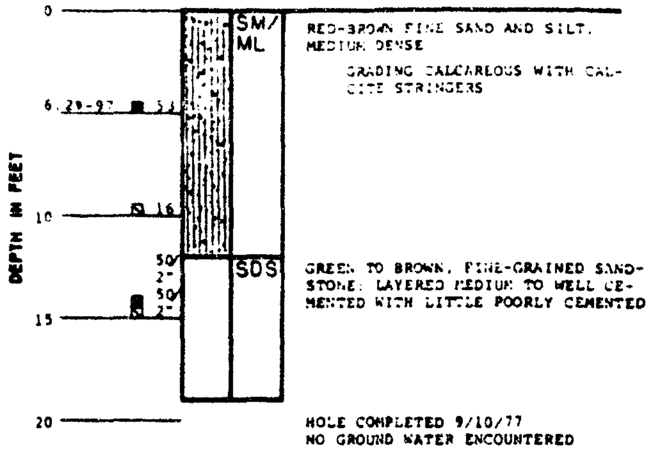
Well Driller's Statement:
This well was drilled under my supervision, and this report is true to the best of my knowledge and belief.
Name W. E. Hoggard Jr. (Person, firm, or corporation) (Type or print)
Address P.O. Box 573 Blanding, Utah
(Signed) [signature] Well Driller
License No. 315 Date Feb. 23 1977

USE OTHER SIDE FOR ADDITIONAL REMARKS

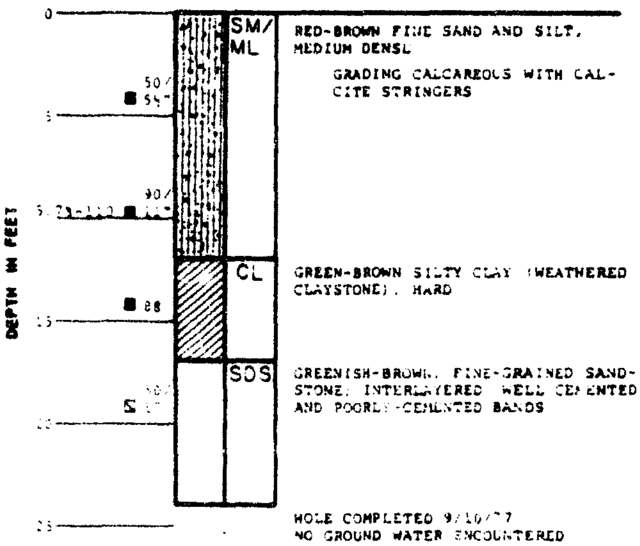
BORING NO. 1
EL. 5629.0 FT.



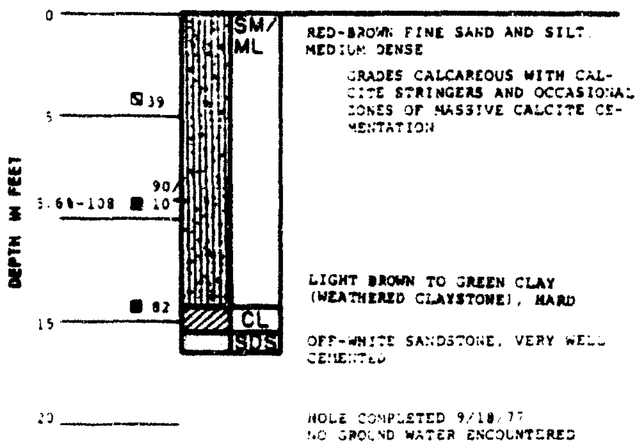
BORING NO. 5
EL. 5632.9 FT.



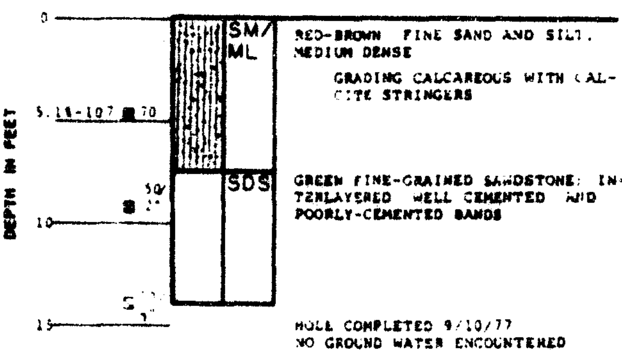
BORING NO. 2
EL. 5634.3 FT.



BORING NO. 6
EL. 5633.5 FT.



BORING NO. 4
EL. 5623.2 FT.



KEY

A-B ■ C — INDICATES DEPTH AT WHICH UNDISTURBED SAMPLE WAS EXTRACTED USING DAMES & MOORE SAMPLER

▩ C — INDICATES DEPTH AT WHICH DISTURBED SAMPLE WAS EXTRACTED USING DAMES & MOORE SAMPLER

□ C — INDICATES SAMPLE ATTEMPT WITH NO RECOVERY

⊠ C — INDICATES DEPTH AT WHICH DISTURBED SAMPLE WAS EXTRACTED USING STANDARD PENETRATION TEST SAMPLER

A — FIELD MOISTURE EXPRESSED AS A PERCENTAGE OF THE DRY WEIGHT OF SOIL

B — DRY DENSITY EXPRESSED IN LBS/CU FT

C — BLOWS/FT OF PENETRATION USING A 140-LB HAMMER DROPPING 30 INCHES

D E — INDICATES NC CORE RUN

D — PERCENT OF CORE RECOVERY

E — RQD*

F — INDICATES PACKER TEST SECTION

F — PERMEABILITY MEASURED BY SINGLE PACKER TEST IN FT/YR

NA — NOT APPLICABLE (USED FOR RQD IN CLAYS OR MECHANICALLY FRACTURED ZONES)

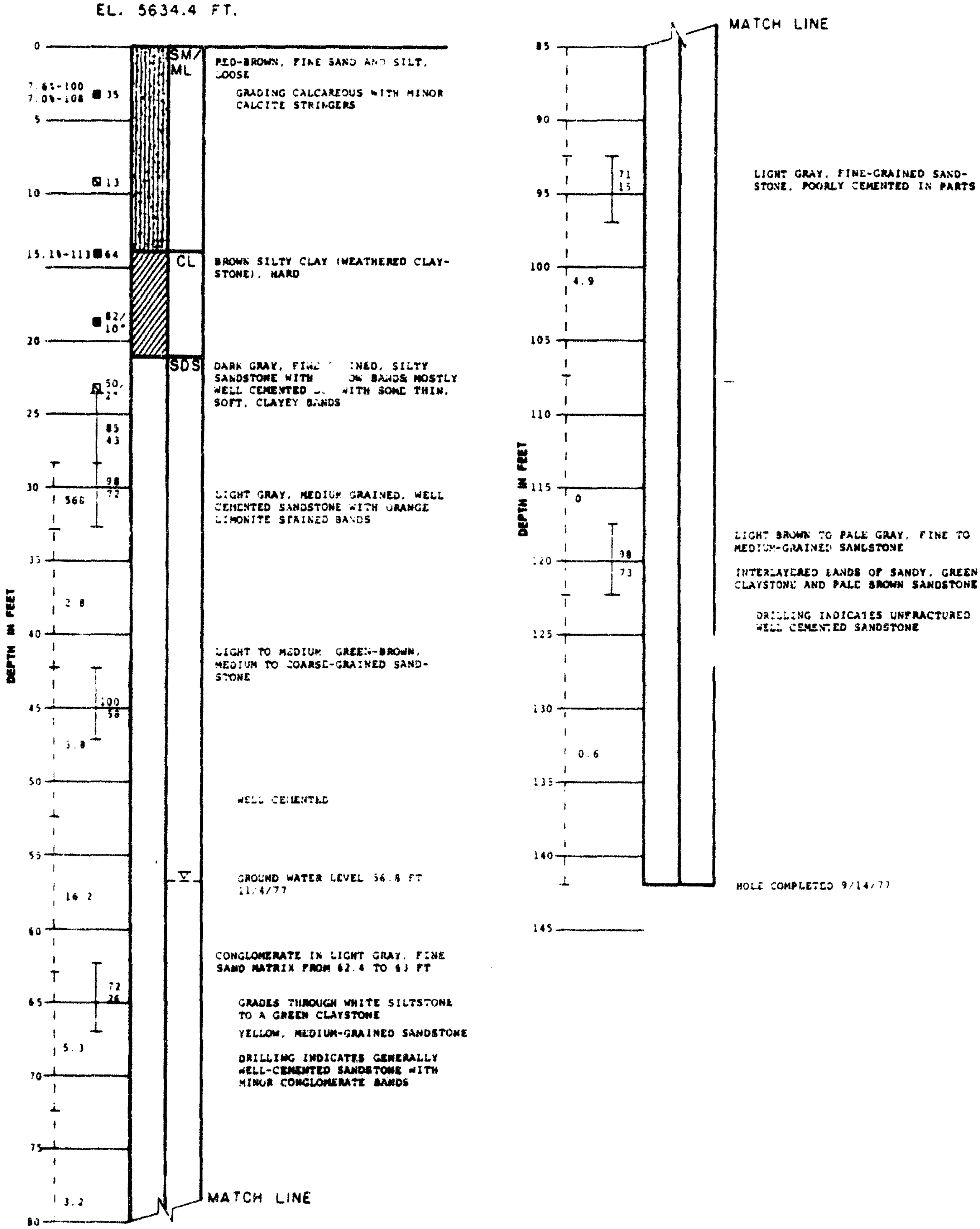
NOTE: ELEVATIONS PROVIDED BY ENERGY FUELS NUCLEAR, INC.

* ROCK QUALITY DESIGNATION -- PERCENTAGE OF CORE RECOVERED IN LENGTHS GREATER THAN 4 INCHES

LOG OF BORINGS

DAMES & MOORE

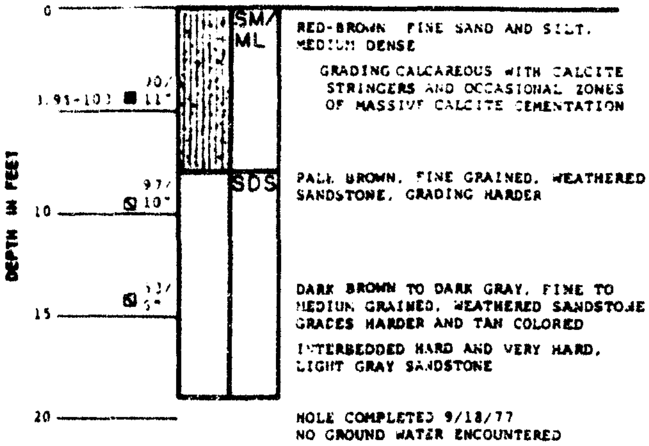
BORING NO. 3
EL. 5634.4 FT.



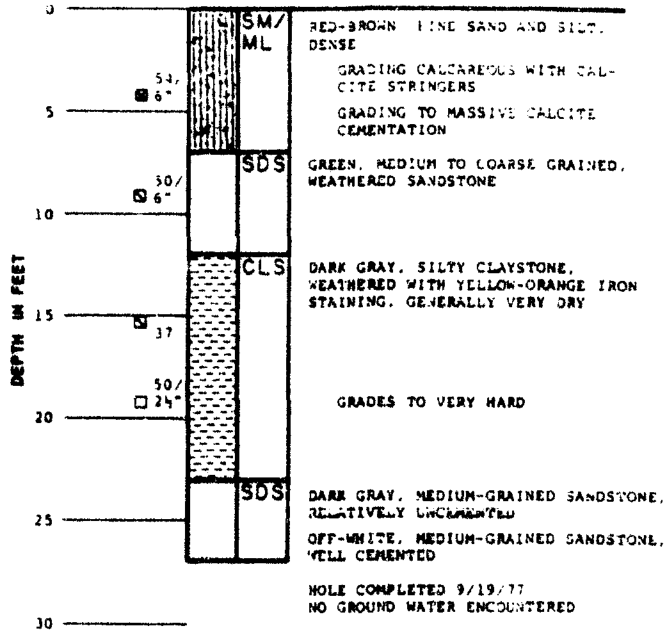
LOG OF BORINGS

DAMES & MOORE

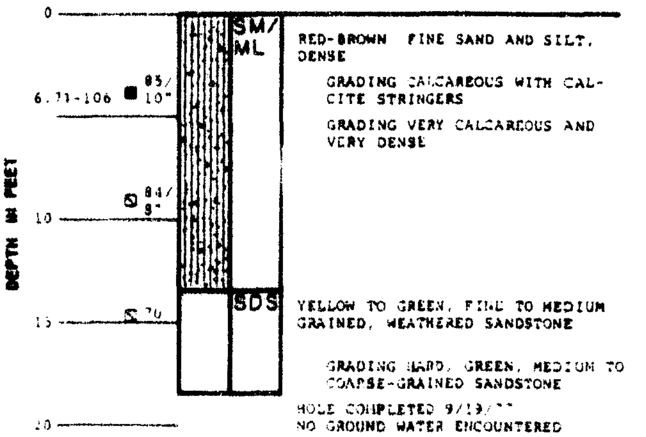
BORING NO. 7
EL. 5656.9 FT.



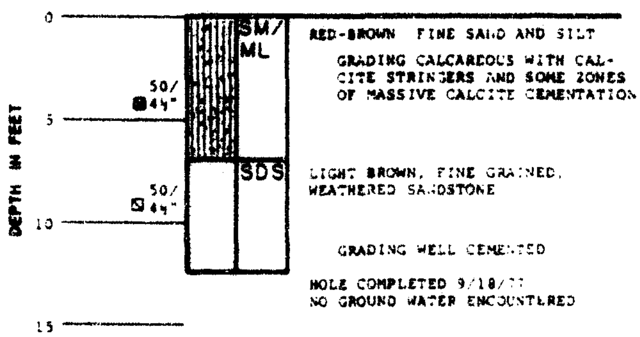
BORING NO. 8
EL. 5668.4 FT.



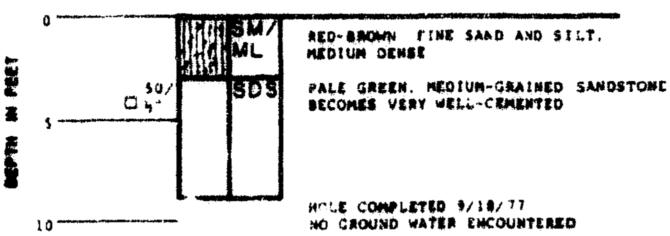
BORING NO. 10
EL. 5690.9 FT.



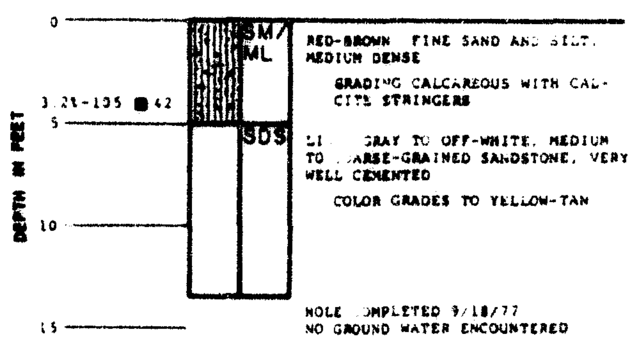
BORING NO. 11
EL. 5677.8 FT.



BORING NO. 13
EL. 5602.4 FT.

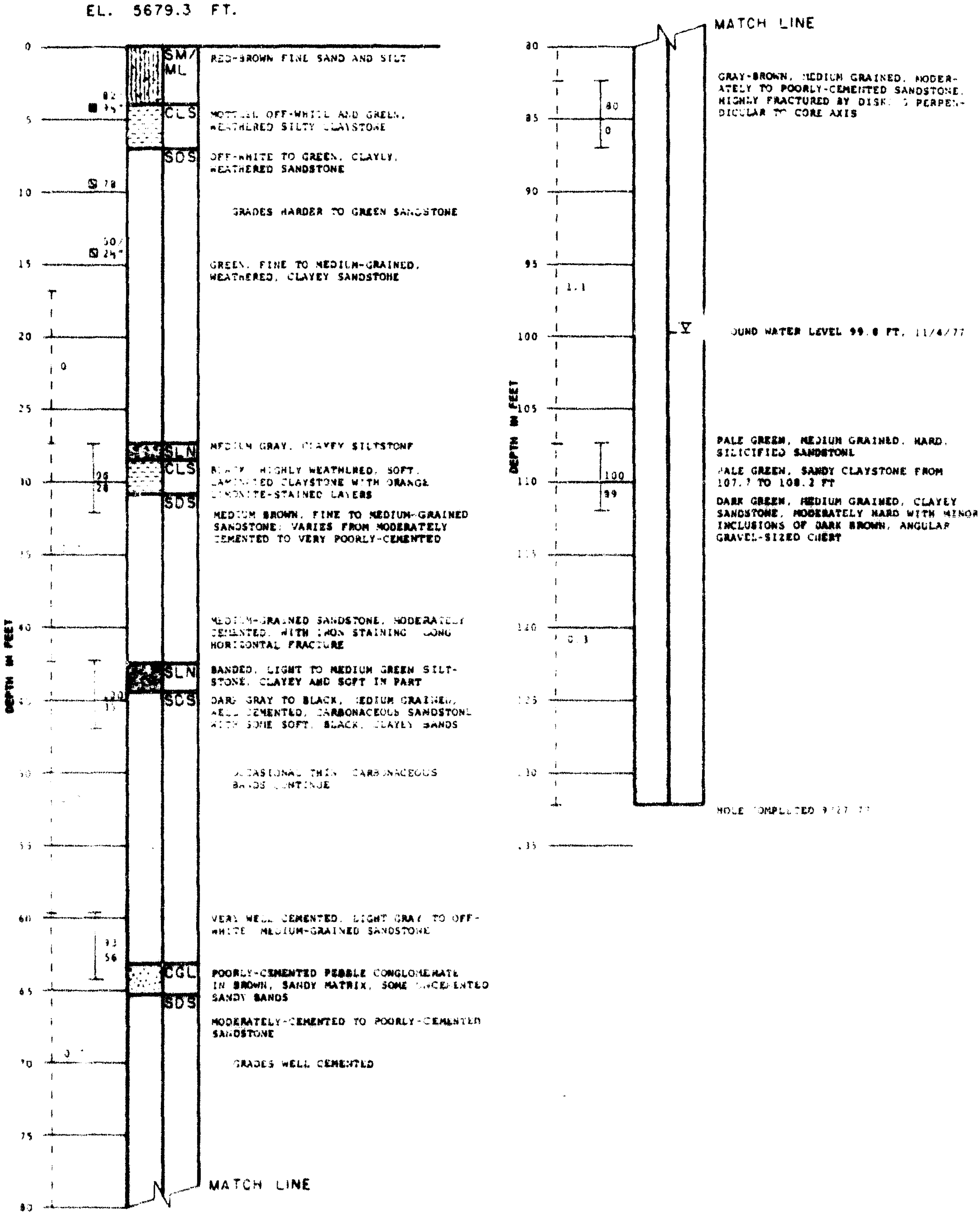


BORING NO. 14
EL. 5597.5 FT.



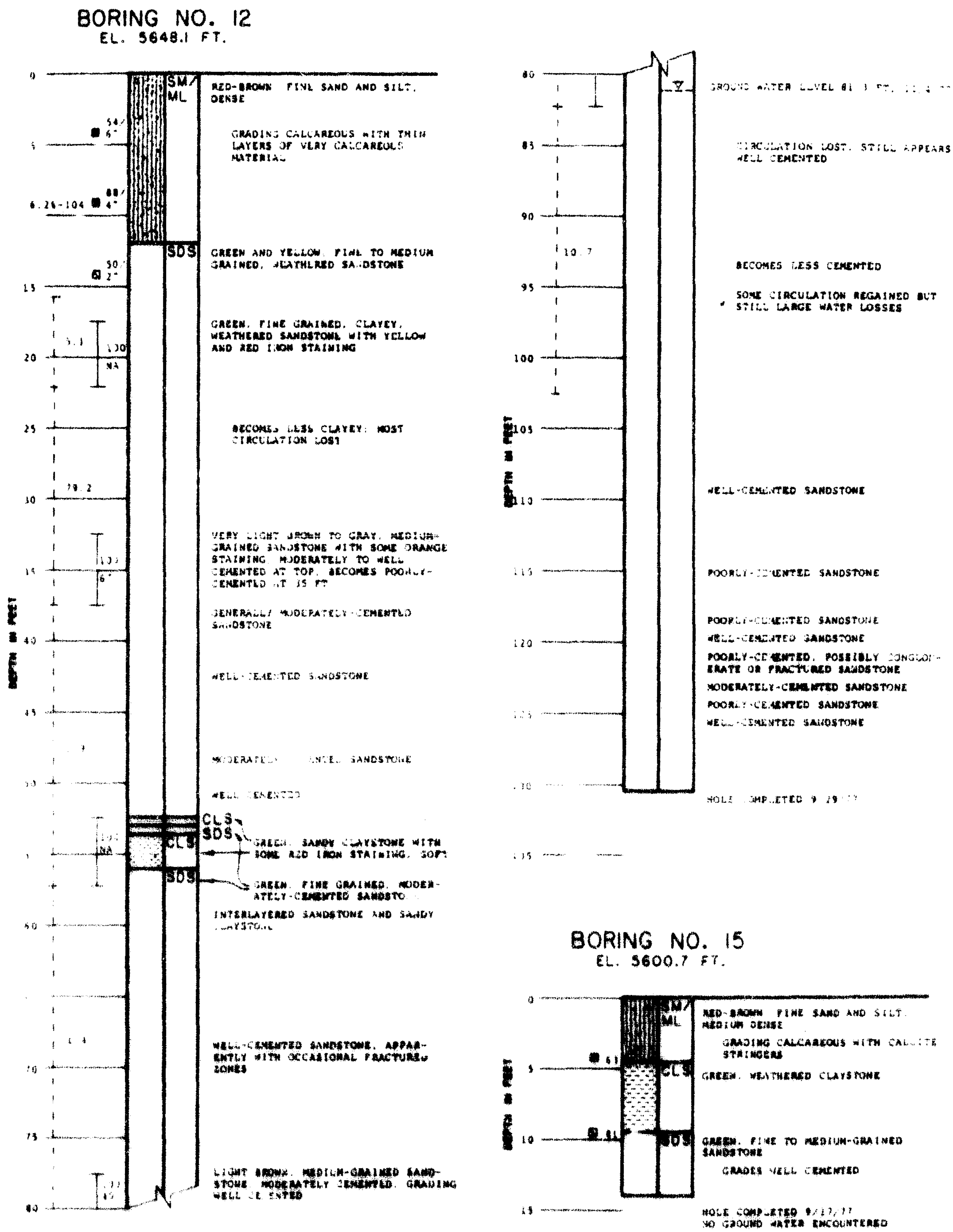
LOG OF BORINGS

BORING NO. 9
EL. 5679.3 FT.

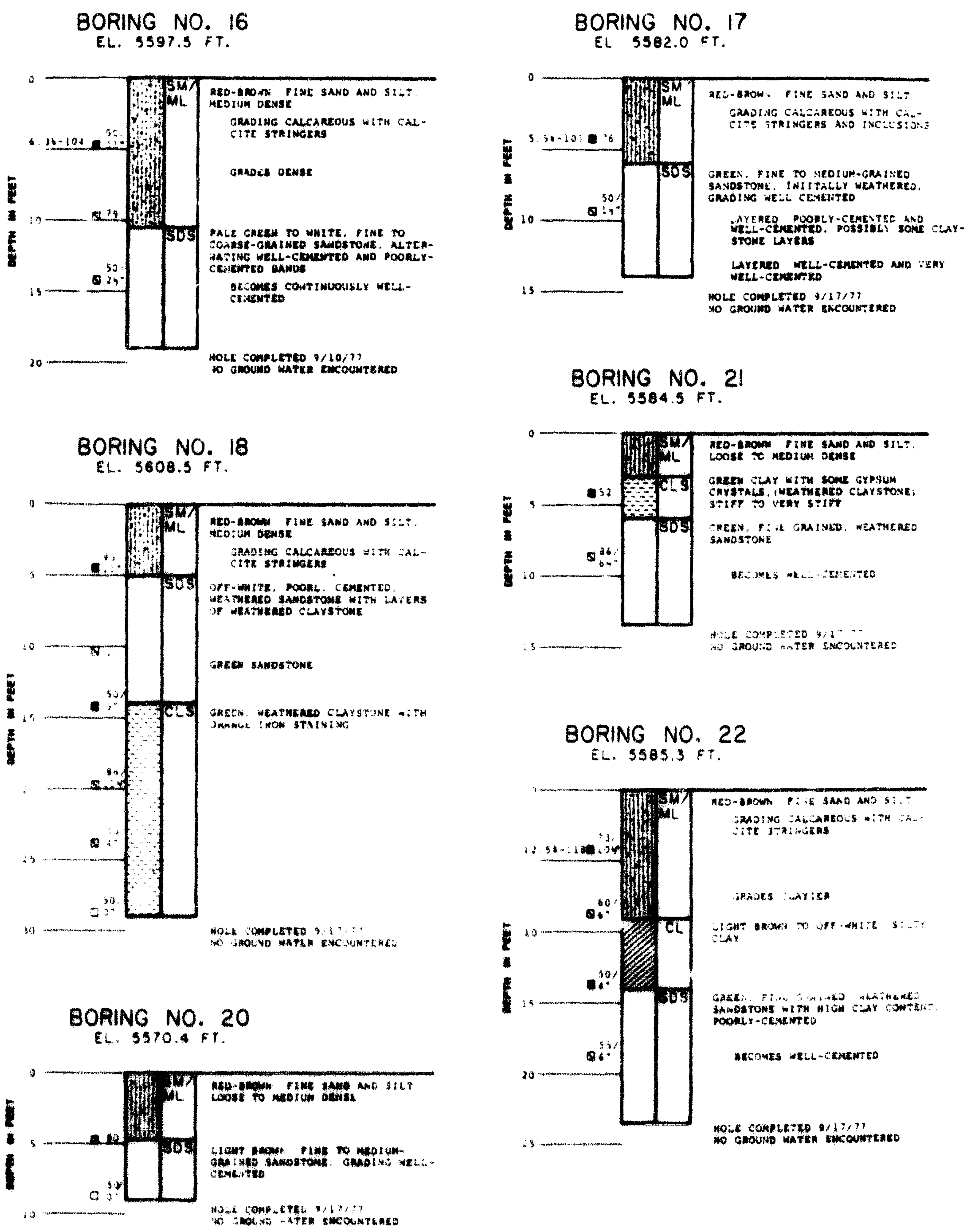


LOG OF BORINGS

DAMES & MOORE



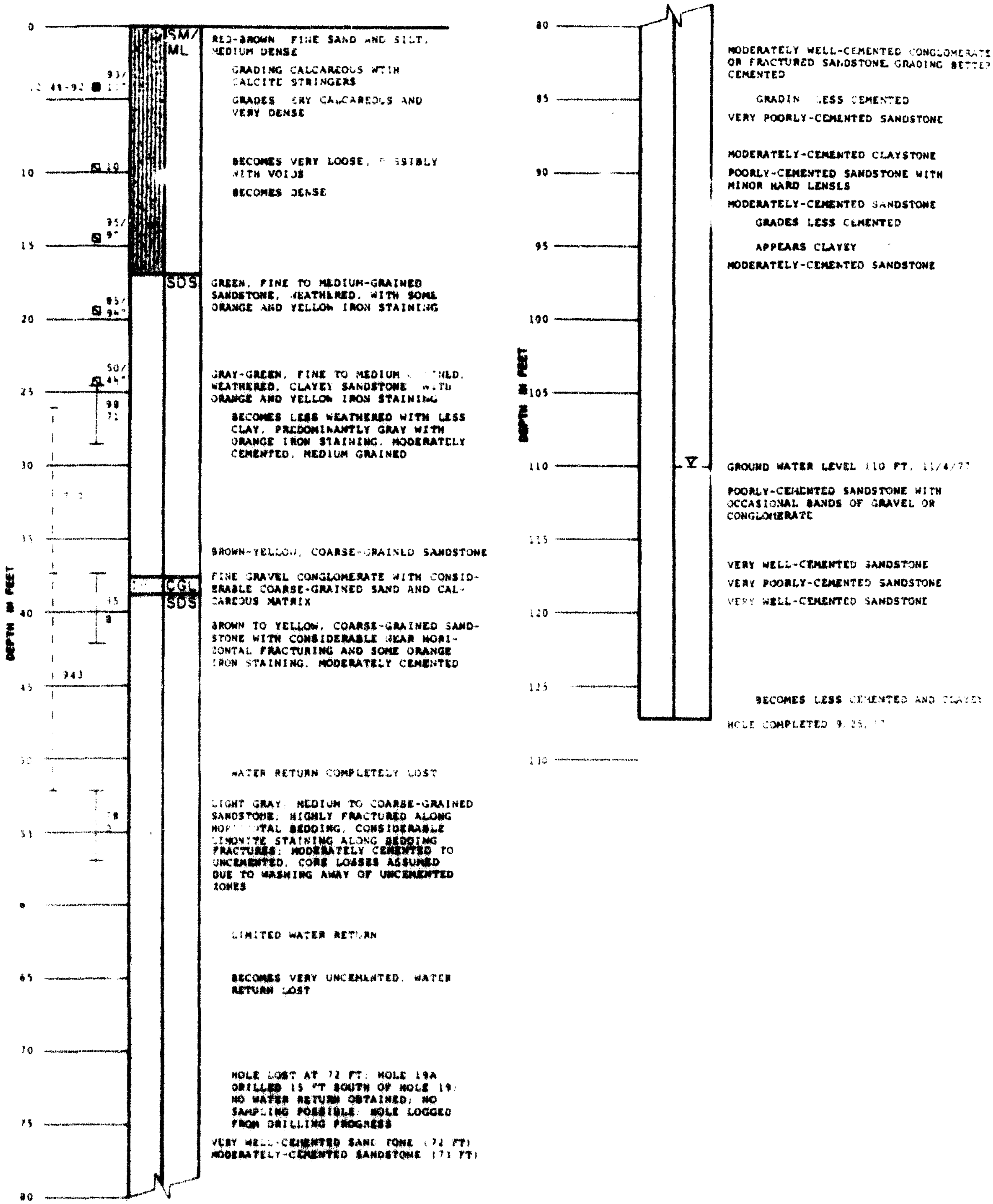
LOG OF BORINGS



LOG OF BORINGS

BORING NO. 19

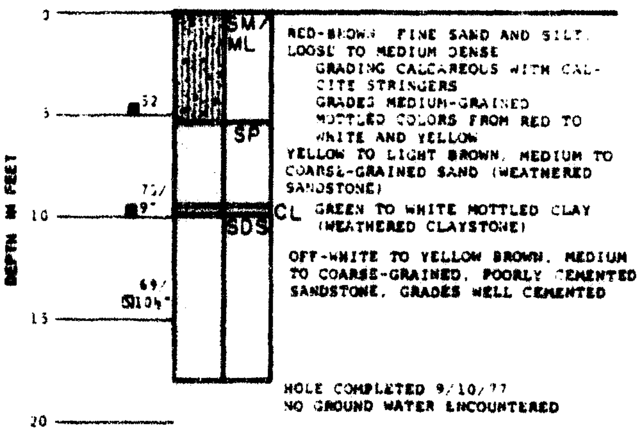
EL. 5600.3 FT.



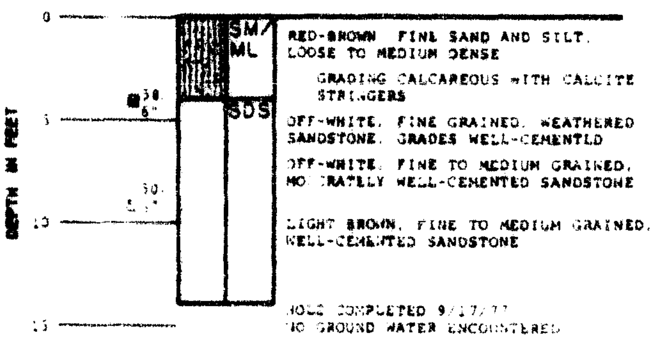
LOG OF BORINGS

DAMES & MOORE

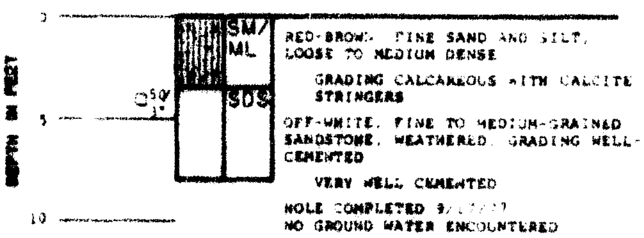
BORING NO. 23
EL. 5555.9 FT.



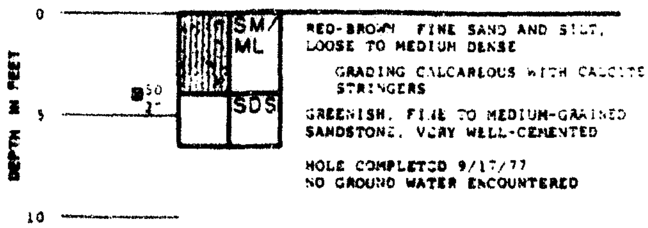
BORING NO. 24
EL. 5573.4 FT



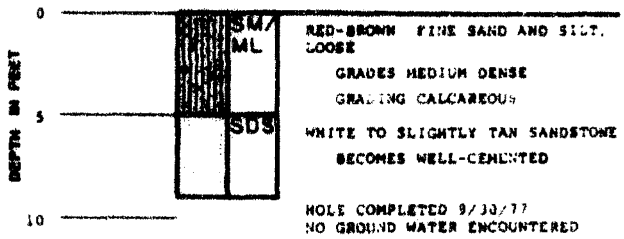
BORING NO. 26
EL. 5578.3 FT.



BORING NO. 27
EL. 5555.0 FT.



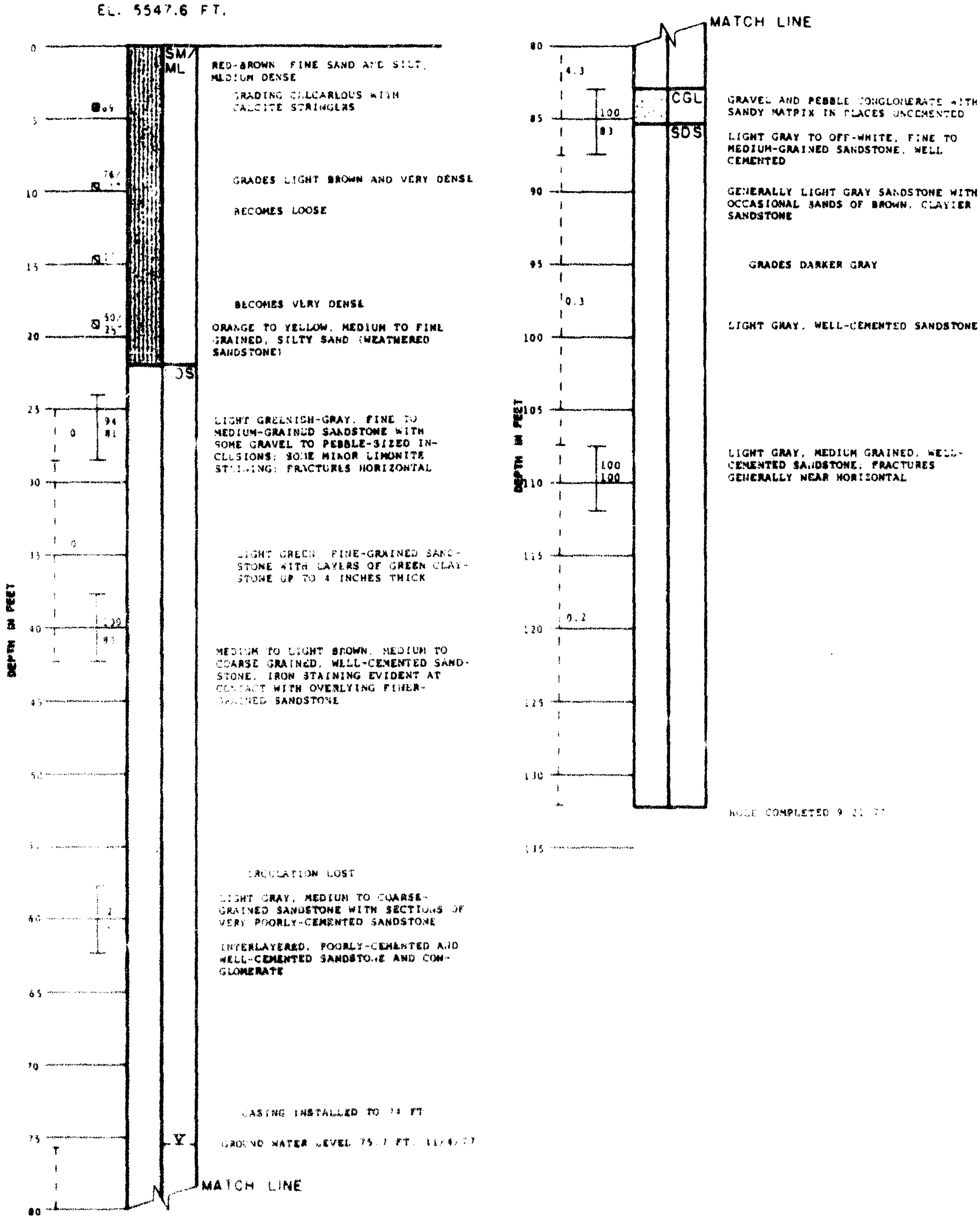
BORING NO. 29
EL. 5655.0 FT. (APPROX)



LOG OF BORINGS

DAMES & MOORE

BORING NO. 28
EL. 5547.6 FT.



LOG OF BORINGS

DAMES & MOORE

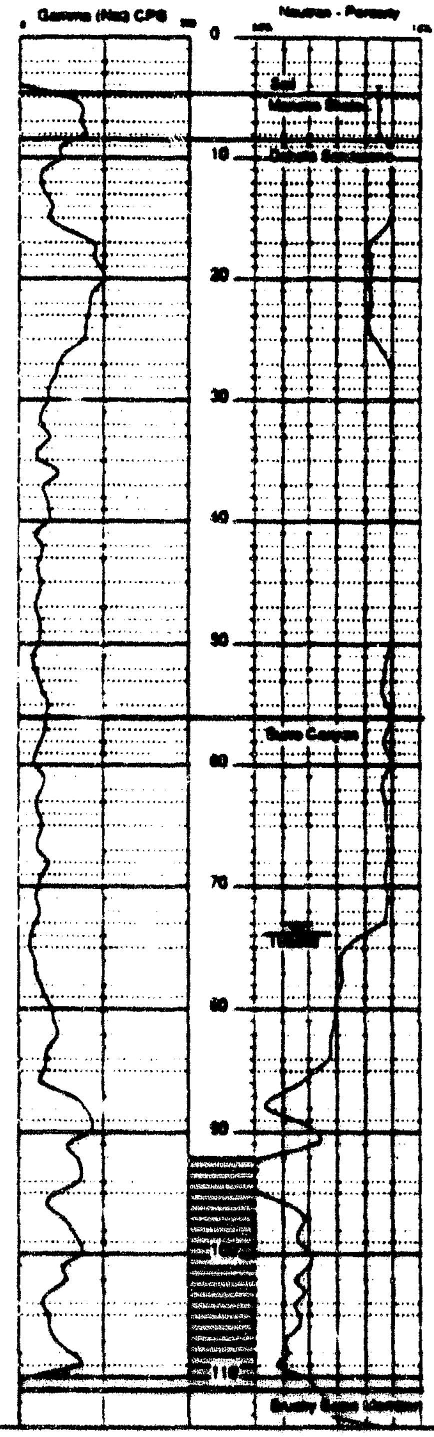
Umetco Minerals Corporation

Location: San Juan County, Utah   Date: 11/[illegible]

Gamma (Nat) - Neutron Porosity

Gd. Elev. [illegible]
T.D. 114

WMMW-1



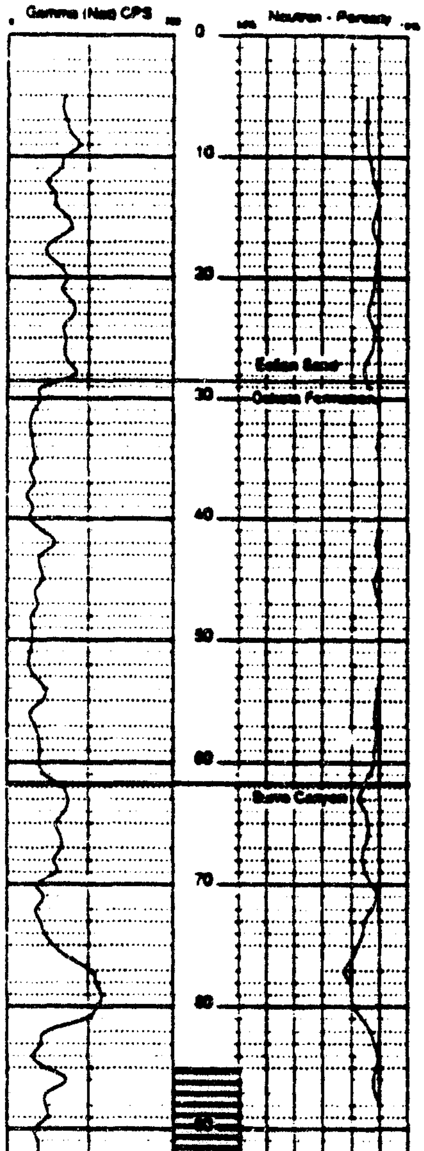
Umetco Minerals Corporation

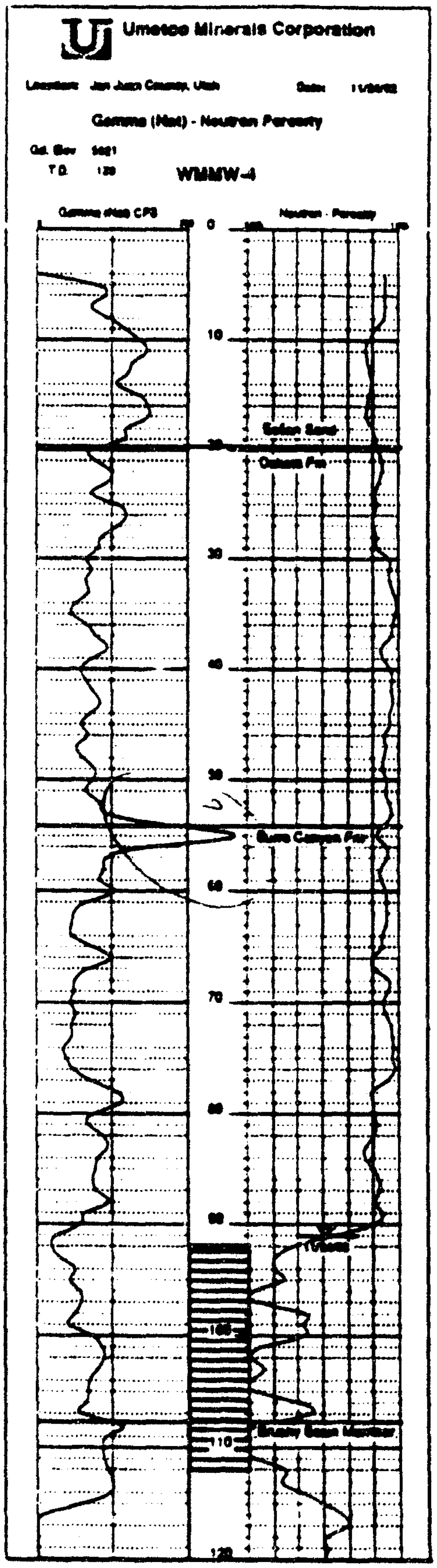
Location: Montrose County   Date: [illegible]

Gamma (Nat) - Neutron Porosity

Gd. Elev 5611.6

T D 134   **WMMW-2**





Umetco Minerals Corporation
Gamma (Nat) - Neutron Porosity
T.D. 120
WMMW-4
0
10
20
30
40
50
60
70
80
90
100
110
120

Umetco Minerals Corporation

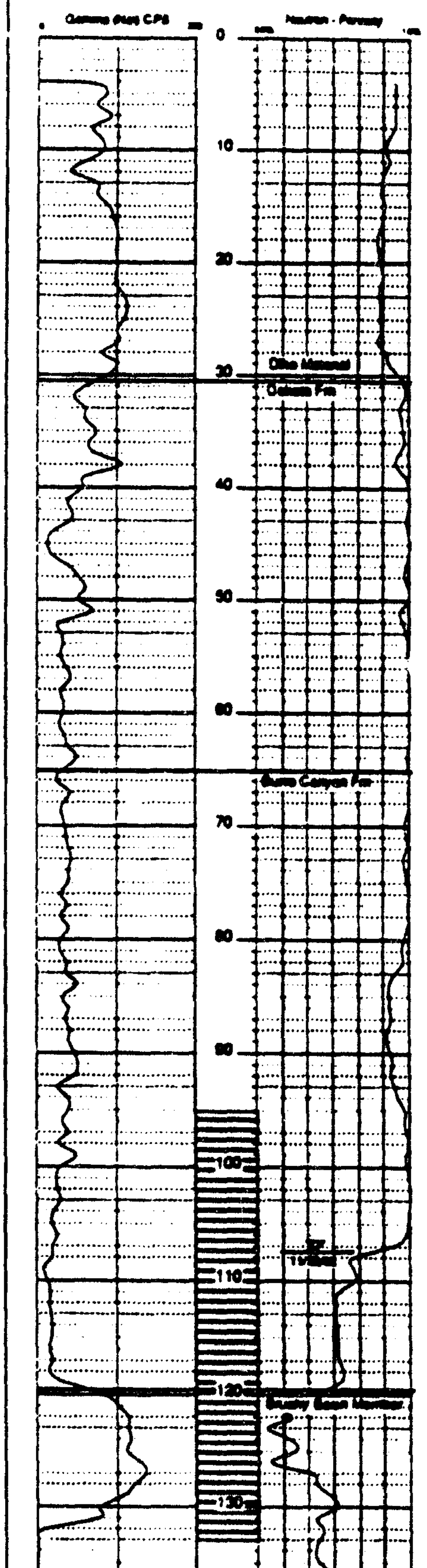
Location: San Juan County, Utah   Date: [illegible]

Gamma (Nat) - Neutron Porosity

Gd. Elev. [illegible]

T.D. 136

WMMW-5



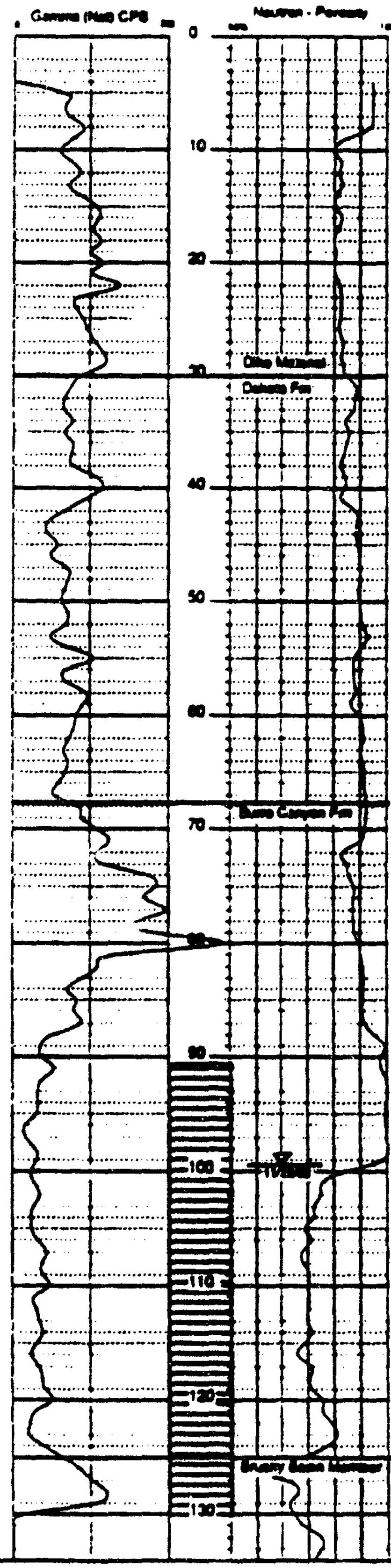
Umetco Minerals Corporation

Location: San Juan County, Utah

Gamma (Nat) - Neutron Porosity

T.D. 134

WMMW-11



Umetco Minerals Corporation

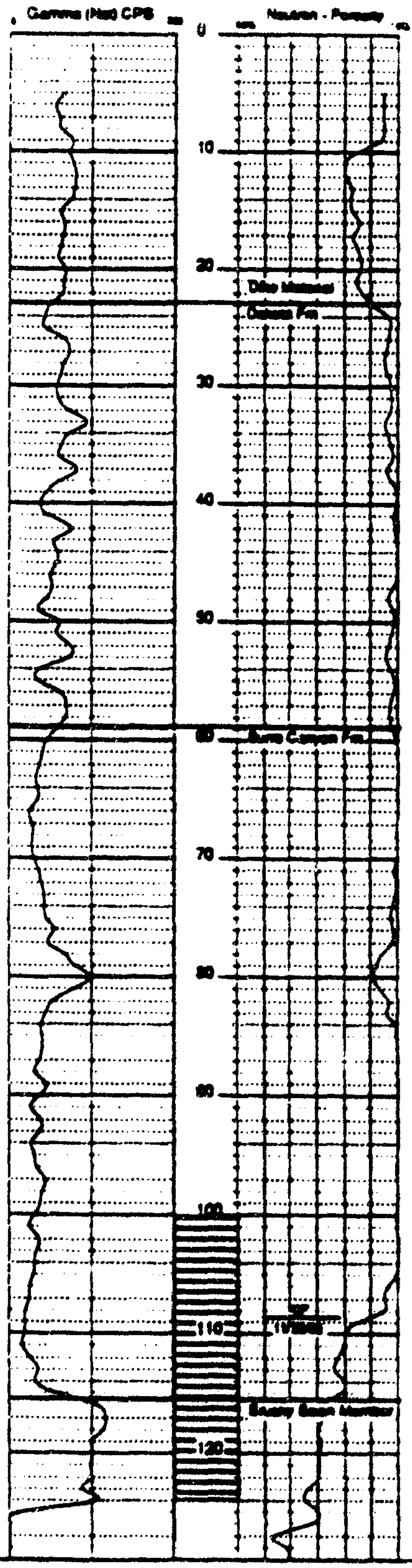
Location: San Juan County, Utah   Date: [illegible]

Gamma (Nat) - Neutron Porosity

Gd. Elev. [illegible]

T.D. 125

WMMW-12



Umetco Minerals Corporation

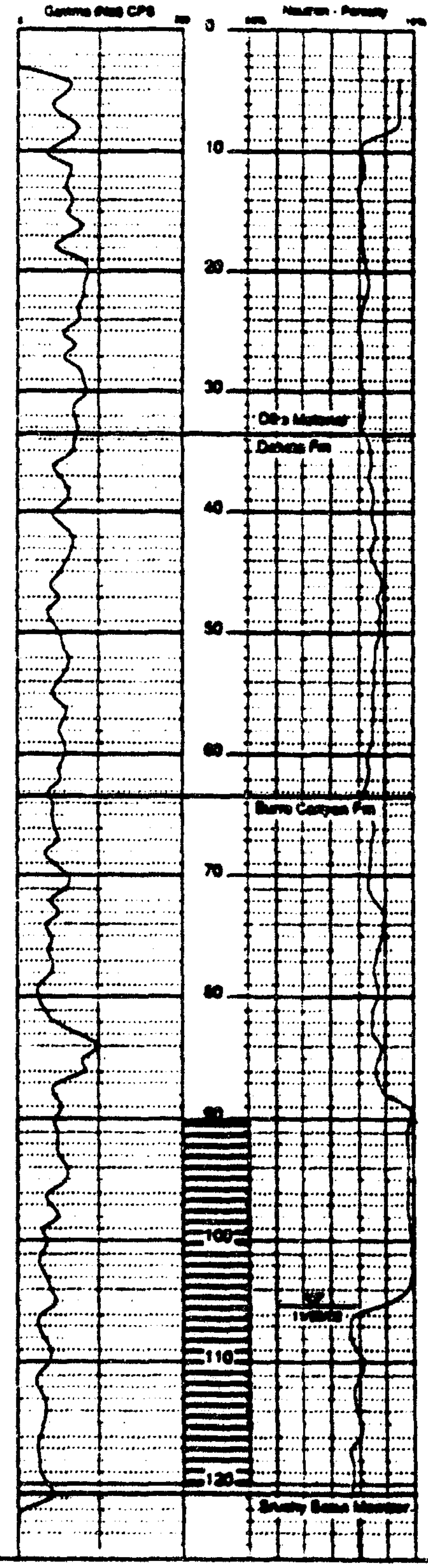
Location: San Juan County, Utah Date:

Gamma (Nat) - Neutron Porosity

Gd. Elev.

T.D. 127

WMMW-14



Umetco Minerals Corporation

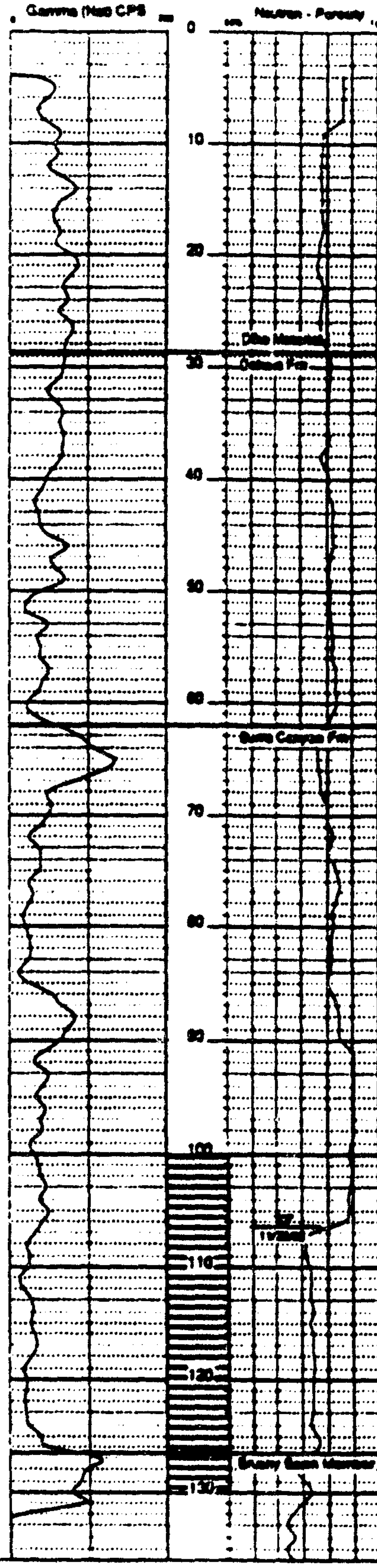
Location: San Juan County, Utah   Date: [illegible]

Gamma (Nat) - Neutron Porosity

Gd. Elev. [illegible]
T.D. 136

WMMW-15

Gamma (Nat) CPS   Neutron - Porosity



APPENDIX B

WATER QUALITY DATA

Ground Water Quality Data

Ammonia mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					0.7	0.6	0.2	0.1	0.1	
20-Nov-89	0.5	0.009	0.009	0.7	0.7	0.6	0.1	0.009	0.2	0.2
15-Dec-89					0.7	0.6	0.1	0.1	0.1	
24-Jan-90					0.5	0.5	0.09	0.09	0.09	

Ground Water Quality Data

Cadmium
(mg/l)

Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					0.0049	0.0049	0.0049	0.0049	0.0049	
20-Nov-89	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049
15-Dec-89					0.0049	0.007	0.006	0.0049	0.0049	
24-Jan-90					0.0049	0.007	0.007	0.0048	0.0049	
24-Sep-91	0.001	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
17-Mar-92	0.0009	0.0009	0.0009	0.0009	0.0009	0.001	0.001	0.0009	0.0009	0.0009
14-Sep-92	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009

Ground Water Quality Data

Water Depth	WM#1	WM#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#13	CULINARY	WM#14	WM#
06-Sep-79				93.0							
07-Sep-79				94.7							
10-Sep-79	108.5	115.2		94.6							
14-Sep-79	77.3	109.6		94.6							
25-Sep-79	76.6	110.1	83.4	94.7							
10-Oct-79	81.7	110.2	84.9	94.7							
10-Jan-80	76.0	109.5	83.2	93.9							
28-Feb-80	74.0	108.1	81.9	92.8							
20-Mar-80	74.0	107.9	80.8	92.4							
30-May-80	75.9	110.0	83.1	94.3	112.2						
17-Jun-80	75.4	110.0	83.7	94.3	108.0						
16-Jul-80	75.4	110.0	83.6	94.3	108.0						
19-Aug-80	75.1	110.0	83.6	94.2	108.0						
07-Sep-80	76.2	111.1	83.7	94.4	108.4						
11-Sep-80	74.3	110.5	83.7	94.3	108.5						
08-Oct-80	76.2	111.1	84.4								
27-Jan-82	75.3	110.0	83.6	94.3	108.6	104.0	118.7	78.0			
26-Sep-84	83.2	112.3	87.5	96.4	108.2	113.4	111.8	77.3			
05-Dec-84	76.0	110.4	84.0	94.0	108.0	104.0	109.6	73.0			
21-Feb-85	76.0	110.3	84.3	94.2	108.0	104.0	110.1	73.3			
25-Jun-85	76.2	110.5	84.5	94.0	108.2	103.9	109.8	73.2			
30-Sep-85	75.4	110.0	83.7	93.4	107.5	102.9	108.8	77.0			
31-Oct-85	75.0	110.8	83.0								
27-Nov-85	75.9	112.2									
15-Dec-85	75.5	110.3	83.7	93.5	108.1	103.7	109.7	77.5			
24-Jan-86	80.2	110.0	83.7								
28-Feb-86	75.8	110.1	83.8								
20-Mar-86	76.2	110.5	84.5	94.0	108.2	103.9	110.8	73.3			
27-Mar-86	75.8	110.3	84.0			103.0	110.0	77.0			
08-Apr-86	75.6	109.9	84.8								
19-Jun-86	75.7	109.8	83.4	93.4	107.9	102.8	109.3	77.2			
28-Jun-86	75.7	109.8	83.4	93.4	107.9	102.8	109.3	77.2			
04-Sep-86	75.9	110.1	83.8	93.5	107.9	103.0	109.3	77.1			
10-Dec-86	76.5	111.3	83.8	95.7	108.2	103.2	111.2	79.3			
20-Feb-87	76.8	111.3	83.8	95.7	108.2	103.2	110.2	79.3			
28-Apr-87	75.7	110.2	83.8	93.2	108.0	102.4	109.7	78.0			
14-Aug-87	76.3	111.1	83.3	93.3	108.3	102.6	108.5	78.0			
20-Nov-87	76.0	110.4	83.9	93.3	108.3	103.2	109.7	77.3			
27-Jan-88	75.9	110.4	83.8	93.6	108.3	102.8	109.7	77.2			
01-Jun-88	75.8	110.4	83.8	93.4	108.3	101.9	109.6	77.2			
23-Aug-88	75.2	110.1	83.4	93.1	110.5	102.0	109.1	77.4			
03-Nov-88	75.3	110.0	83.5	93.3	108.1	102.5	109.2	76.9			
09-Mar-89	73.0	110.1	83.8	93.8	108.7	102.5	109.5	77.4			
21-Jun-89	76.1	110.3	83.7	93.2	108.1	102.5	109.2				
01-Sep-89	75.6	110.0	85.7	93.3	108.2	102.6	109.4				
15-Nov-89	75.8	110.1	83.7	93.1	108.3	102.5	109.5			106.2	107.0
16-Feb-90	75.81	110.01	83.64	93.11	108.14	102.52	109.45			105.34	107.4
08-May-90	75.5	109.8	83.6	92.9	108.1	102.2	109.5			105.44	107
07-Aug-90	75.0	110.0	83.9	92.9	108.2	102.6	109.4			105.47	107.5
13-Nov-90	75.8	109.8	84.2	92.8	109.0	102.5	109.0			106	107
27-Feb-91	75.6	110.1	83.7	92.5	108.1	102.1	109.2			105.37	108.
21-May-91	75.5	110.0	83.7	92.4	108.3	102.5	109.8			105.4	107.
24-Sep-91	75.0	110.3	84.0	92.6	108.5	102.6	109.7			105.48	107.6
03-Dec-91	75.7	110.4	83.9	92.5	108.5	102.5	109.7			106.6	107.
17-Mar-92	75.7	110.0	83.8	92.2	108.2	101.9	109.4			105.25	107.7
11-Jun-92	75.7	110.2	83.7	92.5	108.5	102.3	109.5			105.29	107.5
03-Sep-92	75.2	110.1	83.7	92.4	108.4	102.2	109.5			105.43	107.7
19-Nov-92	75.7	110.0	83.9	92.4	108.4	102.4	109.6			105.58	107.5

Ground Water Quality Data

Phreatic Elevation	WM#1	WM#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#13	CULINARY	WM#14	#15
	5648.22	5613.49	5555.32	5622.57	5609.33	5609.45	5611.08	5570.35		5596.39	5598.62
06-Sep-79				5529.57							
07-Sep-79				5527.87							
10-Sep-79	5539.72	5498.29		5527.97							
14-Sep-79	5570.92	5503.89		5527.97							
25-Sep-79	5571.62	5503.39	5471.92	5527.87							
10-Oct-79	5566.52	5503.29	5470.42	5527.87							
10-Jan-80	5572.22	5503.99	5472.12	5528.67							
28-Feb-80	5574.22	5506.39	5473.42	5529.77							
20-Mar-80	5574.22	5506.59	5474.52	5530.17							
30-May-80	5572.32	5503.49	5472.22	5528.27	5497.13						
17-Jun-80	5572.82	5503.49	5471.62	5528.27	5501.33						
16-Jul-80	5572.82	5503.49	5471.72	5528.27	5501.33						
19-Aug-80	5573.12	5503.49	5471.72	5528.37	5501.33						
07-Sep-80	5572.02	5502.39	5471.62	5528.17	5500.93						
11-Sep-80	5573.92	5502.99	5471.62	5528.27	5500.83						
08-Oct-80	5572.02	5502.39	5470.92								
27-Jan-82	5572.92	5503.49	5471.72	5528.27	5500.73	5506.45	5502.41	5492.35			
26-Sep-84	5568.01	5501.20	5467.78	5526.13	5501.16	5506.08	5499.33	5493.06			
05-Dec-84	5572.22	5503.07	5471.32	5528.57	5501.33	5506.45	5501.50	5497.35			
21-Feb-85	5572.22	5503.16	5471.07	5528.40	5501.33	5505.45	5501.00	5497.10			
25-Jun-85	5572.05	5502.99	5470.82	5528.57	5501.16	5505.53	5501.25	5497.18			
30-Sep-85	5572.80	5503.49	5471.65	5529.15	5501.83	5506.53	5502.25	5493.35			
31-Oct-85	5573.22	5502.56	5472.32								
27-Nov-85	5572.30	5501.32									
15-Dec-85	5572.72	5503.16	5471.65	5529.07	5501.25	5505.78	5501.41	5492.85			
24-Jan-86	5568.05	5503.49	5471.65								
28-Feb-86	5572.39	5503.41	5471.57								
20-Mar-86	5572.05	5502.99	5470.82	5528.57	5501.16	5505.53	5500.28	5497.10			
27-Mar-86	5572.39	5503.16	5471.32			5506.45	5501.08	5493.35			
08-Apr-86	5572.64	5503.57	5470.57								
19-Jun-86	5572.55	5503.66	5471.90	5529.15	5501.41	5506.62	5501.83	5493.18			
26-Jun-86	5572.55	5503.66	5471.90	5529.15	5501.41	5506.62	5501.83	5493.18			
04-Sep-86	5572.30	5503.41	5471.49	5529.07	5501.41	5506.45	5501.83	5493.27			
10-Dec-86	5571.72	5502.19	5471.52	5526.87	5501.13	5506.25	5499.88	5491.05			
20-Feb-87	5571.47	5502.24	5471.57	5526.90	5501.16	5506.28	5500.91	5491.02			
28-Apr-87	5572.55	5503.32	5471.57	5529.40	5501.33	5507.03	5501.41	5492.35			
14-Aug-87	5571.89	5502.41	5471.99	5529.32	5501.00	5506.87	5502.58	5492.35			
20-Nov-87	5572.22	5503.07	5471.40	5529.24	5501.00	5506.28	5501.41	5493.10			
27-Jan-88	5572.30	5503.07	5471.49	5528.99	5501.00	5506.62	5501.41	5493.18			
01-Jun-88	5572.47	5503.12	5471.49	5529.15	5501.08	5507.55	5501.50	5493.18			
23-Aug-88	5573.05	5503.37	5471.90	5529.45	5498.83	5507.45	5502.00	5492.93			
03-Nov-88	5572.12	5503.19	5471.62	5529.34	5501.24	5506.96	5501.85	5570.35			
09-Mar-89	5575.22	5503.39	5471.52	5528.77	5500.63	5506.95	5501.58				
21-Jun-89	5572.12	5503.19	5471.62	5529.34	5501.24	5506.96	5501.85				
01-Sep-89	5572.67	5503.45	5469.59	5529.30	5501.18	5506.85	5501.72				
15-Nov-89	5572.43	5503.37	5471.60	5529.45	5501.08	5506.95	5501.63			5481.19	5480.95
16-Feb-90	5572.41	5503.48	5471.68	5529.46	5501.19	5506.93	5501.63			5481.06	5481.15
08-May-90	5572.71	5503.69	5471.68	5529.67	5501.20	5507.29	5501.55			5480.96	5481.2
07-Aug-90	5573.19	5503.48	5471.45	5529.64	5501.09	5506.89	5501.68			5480.92	5481.0
13-Nov-90	5572.42	5503.69	5471.12	5529.77	5500.33	5506.95	5502.08			5481.20	5480.9
27-Feb-91	5572.64	5503.42	5471.67	5530.10	5501.26	5507.39	5501.86			5481.02	5480.1
21-May-91	5572.77	5503.46	5471.58	5530.15	5501.03	5507.00	5501.52			5480.90	5481.0
24-Sep-91	5573.26	5503.19	5471.36	5529.97	5500.80	5506.89	5501.43			5480.83	5481.0
03-Dec-91	5572.52	5503.11	5471.42	5530.03	5500.84	5506.94	5501.36			5480.79	5480.8
17-Mar-92	5572.52	5503.47	5471.57	5530.37	5501.15	5507.53	5501.64			5481.14	5480.9
11-Jun-92	5572.52	5503.27	5471.64	5530.09	5500.86	5507.18	5501.55			5481.10	5481.1
03-Sep-92	5572.99	5503.40	5471.64	5530.14	5500.96	5507.27	5501.55			5480.96	5480.9
19-Nov-92	5572.55	5503.46	5471.46	5530.16	5500.89	5507.10	5501.44			5480.81	5481.0

Conductance

	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#1
31-Oct-79	348	1270	2260	3360							
30-May-80	1500	2413	3915	3205	2660						
30-Jun-80	1367	3031	4275	3196	2372						
31-Jul-80	1469	2500	4386	3264	2371						
31-Aug-80	1565	2712	4537	3223	2440						
30-Sep-80	1547	2791	4768	2791	2559						
31-Oct-80	1578	2930	4846	3268	2479						
30-Nov-80	1509	2568	4782	3289	2568						
31-Dec-80	1568	2730	4828	3254	2412						
31-Jan-81	1682	3190	5398	3435	2282						
28-Feb-81	1723	3089	5054	3370	2268						
31-Mar-81	1472		5153	3391	2538						
30-Apr-81	1425	3097	4893	3363	2589						
30-May-81	1543	2985	4918	3064	2422						
30-Jun-81	1303	2806	4433	3108	2699						
14-Aug-81	1716	3702	5632	3963	3077						
27-Jan-82	1450	3450	5100	3370	3050						
07-Apr-82	1635	3402	5489	3630	3275				459		
07-Jul-82	1570	3340	5170	3380	2790				573		
10-Dec-82	1320	2720	4390	3030	2220	2102	3280	3360	530		
25-Jan-83	1310	2680	4260	2910	2150	1630	3130	3280	439		
30-Apr-83	1320	2800	4820	3420	2490	2330	3400	3970	450		
07-Sep-83	1390	2810	4490	2970	2130	2260	3250	3160	412		
26-Oct-83	1680	3580	5550	3700	2840	2600	4000	4380	470		
20-Mar-84	1200	2380	4200	2340	2150	1500	3050	3200	312		
14-Jun-84	1200	2400	4500	2500	2300	1800	3200	3200	370		
05-Dec-84	1100	2275	3975	2325	2000	1900	3000	3050	238		
21-Feb-85	1300	2800	4000	2700	2100	1900	4000	3200	380		
25-Jun-85	1100	2600	4200	2800	2200	1850	3300	3150	300		
30-Sep-85	1500	2500	5000	3300	2800	2350	3800	3800	470		
15-Dec-85	3000	3200	4700	3000	2200	3100	2800	3800			
27-Mar-86	1350	2650	4000	2800	2300	1900	3100	3000	500		
26-Jun-86	1900	3800	5600	3600	3800	3400	5400	4400	700		
04-Sep-86	1800	3700	6000	4100	3250	2700	5500	5000	550		
10-Dec-86	2200	3200	4600	3400	2400	1500	3300	3800	800		
20-Feb-87	1800	3800	5600	3200	2800	3400	5600	4400	480		
29-Apr-87	1800	5000	5800	2600	3700	3250	4400	3900	500		
19-Aug-87	1500	3300	5400	3800	2700	2800	3100	4200	500		
20-Nov-87	1600	3400	5000	3700	2600	2300	3900	4000	600		
27-Jan-88	1300	2600	4500		1900	1800	3000	3050	265		
01-Jun-88	1350	2800	4500	2850	2100	2000	3250	3400	340		
23-Aug-88	1550	3400	4500	3100	2200	1800	3400	3350	310		
03-Nov-88	1250	2850	4400		2000	1950	3000	3300			
09-Mar-89	1300	2800	4200	2700	2100	2000	3200	3150			
21-Jun-89	1694	3660	5660	3690	2710	2520	4000		550		
01-Sep-89	1670	3670	5550	3670	2740	2580	4010		575	3880	456
15-Nov-89	1680	3620	5590	3640	2750	2510	4020		683	3880	44
20-Feb-90	1696	3630	5580	3630	2780	2750	3980		684	3830	43
08-May-90	1694	3630	5880	3660	2750	2550	4000		700	3880	43
07-Aug-90	1667	3580	5480	3550	2680	2530	3880		688	3710	42
13-Nov-90	1040	2060	4010	2070	2000	1080	3000		550	2080	3
27-Feb-91	1700	3720	5530	3730	2640	2680	4120		449	3880	43
21-May-91	1706	3680	5660	3670	2650	2620	4040		448	3880	44
24-Sep-91	1728	3660	5570	3660	2650	2660	4030		447	3840	431
03-Dec-91	1706	3650	5560	3610	2630	2610	4100		442	3900	42
17-Mar-92	1702	3600	5490	3670	2620	2630	4070		440	3890	432
11-Jun-92	1669	3640	5480	3620	2600	2600	4000		447	3850	43
03-Sep-92	1694	3620	5590	3610	2600	2630	4000		411	3810	420
19-Nov-92	1690	3660	5710	3650	2680	2630	4070		407	3860	427

Ground Water Quality Data

pH

	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15
31-Oct-79	8.6	7.2	7.3	7.1							
31-Jan-80	7.4	7.2	6.8	7.1							
30-May-80	7.3	7.4	7.2	7.2	7.5						
30-Jun-80	7.5	7.4	7.2	7.3	7.6						
31-Jul-80	7.4	7.5	7.2	7.3	7.7						
31-Aug-80	7.2	7.2	6.9	7.1	7.4						
30-Sep-80	7.6	7.6	7.6	7.7	7.7						
31-Oct-80	7.4	7.3	7.2	7.8	7.6						
30-Nov-80	7.5	7.4	7.1	7.3	7.7						
31-Dec-80	7.4	7.4	7.1	7.2	7.2						
31-Jan-81	7.2	7.2	7	7.1	7.4						
28-Feb-81	7.2	7.1	6.8	7	7.3						
31-Mar-81	7.5	7.15	7	7.7	7.7						
30-Apr-81	7.5	7.2	7.1	7.5	7.5						
30-May-81	7	7	6.5	6.8	7.2						
30-Jun-81	7.3	7.2	6.8	7.3	7.3						
31-Aug-81	7.4	7.4	6.9	7.2	7.8						
31-Dec-81	7.5	7.7	7.3	7.7	7.7						
31-Jan-82	7.3	7.2	6.7	7.1	7.35						
30-Apr-82	7.7	7.5	7.2	7.3	7.8						
31-Aug-82	7.8	7.7	7.5	7.8	8						
31-Dec-82	7.8	7.7	7.5	7.6	8	8.2	7.8	7.85			
31-Mar-83	7.6	7.5	7.2	7.3	8.05	7.4	6.7	7.4			
30-Jun-83	7.8	7.7	7.5	7.7	8.12	8	7.4	8			
31-Dec-83	7.6	7.55	7.4	7.55	7.7	7.2	7.2	7.6			
31-Mar-84	7.7	7.0	6.8	7.8	7.9	7.8	7.2	7.0	7.6		
30-Jun-84	7.6	7.2	7.4	7.8	7.8	7.2	7.8	7.5	8.2		
30-Sep-84	7.5	7.1	6.6	7.0	7.5	7.9	6.8	7.0	7.8		
31-Dec-84	7.7	7.1	6.8	6.8	7.8	7.9	6.7	7.1	8.3		
31-Mar-85	7.8	7.6	6.9	7.1	7.8	7.9	7.1	7.4	8.0		
30-Jun-85	7.6	7.0	6.8	6.7	7.9	8.0	6.8	7.2	7.8		
30-Sep-85	6.8	7.1	6.4	6.3	7.0	7.9	6.9	6.5	7.4		
31-Dec-85	7.3	7.3	6.8	6.9	8.1	7.1	7.7	7.1			
31-Mar-86	7.0	7.0	6.6	6.9	7.0	7.0	6.7	6.9	7.0		
30-Jun-86	7.5	7.0	6.7	7.0	7.5	7.9	6.7	6.9			
04-Sep-86	7.3	6.9	6.7	6.8	7.6	7.9	6.8	7.0	7.0		
10-Dec-86	7.7	6.9	6.5	7.0	7.1	7.9	7.1	7.1	7.6		
20-Feb-87	7.4	7.1	6.5	7.0	7.6	7.9	6.9	7.0	8.5		
29-Apr-87	7.6	6.7	6.5	6.9	7.6	7.8	6.9	7.0	7.6		
19-Aug-87	7.6	6.7	6.6	7.9	7.4	7.5	7.0	7.1	7.4		
20-Nov-87	7.8	7.4	7.2	7.2	8.0	7.8	7.3	7.4	7.4		
27-Jan-88	8.0	7.4	6.8		7.7	7.0	7.1	7.1	7.7		
01-Jun-88	8.1	7.2	7.0	7.1	7.6	7.9	7.1	7.3	8.2		
23-Aug-88	7.6	7.1	6.7	6.8	7.8	7.7	6.7	6.9	7.8		
03-Nov-88	7.5	7.2	6.7		7.5	8.0	6.6	7.0	7.8		
09-Mar-89	7.4	7.1	6.7	7.3	7.6	7.9	6.9	6.8			
21-Jun-89	8.0	7.1	6.7	6.9	7.4	7.8	6.8		7.7		
01-Sep-89	7.3	7.4	6.9	7.0	7.7	7.8	6.8		7.7		
15-Nov-89	7.5	7.0	6.5	6.8	7.8	7.8	7.1		7.6	6.9	6.9
20-Feb-90	7.8	7.5	6.8	7.0	8.0	8.1	7.2		8.0	6.87	7.46
08-May-90	7.5	7.1	6.6	7.0	7.6	7.8	6.9		7.9	6.8	7.07
07-Aug-90	7.5	7.0	6.8	7.7	7.7	7.4	7.0		7.8	6.87	7.18
13-Nov-90	7.9	7.5	6.6	7.7	8.0	8.0	7.5		8.2	6.47	7.06
27-Feb-91	7.9	7.5	6.6	7.7	8.0	8.0	7.5		8.2	6.47	7.06
21-May-91	7.4	7.1	6.3	6.8	7.4	7.9	7.0		7.1	6.82	7.06
24-Sep-91	7.7	7.0	6.7	7.0	7.4	8.0	6.8		7.3	6.89	6.94
03-Dec-91	7.6	7.3	6.8	6.9	7.7	7.9	6.9		7.8	6.8	7
17-Mar-92	6.7	7.2	5.8	6.9	7.6	7.9	7.0		7.1	7	7.21
11-Jun-92	7.1	6.9	6.1	6.7	7.2	7.4	6.6		7.7	6.6	7.32
03-Sep-92	8.1	7.9	6.7	7.0	7.6	7.9	7.4		7.6	6.89	7.02
19-Nov-92	7.5	7.8	7.1	6.9	7.8	6.2	8.1		7.7	6.83	7.16

Ground Water Quality Data

Sodium	mg/l MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15
31-Oct-79	106	154	282	342							
31-Jan-80	140	213	334	274							
30-May-80	165	346	575	346	478						
30-Jun-80	166	361	542	322	462						
31-Jul-80	160	418	442	335	435						
31-Aug-80	158	410	653	336	465						
30-Sep-80	158	468	586	371	500						
31-Oct-80	162	415	677	341	443						
30-Nov-80	166	419	567	309	428						
31-Dec-80	168	442	699	338	460						
31-Jan-81	170	467	756	335	467						
28-Feb-81	148	462	704	384	487						
31-Mar-81	175	470	745	338	473						
30-Apr-81	161	476	703	314	467						
30-May-81	160	472	718	350	458						
30-Jun-81	162	458	685	351	437						
31-Aug-81	161	460	688	323	428						
31-Dec-81	170	468	730	330	460						
31-Jan-82	170	483	757	340	490						
30-Apr-82	190	460	790	330	510						
31-Aug-82	160	470	750	340	470						
31-Dec-82	170	480	910	334	431	550	310	630	67		
30-Jun-83	170	470	770	330	458	480	310	640	27		
31-Dec-83	170	500	800	320	480	540	290	540			
30-Jun-84	170	500	780	310	470	530	320	650	5.6		
31-Dec-84	182	443	489	340	428	446	328	450	7.2		
30-Jun-85	20	540	790	370	540	610	330	660	7.3		
31-Dec-85	320	490	780	340	530	550	380	600	5.5		
19-Jun-86	262	543	937	326	514	580	430	650	23.6		
04-Sep-86	175	456	746	289	436	477	298	541	29.5		
10-Dec-86	210	528	784	335	501	250	324	582	68.0		
20-Feb-87	116	333	513	208	307	366	197	380	54.3		
29-Apr-87	134	382	518	232	380	378	235	388	7.0		
20-Nov-87	212	618	958	396	564	768	334	677	11.6		
27-Jan-88	185	507	778								
23-Aug-88	157	495	768	286	432	535	244	445	15.2		
03-Nov-88	172	480	658	289	410	486	280	510	17.4		
08-Mar-89	169	464	713	275	321	375	108	564	22.0		
01-Sep-89	163	466	713	287	411	489	269				
15-Nov-89	194	515	637	270	508	567	321		70.1	70.7	72.6
09-May-90	188	504	758	291	456	517	284		70.8	388.0	568.0
13-Nov-90	165	470	698	285	410	475	277		48.9	348.0	540.0
27-Feb-91	171	477	708	284	430	522	213		19.0	288.0	468.0
21-May-91	177	503	796	274	440	548	271		15.0	353.0	590.0
03-Dec-91	179	492	797	324	466	646	336		17.0	388.0	490.0
11-Jun-92	180	480	780	300	410	540	290		15.2	380.0	510.0
03-Sep-92	162	475	742	291	428	538	291		9.5	348	504
19-Nov-92	182	487	738	318	453	520	318		8.5	358.0	478.0

Ground Water Quality Data

Cl mg/l

	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15
31-Oct-79	2.5	5	12.5	20.1							
31-Jan-80	14	18	25	35							
30-May-80	20	18	50	44	50						
30-Jun-80	16	15	51	43	57						
31-Jul-80	20	20	52	48	60						
31-Aug-80	18	16	55	56	60						
30-Sep-80	13	15	52	43	51						
31-Oct-80	30	20	55	50	55						
30-Nov-80	12	8	64	38	49						
31-Dec-80	13	10	55	41	52						
31-Jan-81	15	11	71	48	53						
28-Feb-81	14	9	65	41	54						
31-Mar-81	14	10	66	40	55						
30-Apr-81	13	11	66	41	53						
30-May-81	14	13	110	41	53						
30-Jun-81	12	10	69	43	53						
31-Aug-81	14	7	67	32	52						
31-Dec-81	15	14	66	41	20						
31-Jan-82	13	8	64	42	51						
30-Apr-82	12	7	64	40	50						
31-Aug-82	12	6	67	43	43						
31-Dec-82	10.9	5.5	53	36	47.1	24.4	57.4	40.5	4.6		
25-Jan-83	16	11	71	46	57	32	70	53	3.4		
30-Jun-83	16.5	25	66.5	37.3	48.1	26.8	80.5	43.8	2.8		
31-Dec-83	13	8	63	36	54	32	65				
31-Mar-84	14.3	9.4	67.2	43.1	57.8	31.4	64.1	50.4	2.4		
30-Jun-84	12.0	7.0	63.0	43.0	54.0	32.0	65.0	49.0	3.0		
30-Sep-84	15.4	10.9	57.4	44.6	56.6	33.9	64.6	50.9	1.9		
31-Dec-84	14.2	7.1	67.4	42.5	53.2	31.9	67.4	49.6	3.5		
31-Mar-85	14.0	13.0	68.0	46.0	59.0	34.0	67.0	50.0	10.0		
30-Jun-85	17.0	7.8	73.0	42.0	53.0	31.0	62.0	46.0	1.0		
30-Sep-85	18.0	17.0	78.0	47.0	62.0	38.0	71.0	47.0	47.0		
31-Dec-85	53.2	70.9	35.0	53.0	71.0	71.0	53.0	71.0	62.0		
19-Jun-86	25.0	15.0	140.0	98.0	130.0	77.0	170.0	120.0	7.7		
30-Jun-86	25.0	17.0	140.0	95.0	130.0	70.0	150.0	100.0	9.1		
04-Sep-86	2.0	9.5	64.0	42.0	53.0	32.0	58.0	48.0	8.1		
10-Dec-86	8.8	2.7	68.0	45.0	54.0	33.0	64.0	50.0	3.3		
20-Feb-87	11.0	6.6	56.0	44.0	54.0	32.0	63.0	48.0	32.0		
29-Apr-87	12.1	7.7	65.3	42.4	54.3	43.2	62.7	48.7	1.7		
19-Aug-87	11.0	6.0	65.0	46.0	54.0	33.0	61.0	51.0	0.4		
20-Nov-87	9.3	4.6	62.6	45.3	53.2	31.9	61.2	49.2	0.1		
27-Jan-88	10.0	3.7	64.0	45.0	54.0	31.0	61.0	48.0	0.9		
01-Jun-88	9.9	4.8	66.0	45.0	53.0	32.0	64.0	50.0	0.1		
23-Aug-88	13.2	6.4	68.1	48.5	53.8	33.5	64.8	51.2	0.9		
03-Nov-88	11.8	6.6	67.7	48.2	54.7	35.2	65.1	52.1	2.7		
09-Mar-89	12.0	7.6	64.0	45.0	52.6	32.3	61.5	48.8	5.7		
21-Jun-89	11.3	6.4	68.9	45.9	54.6	32.4	60.8		5.2		
01-Sep-89	10.0	6.0	65.0	46.0	54.0	34.0	59.0		8.0		
15-Nov-89	11.0	5.0	66.0	45.0	54.0	34.0	63.0		7.0	25.0	49.0
20-Feb-90	11.0	5.0	65.0	47.0	55.0	33.0	63.0		4.0	20.0	44.0
08-May-90	12.0	7.0	67.0	48.0	56.0	33.0	62.0		6.0	23.0	44.0
07-Aug-90	11.0	6.0	65.0	48.0	53.0	33.0	63.0		7.0	21.0	44.0
13-Nov-90	12.0	6.0	68.0	50.0	54.0	34.0	63.0		4.0	23.0	44.0
27-Feb-91	12.0	10.0	68.0	50.0	50.0	31.0	61.0		1.0	23.0	41.0
21-May-91	12.0	6.0	56.0	44.0	48.0	30.0	55.0		1.0	21.0	38.0
24-Sep-91	11.0	9.0	60.0	45.0	54.0	30.0	59.0		2.0	15.0	38.0
03-Dec-91	13.0	7.0	64.0	46.0	50.0	31.0	60.0		2.0	19.0	38.0
17-Mar-92	13.0	7.0	64.0	48.0	51.0	32.0	60.0		2.0	22.0	40.0
11-Jun-92	10.0	6.0	76.0	43.0	46.0	29.0	58.0		1.0	18.0	35.0
03-Sep-92	11	6	58	43	46	31	56		1	20	37
19-Nov-92	13.0	6.0	63.0	45.0	50.0	41.0	62.0		1.0	18.0	39.0

Ground Water Quality Data

Sulfates	mg/l MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15
31-Oct-79	220	240	930	1220							
31-Jan-80	520	630	2100	1700							
30-May-80	535	1075	2430	1860	1290						
30-Jun-80	622	1290	2525	1850	1200						
31-Jul-80	610	1400	2450	1980	1100						
31-Aug-80	612	1345	2975	1980	1150						
30-Sep-80	640	1550	2800	2075	960						
31-Oct-80	570	1535	3050	2020	1060						
30-Nov-80	613	1425	2750	1780	1050						
31-Dec-80	620	1520	3080	1780	1150						
31-Jan-81	638	1530	3012	1900	1140						
28-Feb-81	600	1550	2780	1980	1260						
31-Mar-81	658		3150	1890	1210						
30-Apr-81	620	1680	3030	1880	1220						
30-May-81	650	1730	3100	1910	1190						
30-Jun-81	626	1690	3040	2070	1105						
31-Aug-81	630	1750	3060	1910	1115						
31-Jan-82	613	1590	3100	1920	260						
30-Apr-82	697	1766	3239	2056	1518						
31-Aug-82	662	1788	3185	2047	1295						
31-Dec-82	653	1749	3259	1979	1182	926	2395	2288	39		
30-Jun-83	658	1801	3226	2109	1228	943	2420	2324	41		
31-Dec-83	660	1820	3200	2075	1200	900	2338	2266	64		
29-Feb-84	637	1835	3235	2056	1175	937	2400	2250	77		
30-Jun-84	680	1900	3300	2075	1200	920	2400	2200	32		
31-Dec-84	637	1836	3235	2056	1175	937	2400	2250			
30-Jun-85	816	1890		2040	1210	909	2440	2300	18		
31-Dec-85	1080	1270	2870	2020	7820	79	7820	2120	79		
19-Jun-86	703	2010	3450	2120	1240	943	2500	2420	45		
30-Jun-86	691	2040	3400	2150	1080	949	2520	2420	43		
04-Sep-86	707	2020	3410	2160	1230	956	2470	2400	49		
10-Dec-86	680	1880	2620	2000	1140	911	2370	2240	77		
20-Feb-87	657	1910	2640	2030	1120	896	2100	1980	62		
29-Apr-87	684	1920	3200	1930	1310	1020	2300	2270	22		
19-Aug-87	691	2000	3400	2130	1140	951	2430	2280	26		
20-Nov-87	697	2040	3520	2170	1120	961	2560	2450	25		
27-Jan-88	690	1930	3020	2080	1130	919	2360	2300	22		
01-Jun-88	681	1900	3360	2120	1030	947	2450	2370	25		
23-Aug-88	648	1970	3330	2100	1050	915	2290	2330	7		
03-Nov-88	686	1980	3410	2120	1090	974	2500	2240	34		
09-Mar-89	694	1990	3410	2070	1180	975	2530	2400	41		
21-Jun-89	718	2040	3500	2180	1180	1020	2500		55		
01-Sep-89	352	2000	3500	2140	1140	1020	2250		60		
15-Nov-89	697	1990	2670	2150	1180	983	2250		105	2230	2580
20-Feb-90	692	2020	3330	2140	1210	1010	2460		98	2250	2490
08-May-90	684	2020	3480	2080	1180	1000	2070		51	1180	1280
07-Aug-90	686	1970	3400	2080	1140	973	2460		88	2240	2446
13-Nov-90	687	1980	3480	2130	1100	975	2480		89	3230	2470
27-Feb-91	682	1840	2712	1946	1028	967	1850		45	1512	1876
21-May-91	652	1886	2947	1986	1010	936	2255		51	2112	2290
24-Sep-91	692	1848	2532	1939	860	956	2240		49	1971	2215
03-Dec-91	677	1883	2214	1968	1036	966	2326		27	1919	2253
17-Mar-92	687	1890	3220	2035	1022	976	2330		21	2182	2314
11-Jun-92	642	1862	2884	1983	998	976	2304		26	2138	2283
03-Sep-92	670	1933	3312	2029	1033	1006	2352		30	2208	2266
19-Nov-92	654	1864	3200	1951	1055	1507	2343		21	2088	2362

TDS	mg/l MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#1
31-Oct-79	525	750	2100	2950							
31-Jan-80	870	1080	2450	2800							
30-May-80	1250	1950	4400	3600	2300						
30-Jun-80	1250	2300	4750	2500	2280						
31-Jul-80	1182	2449	4024	3198	2060						
31-Aug-80	1220	2278	4908	3480	2218						
30-Sep-80	1285	2769	4593	2525	2182						
31-Oct-80	1220	2552	4828	3402	2096						
30-Nov-80	1166	2492	4522	2990	1960						
31-Dec-80	1194	2648	4982	2998	2105						
31-Jan-81	1273	2768	5253	2330	2072						
28-Feb-81	1254	2835	4824	2322	2192						
31-Mar-81	1317		5122	2220	2256						
30-Apr-81	1330	3028	5130	3318	2309						
30-May-81	1306	2988	5198	3296	2207						
30-Jun-81	1188	2983	5387	3608	2114						
31-Aug-81	1197	2932	5124	3337	2119						
31-Dec-81	1199	2901	5167	3377	2180						
31-Jan-82	1200	2800	4960	3200	2250						
30-Apr-82	1200	2800	5125	3200	2500						
31-Aug-82	1200	2950	5300	3500	2250						
31-Dec-82	1326	3056	5366	3470	2180		4116	3780	334		
30-Jun-83	1150	3500	4900	3500	2200		4050	3850			
31-Dec-83	1200	2950	5150	3250	2100		3950	3750			
30-Jun-84	1400	3200	5300	3500	2200	0	4100	3700	280		
31-Dec-84	683	1479	2733	1581	1300		2000	2033	139		
30-Jun-85	1560	3130		3610	2200	1700	4300	3900	221		
31-Dec-85	4000	3700	5000	4600	6800	5100	5100	6800			
19-Jun-86	1280	3200	5500	3450	2130	1700	4140	3870	277		
30-Jun-86	1330	3250	5500	3610	3210	1700	4210	3850	292		
04-Sep-86	1250	3240	5320	3480	2040	1710	4040	3770	263		
10-Dec-86	1270	3140	5290	3530	2100	1710	4110	3820	403		
20-Feb-87	1270	3230	5330	3480	2080	1710	4120	3780	311		
29-Apr-87	1270	3180	5400	3340	2380	1889	4120	3810	249		
19-Aug-87	1280	3190	5320	3530	1980	1680	3980	3750	234		
20-Nov-87	1330	3280	5520	3570	1970	1720	4130	3840	236		
27-Jan-88	1310	3270	5100	3480	2030	1640	3960	3740	22		
01-Jun-88	1250	3140	5240	3430	1880	1680	4080	3720	25		
23-Aug-88	1220	3080	5230	3320	1930	1630	3010	3720	207		
03-Nov-88	1250	3150	5430	3450	1890	1710	4060	3670	170		
09-Mar-89	1280	3140	5270	3530	2010	1730	3960	3780			
21-Jun-89	1280	3210	5450	3580	2020	1750	4030		316		
01-Sep-89	1210	3040	5290	3430	1940	1760	3630		296		
15-Nov-89	1200	3060	5250	3370	2090	1860	3900		544	3430	399
20-Feb-90	1280	3190	5300	3540	2110	1780	4030		202	3710	387
08-May-90	1180	3060	5080	3240	1950	1680	3700		338	3000	374
07-Aug-90	1210	3080	5220	3320	1970	1700	3750		344	3500	377
13-Nov-90	1170	3150	5290	3280	1880	1720	3780		308	3440	378
27-Feb-91	1272	3154	5268	3424	1860	1686	3280		252	2884	335
21-May-91	1275	3037	5326	3348	1871	1740	3943		250	3613	396
24-Sep-91	1352	3149	5308	3471	2139	1819	3810		266	3818	381
03-Dec-91	1286	3179	5188	3462	1943	1810	3930		238	3851	384
17-Mar-92	1286	3206	5317	3523	1922	1797	4024		237	3704	381
11-Jun-92	980	2910	4830	3190	1810	1740	3900		219	3580	380
03-Sep-92											
19-Nov-92											

ARSENIC

	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#
31-Jul-80	0.0009	0.016	0.012	0.008	0.006						
31-Aug-80	0.004	0.004	0.0009	0.002	0.0009						
30-Sep-80	0.002	0.002	0.002	0.0009	0.0009						
31-Oct-80	0.0009	0.0009	0.0009	0.0009	0.0009						
30-Nov-80	0.002	0.004	0.004	0.002	0.002						
31-Dec-80	0.0009	0.0009	0.0009	0.0009	0.0009						
31-Jan-81	0.0009	0.0009	0.0009	0.0009	0.0009						
28-Feb-81	0.0009	0.0009	0.0009	0.0009	0.0009						
31-Mar-81	0.0009	0.0009	0.0009	0.0009	0.0009						
30-Apr-81	0.0009	0.0009	0.0009	0.0009	0.0009						
30-May-81	0.0009	0.0009	0.0009	0.0009	0.0009						
30-Jun-81	0.0009	0.0009	0.0009	0.0009	0.0009						
31-Aug-81	0.0009	0.0009	0.0009	0.0009	0.0009						
31-Jan-82	0.0009	0.0009	0.0009	0.0009	0.0009						
05-May-85	0.0009	0.0009	0.0009								
28-Jun-85	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.008		
23-Jul-85	0.0009	0.021	0.0009								
06-Aug-85	0.001	0.001	0.0009								
30-Sep-85	0.0009	0.0009	0.0009								
30-Oct-85	0.0009	0.0009	0.0009								
27-Nov-85	0.0009	0.0009	0.0009								
15-Dec-85	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009		
24-Jan-86	0.0009	0.0009	0.0009								
28-Feb-86	0.0009	0.0009	0.0009								
27-Mar-86	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.002	0.0009		
08-Apr-86	0.0009	0.0009	0.0009								
02-May-86	0.0009	0.0009	0.0009								
04-Sep-86	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009		
10-Dec-86	0.001	0.003	0.005								
20-Feb-87	0.0009	0.002	0.002	0.002	0.002	0.001	0.002	0.002	0.0009		
28-Apr-87	0.002	0.002	0.001	0.0009	0.0009	0.002	0.003	0.002	0.011		
20-Nov-87	0.003	0.005	0.008	0.002	0.001	0.001	0.009	0.008	0.013		
27-Jan-88	0.0030	0.0009	0.0030								
23-Aug-88	0.0140	0.0190	0.0250	0.0220	0.0170	0.0180	0.0230	0.0190	0.0070		
03-Nov-88	0.0009	0.0040	0.0110	0.0009	0.0009	0.0009	0.0009	0.0030	0.0009		
08-Mar-89	0.0150	0.0320	0.0460	0.0330	0.0180	0.0150	0.0360	0.0300	0.0070		
22-Jun-89	0.0040	0.0140	0.0330	0.0170	0.0100	0.0060	0.0210		0.0150		
01-Sep-89	0.0010	0.0060	0.0060	0.0030	0.0010	0.0000	0.0000		0.0080		
15-Nov-89	0.0010	0.0060	0.0100	0.0020	0.0070	0.0020	0.0030		0.0130	0.0000	0.00
08-May-90	0.0020	0.0010	0.0060	0.0010	0.0009	0.0010	0.0010		0.0120	0.0010	0.00
13-Nov-90	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009		0.0110	0.0009	0.00
27-Feb-91	0.0010	0.0009	0.0009	0.0020	0.0009	0.0020	0.0010		0.0140	0.0009	0.0
24-Sep-91	0.0009	0.0010	0.0009	0.0020	0.0060	0.0009	0.0010		0.0130	0.0009	0.0
17-Mar-92	0.0009	0.0009	0.0009	0.0020	0.0100	0.0020	0.0009		0.0130	0.0009	0.0
03-Sep-92	0.0009	0.0009	0.0009	0.0009	0.0060	0.0080	0.0009		0.0210	0.0009	0.00

SELENIUM

	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15
31-Jul-80	0.0009	0.025	0.0009	0.0009	0.0009						
31-Aug-80	0.002	0.026	0.005	0.002	0.003						
30-Sep-80	0.0009	0.012	0.0009	0.0009	0.0009						
31-Oct-80	0.0009	0.017	0.0009	0.0009	0.0009						
30-Nov-80	0.001	0.011	0.003	0.001	0.001						
31-Dec-80	0.0009	0.0009	0.0009	0.0009	0.0009						
31-Jan-81	0.0009	0.016	0.0009	0.0009	0.0009						
28-Feb-81	0.0009	0.0009	0.0009	0.0009	0.0009						
31-Mar-81	0.0009		0.0009	0.0009	0.0009						
30-Apr-81	0.0009	0.0009	0.0009	0.0009	0.0009						
30-May-81	0.0009	0.002	0.0009	0.0009	0.0009						
30-Jun-81	0.0009	0.01	0.0009	0.0009	0.0009						
31-Aug-81	0.0009	0.004	0.0009	0.0009	0.0009						
31-Jan-82	0.0009	0.009	0.003	0.003	0.0009						
30-Jun-84	0.0049	0.015	0.031	0.009	0.0049	0.0049	0.0049	0.005	0.0049		
06-May-85	0.0009	0.0009	0.0009								
28-Jun-85	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009		
23-Jul-85	0.007	0.0009	0.0009								
06-Aug-85	0.0009	0.0009	0.0009								
30-Sep-85	0.0009	0.0009	0.0009								
30-Oct-85	0.0009	0.0009	0.0009								
27-Nov-85	0.0009	0.0009	0.0009								
15-Dec-85	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0005		
24-Jan-86	0.0009	0.0009	0.0009								
28-Feb-86	0.0009	0.0009	0.0009								
27-Mar-86	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009		
08-Apr-86	0.0009	0.003	0.0009								
02-May-86	0.0009	0.0009	0.0009								
04-Sep-86	0.0009	0.0009	0.001	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009		
10-Dec-86	0.0019	0.0019	0.0019								
20-Feb-87	0.0009	0.0009	0.002	0.0009	0.001	0.003	0.001	0.007	0.0009		
28-Apr-87	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009			
20-Nov-87	0.006	0.023	0.036	0.01	0.018	0.02	0.004	0.027	0.0009		
27-Jan-88	0.008	0.01	0.016								
23-Aug-88	0.014	0.045	0.081	0.008	0.061	0.072	0.015	0.057	0.0009		
03-Nov-88	0.006	0.024	0.037	0.006	0.026	0.089	0.004	0.03	0.0009		
09-Mar-89	0.004	0.017	0.027	0.019	0.006	0.002	0.021	0.027	0.001		
22-Jun-89	0.001	0.002	0.003	0.003	0.004	0.004	0.001		0.001		
01-Sep-89	0.001	0.001	0.004	0.003	0	0	0		0.001		
15-Nov-89	0.006	0.015	0.019	0.015	0.006	0.02	0.02		0.001	0.014	0.019
08-May-90	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009		0.0009	0.0009	0.0009
13-Nov-90	0.0009	0.004	0.003	0.0009	0.0009	0.0009	0.0009		0.0009	0.0009	
27-Feb-91	0.002	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019		0.0019	0.0019	0.0019
24-Sep-91	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019		0.0019	0.0019.	0.0019
17-Mar-92	0.0019	0.002	0.0019	0.0019	0.0019	0.0019	0.0019		0.0019	0.0019	0.0019
03-Sep-92	0.0019	0.003	0.011	0.0019	0.0019	0.0016	0.0019		0.0019	0.0019	0.017

Ground Water Quality Data

Ra-228

pCi/l	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15
31-Jul-80	1	1.3	1	0.7	1						
31-Aug-80	0.7	1.7	0.6	0.7	0.6						
30-Sep-80	0.7	0.3	0.5	0.4	0.2						
31-Oct-80	0.8	1.9	1.1	0.9	1.1						
30-Nov-80	0.7	1.1	0.8	0.8	0.8						
31-Dec-80	0.5	0.4	0.3	0.7	0.4						
31-Jan-81	0.5	1.3	1.3	0.5	0.6						
28-Feb-81	0.6	1.7	0.6	0.9	0.6						
31-Mar-81	2	1.6	0.8	0.9	0.7						
30-Apr-81	2.2	1.3	1.8	0.5	0.3						
30-May-81	3.5	2.3	1.5	1.3	0.8						
30-Jun-81	1.5	2	2.3	1.2	1.8						
31-Aug-81	0.8	7.5	15.5	1.1	1.6						
30-Sep-81	0.4	1.1	0.5	0.8	0.2						
31-Jan-82	0.8	1.6	1.1	1	0.9						
30-Apr-82	0.3	0.6	0.5	1	0.3						
30-Jun-83	0.4	0.17	1.4	1	1.2	0.4	0.6	0.6	0.4		
30-Jun-84	3	8	8	7	2	2	6	3	7		
30-Jun-85	1	1.3	1	1.4	0.3	0.1	1.1	0.9	2		
31-Dec-85	0.5	0.9	5.3	0.9	0.8	0.1	0.7	0.4	0.55		
21-Mar-86	0.5	1	0.8	0.6	0.2	0.1	0.6	0.1	0.4		
19-Jun-86	0.5	0.9	5.3	0.9	0.8	0.1	0.7	0.4	0.055		
04-Sep-86	1.5	0.8	0.9	0.6	0.2	0.2	0.9	0.1	1.3		
10-Dec-86	0.4	0.5	1.1	0.7	0.3	0.3	0.7	0.3	0.3		
20-Feb-87	0.2	0.5	1.1	0.5	0.4	0.4	0.7	0.2	0.3		
29-Apr-87	0.6	0	0.3	0.4	0.3	0.2	0.6	0.3	0.5		
20-Nov-87	0.3	0.2	0.3	0.1	0	0.2	0.3	0	0.6		
27-Jan-88	0.6	0.2	0.8								
23-Aug-88	0.5	0.2	0.7	0.3	0.1	0.1	0.5	0.1	0.5		
03-Nov-88	0.1	0.2	0.3	0.1	0	0.2	0.7	0	0.5		
08-Mar-89	0.1	0.2	0.3	0.1	0.1	0.1	0.2	0.2	0.9		
01-Sep-89	0	0.5	0.2	0.2	0	0.1	0.5		0.2		
15-Nov-89	0.2	0.2	0.4	0.2	0.1	0.2	0.1		0.1	0.1	[illegible]
08-May-90	0.2	0.3	0.6	0.4	0.2	0.1	0.4		0.3	0.1	[illegible]
13-Nov-90	0.2	0.4	0.2	0.1	0.2	0.4	0.1		0.4	0.2	[illegible]
27-Feb-91	0.1	0.3	0.2	0.3	0	0.1	0.3		0.3	0.3	
24-Sep-91	0.4	0.1	0.2	0	0	0	0.3		0.2	0.2	
17-Mar-92	0.4	0.2	0.7	0.9	0.4	0.3	0.2		0.3	0.4	[illegible]
03-Sep-92	0.2	0.8	0.8	0.4	0.1	0.1	0.4		0.7	0.2	

Ground Water Quality Data

Ra-228

pCi/l	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15
27-Feb-91	1.7	2.5	1.1	2.1	1.2	0.9	2.8		1.4	0.5	[illegible]
24-Sep-91	1.8	2.2	1.9	1.9	0.8	0.7	2.1		0	0	[illegible]
17-Mar-92	1.6	1.6	0	2.1	0.4	0	1.6		0.6	0.9	[illegible]
03-Sep-92	1.8	0	2.5	1.4	0	0	0		0	0.6	[illegible]
Average	1.725	1.575	1.375	1.875	0.600	0.400	1.625	#DIV/0!	0.500	0.500	0.55
Standard Deviation	0.083	0.965	0.936	0.286	0.447	0.406	1.030	#NUM!	0.574	0.324	0.37
Minimum	1.600	0.000	0.000	1.400	0.000	0.000	0.000	0.000	0.000	0.000	0.30
Maximum	1.800	2.500	2.500	2.100	1.200	0.900	2.800	0.000	1.400	0.900	1.20

Ground Water Quality Data

Th-230 pCi/l	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15
31-Jul-80	0.4	0.3	0.3	0.4	0.5						
31-Aug-80	0.4	0.4	0.5	0.3	0.3						
30-Sep-80	0.8	0.5	0.4	0.7	0.9						
31-Oct-80	0.5	0.9	0.4	0.9	1.1						
30-Nov-80	0.8	0.8	0.5	0.6	0.9						
31-Dec-80	0.5	0.4	0.8	0.9	0.6						
31-Jan-81	0.5	1.3	1.3	0.5	0.6						
28-Feb-81	0.5	0.8	0.6	0.7	0.6						
31-Mar-81	0.8	0.4	0.8	0.8	0.5						
30-Apr-81	0.5	0.8	0.6	0.5	0.9						
30-May-81	1.1	0.7	0.5	1.2	0.8						
30-Jun-81	1.7	1.1	0.8	1.3	0.7						
31-Aug-81	0.7	1.2	1.1	1.4	0.8						
31-Jan-82	1.1	0	0	1	2.9						
30-Apr-82	0.8	0.9	1.5	0.8	1.7						
31-Aug-82	0.2	0	0	0	0						
30-Jun-83	0	0.4	0.5	0.1	0.2	0	0.1	0.1	0		
30-Jun-84	2	4	1	0	0.1	2	0	5	2		
30-Jun-85	1.2	0.5	0.5	0.9	0.1	1.2	0.6	0.5	0.3		
31-Dec-85	0.1	0	0.7	0.1	0.1	0.1	0.5	0.1	0.06		
21-Mar-86	0.1	0	0.7	0.1	0.1	0.1	0.5	0.1	0.06		
19-Jun-86	0.1	0	0.7	0.1	0.1	0.1	0.5	0.1	0.05		
04-Sep-86	0.4	0.7	0.9	2.4	1.8	1.2	0	0.5	0.5		
10-Dec-86	0	0	0	0.5	0.1	0	0	0	0		
20-Feb-87	0.2	1.5	0	0	0.9	0	0	0	0.1		
28-Apr-87	0.1	0.1	0.2	0.6	0.3	1.9	5.4	4.3	1.2		
20-Nov-87	0	0	0	0.1	0	0.1	0	0.1	0		
27-Jan-88	0.1	0.1	0.3								
23-Aug-88	0.9	0	0.7	0	0.4	0	0	0	0.4		
03-Nov-88	0.7	0.2	0.3	0.4	0	0	0.5	0.5	0.2		
09-Mar-89	0	0	0	0.1	0	0.2	0.2	0.2	0		
01-Sep-89	0	0	0	0	0.1	0	0.4		0		
20-Nov-89	0	0	10	0.1	0	0	0		0.2	0	4
08-May-90	0.1	0	0.1	0	0	0	0		0	0	
13-Nov-90	0.2	0.1	0	0.1	0	0.2	0.2		0	0	0
27-Feb-91	0	0	0.1	0	0	0	0		0.1	0	0
24-Sep-91	0	0	0	0	0	0	0.1		0	0	0
17-Mar-92	0	0	0	0	0	0	0		0	0	
03-Sep-92	0	0	0	0	0	0	0		0	0	0

Ground Water Quality Data

Pb-210 pCi/l	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15
31-Jul-80	3	3	3	3	5						
31-Aug-80	3	3	5	2	3						
30-Sep-80	3	3	2	3	5						
31-Oct-80	3	3	3	2	3						
30-Nov-80	3	2	4	5	4						
31-Dec-80	5	3	3	4	2						
31-Jan-81	3	3	4	2	4						
28-Feb-81	4	5	4	3	5						
31-Mar-81	4		5	3	5						
30-Apr-81	4	5	5	3	5						
30-May-81	4	3	5	3	4						
30-Jun-81	3	5	6	3	5						
31-Aug-81	2	3	6	5	3						
31-Jan-82	0	5	0	0	8						
30-Apr-82	1.3	1.2	1.8	0.9	1.1						
31-Aug-82	0	0.5	1.08	0.9	0						
30-Jun-83	0	0	0.8	0	0	0	0	0	0		
30-Jun-84	1.2	8	7	1	3	1	8	1.2	4.8		
30-Jun-85	2.7	8.3	1.2	0	0.3	0.8	0	0.2	1.6		
31-Dec-85	0	1	0.4	0.2	0.3	0.9	0.1	0.2	0.2		
21-Mar-86	0	1	0.4	0.2	0.3	0.9	0.1	0.2	0.2		
19-Jun-86	0	1	0.4	0.2	0.3	0.8	0.1	0.2	0.2		
04-Sep-86	0.3	0	0	0	3.6	0.1	0.3	0	0		
10-Dec-86	2.2	3	0	0	0	0.8	0	0	0		
20-Feb-87	2.2	2.3	1.8	1.5	2.7	1.5	2.1	1.1	1.3		
28-Apr-87	3.1	0.3	0.5	6.6	2.4	4	0	1.8	0.9		
20-Nov-87	0.7	0.0	0.0	1.7	0.6	6.7	2.3	1.2	0.9		
27-Jan-88	0.0	0.0	0.0								
23-Aug-88	0.0	0.4	0.0	0.0	0.0	0.4	0.0	0.0	0.0		
03-Nov-88	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0		
08-Mar-89	0.2	0.8	0.1	0.8	0.1	0.7	0.3	0.8	0.9		
01-Sep-89	0.0	[illegible]	0.0	0.5	0.0	0.1	0.0		0.3		
20-Nov-89	0.4	[illegible]	1.3	0.1	1.0	0.1	0.2		1.2	0	0.0
08-May-90	0.4	0.0	1.0	0.4	1.1	0.7	0.8		0.0	0.7	1.3
13-Nov-90	0.7	1.3	0.4	0.9	0.0	1.1	0.3		0.0	0.6	0.1
27-Feb-91	0.0	0.4	0.1	2.6	0.9	0.6	0.3		0.8	0.6	0.7
24-Sep-91	0.5	0.7	1.1	0.0	0.0	0.1	1.8		1.8	1.7	0.0
17-Mar-92	1.4	2.6	1.3	1.5	1.8	1.5	2.2		2.0	2.3	2.2
03-Sep-92	0.0	0.0	0.0	0.0	1.1	0.4	0.0		0.6	0.6	0.0

Ground Water Quality Data

U-Nat uCi/ml

	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15
30-Sep-81	2.7E-09	3.2E-08	2.4E-08	1.5E-08	1.4E-08				5.8E-10		
31-Dec-81	5.5E-10	3.0E-09	1.4E-08	2.2E-09	3.3E-09				5.9E-10		
31-Mar-82	6.5E-10	2.3E-09	2.7E-09	5.9E-10	5.8E-10				6.9E-10		
30-Jun-82	1.4E-09	4.7E-07	2.4E-08	1.3E-09	2.7E-09				7.0E-10		
30-Sep-82	5.8E-10	2.7E-09	3.9E-09	5.8E-10	5.7E-10				4.5E-09		
31-Dec-82	5.8E-10	5.8E-10	2.5E-08	5.7E-10	5.7E-10				6.6E-10		
31-Mar-83	1.4E-09	2.0E-08	1.0E-08	5.5E-09	8.0E-10	3.4E-10	5.0E-09	4.1E-09			
30-Jun-83	5.7E-10	3.4E-09	2.0E-08	5.8E-10	6.7E-10	6.8E-10	2.0E-09	4.0E-09			
30-Sep-83	2.3E-09	2.3E-09	1.4E-08	2.3E-09	5.6E-09	6.5E-09	1.1E-08	6.8E-09			
31-Dec-83	2.3E-09	6.0E-09	2.8E-08	5.7E-10	6.6E-10	5.9E-10	1.0E-08	1.4E-08			
31-Mar-84	2.71E-09	1.36E-09	1.49E-08	1.36E-09	1.36E-09	7.45E-09	2.91E-08	5.24E-09	3.25E-08		
30-Jun-84	2.71E-09	2.71E-09	1.26E-08	2.71E-09	2.71E-09	2.71E-09	1.63E-08	1.63E-08	2.71E-09		
30-Sep-84	8.12E-10	4.06E-10	1.22E-09	4.06E-10	4.06E-10	4.06E-10	4.06E-10	4.06E-10	4.06E-10		
31-Dec-84	4.06E-10	0.00E+00	1.49E-09	8.12E-10	0.00E+00	1.78E-09	1.62E-09	1.49E-09	1.35E-09		
31-Mar-85	1.76E-09	1.90E-09	1.56E-09	4.20E-09	6.00E-10	2.71E-10	4.74E-10	2.30E-09	2.03E-10		
30-Jun-85	7.00E-10	6.20E-09	1.00E-09	9.00E-10	6.00E-10	2.00E-10	6.60E-09	2.50E-09	1.50E-09		
30-Sep-85	1.30E-09	1.60E-08	3.00E-08	1.30E-09	3.30E-09	8.40E-09	3.30E-09	2.00E-09	1.60E-09		
31-Dec-85	1.70E-09	9.40E-09	2.08E-08	1.60E-09	5.00E-10	5.00E-10	6.60E-09	1.38E-08	2.19E-09		
31-Mar-86	1.90E-09	8.80E-09	1.90E-08	2.20E-09	1.10E-09	1.70E-09	9.60E-09	1.40E-08			
30-Jun-86	1.90E-09	6.40E-09	1.50E-08	1.60E-09	5.00E-09	1.50E-09	9.60E-09	1.10E-08	1.00E-09		
04-Sep-86	2.30E-09	5.60E-09	1.67E-08	1.00E-09	7.00E-10	4.00E-10	9.00E-09	1.17E-08	2.00E-09		
10-Dec-86	2.90E-09	6.20E-09	1.21E-08	1.90E-10	1.60E-09	1.90E-10	1.26E-08	1.17E-08	2.20E-09		
20-Feb-87	1.90E-10	3.50E-09	1.10E-08	1.90E-10	1.90E-10	1.90E-10	9.10E-09	7.00E-09	1.90E-10		
30-Apr-87	1.90E-09	3.10E-09	1.26E-08	1.30E-09	9.00E-10	3.00E-10	1.06E-08	9.50E-09	7.30E-10		
19-Aug-87	2.40E-09	6.20E-09	2.30E-08	1.50E-09	2.10E-09	7.00E-10	9.00E-09	1.20E-08	5.00E-10		
20-Nov-87	1.30E-09	4.10E-09	1.60E-08	9.00E-10	3.00E-10	5.00E-10	9.40E-09	1.20E-08	3.00E-10		
28-Jan-88	1.60E-09	4.10E-09	2.00E-08	1.60E-09	1.00E-09	1.90E-10	8.90E-09	1.20E-08	3.00E-10		
01-Jun-88	7.00E-10	4.70E-09	1.84E-08	1.40E-09	9.00E-10	5.00E-10	1.22E-08	1.40E-08	8.00E-10		
20-Aug-88	7.20E-09	1.10E-09	1.50E-08	5.40E-10	1.20E-10	5.00E-11	1.00E-08	1.20E-09	2.20E-10		
08-Nov-88	1.20E-09	4.94E-09	1.48E-07	3.60E-12	1.00E-09	2.71E-10	1.20E-07	1.20E-07	1.60E-09		
09-Mar-89	1.00E-09	6.00E-09	2.30E-08	1.40E-09	1.50E-09	9.00E-10	1.00E-08	0.00E+00	1.90E-09		
21-Jun-89	2.00E-09	6.80E-09	2.30E-08	1.20E-09	6.00E-10	8.00E-10	1.10E-08	0.00E+00	6.00E-10		
01-Sep-89	9.00E-10	8.60E-09	2.20E-08	2.00E-09	1.10E-09	1.60E-09	1.10E-08	0.00E+00	9.00E-10		
20-Nov-89	2.00E-10	9.50E-09	1.90E-08	9.00E-10	4.00E-10	8.00E-11	1.60E-09		0.00E+00	2.7E-08	4.4E-08
16-Feb-90	2.40E-09	7.40E-09	1.40E-08	1.00E-09	7.00E-10	7.00E-10	9.60E-09		3.00E-10	3.3E-08	3.6E-08
08-May-90	7.00E-10	8.00E-09	2.30E-08	1.60E-09	7.00E-10	8.00E-10	1.00E-08		3.00E-10	3.3E-08	3.0E-08
16-Aug-90	4.67E-10	5.67E-09	1.67E-08	1.27E-09	6.00E-10	4.67E-10	1.07E-08		4.00E-10	3.3E-08	2.8E-08
13-Nov-90	5.30E-10	7.20E-09	1.60E-08	1.20E-09	3.00E-10	6.00E-10	1.00E-08		5.00E-10	3.2E-08	2.4E-08
27-Feb-91	2.20E-10	3.50E-09	8.00E-09	1.30E-09	2.70E-10	2.00E-10	8.80E-09		2.00E-10	2.4E-08	2.0E-08
21-May-91	9.10E-10	4.30E-09	1.30E-08	7.70E-10	1.10E-09	2.30E-10	1.30E-08		8.00E-10	2.2E-08	1.8E-0[illegible]
24-Sep-91	8.20E-10	7.80E-09	2.20E-08	9.00E-10	8.00E-10	7.40E-10	1.10E-08		9.90E-10	3.1E-08	3.3E-08
03-Dec-91	4.30E-10	9.50E-09	8.10E-09	7.40E-10	5.30E-10	2.40E-10	6.80E-09		2.40E-10	3.0E-08	2.3E-08
17-Mar-92	4.54E-10	7.07E-09	4.53E-09	1.02E-09	1.60E-09	2.70E-09	1.01E-08		1.44E-09	3.0[illegible]E-08	2.37E-08
11-Jun-92	2.78E-09	4.66E-09	9.13E-09	2.00E-10	2.00E-10	2.00E-10	5.53E-09		2.00E-10	2.8E-08	1.9E-08
03-Sep-92	2.03E-09	1.11E-08	1.9E-08	4.06E-09	4.06E-09	3.39E-09	1.29E-08		2.03E-09	4.27E-08	2.70E-08
19-Nov-92	5.42E-10	1.08E-08	1.12E-08	1.42E-07	6.77E-10	3.18E-09	1.39E-08		1.63E-09	4.3E-08	2.7E-08

Ground Water Quality Data

Alkalinity (mg/l)

Date	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#14	MW#15	Culinary
01-Nov-[illegible]					326	316	346	428	374	0
20-Nov-89	260	344	2[illegible]	347	322	301	342	379	353	240
15-Dec-89					314	304	324	392	356	
24-Jan-90					300	300	319	382	353	
27-Feb-91	271	349	204	384	303	301	296	361	356	201
19-Nov-92	258	345	352	350	322	329	334	406	357	1[illegible]

Ground Water Quality Data

Cyanide (mg/l)

Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					0.009	0.009	0.009	0.009	0.009	
20-Nov-89	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
15-Dec-89					0.009	0.009	0.009	0.009	0.009	
24-Jan-90					0.009	0.009	0.009	0.009	0.009	

Ground Water Quality Data

Chromium

(mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					0.009	0.009	0.009	0.009	0.009	
20-Nov-89	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
15-Dec-89					0.009	0.009	0.009	0.009	0.009	
24-Jan-90					0.009	0.009	0.009	0.009	0.009	

Ground Water Quality Data

Calcium (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
03-Sep-92	126	306	377	377	110	34.5	488	467	359	47
14-Nov-92	152	334	437	424	132	198	504	474	431	49

Ground Water Quality Data

Beryllium (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
24-Sep-91	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
17-Mar-92	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
03-Sep-92	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009

Ground Water Quality Data

2-Butanone

(ug/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					99	99	99	99	99	
20-Nov-89	99	99	99	99	99	99	99	99	99	99
15-Dec-89					9.9	9.9	9.9	9.9	9.9	
24-Jan-90					9.9	9.9	9.9	9.9	9.9	

Ground Water Quality Data

Chloroform (ug/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					4.9	4.9	4.9	4.9	4.9	
20-Nov-89	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
15-Dec-89					4.9	4.9	4.9	4.9	4.9	
24-Jan-90					4.9	4.9	4.9	4.9	4.9	

Ground Water Quality Data

Carbon Disulfide (ug/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					4 9	4 9	4 9	4 9	4 9	
20-Nov-89	4 9	4 9	4 9	4 9	4 9	4 9	4 9	4 9	4 9	4 9
15-Dec-89					4 9	4 9	4 9	4 9	4 9	
24-Jan-90					4 9	4 9	4 9	4 9	4 9	

Ground Water Quality Data

Acetone (ug/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					99	99	99	99	99	
20-Nov-89	99	99	99	99	99	99	99	99	99	99
15-Dec-89					9.9	9.9	9.9	9.9	9.9	
24-Jan-90					9.9	9.9	9.9	9.9	9.9	

Ground Water Quality Data

Methylene Chloride (ug/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					4.9	4.9	4.9	4.9	4.9	
20-Nov-89	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	130
15-Dec-89					4.9	4.9	4.9	4.9	4.9	
24-Jan-90					4.9	4.9	4.9	4.9	4.9	

Ground Water Quality Data

Gross Beta Dissolved pCi/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					12	21	30	43	55	
20-Nov-89	11	31	50	15	18	7	34	40	29	6.7
15-Dec-89					19	16	44	37	51	
24-Jan-90					13	10	29	37	41	
27-Feb-91	7.1	21	31	13	6.3	8.3	26	25	18	
24-Sep-91	15	21	63	40	17	18	25	33	42	5.6
17-Mar-92	20	28	42	22	13	16	25	56	29	4.2
03-Sep-92	12	58	60	10	10	14	38	67	39	4.2

Ground Water Quality Data

Gross Alpha Dissolved (pCi/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					7	42	47	53	89	
20-Nov-89	6.3	39	55	4	8	17	27	68	81	1.9
15-Dec-89					7	13	62	67	90	
24-Jan-90					0	0	16	40	68	
27-Feb-01	0	4	0	10	15	17	24	48	19	0.1
24-Sep-91	0	21	76	2	5	5	27	62	24	5.9
17-Mar-92	0	67	38	31	12	10	0	82	47	0.2
03-Sep-92	5	36	34	5	10	0	10	48	27	0

Ground Water Quality Data

Thallium (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					0.009	0.009	0.009	0.009	0.009	
20-Nov-89	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	
15-Dec-89					0.009	0.009	0.009	0.009	0.009	0.009
24-Jan-90					0.009	0.009	0.009	0.009	0.009	

Ground Water Quality Data

Vanadium
mg/l)

Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					0.009	0.009	0.009	0.009	0.009	
20-Nov-89	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.03	0.04
15-Dec-89					0.009	0.009	0.009	0.009	0.01	
24-Jan-90					0.009	0.009	0.009	0.009	0.009	

Ground Water Quality Data

Nickel

mg/l)

Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					0.009	0.009	0.03	0.03	0.02	
20-Nov-89	0.009	0.009	0.05	0.02	0.009	0.009	0.02	0.02	0.02	
15-Dec-89					0.009	0.009	0.02	0.03	0.02	[illegible]
24-Jan-90					0.009	0.009	0.009	0.01	0.009	
27-Feb-91	0.02	0.06	0.1	0.07	0.04	0.05	0.06	0.05	0.07	
24-Sep-91	0.009	0.01	0.02	0.009	0.009	0.009	0.009	0.009	0.009	0.01
17-Mar-92	0.009	0.01	0.01	0.009	0.009	0.009	0.009	0.009	0.009	0.009
14-Sep-92	0.0009	0.0009	0.019	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009

Ground Water Quality Data

Molybdenum (mg/l)

Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					0.009	0.009	0.02	0.02	0.04	
20-Nov-89	0.01	0.02	0.009	0.02	0.009	0.009	0.02	0.02	0.009	0.009
15-Dec-89					0.009	0.009	0.02	0.02	0.03	
24-Jan-90					0.009	0.009	0.009	0.009	0.01	
24-Sep-91	0.001	0.003	0.01	0.014	0.0009	0.0009	0.006	0.025	0.001	
17-Mar-92	0.001	0.001	0.0009	0.0009	0.0009	0.0009	0.002	0.003	0.003	0.001
14-Sep-92	0.0009	0.0009	0.0009	0.0009	0.001	0.001	0.001	0.002	0.0009	0.001

Ground Water Quality Data

Mercury (mg/l) Date	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					0.0001[illegible]	0.00019	0.00019	0.00019	0.00019	
20-Nov-89	0.00019	0.00019	0.00019	[illegible].00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019
15-Dec-89					0.00019	0.00019	0.00019	0.00019	0.00019	
2[illegible]-Jan-90					0.00019	0.00019	0.00019	0.00019	0.00019	

Ground Water Quality Data

Potassium (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
03-Sep-92	6.77	11.4	23.9	10.17	7.7	6.3	13.8	12	10.2	3.27
14-Nov-92	6.65	12.25	24.3	10.6	7.85	10.55	13.25	11.5	10.1	3.15

Ground Water Quality Data

Magnesium (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
03-Sep-92	60.5	105	252	192	42	72	231	161	166	23
14-Nov-92	63	104	244	185	43	73	224	157	172	21

data collected was ~Nov 1991 per RUH

HOLT JET PUMP WELL

PARAMETER	RESULTS	DRINKING WATER STANDARDS MG/L UNLESS OTHERWISE SPECIFIED
ARSENIC	<0.001	0.05
BARIUM	0.02	1
CADMIUM	0.004	0.01
CHROMIUM	<0.01	0.05
LEAD	0.04	0.05
MERCURY	<0.0002	0.002
NITRATE	2.8	10
SELENIUM	0.00	0.01
SILVER	<0.01	0.05
RADIUM (228)	8.8 pCi/l	
RADIUM 226	17 pCi/l	
RADIUM (226 + 228)	25.8 pCi/l	5 pCi/l
TH-230	0.8 pCi/l	
URANIUM	0.0114	
GROSS ALPHA	[illegible] pCi/l	15 pCi/l
GROSS BETA	100 pCi/l	4 MREM/YR
CHLORIDE	[illegible]	250
COPPER	<0.01	1
IRON	0.05	0.3
MANGANESE	7.79	0.05
pH	4.24	6.5–8.5
SULFATE	1670	250
TOTAL DISSOLVED SOLIDS	[illegible]	500
ZINC	2.15	5
ALUMINUM	52.5	
AMMONIA	8.0	
ANTIMONY	<0.003	
BERYLLIUM	0.06	
BORON	0.2	
CALCIUM	[illegible]	
ALKALINITY (CO3)	12	
ALKALINITY (HCO3)	241	
COBALT	0.42	
CYANIDE	0.02	
GALLIUM	0.08	
LITHIUM	1.9	
MAGNESIUM	[illegible]	
MOLYBDENUM	<0.01	
NICKEL	0.41	
NO2	0.01	
PHOSPHATE	<0.1	
POTASSIUM	6.8	
SODIUM	157	
STRONTIUM	8.68	
THALLIUM	<0.01	
TOTAL SUSPENDED SOLIDS	5	
TIN	<0.005	
TITANIUM	<0.05	
VANADIUM	0.01	

JONES WELL

PARAMETER	RESULTS	DRINKING WATER STANDARDS (MG/L UNLESS OTHERWISE SPECIFIED)
ARSENIC	<0.001	0.05
BARIUM	<0.01	1
CADMIUM	<0.005	0.01
CHROMIUM	<0.01	0.05
LEAD	<0.05	0.05
MERCURY	<0.0002	0.002
NITRATE	<0.01	10
SELENIUM	0.005	0.01
SILVER	<0.01	0.05
RADIUM 226	0.3 pCi/l	
RADIUM 228	0.4 pCi/l	
RADIUM (226 + 228)	0.7 pCi/l	5 pCi/l
TH-230	0.1 pCi/l	
URANIUM	0.0067	
GROSS ALPHA	2.6 pCi/l	15 pCi/l
GROSS BETA	7.2 pCi/l	4 MREM/YR
✓CHLORIDE	15	250
COPPER	<0.01	1
IRON	<0.01	0.3
MANGANESE	0.04	0.05
pH	8.15	6.5-8.5
✓SULFA	460	250
TOTAL DISSOLVED SOLIDS	1080	500
ZINC	0.011	5
ALUMINUM	<0.05	
AMMONIA	0.5	
ANTIMONY	<0.003	
BERYLLIUM	<0.01	
BORON	0.61	
CALCIUM	10.7	
ALKALINITY (CO3)	0	
ALKALINITY (HCO3)	346	
COBALT	<0.01	
CYANIDE	0.02	
GALLIUM	<0.05	
LITHIUM	0.2	
MAGNESIUM	3.15	
MOLYBDENUM	0.02	
NICKEL	<0.01	
NO2	<0.01	
PHOSPHOROUS	<0.1	
POTASSIUM	2.5	
SODIUM	372	
STRONTIUM	0.59	
THALLIUM	<0.01	
TOTAL SUSPENDED SOLIDS	15	
TIN	<0.005	
TITANIUM	<0.05	
VANADIUM	<0.01	

ANDERSON WELL

PARAMETER	RESULTS	DRINKING WATER STANDARDS MG/L UNLESS OTHERWISE SPECIFIED
ARSENIC	<0.001	0.05
BARIUM	<0.01	1
CADMIUM	<0.005	0.01
CHROMIUM	<0.01	0.05
LEAD	<0.05	0.05
MERCURY	<0.0002	0.002
NITRATE	0.2	10
SELENIUM	0.002	0.01
SILVER	<0.01	0.05
RADIUM (226)	1.3 pCi/l	
RADIUM 228	1.2 pCi/l	
RADIUM (226 + 228)	2.5 pCi/l	5 pCi/l
TH-230	0.0 pCi/L	
URANIUM	0.0400	
GROSS ALPHA	20 pCi/l	15 pCi/l
GROSS BETA	25 pCi/l	4 MREM/YR
CHLORIDE	65	250
COPPER	<0.01	1
IRON	0.80	0.3
MANGANESE	2.85	0.05
pH	6.88	6.5-8.5
SULFATE	1500	250
TOTAL DISSOLVED SOLIDS	2500	500
ZINC	0.570	5
ALUMINUM	<0.05	
AMMONIA	<0.1	
ANTIMONY	<0.003	
BERYLLIUM	<0.01	
BORON	0.04	
CALCIUM	500	
ALKALINITY (CO3)	12	
ALKALINITY (HCO3)	250	
COBALT	0.01	
CYANIDE	0.02	
GALLIUM	0.05	
LITHIUM	0.1	
MAGNESIUM	107	
MOLYBDENUM	0.01	
NICKEL	<0.01	
NO2	0.01	
PHOSPHATE	<0.1	
POTASSIUM	5.4	
SODIUM	90.6	
STRONTIUM	2.65	
THALLIUM	<0.01	
TOTAL SUSPENDED SOLIDS	9	
TIN	<0.005	
TITANIUM	<0.05	
VANADIUM	0.01	

HOLT WINDMILL WELL

PARAMETER	RESULTS	DRINKING WATER STANDARDS MG/L UNLESS OTHERWISE SPECIFIED
ARSENIC	<0.001	0.05
BARIUM	0.04	1
CADMIUM	0.005	0.01
CHROMIUM	<0.01	0.05
LEAD	<0.04	0.05
MERCURY	<0.0002	0.002
NITRATE	0.5	10
SELENIUM	<0.002	0.01
SILVER	<0.01	0.05
RADIUM (226)	0.7 pCi/l	
RADIUM 228	1.6 pCi/l	
RADIUM (226 + 228)	2.3 pCi/l	5 pCi/l
TH-230	0.0 pCi/l	
URANIUM	0.0056	
GROSS ALPHA	10 pCi/l	15 pCi/l
GROSS BETA	18 pCi/l	4 MREM/YR
CHLORIDE	24	250
COPPER	<0.01	1
IRON	0.52	0.3
MANGANESE	1.89	0.05
pH	6.57	6.5–8.5
SULFATE	1100	250
TOTAL DISSOLVED SOLIDS	2140	500
ZINC	0.106	5
ALUMINUM	<0.05	
AMMONIA	0.2	
ANTIMONY	<.003	
BERYLLIUM	<0.01	
BORON	0.09	
CALCIUM	215	
ALKALINITY (CO3)	12	
ALKALINITY (HCO3)	192	
COBALT	<0.01	
CYANIDE	[illegible]	
GALLIUM	[illegible]	
LITHIUM	0.1	
MAGNESIUM	234	
MOLYBDENUM	<0.01	
NICKEL	0.01	
NO2	0.1	
PHOSPHATE	<0.1	
POTASSIUM	11.7	
SODIUM	[illegible]	
STRONTIUM	[illegible]	
THALLIUM	<0.01	
TOTAL SUSPENDED SOLIDS	[illegible]	
TIN	<0.005	
TITANIUM	<0.05	
VANADIUM	0.02	

MAY 1991

TABLE 1

Parameter	CELL 2 LDS		FLY ASH POND				
	C2 LDS	Blind Duplicate	Upper Pool	Lower Pool	Previous Sample	Slimes Drain	Blank
Na, mg/l ✓	34	36	381	270	570	2346	ND
Ni, mg/l	0.02	0.02	0.05	0.04	3.8	72	ND
K, mg/l ✓	2.6	3.3	72	[illegible]	23	351	[illegible]
Se, mg/l	ND	NS	[illegible]	[illegible]	[illegible]	[illegible]	ND
As, mg/l	ND	ND	ND	ND	[illegible]	[illegible]	ND
Sr, mg/l	2.2	2.5	1.1	2.1	1.4	14	ND
Ti, mg/l	0.04	[illegible]	[illegible]	0.04	[illegible]	1.1	ND
U, µCi/ml	1.2E-08	1.2E-08	2.6E-07	2.7E-07	1.6E-07	1.0E-05	ND
V, mg/l	[illegible]	[illegible]	8.7	11	0.48	165	ND
Zn, mg/l	ND	ND	ND	ND	7.9	[illegible]	ND
Zr, mg/l	ND	ND	ND	ND	ND	ND	ND
Total Alkalinity, meq/l ✓	3.6	3.82	2.82	1.35	[illegible]	ND	0.2
NH3-N, mg/l	ND	ND	1.4	4.6	87	1791	ND
Cl, mg/l	178	186	134	74	[illegible]	3091	ND
CN (total), mg/l	ND	ND	ND	ND	ND	ND	ND
P (total), mg/l	ND	NS	0.1	0.3	0.2	0.2	ND
SO4, mg/l ✓	[illegible]	[illegible]	654	[illegible]	1414	33404	ND
TDS, mg/l	765	770	1804	1300	[illegible]	67770	ND
TSS, mg/l	ND	ND	ND	ND	ND	ND	ND
Report Date	Feb-91	Feb-91	Feb-91	Feb-91	Oct-90	Feb-91	Feb-91

mg/l = milligrams per liter
pCi/l = picoCuries per liter
ug/l = micrograms per liter
ND = not detected
NS = not sampled

Note: The blank sample is obtained by flushing the sampling equipment with deionized water. After 10 to 20 minutes of flushing, fresh deionized water is pumped through the equipment and sampled.

Sept 1991

TABLE 1

Parameter	CELL 2 LDS: C2 LDS	CELL 2 LDS: Blind Duplicate	FLY ASH POND: Upper Pool	FLY ASH POND: Lower Pool	FLY ASH POND: Previous Sample	Silica Dam	Blank
[illegible]	4.5	7.8	[illegible]	[illegible]	[illegible]	[illegible]	0.9
[illegible]	4.70	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.5
[illegible]	1.70	1.40	0.7	3.6	[illegible]	40	0.6
[illegible]	[illegible]	[illegible]	1.7	0.7	1.5	1.5	1.4
[illegible]	[illegible]	[illegible]	2.4	23	[illegible]	[illegible]	[illegible]
[illegible]	ND	ND	ND	ND	NS	[illegible]	ND
[illegible]	ND	ND	ND	ND	NS	15.13	ND
[illegible]	ND	ND	ND	ND	NS	[illegible]	ND
[illegible]	ND	ND	ND	ND	NS	0.35	ND
[illegible]	ND	ND	1.3	ND	NS	1.8	ND
[illegible]	ND	ND	1.15	ND	NS	ND	ND
[illegible]	ND	ND	1.75	ND	NS	ND	ND
[illegible]	ND	ND	1.30	1.2	NS	1.13	ND
[illegible]	ND	ND	1.30	ND	NS	ND	ND
[illegible]	ND	ND	ND	ND	NS	32.4	ND
[illegible]	ND	ND	ND	ND	NS	2.44	ND
[illegible]	ND	ND	ND	ND	NS	2.76	ND
[illegible]	ND	ND	ND	ND	NS	12.10	ND
Al, mg/l	[illegible]	[illegible]	0.40	[illegible]	1.0	[illegible]	0.01
As, mg/l	[illegible]	[illegible]	0.24	0.45	[illegible]	[illegible]	[illegible]
[illegible]	0.10	0.10	[illegible]	0.04	0.10	ND	ND
[illegible]	0.1	0.1	0.3	0.3	0.2	3.5	ND
[illegible]	109	110	72	112	51	474	ND
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.2	0.001
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.6	ND
[illegible]	ND	ND	ND	ND	1.6	14	ND
[illegible]	ND	ND	ND	ND	30	177	ND
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	ND
[illegible]	31	32	[illegible]	35	101	[illegible]	ND
[illegible]	4.1	4.1	ND	ND	2.3	[illegible]	ND
[illegible]	[illegible]	[illegible]	1.6	2.8	0.49	9.44	ND

ANALYTICAL LABORATORY
WHITE MESA MILL
P.O. BOX [illegible]
BLANDING, UTAH 84511

REPORT OF ANALYSIS

Laboratory Sample ID: [illegible]

Sample Description: WMMW #1

Date Sample Received: 05-Mar-91

Report Date: 18-Apr-91

Reference Code(s):
1) Filtered .45u pH<2 HNO3
2) Unfiltered Raw
3) Analyst – R. Martin
4) Analyst – V. Martin

Units Of Measurement: mg/l except where otherwise specified

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Alkalinity ✓	5.42 meq/l 271.77 mg/l	EPA 310.1	16-Mar-91	2,4
As ✓	0.001	EPA 206.2	29-Mar-91	1,3
Be	0.001	EPA 210.2	09-Apr-91	1,3
Ca	[illegible]	EPA 215.1	22-Mar-91	1,3
Cl ✓	12	EPA 325.3	18-Mar-91	2,3
Mg	[illegible]	EPA 242.1	26-Mar-91	1,3
Mn	[illegible]	EPA 243.1	26-Mar-91	1,3
Na	171	EPA 273.1	21-Mar-91	1,3
Ni	0.02	EPA 249.2	27-Mar-91	1,3
K	6.6	EPA 258.1	26-Mar-91	1,3
Se ✓	[illegible]	EPA 270.2	11-Apr-91	1,3
SO4 ✓	[illegible]	EPA 375.3	16-Mar-91	2,3
TDS ✓	[illegible]	EPA 160.1	15-Mar-91	2,3
U ✓ (uCi/ml)	[illegible]E-10	ASTM [illegible]	18-Apr-91	1,4

Approved by: [signature]
Chief Chemist

[illegible] ANALYTICAL LABORATORY
WHITE MESA MILL
P.O. BOX [illegible]
BLANDING, UTAH 84511

REPORT OF ANALYSIS

Laboratory Sample ID: 1[illegible]

Sample Description: WMMW #[illegible]

Date Sample Received: 0[illegible]-Mar-91

Report Date: 18-Apr-91

Reference Code(s):
1) Filtered .45u pH<2 HNO3
2) Unfiltered Raw
3) Analyst - R. Martin
4) Analyst - V. Martin

Units Of Measurement: mg/l except where otherwise specified

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Alkalinity	0.66 mg..	EPA 310.1	15-Mar-91	2,4
As	<0.001	EPA 206.2	2[illegible]-Mar-91	1,3
Be	0.004	EPA 210.2	0[illegible]-Apr-91	1,3
Ca	[illegible]	EPA 215.1	[illegible]-Mar-91	1,3
Cl	10	EPA [illegible]	1[illegible]-Mar-91	2,3
Mg	91	EPA 242.1	[illegible]-Mar-91	1,3
Mn	0.02	EPA 243.1	[illegible]-Mar-91	1,3
Na	477	EPA 273.1	21-Mar-91	1,3
Ni	0.03	EPA 249.2	27-Mar-91	1,3
K	11	EPA 258.1	22-Mar-91	1,3
Se	<0.002	EPA 270.2	11-Apr-91	1,3
SO4	1[illegible]	EPA 375.3	15-Mar-91	2,3
TDS	3164	EPA 160.1	15-Mar-91	2,3
U (uCi/ml)	3.[illegible]E-09	ASTM D2907	18-Apr-91	1,4

Approved by: [signature]
CHIEF CHEMIST

[illegible]
ANALYTICAL LABORATORY
WHITE MESA MILL
P.O. BOX [illegible]
BLANDING, UTAH 84511

REPORT OF ANALYSIS

Laboratory Sample ID: 19667

Sample Description: [illegible]

Date Sample Received: [illegible]-Mar-91

Report Date: 18-Apr-91

Reference Code(s):
1) Filtered .45u pH<2 HNO3
2) Unfiltered Raw
3) Analyst - R. Martin
4) Analyst - V. Martin

Units Of Measurement: mg/l except where otherwise specified

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Alkalinity	4.68 meq/l	EPA 310.1	16-Mar-91	2,4
As	<0.001	EPA 206.2	[illegible]-Mar-91	1,3
Be	[illegible]	EPA 210.2	[illegible]-Apr-91	1,3
Ca	407	EPA 215.1	[illegible]-Mar-91	1,3
Cl	[illegible]	EPA 325.3	16-Mar-91	2,3
Mg	[illegible]	EPA [illegible]	[illegible]-Mar-91	1,3
Mn	0.50	EPA [illegible]	[illegible]-Mar-91	1,3
Na	[illegible]	EPA [illegible]	21-Mar-91	1,3
Ni	0.10	EPA [illegible]	27-Mar-91	1,3
K	[illegible]	EPA [illegible]	[illegible]-Mar-91	1,3
Se	<0.005	EPA 270.2	11-Apr-91	1,3
SO4	[illegible]	EPA 375.3	16-Mar-91	2,3
TDS	[illegible]	EPA 160.1	16-Mar-91	2,3
U (uCi/ml)	[illegible]	ASTM D2907	18-Apr-91	1,4

Approved by: [signature]
[illegible]

ANALYTICAL LABORATORY
WHITE MESA MILL
P.O. BOX 809
BLANDING, UTAH 84511

REPORT OF ANALYSIS

Laboratory Sample ID: 18996

Sample Description: WMMW 64

Date Sample Received: 06-Mar-91

Report Date: 18-Apr-91

Reference Code(s):
1) Filtered .45u pH<2 HNO3
2) Unfiltered Raw
3) Analyst - R. Martin
4) Analyst - V. Martin

Units Of Measurement: mg/l except where otherwise specified

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Alkalinity	6.56 meq/l 3/14 J	EPA 310.1	18-Mar-91	2,4
As	0.002	EPA 206.2	28-Mar-91	1,3
Cr	0.004	EPA 218.2	09-Apr-91	1,3
Mg	174	EPA 242.1	28-Mar-91	1,3
Mn	1.4	EPA 243.1	26-Mar-91	1,3
Na	394	EPA 273.1	21-Mar-91	1,3
Ni	0.07	EPA 249.2	27-Mar-91	1,3
K	10	EPA 258.1	28-Mar-91	1,3
Se	<0.002	EPA 270.2	11-Apr-91	1,3
SO4	1946	EPA 375.3	19-Mar-91	2,3
TDS	3464	EPA 160.1	18-Mar-91	2,3
U (uCi/ml)	1.3E-09	ASTM D2907	18-Apr-91	1,4

Approved by: [signature]
Chief Chemist

[illegible]
[illegible] LABORATORY
[illegible] MILL
P.O. BOX [illegible]
BLANDING, UTAH 84511

REPORT OF ANALYSIS

Laboratory Sample ID: [illegible]

Sample Description: [illegible] duplicated [illegible]

Date Sample Received: [illegible]-Mar-91

Report Date: 18-Apr-91

Reference Code(s):
1) Filtered .45u pH<2 HNO3
2) Unfiltered Raw
3) Analyst - R. Martin
4) Analyst - V. Martin

Units Of Measurement: mg/l except where otherwise specified

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Alkalinity	6.06 meq/l	EPA 310.1	15-Mar-91	2,4
As	<0.001	EPA [illegible]	22-Mar-91	1,3
Se	0.405	EPA [illegible]	09-Apr-91	1,3
Ca	118	EPA 215.1	26-Mar-91	1,3
Cl	60	EPA [illegible]	15-Mar-91	2,3
Mg	54	EPA 242.1	20-Mar-91	1,3
Mn	0.22	EPA 243.1	26-Mar-91	1,3
Na	460	EPA 273.1	21-Mar-91	1,3
Ni	0.04	EPA 249.2	27-Mar-91	1,3
K	7.4	EPA 258.1	20-Mar-91	1,3
Sn	<0.002	EPA [illegible]	1-Apr-91	1,3
SO4	1585	EPA [illegible]	15-Mar-91	2,3
TDS	1890	EPA 160.1	15-Mar-91	2,3
U (uCi/ml)	2.7E-10	ASTM D2907	18-Apr-91	1,4

Approved by: [signature]

ANALYTICAL LABORATORY
WHITE MESA MILL
P.O. BOX [illegible]
BLANDING, UTAH 84511

REPORT OF ANALYSIS

Laboratory Sample ID: 18200

Sample Description: WMMW #11

Date Sample Received: 08-Mar-91

Report Date: 18-Apr-91

Reference Code(s):
1) Filtered .45u pH<2 HNO3
2) Unfiltered Raw
3) Analyst – R. Martin
4) Analyst – V. Martin

Units Of Measurement: mg/l except where otherwise specified

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Alkalinity	8.02 meq/l	EPA 310.1	18-Mar-91	2,4
As	0.003	EPA 206.2	28-Mar-91	1,3
Se	0.003	EPA 270.2	03-Apr-91	1,3
Ca	88	EPA 215.1	22-Mar-91	1,3
Cl	81	EPA 325.3	18-Mar-91	2,3
Mg	8.7	EPA 242.1	22-Mar-91	1,3
Mn	0.08	EPA 243.1	26-Mar-91	1,3
Na	828	EPA 273.1	21-Mar-91	1,3
Ni	0.06	EPA 249.2	27-Mar-91	1,3
K	6.0	EPA 258.1	22-Mar-91	1,3
Se	<0.002	EPA 270.2	11-Apr-91	1,3
SO4	887	EPA 375.3	18-Mar-91	2,3
TDS	1888	EPA 160.1	18-Mar-91	2,3
U (uCi/ml)	<2.0E-10	ASTM D2907	18-Apr-91	1,4

Approved by: [signature]
Chief Chemist

UMETCO MINERALS CORP.
ANALYTICAL LABORATORY
WHITE MESA MILL
P.O. BOX 669
BLANDING, UTAH 84511

REPORT OF ANALYSIS

Laboratory Sample ID: 16891

Sample Description: WMMW #12

Date Sample Received: 05-Mar-91

Report Date: 18-Apr-91

Reference Code(s):
1) Filtered .45u pH<2 HNO3
2) Unfiltered Raw
3) Analyst – R. Martin
4) Analyst – V. Martin

Units Of Measurement: mg/l except where otherwise specified

Parameter	Value	Method Number	Analysis Date	Reference Code(s)
Total Alkalinity	5.88 meq/l	EPA 310.1	15-Mar-91	2,4
As	0.001	EPA 206.2	28-Mar-91	1,3
Ba	0.004	EPA 210.2	03-Apr-91	1,3
Ca	318	EPA 215.1	22-Mar-91	1,3
Cl	61	EPA 325.3	18-Mar-91	2,3
Mg	81	EPA 242.1	22-Mar-91	1,3
Mn	1.3	EPA 243.1	26-Mar-91	1,3
Na	218	EPA 273.1	21-Mar-91	1,3
Ni	0.06	EPA 249.2	27-Mar-91	1,3
K	9.6	EPA 258.1	22-Mar-91	1,3
Se	<0.002	EPA 270.2	11-Apr-91	1,3
SO4	1680	EPA 375.3	18-Mar-91	2,3
TDS	2660	EPA 160.1	18-Mar-91	2,3
U (µCi/ml)	2.8E-08	ASTM D2907	18-Apr-91	1,4

Approved by: [signature]
Chief Chemist

ANALYTICAL LABORATORY
WHITE MESA MILL
P.O. BOX 669
BLANDING, UTAH 84511

REPORT OF ANALYSIS

Laboratory Sample ID: 13802

Sample Description: WMMW #13A

Date Sample Received: 05-Mar-91

Report Date: 19-Apr-91

Reference Code(s):
1) Filtered .45u pH<2 HNO3
2) Unfiltered Raw
3) Analyst -- R. Martin
4) Analyst -- V. Martin

Units Of Measurement: mg/l except where otherwise specified

Parameter	Value	Method Number	Analysis Date	Reference Code(s)
Total Alkalinity	0.14 meq/l	EPA 310.1	15-Mar-91	2,4
As	0.002	EPA 206.2	26-Mar-91	1,3
Be	0.001	EPA 210.2	03-Apr-91	1,3
Ca	0.82	EPA 215.1	22-Mar-91	1,3
Cl	<1	EPA 325.3	18-Mar-91	2,3
Mg	0.04	EPA 242.1	22-Mar-91	1,3
Mn	0.01	EPA 243.1	25-Mar-91	1,3
Na	<0.01	EPA 273.1	21-Mar-91	1,3
Ni	0.02	EPA 249.2	27-Mar-91	1,3
K	0.02	EPA 258.1	22-Mar-91	1,3
Se	<0.002	EPA 270.2	11-Apr-91	1,3
SO4	11	EPA 375.3	18-Mar-91	2,3
TDS	15	EPA 160.1	15-Mar-91	2,3
U (uCi/ml)	1.6E-09	ASTM D2907	18-Apr-91	1,4

Background of de-i water recycled through hose reel after a good flush with plain water.

Approved by: [signature]
Chief Chemist

UMETCO MINERALS CORP.
ANALYTICAL LABORATORY
WHITE MESA MILL
P.O. BOX 809
BLANDING, UTAH 84511

REPORT OF ANALYSIS

Laboratory Sample ID: 18808

Sample Description: WMMW #14

Date Sample Received: 05-Mar-91

Report Date: 18-Apr-91

Reference Code(s):
1) Filtered .45u pH<2 HNO3
2) Unfiltered Raw
3) Analyst – R. Martin
4) Analyst – V. Martin

Units Of Measurement: mg/l except where otherwise specified

Parameter	Value	Method Number	Analysis Date	Reference Code(s)
Total Alkalinity	7.22 meq/l	EPA 310.1	15-Mar-91	2,4
As	<0.001	EPA 2[illegible].2	26-Mar-91	1,3
Be	0.008	EPA 210.2	08-Apr-91	1,3
Ca	308	EPA 215.1	22-Mar-91	1,3
Cl	22	EPA 325.3	18-Mar-91	2,3
Mg	41	EPA 242.1	22-Mar-91	1,3
Mn	1.6	EPA 243.1	26-Mar-91	1,3
Na	265	EPA 273.1	21-Mar-91	1,3
Ni	0.06	EPA 249.2	27-Mar-91	1,3
K	7.9	EPA 258.1	28-Mar-91	1,3
Se	<0.002	EPA 270.2	11-Apr-91	1,3
SO4	1612	EPA 375.3	16-Mar-91	2,3
TDS	2224	EPA 160.1	15-Mar-91	2,3
U (uCi/ml)	2.4E-06	ASTM D2907	18-Apr-91	1,4

Approved by: [signature]
Chief Chemist

UMETCO MINERALS CORP.
ANALYTICAL LABORATORY
WHITE MESA MILL
P.O. BOX 669
BLANDING, UTAH 84511

REPORT OF ANALYSIS

Laboratory Sample ID: 13904

Sample Description: WMMW #18

Date Sample Received: 05-Mar-91

Report Date: 18-Apr-91

Reference Code(s):
1) Filtered .45u pH<2 HNO3
2) Unfiltered Raw
3) Analyst - R. Martin
4) Analyst - V. Martin

Units Of Measurement: mg/l except where otherwise specified

Parameter	Value	Method Number	Analysis Date	Reference Code(s)
Total Alkalinity	7.12 meq/l	EPA 310.1	15-Mar-91	2,4
As	<0.001	EPA 206.2	26-Mar-91	1,3
Be	0.004	EPA 210.2	08-Apr-91	1,3
Ca	385	EPA 215.1	22-Mar-91	1,3
Cl	41	EPA 325.3	18-Mar-91	2,3
Mg	120	EPA 242.1	22-Mar-91	1,3
Mn	0.66	EPA 243.1	25-Mar-91	1,3
Na	468	EPA 273.1	21-Mar-91	1,3
Ni	0.07	EPA 249.2	27-Mar-91	1,3
K	9.4	EPA 258.1	22-Mar-91	1,3
Se	<0.002	EPA 270.2	11-Apr-91	1,3
SO4	1576	EPA 375.3	18-Mar-91	2,3
TDS	3658	EPA 160.1	15-Mar-91	2,3
U (µCi/ml)	2.0E-08	ASTM D2907	18-Apr-91	1,4

Approved by: [signature]
Chief Chemist

UMETCO MINERALS CORP.
ANALYTICAL LABORATORY
WHITE MESA MILL
P.O. BOX [illegible]
BLANDING, UTAH 84511

REPORT OF ANALYSIS

Laboratory Sample ID: 12806

Sample Description: WMMW #15A duplicate of 5

Date Sample Received: 05-Mar-91

Report Date: 15-Apr-91

Reference Code(s):
1) Filtered .45u pH<2 HNO3
2) Unfiltered Raw
3) Analyst – R. Martin
4) Analyst – V. Martin

Units Of Measurement: mg/l except where otherwise specified

Parameter	Value	Method Number	Analysis Date	Reference Code(s)
Total Alkalinity	5.78 meq/l	EPA 310.1	15-Mar-91	2,4
As	<0.001	EPA 206.2	25-Mar-91	1,3
Be	0.008	EPA 210.2	08-Apr-91	1,3
Ca	118	EPA 215.1	22-Mar-91	1,3
Cl	30	EPA 325.3	18-Mar-91	2,3
Mg	34	EPA 242.1	22-Mar-91	1,3
Mn	0.26	EPA 243.1	25-Mar-91	1,3
Na	427	EPA 273.1	21-Mar-91	1,3
Ni	0.04	EPA 249.2	27-Mar-91	1,3
K	7.5	EPA 258.1	22-Mar-91	1,3
Se	<0.002	EPA 270.2	11-Apr-91	1,3
SO4	980	EPA 375.3	18-Mar-91	2,3
TDS	1808	EPA 160.1	15-Mar-91	2,3
U (uCi/ml)	3.4E-10	ASTM D2907	15-Apr-91	1,4

Approved by: [signature]
Chief Chemist

UMETCO MINERALS CORP.
ANALYTICAL LABORATORY
WHITE MESA MILL

QUALITY CONTROL DATA SHEET

Yc: [illegible]
GGE
WHB
JSH
SRC ✓

Number Of Samples Received: 14
Type Of Sample Container(s): Plastic 1 liter

DUPLICATE and LLD RESULTS

on computer 4-23-91

Laboratory Sample ID	Parameter	Result	Duplicate Result	Coefficient of Variation (%)	LLD
[illegible]	Total Alkalinity	6.42	[illegible]	[illegible]	.1 meq/l
1[illegible]	Arsenic – As	0.014	0.014	0.0	.001 mg/l
1[illegible]	Beryllium – Be	0.001	0.001	0.0	.001 mg/l
1[illegible]	Calcium – Ca	[illegible]	[illegible]	3.9	.01 mg/l
1[illegible]	Chloride – Cl	[illegible]	[illegible]	2.1	1 mg/l
1[illegible]7	Magnesium – Mg	174	172	0.8	.01 mg/l
1[illegible]	Manganese – Mn	1.3	1.5	10.1	.01 mg/l
1[illegible]01	Sodium – Na	[illegible]	457	1.4	.01 mg/l
1[illegible]04	Nickel – Ni	0.05	0.05	0.0	.01 mg/l
1[illegible]	Potassium – K	9.4	[illegible]	[illegible]	.01 mg/l
1[illegible]04	Selenium – Se	<.002	<.002	0.0	.002 mg/l
1[illegible]7	Sulfate – SO4	45	[illegible]	3.2	4 mg/l
1[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10 mg/l

UMETCO MINERALS CORP.
ANALYTICAL LABORATORY
WHITE MESA MILL
P.O. BOX 669
BLANDING, UTAH 84511

REPORT OF ANALYSIS

Laboratory Sample ID: 13806

Sample Description: Culinary

Date Sample Received: 05-Mar-91

Report Date: 18-Apr-91

Reference Code(s):
1) Filtered .45u pH<2 HNO3
2) Unfiltered Raw
3) Analyst – R. Martin
4) Analyst – V. Martin

Units Of Measurement: mg/l except where otherwise specified

Parameter	Value	Method Number	Analysis Date	Reference Code(s)
Total Alkalinity	4.02 meq/l	EPA 310.1	15-Mar-91	2,4
As	0.014	EPA 206.2	28-Mar-91	1,3
Be	<0.001	EPA 210.2	03-Apr-91	1,3
Mg	30	[illegible]	[illegible]-Mar-91	1,3
Mn	0.02	EPA 243.1	25-Mar-91	1,3
Na	19	EPA 273.1	21-Mar-91	1,3
Ni	0.01	EPA 249.2	27-Mar-91	1,3
K	4.8	EPA 258.1	22-Mar-91	1,3
Se	<0.002	EPA 270.2	11-Apr-91	1,3
SO4	45	EPA 375.3	16-Mar-91	2,3
TDS	282	EPA 160.1	15-Mar-91	2,3
U (uCi/ml)	<2.0E-10	ASTM D2907	18-Apr-91	1,4

Approved by:
Chief Chemist

UMETCO MINERALS CORP.
ANALYTICAL LABORATORY
WHITE MESA MILL
P.O. BOX 669
BLANDING, UTAH 84511

REPORT OF ANALYSIS

Laboratory Sample ID: 15903

Sample Description: #2 Standpipe

Date Sample Received: February 4, 1993

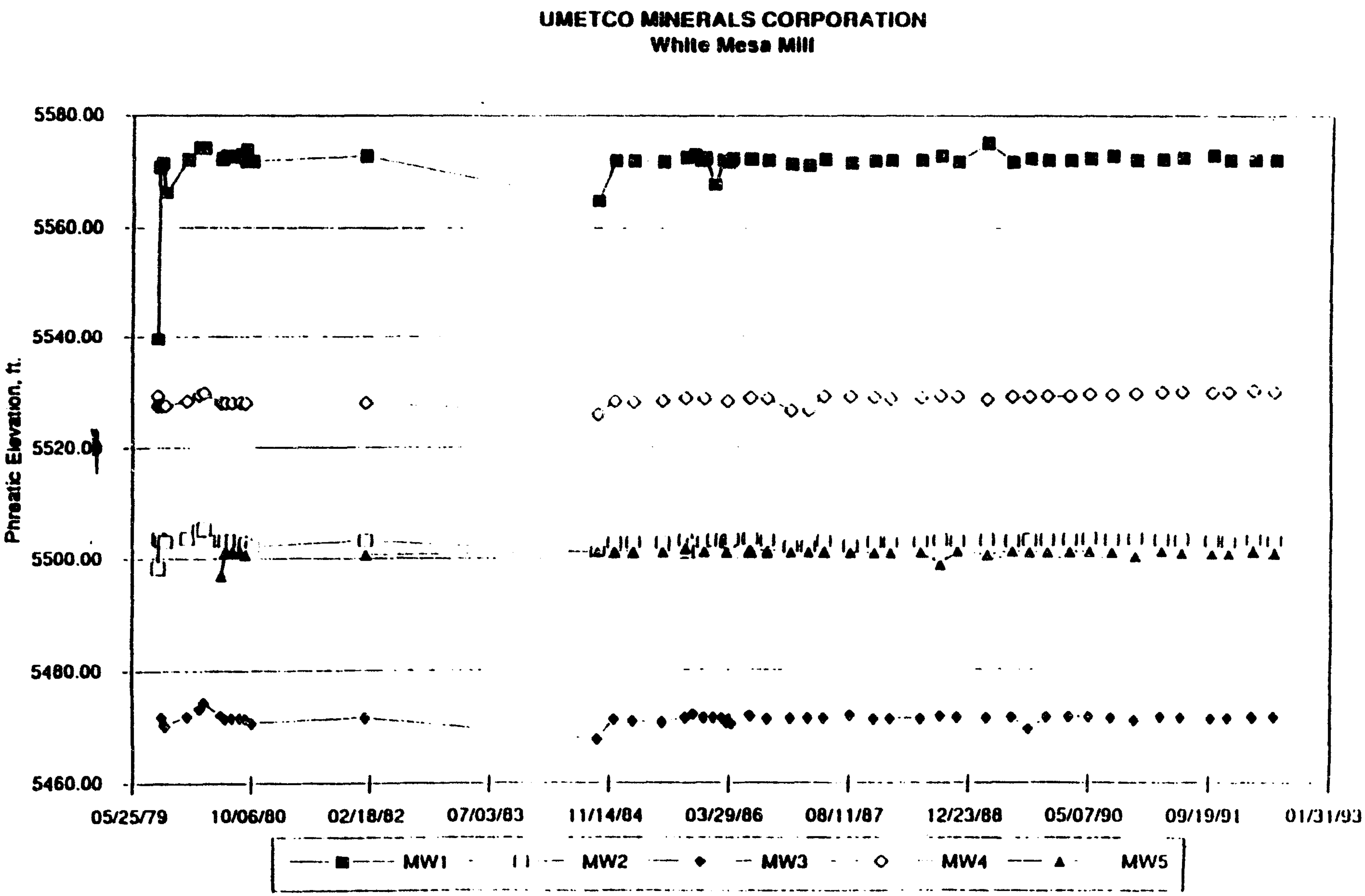
Report Date: February 10, 1993

Units Of Measurement: mg/l

Reference Code(s):
1) Filtered .45u pH<2 HNO3
2) Unfiltered Raw
3) Analyst – T. Slade

Parameter	Value	Method Number	Analysis Date	Reference Codes
Ca	93.0	EPA 215.1	10-Feb-93	2,3
K	2.55	EPA 258.1	10-Feb-93	2,3
Mg	5.25	EPA 242.1	10-Feb-93	2,3
Na	26.0	EPA 273.1	10-Feb-93	2,3
Se	<0.002	EPA 270.2	10-Feb-93	2,3
Cl	175	EPA 325.3	09-Feb-93	2,3
SO4	99	EPA 375.3	09-Feb-93	2,3
Alkinity as CaCO3	138	EPA 310.1	08-Feb-93	2,3
pH	7.7		08-Feb-93	2,3

Approved by: Tony Slade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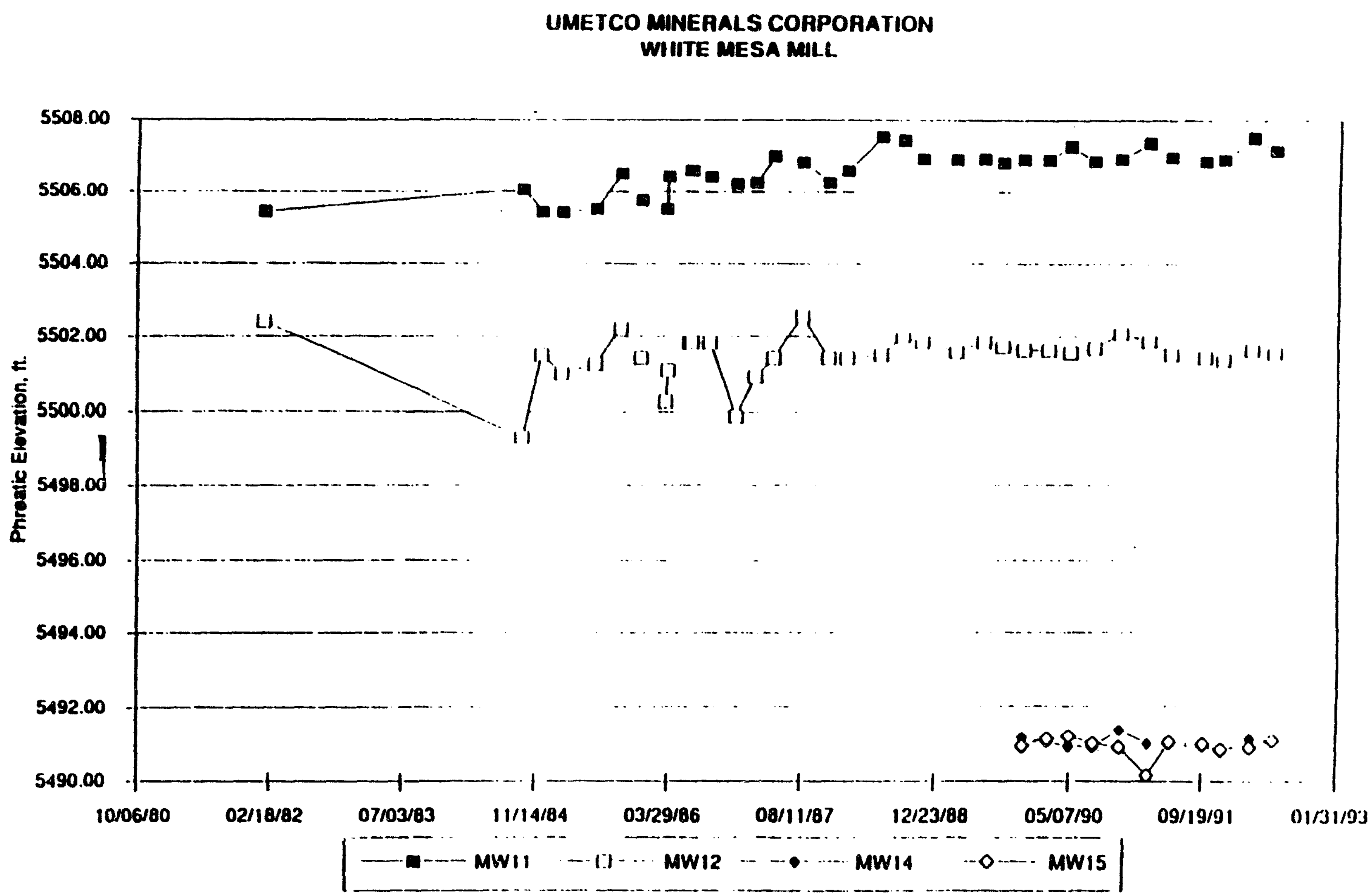
White Mesa Mill
5580.00
5560.00
5540.00
5520.00
5500.00
5480.00
5460.00
Phreatic Elevation, ft.
05/25/79
10/06/80
02/18/82
07/03/83
11/14/84
03/29/86
08/11/87
12/23/88
05/07/90
09/19/91
01/31/93
MW1
MW2
MW3
MW4
MW5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WHITE MESA MILL
Phreatic Elevation, ft.
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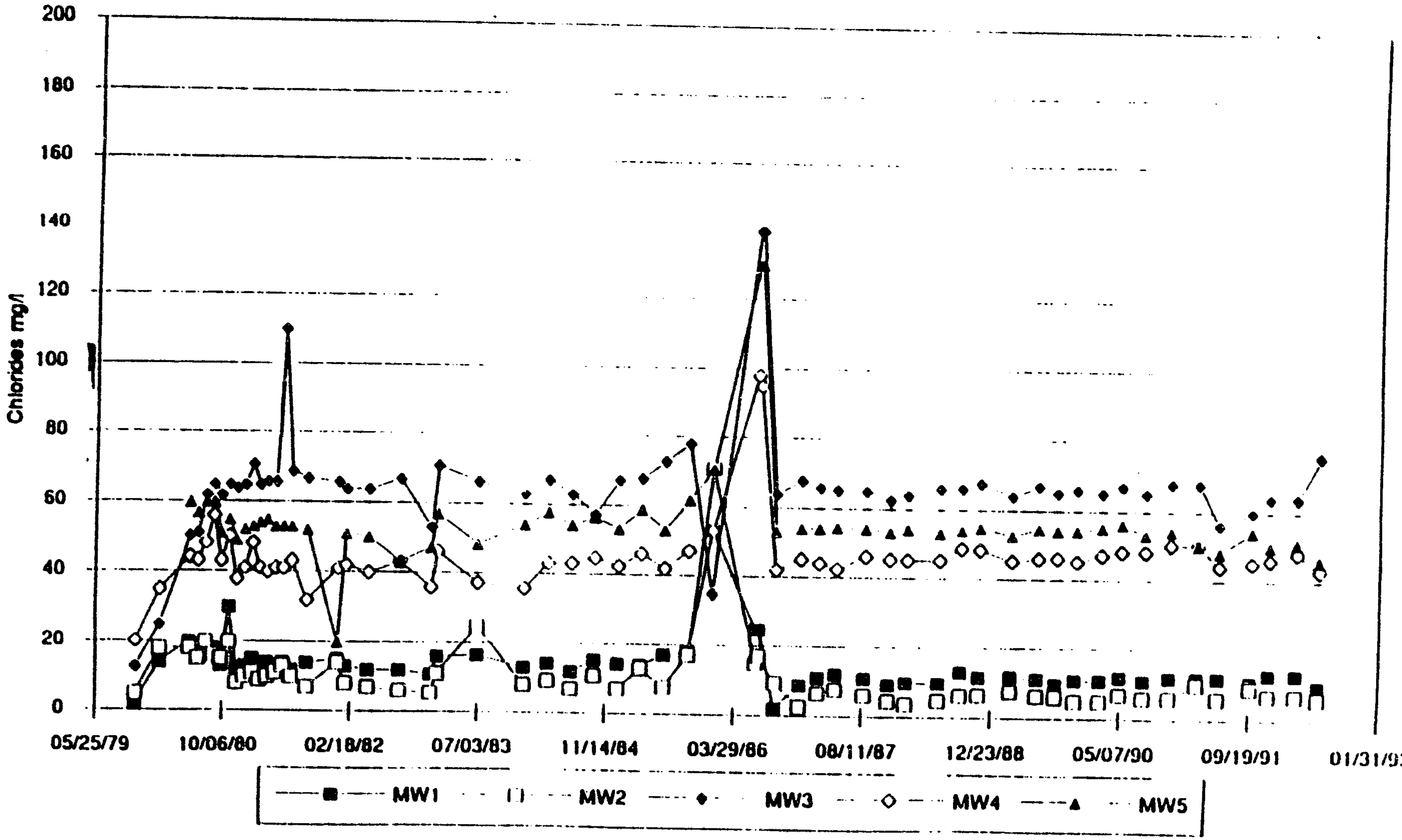
5506.00
5504.00
5502.00
5500.00
5498.00
5496.00
5494.00
5492.00
5490.00
10/06/80
02/18/82
07/03/83
11/14/84
03/29/86
08/11/87
12/23/88
05/07/90
09/19/91
01/31/93
MW11
MW12
MW14
MW15

UMETCO MINERALS CORPORATION
White Mesa Mill



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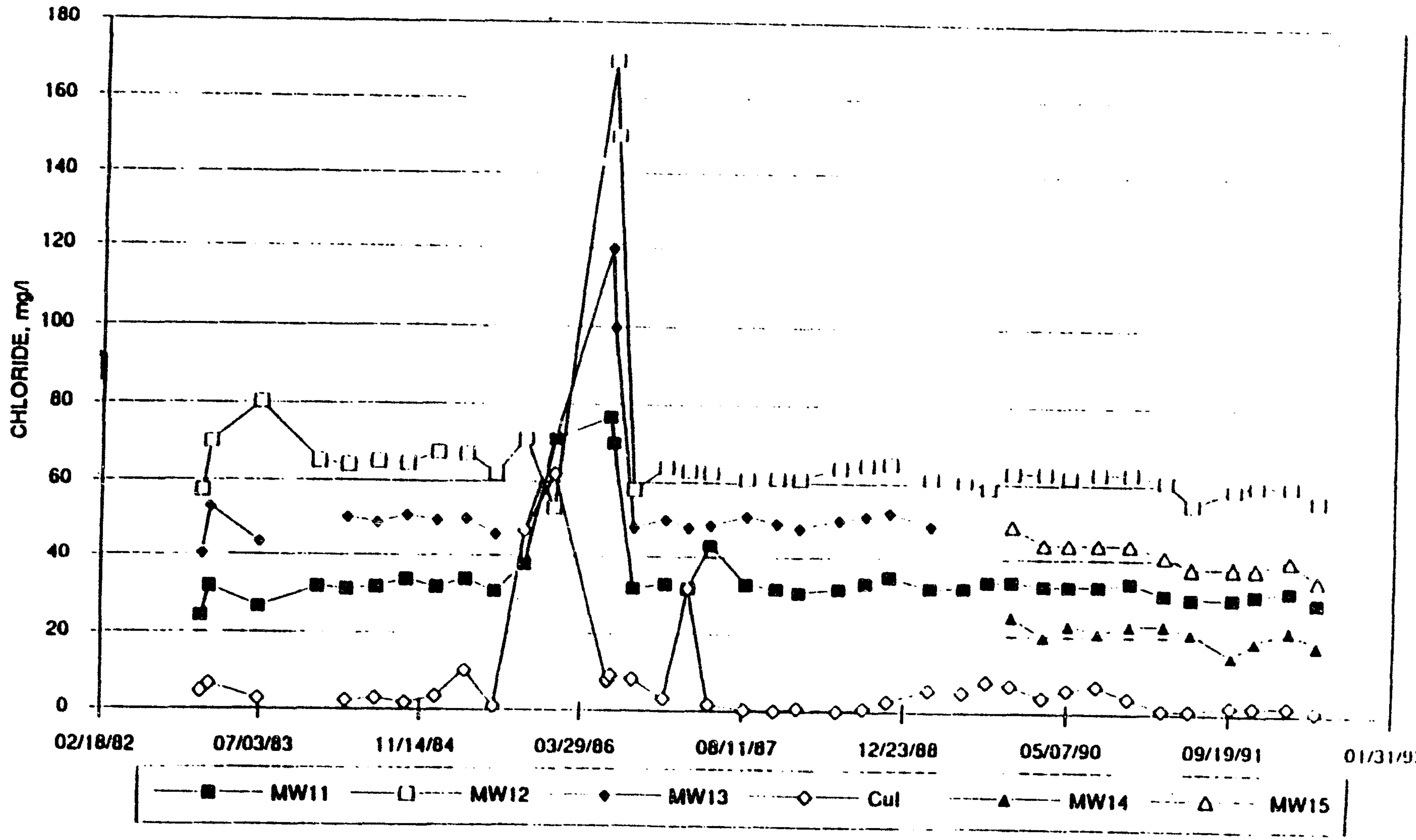
Wite Mesa Mill



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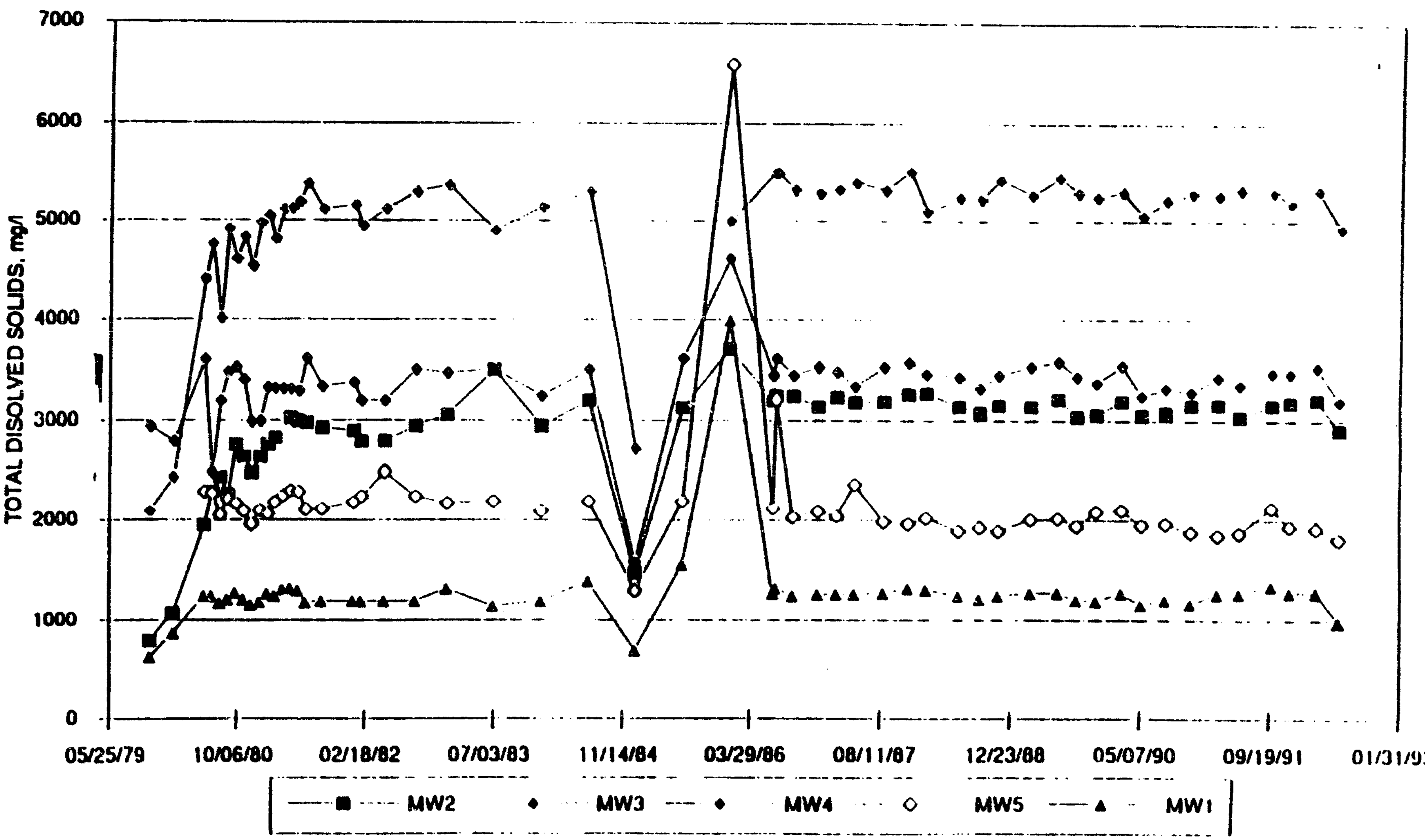

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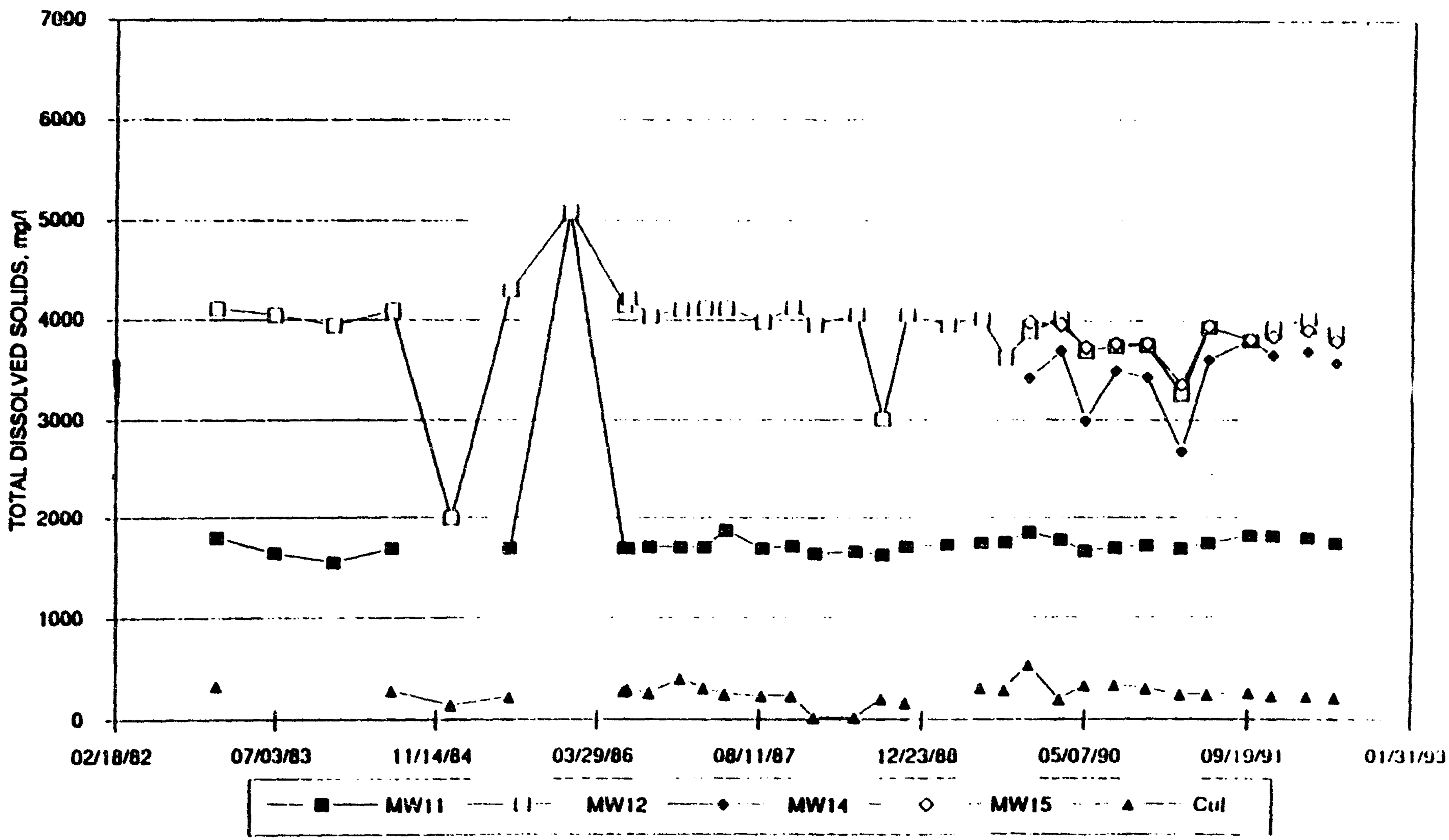

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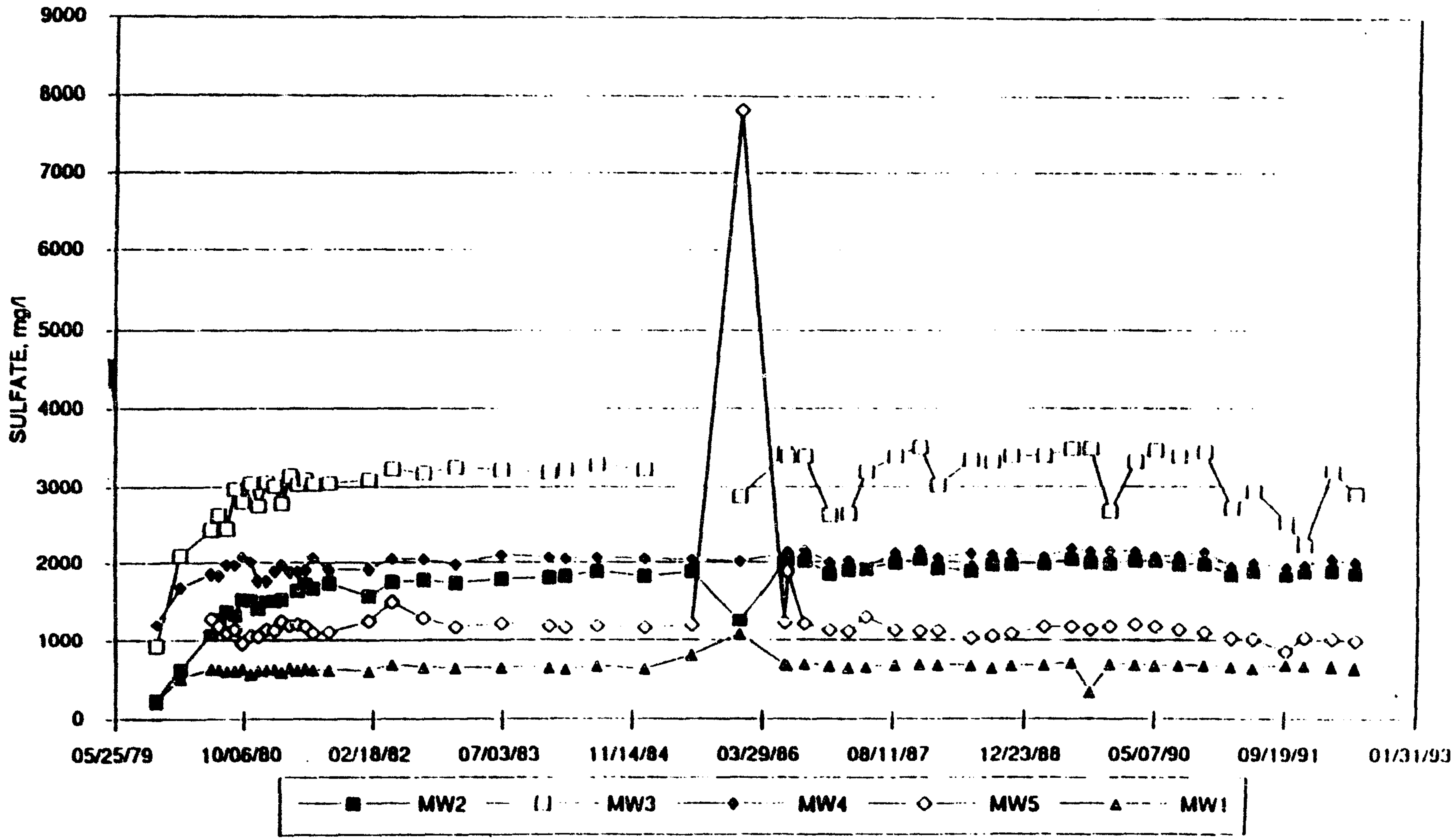

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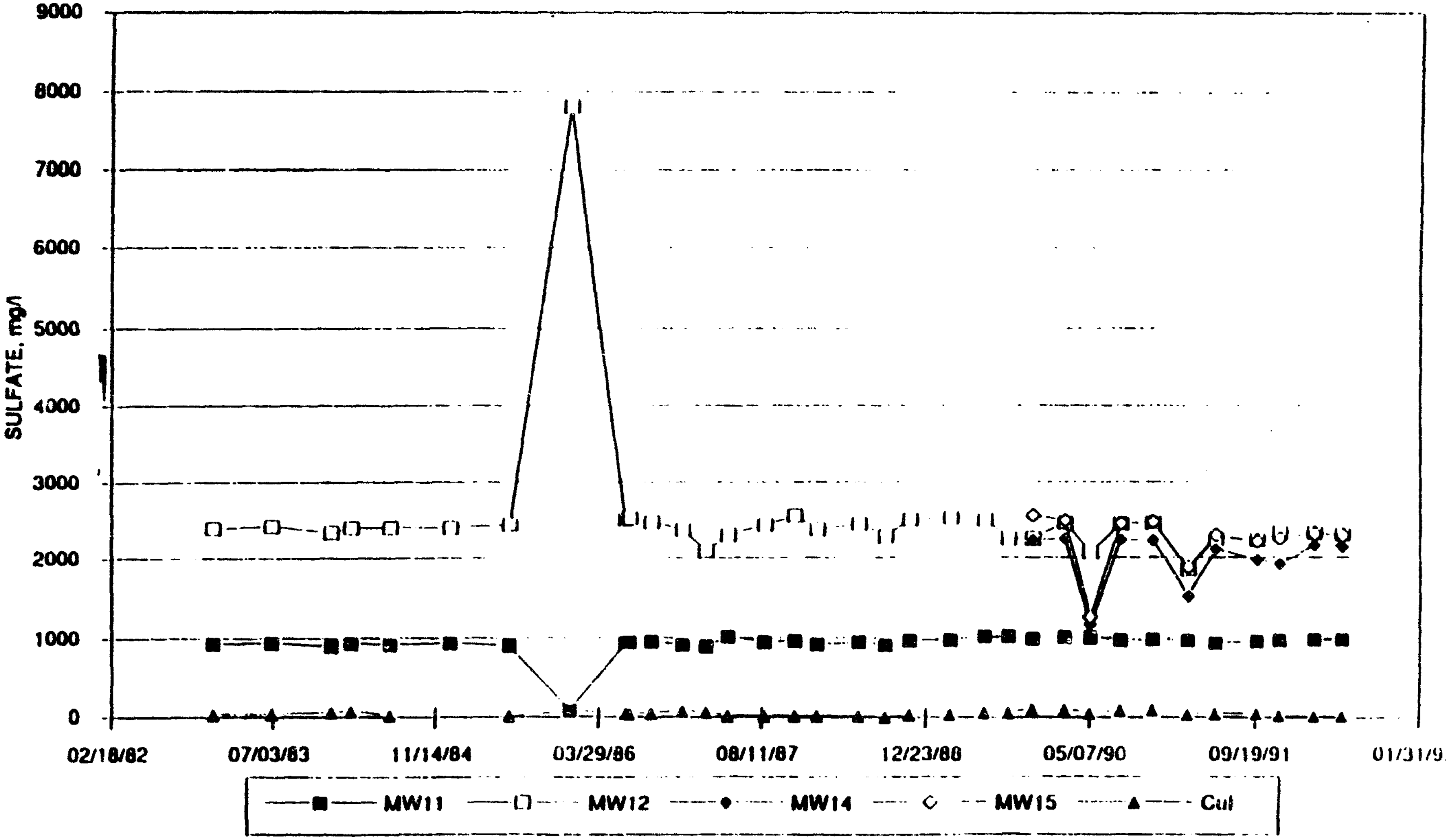

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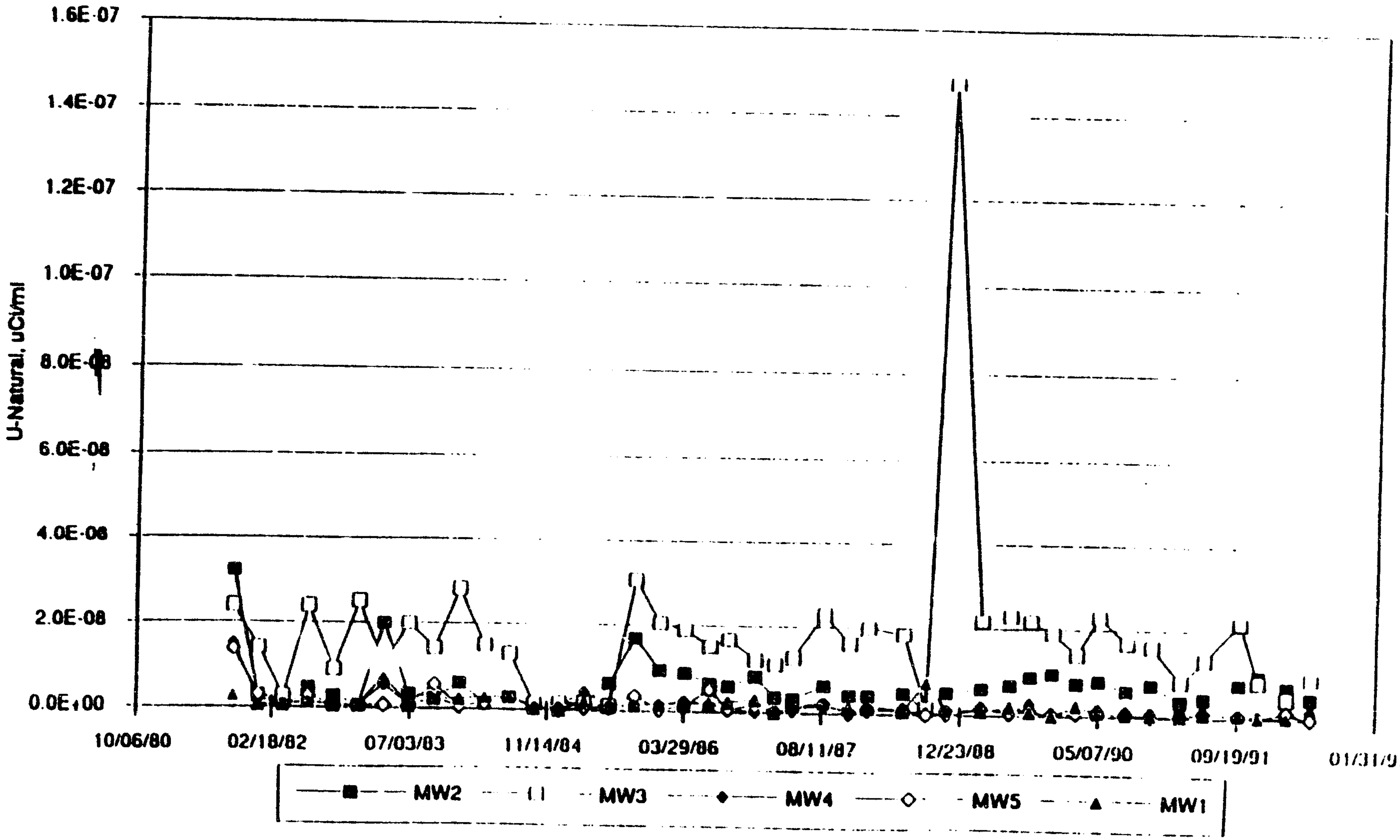

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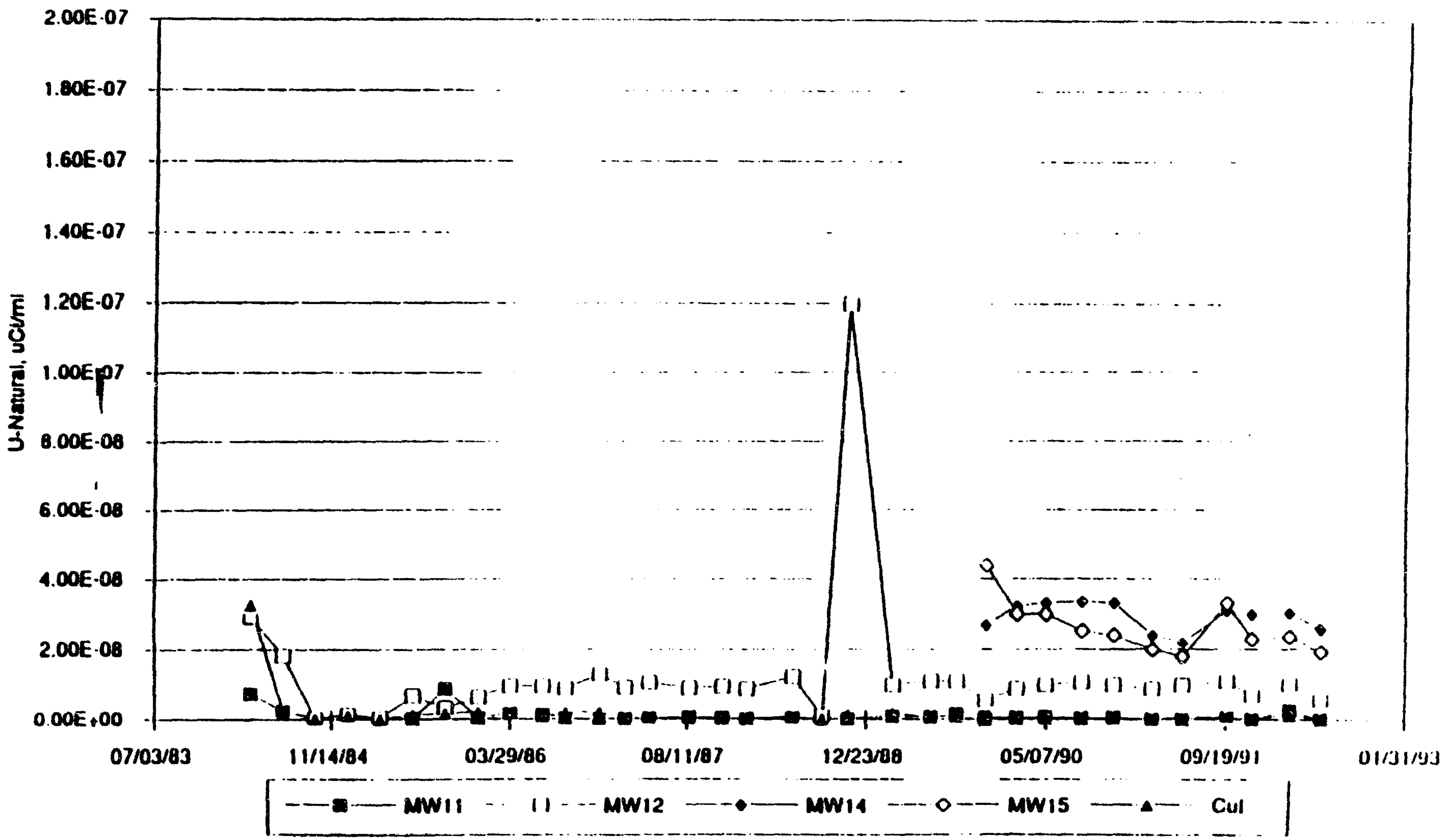

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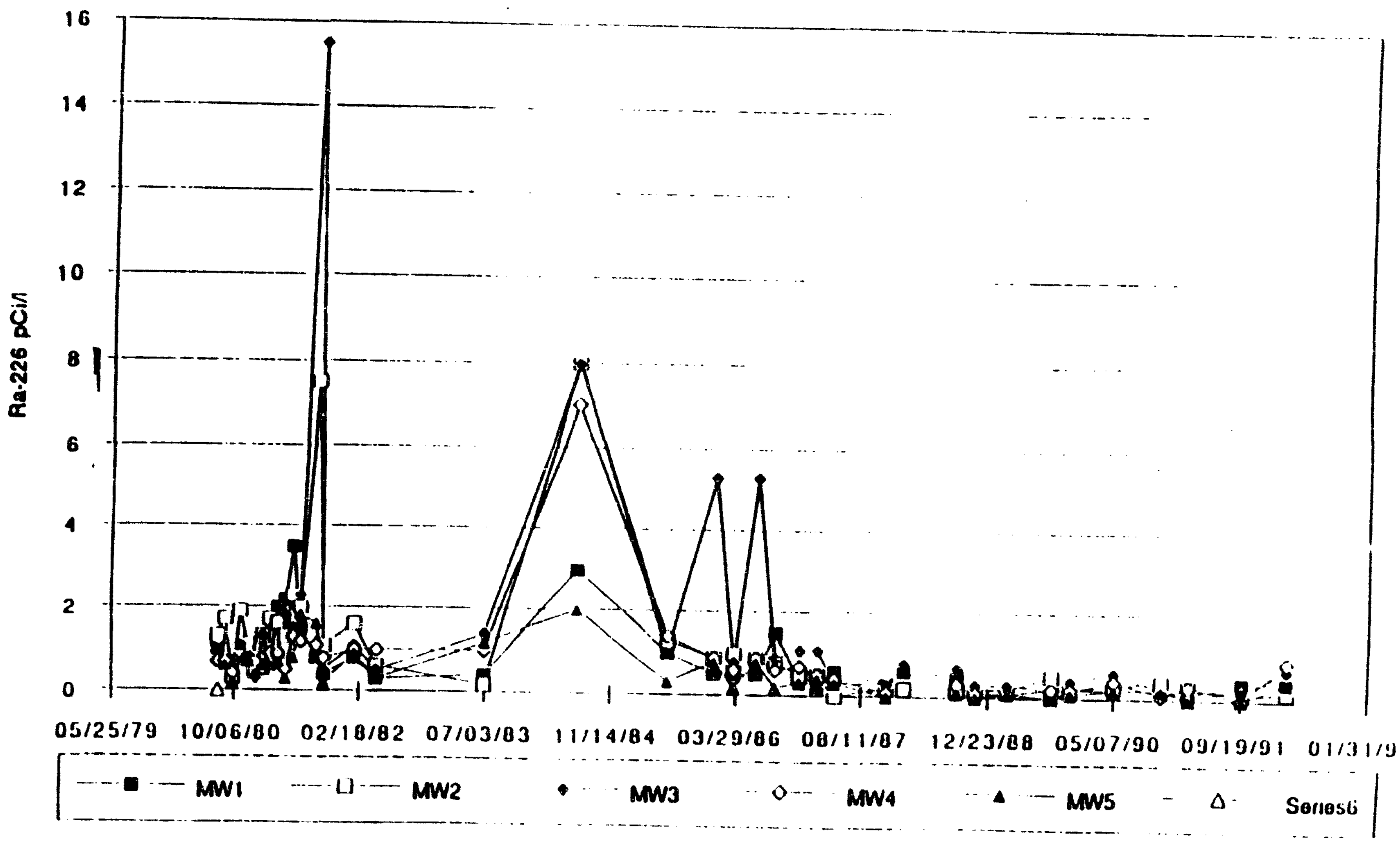

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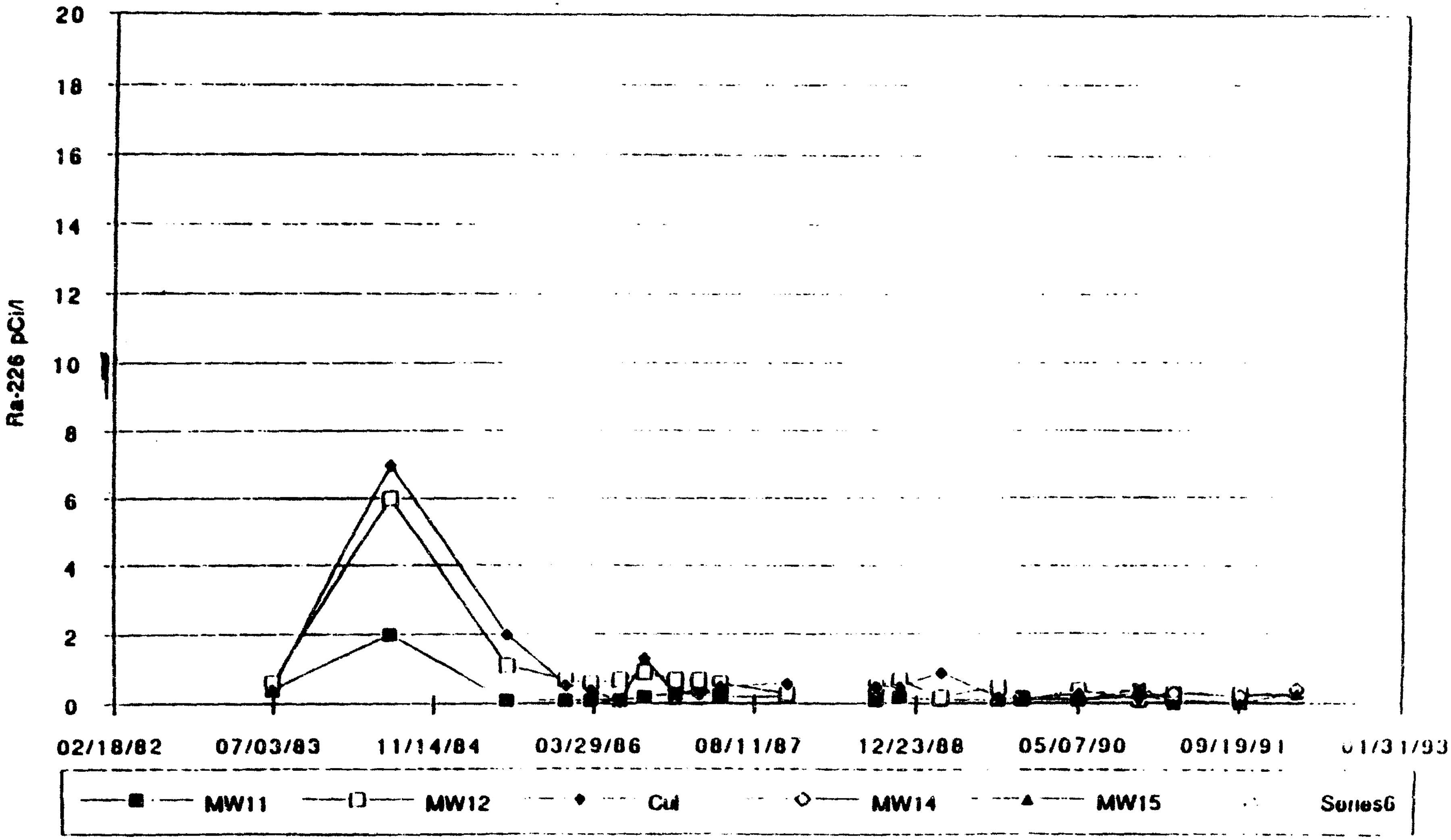

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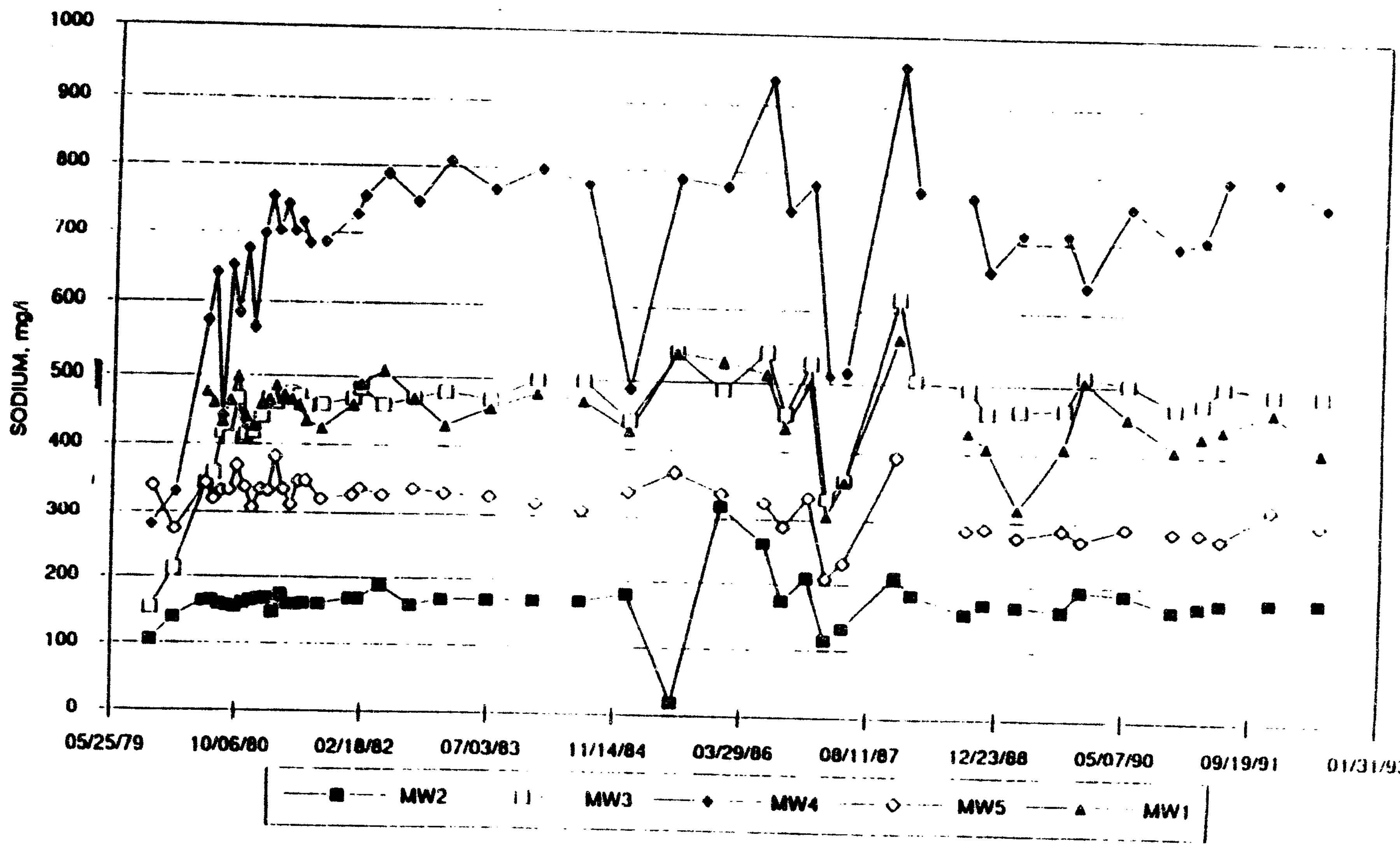
WHITE MESA MILL



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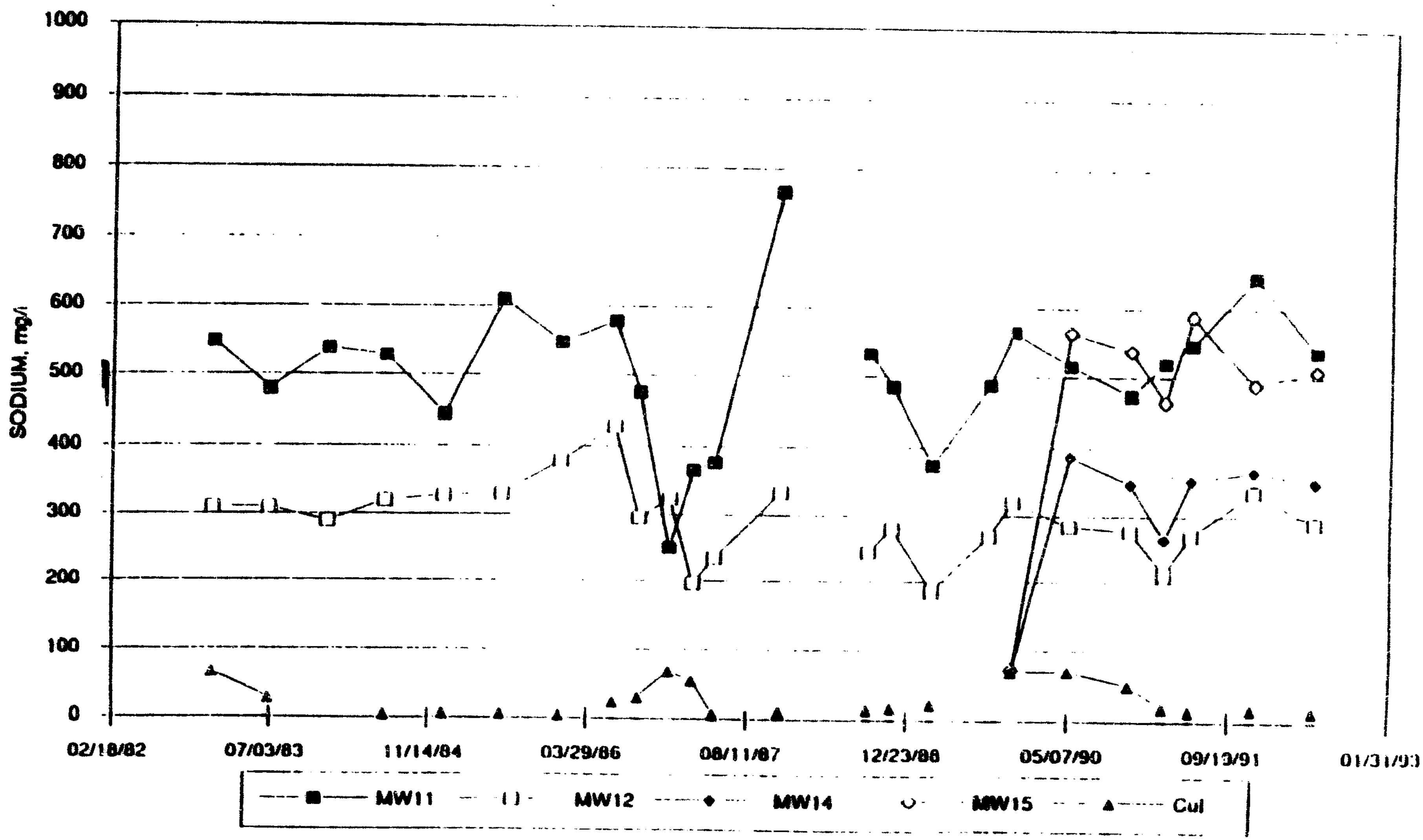
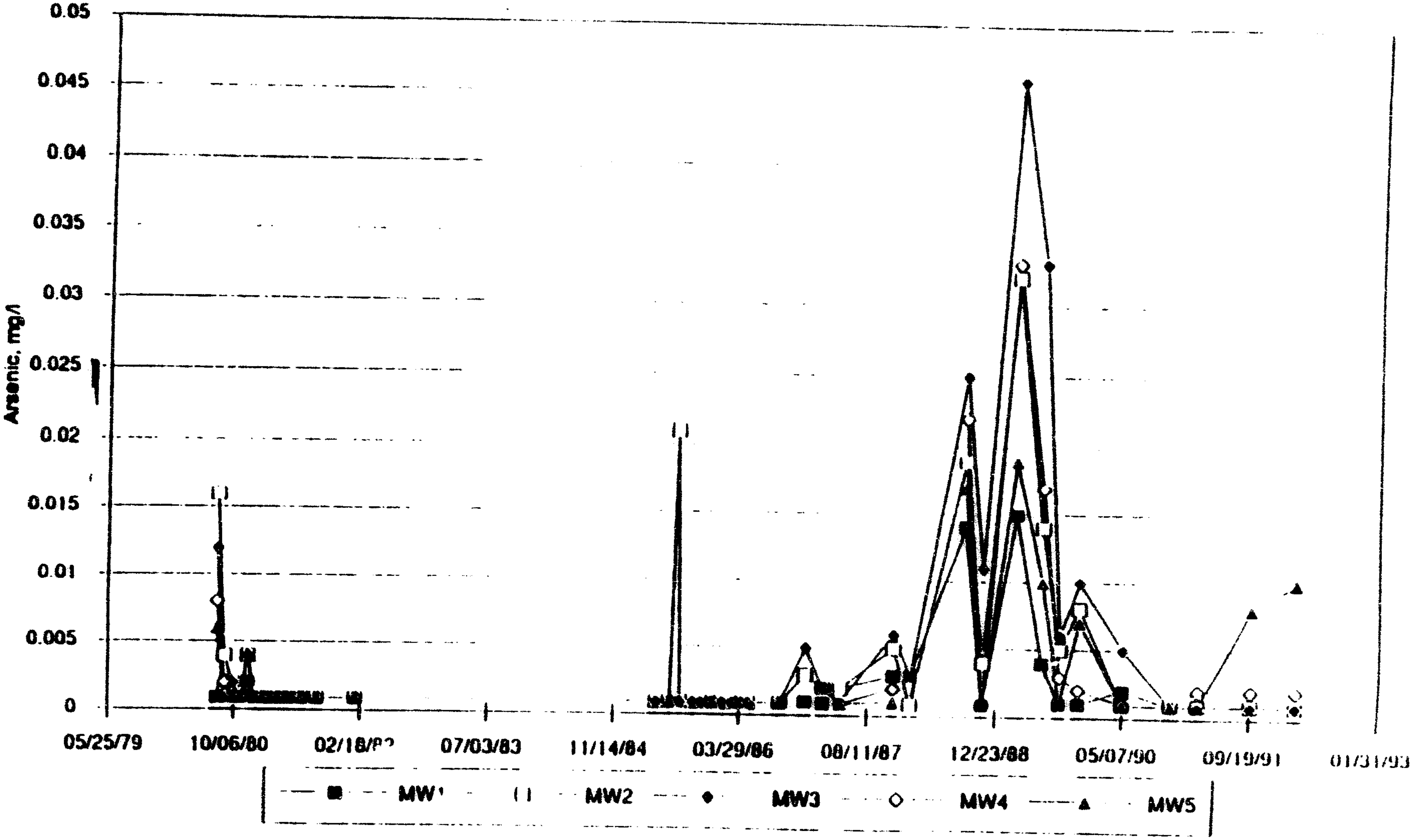
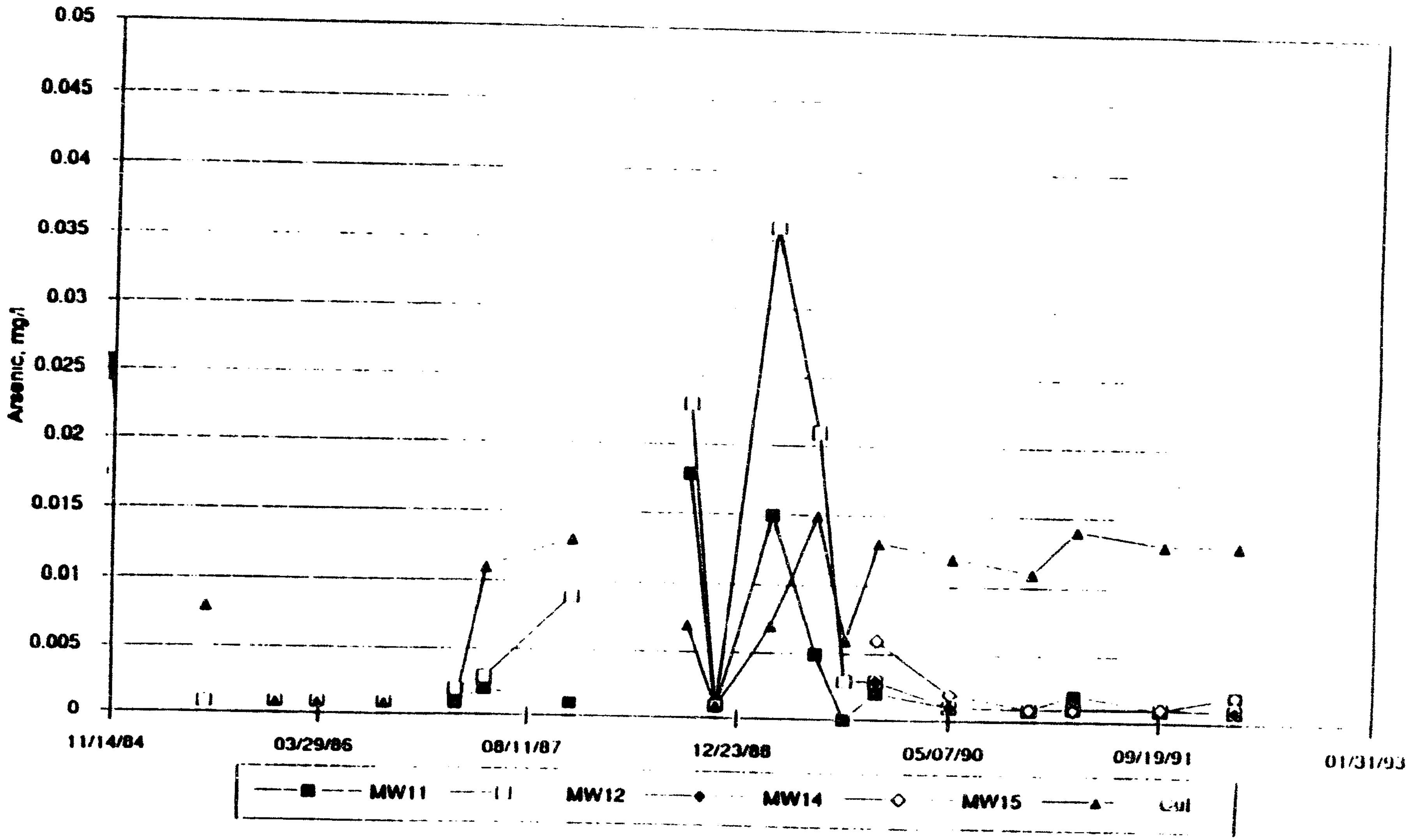
WHITE MESA MILL



UMETCO MINERALS CORPORATION
White Mesa Mill



UMETCO MINERALS CORPORATION
White Mesa Mill



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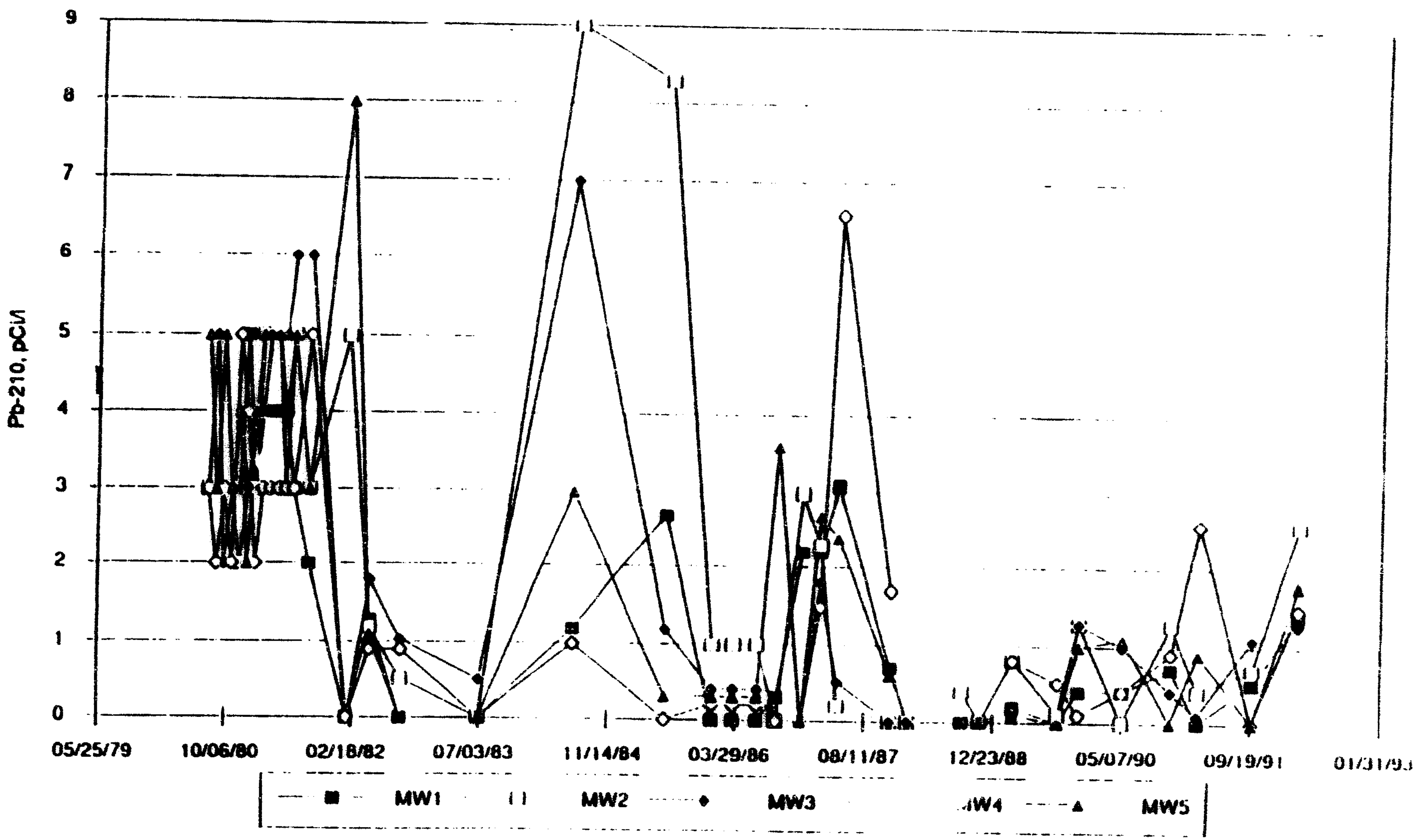
WHITE MESA MILL



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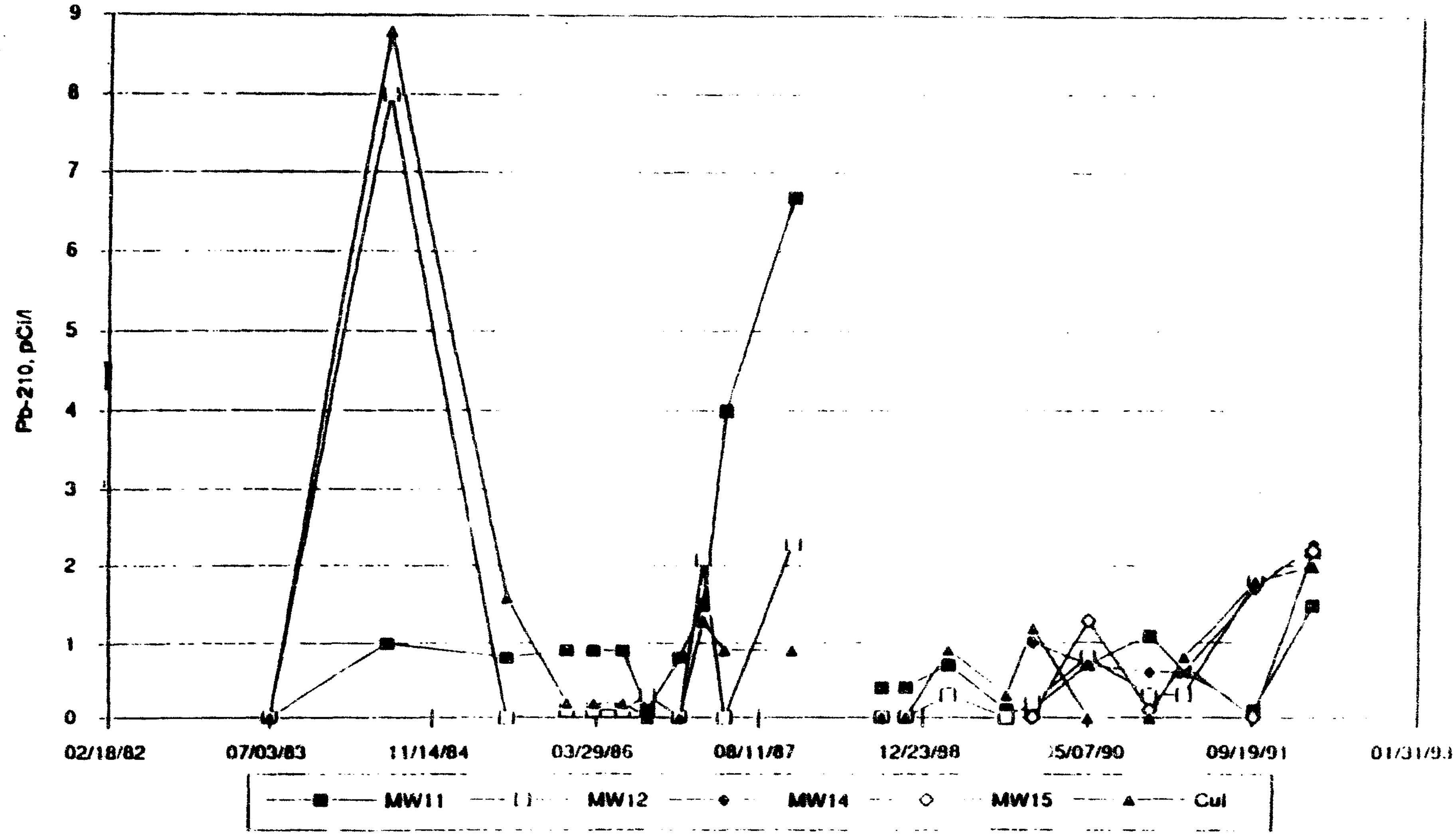
WHITE MESA MILL



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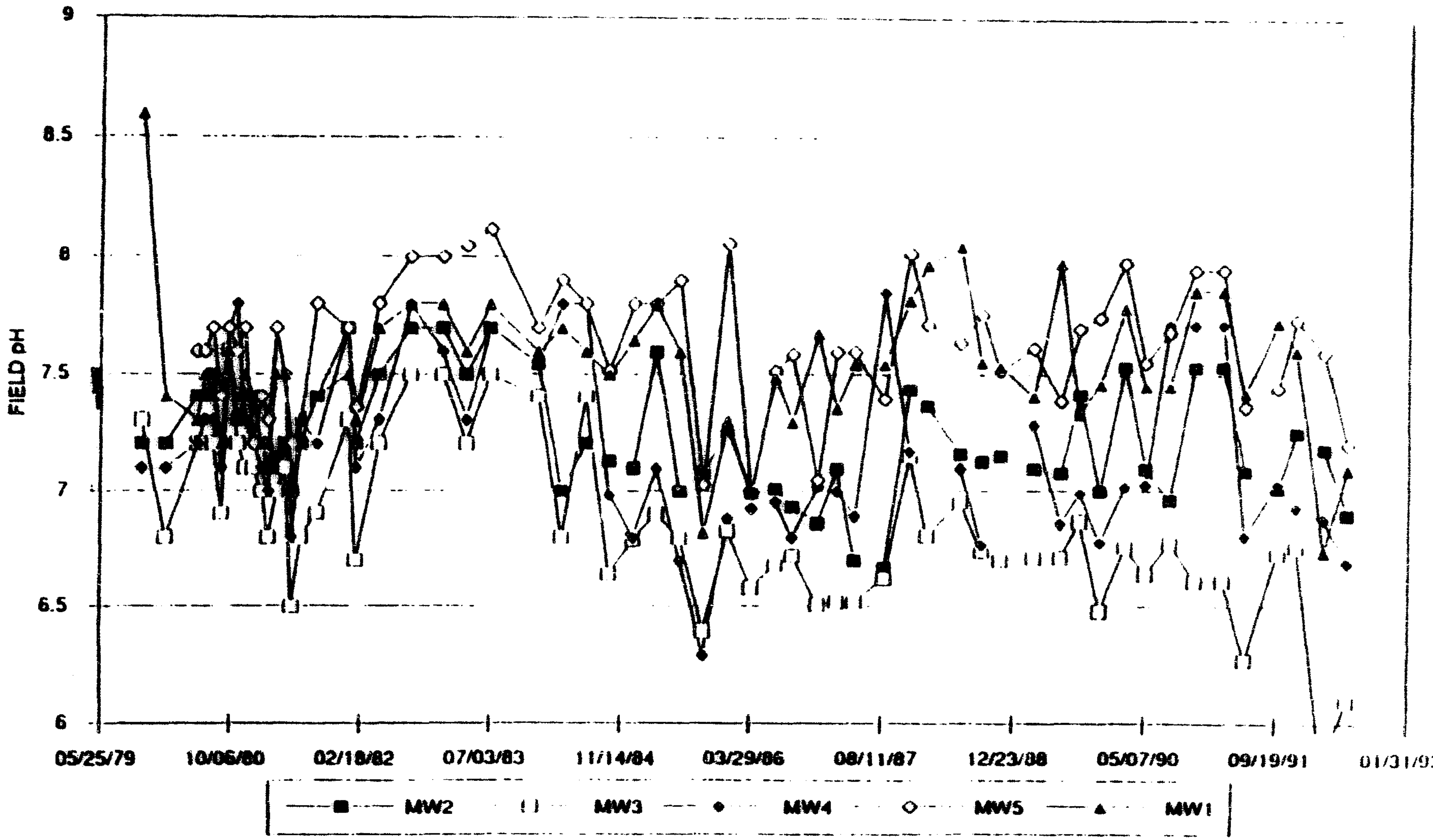
WHITE MESA MILL



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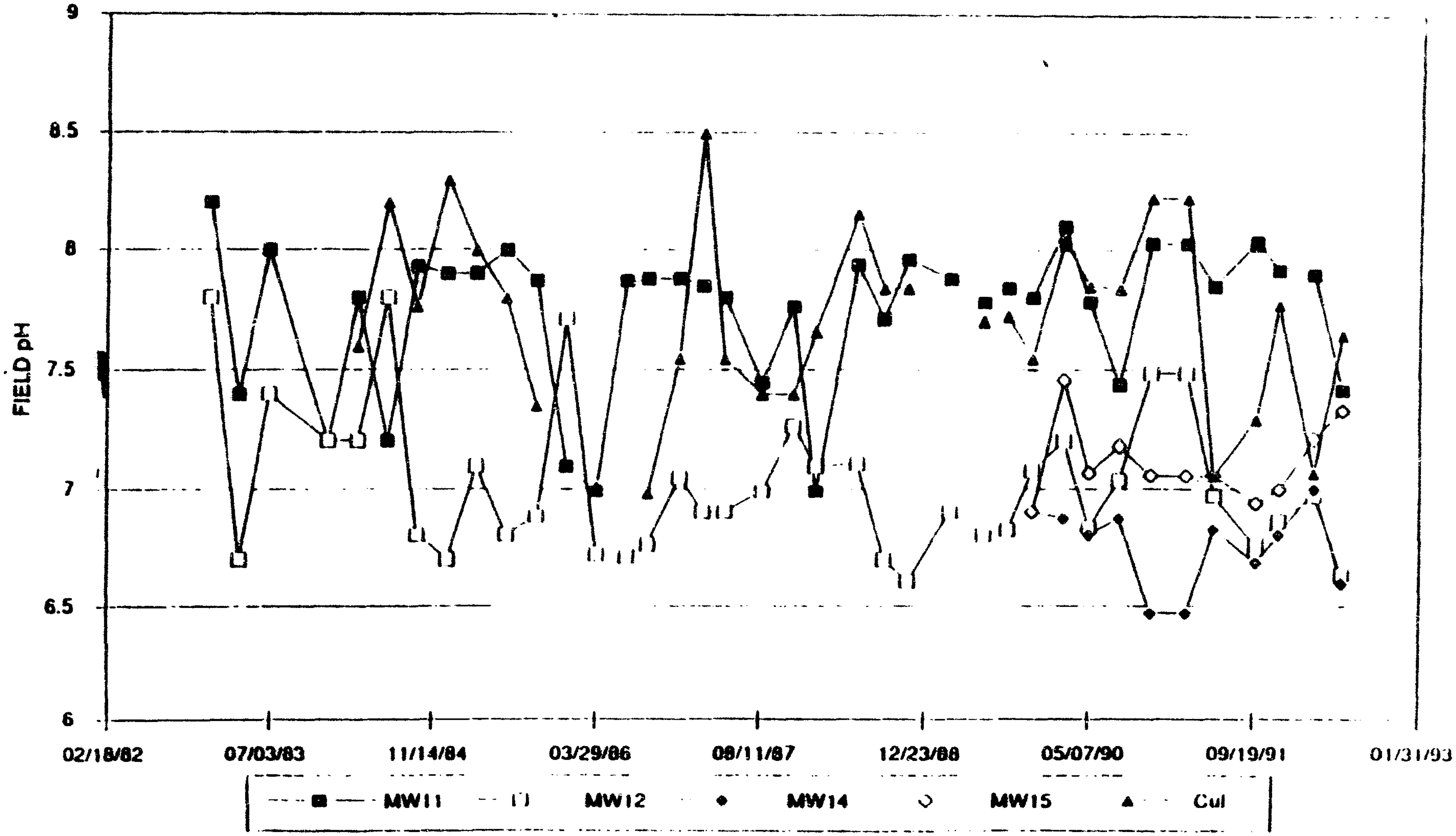

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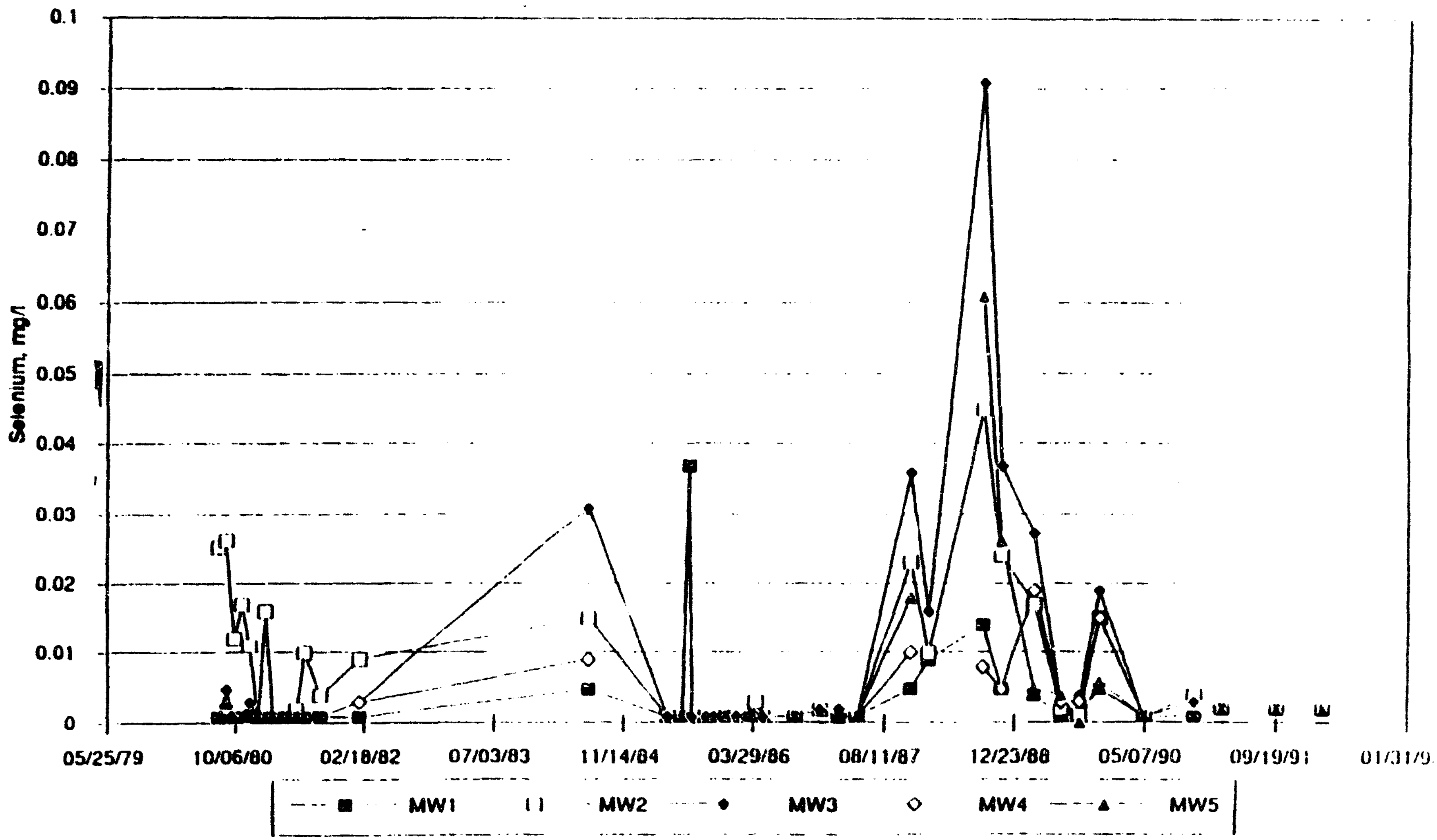
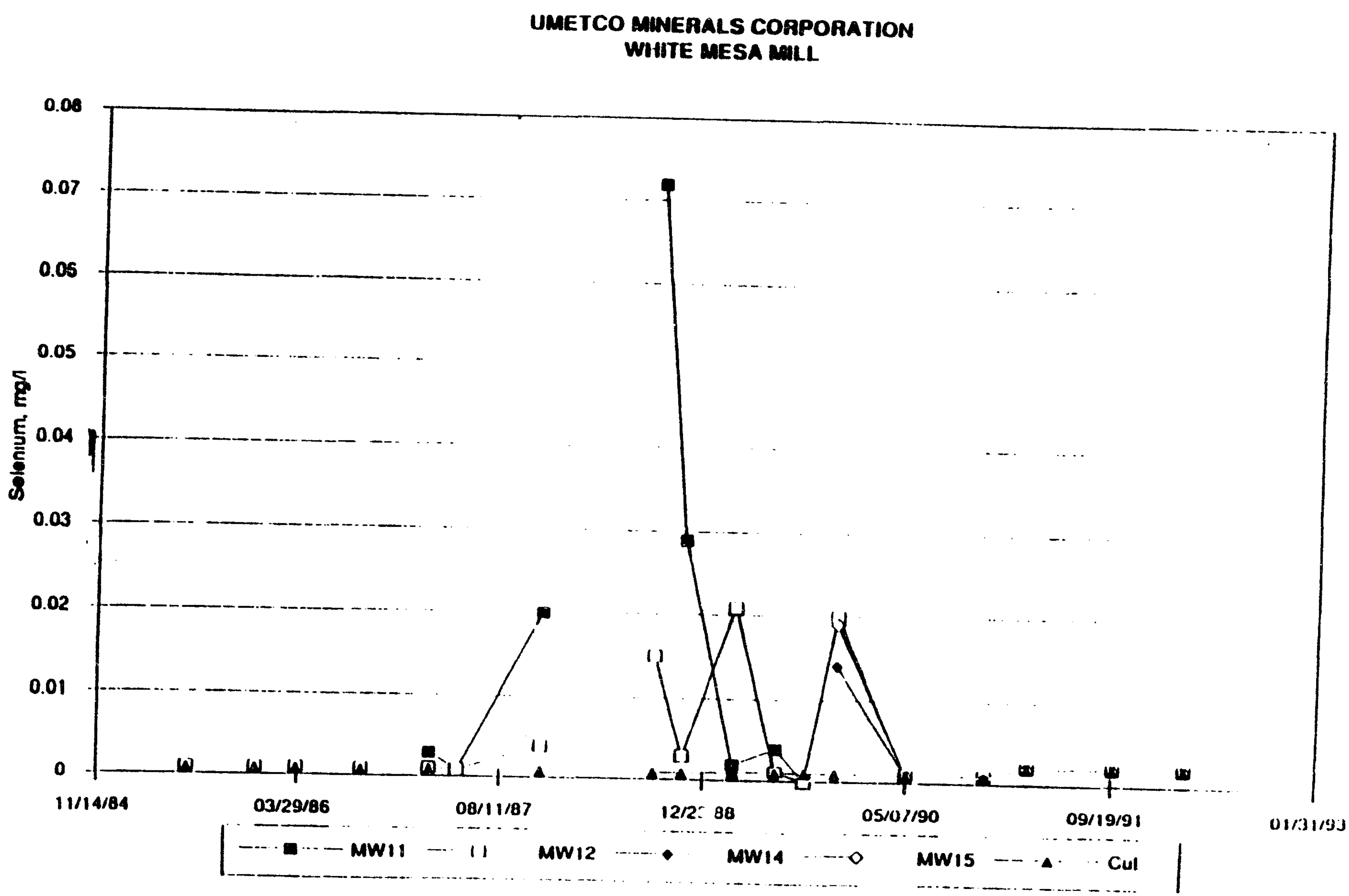
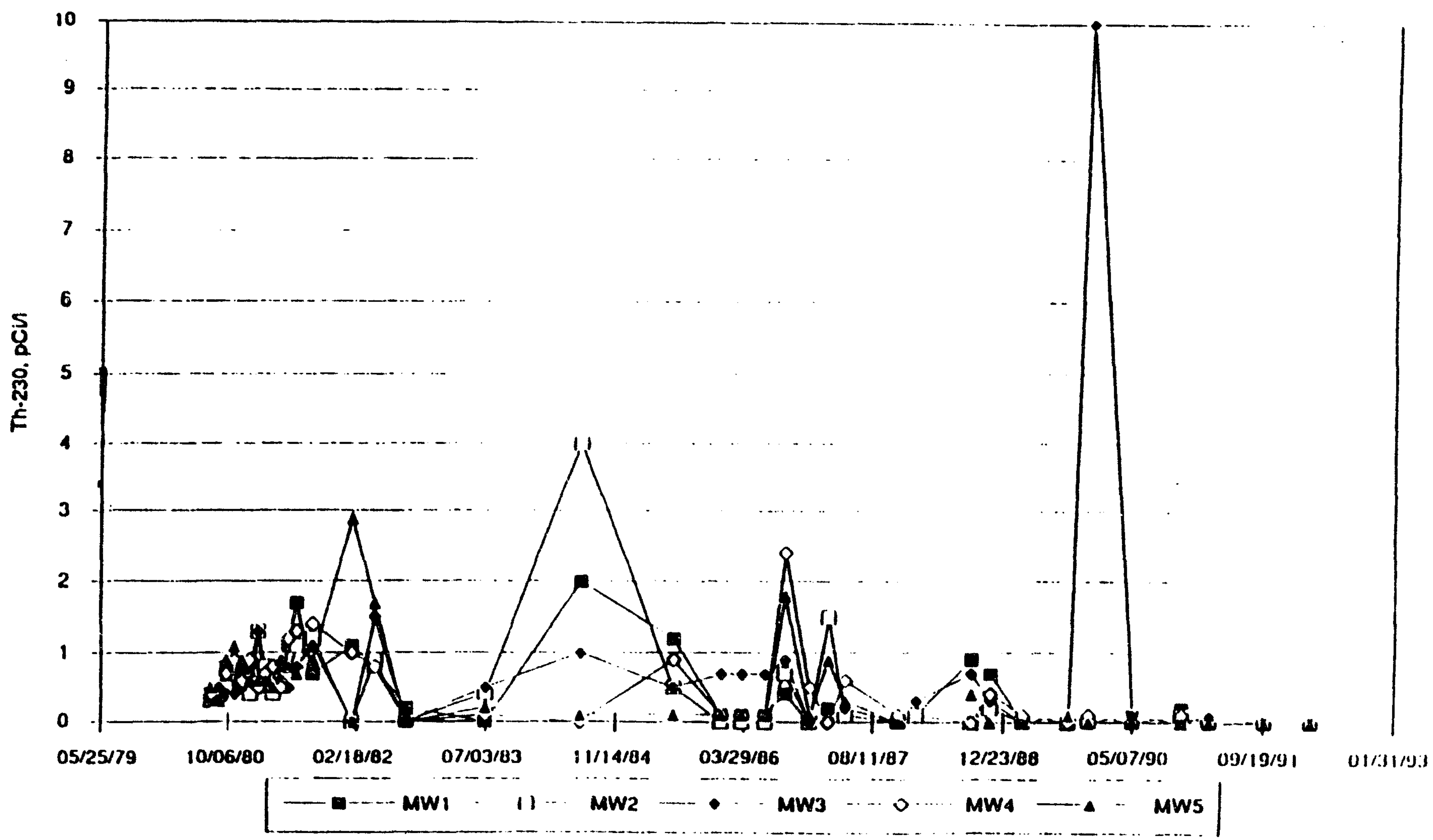
WHITE MESA MILL





UMETCO MINERALS CORPORATION
WHITE MESA MILL
Selenium, mg/l
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
11/14/84
03/29/86
08/11/87
05/07/90
09/19/91
MW11
MW12
MW14
MW15
Cul

UMETCO MINERALS CORPORATION
WHITE MESA MILL



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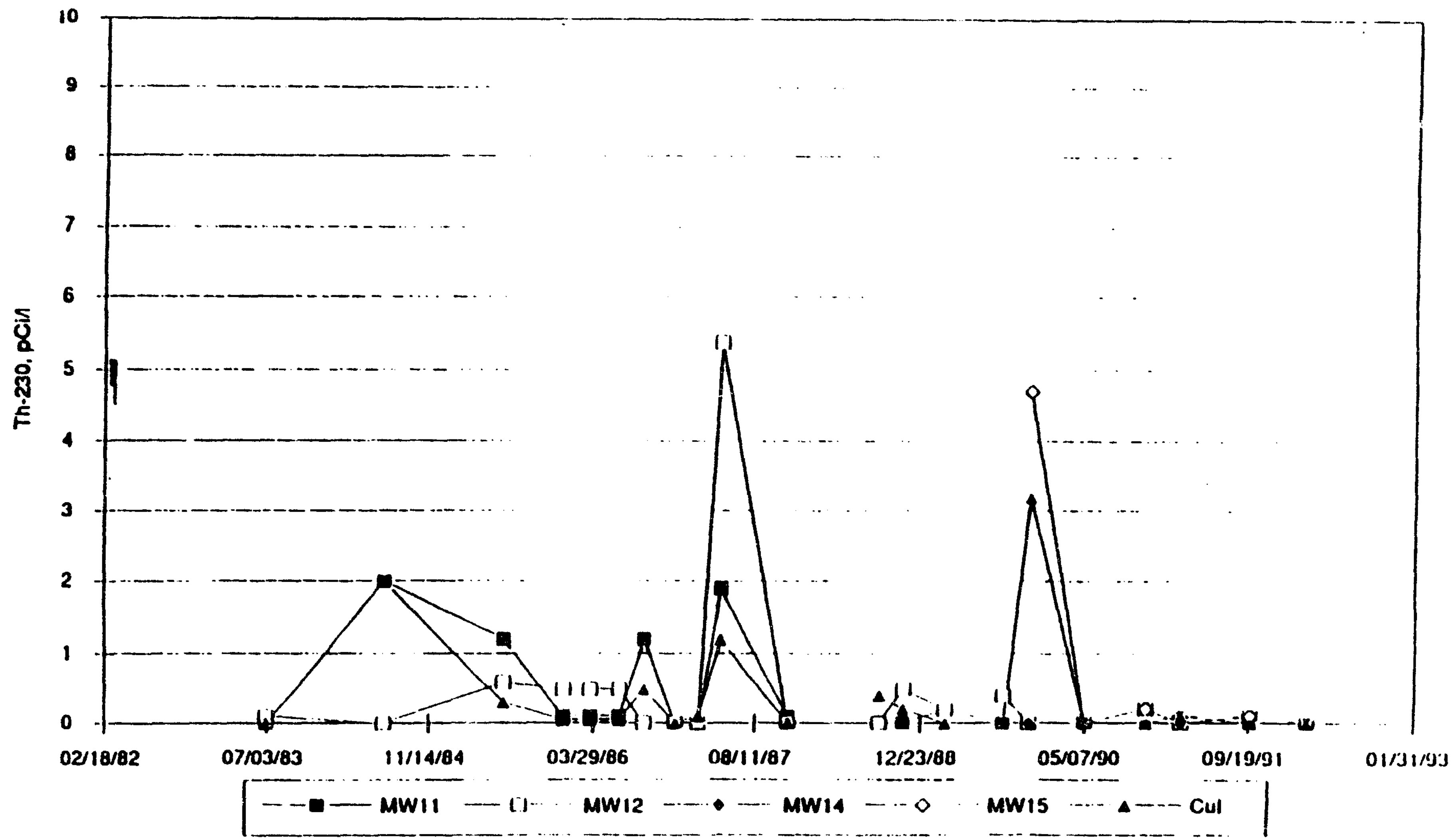
WHITE MESA MILL



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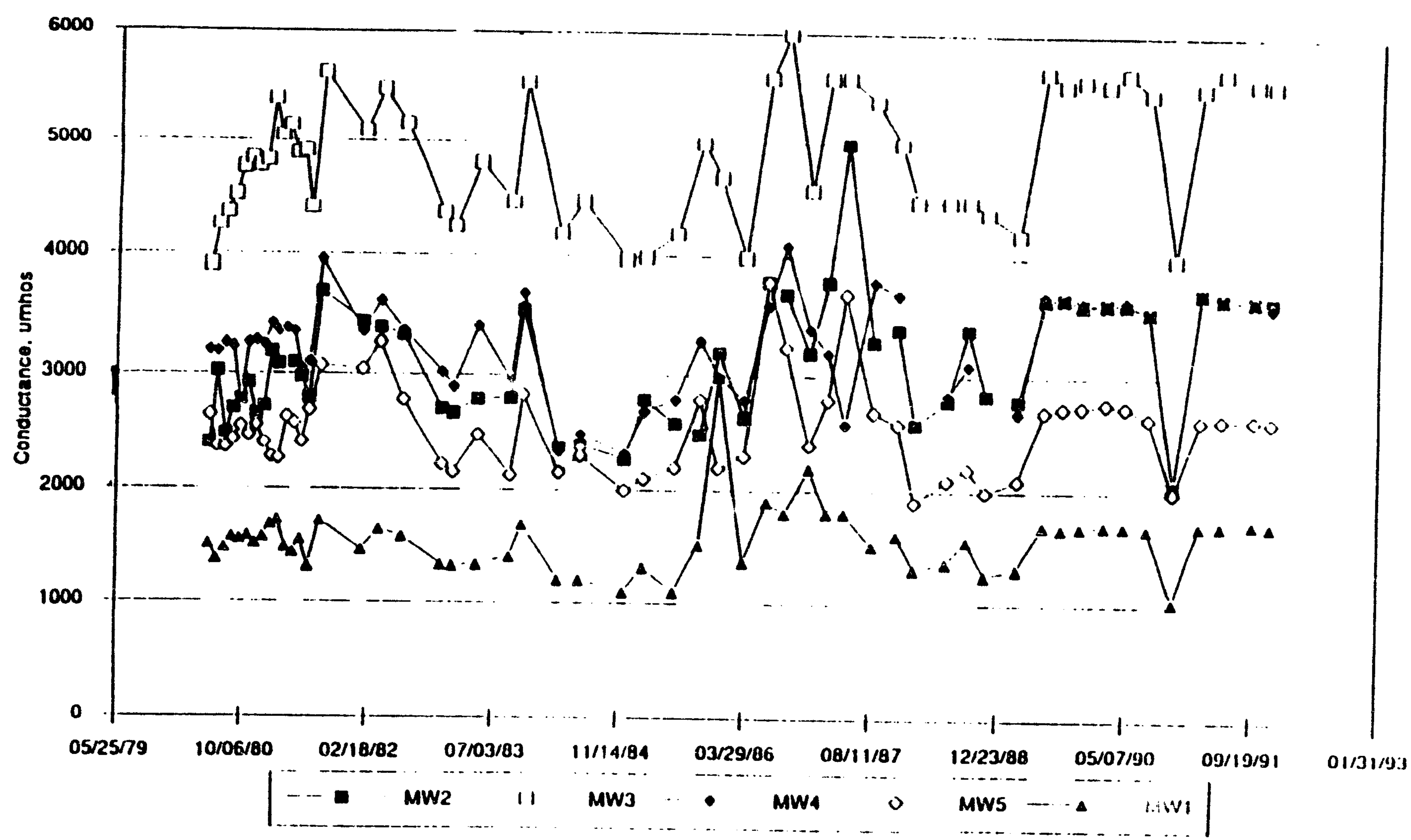
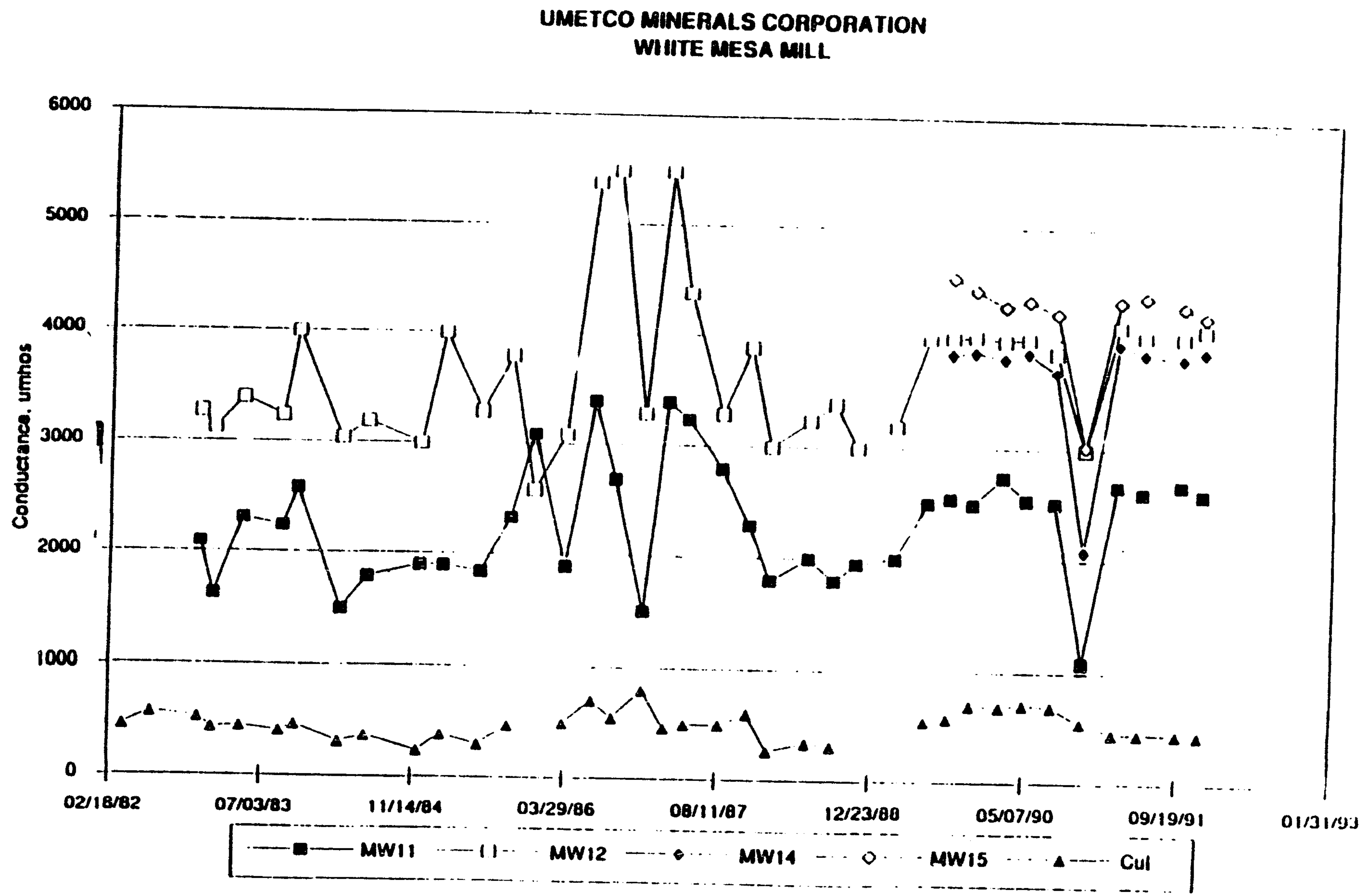
WHITE MESA MILL




UMETCO MINERALS CORPORATION
WHITE MESA MILL
Conductance, umhos
6000
5000
4000
3000
2000
1000
0
02/18/82
07/03/83
11/14/84
03/29/86
08/11/87
12/23/88
05/07/90
09/19/91
01/31/93
MW11
MW12
MW14
MW15
Cul

Chlorides "T" Test
Monitor Well MW-1

Date	Data set 1	Date	Data set 2
30-Nov-80	12	07-Aug-90	11.0
31 Dec 80	13	13-Nov 90	12 0
31 Jan 81	15	27 Feb 91	12 0
28 Feb 81	14	21 May 91	12 0
31-Mar 81	14	24 Sep 91	11 0
30 Apr 81	13	03 Dec 91	13 0
30-May 81	14	17 Mar 92	13 0
30-Jun 81	12	11 Jun 92	10 0
31 Aug 81	14	03 Sep 92	11
31-Dec 81	15	19 Nov 92	13.0

t Test: Two Sample Assuming Equal Variances

	Data set 1	Data set 2
Mean	13 6	11.8
Variance	1	1
Observations	10	10
Pooled Variance	1.11	
Hypothesized Mean Differenc	0.00	
df	18 00	
t	3 82	
P(T<=t) one tail	0 00	
t Critical one-tail	1.73	
P(T<=t) two-tail	0 00	
t Critical two-tail	2.10	

Data set 1	
Mean	13 60
Standard Error	0.34
Median	14 00
Mode	14 00
Standard Deviation	1 07
Variance	1.16
Kurtosis	-0.88
Skewness	-0 32
Range	3.00
Minimum	12 00
Maximum	15 00
Sum	136.00
Count	10

Data set 2	
Mean	11 80
Standard Error	0.33
Median	12.00
Mode	11 00
Standard Deviation	1.03
Variance	1 07
Kurtosis	-0.90
Skewness	-0 27
Range	3.00
Minimum	10.00
Maximum	13.00
Sum	118.00
Count	10

U nat "T" Test
Monitor Well MW 1

Date	Data set 1	Date	Data set 2
30-Sep-81	2.7E-09	16-Aug-90	4.67E-10
31-Dec-81	6.5E-10	13-Nov-90	5.00E-10
31-Mar-82	6.5E-10	27-Feb-91	2.20E-10
30-Jun-82	1.4E-09	21-May-91	9.10E-10
30-Sep-82	6.8E-10	24-Sep-91	8.20E-10
31-Dec-82	6.8E-10	03-Dec-91	4.30E-10
31-Mar-83	7.4E-09	17-Mar-92	4.54E-10
30-Jun-83	6.7E-10	11-Jun-92	2.76E-09
30-Sep-83	2.3E-09	03-Sep-92	2.03E-09
31-Dec-83	2.3E-09	19-Nov-92	5.42E-10

t Test: Two-Sample Assuming Equal Variances

	Data set 1	Data set 2
Mean	1.938E-09	9.133E-10
Variance	0	0
Observations	10	10
Pooled Variance	0.00	
Hypothesized Mean Differenc	0.00	
df	18.00	
t	1.45	
P(T<=t) one tail	0.08	
t Critical one-tail	1.73	
P(T<=t) two-tail	0.17	
t Critical two tail	2.10	

Data set 1	
Mean	1.94E-09
Standard Error	6.59E-10
Median	1.02E-09
Mode	6.50E-10
Standard Deviation	2.08E-09
Variance	4.35E-18
Kurtosis	6.10E+00
Skewness	2.35E+00
Range	6.75E-09
Minimum	6.50E-10
Maximum	7.40E-09
Sum	1.94E-08
Count	10

Data set 2	
Mean	9.13E-10
Standard Error	2.60E-10
Median	5.21E-10
Mode	#N/A
Standard Deviation	8.23E-10
Variance	6.78E-19
Kurtosis	2.13E+00
Skewness	1.73E+00
Range	2.54E-09
Minimum	2.20E-10
Maximum	2.76E-09
Sum	9.13E-09
Count	10

Sulfates "T" Test
Monitor Well MW-1

Date	Data set 1	Date	Data set 2
31-Jan-80	520	07-Aug-90	685
30-May-80	635	13-Nov-90	687
30-Jun-80	632	27-Feb-91	662
31-Jul-80	610	21-May-91	652
31-Aug-80	612	24-Sep-91	692
30-Sep-80	640	03-Dec-91	677
31-Oct-80	570	17-Mar-92	667
30-Nov-80	613	11-Jun-92	642
31-Dec-80	620	03-Sep-92	670
31-Jan-81	638	19-Nov-92	654

t-Test: Two-Sample Assuming Equal Variances

	Data set 1	Data set 2
Mean	609	668.8
Variance	1400	274
Observations	10	10
Pooled Variance	836.98	
Hypothesized Mean Difference	0.00	
df	18.00	
t	-4.62	
P(T<=t) one-tail	0.00	
t Critical one-tail	1.73	
P(T<=t) two-tail	0.00	
t Critical two-tail	2.10	

Data set 1	
Mean	6.09E+02
Standard Error	1.18E+01
Median	6.17E+02
Mode	#N/A
Standard Deviation	3.74E+01
Variance	1.40E+03
Kurtosis	3.18E+00
Skewness	-1.80E+00
Range	1.20E+02
Minimum	5.20E+02
Maximum	6.40E+02
Sum	6.09E+03
Count	10

Data set 2	
Mean	6.69E+02
Standard Error	5.24E+00
Median	6.69E+02
Mode	#N/A
Standard Deviation	1.66E+01
Variance	2.74E+02
Kurtosis	-1.10E+00
Skewness	-1.29E-01
Range	5.00E+01
Minimum	6.42E+02
Maximum	6.92E+02
Sum	6.69E+03
Count	10

Chlorides "T" Test
Monitor Well MW-3

Date	Data set 1	Date	Data set 2
30-Nov-80	64	07-Aug-90	65.0
31-Dec-80	65	13-Nov-90	68.0
31-Jan-81	71	27-Feb-91	68.0
28-Feb-81	65	21-May-91	56.0
31-Mar-81	66	24-Sep-91	60.0
30-Apr-81	66	03-Dec-91	64.0
30-May-81	110	17-Mar-92	64.0
30-Jun-81	69	11-Jun-92	76.0
31-Aug-81	67	03-Sep-92	58
31-Dec-81	66	19-Nov-92	63.0

t-Test: Two-Sample Assuming Equal Variances

	Variable 1	Variable 2
Mean	70.9	64.2
Variance	193	33
Observations	10	10
Pooled Variance	112.81	
Hypothesized Mean Difference	0.00	
df	18.00	
t	1.41	
P(T<=t) one-tail	0.09	
t Critical one-tail	1.73	
P(T<=t) two-tail	0.18	
t Critical two-tail	2.10	

Data set 1	
Mean	70.90
Standard Error	4.39
Median	66.00
Mode	66.00
Standard Deviation	13.89
Variance	192.99
Kurtosis	9.40
Skewness	3.04
Range	46.00
Minimum	64.00
Maximum	110.00
Sum	709.00
Count	10

Data set 2	
Mean	64.20
Standard Error	1.81
Median	64.00
Mode	68.00
Standard Deviation	5.71
Variance	32.62
Kurtosis	1.02
Skewness	0.66
Range	20.00
Minimum	56.00
Maximum	76.00
Sum	642.00
Count	10

U Nat "T" Test
Monitor Well-MW 3

Date	Data set 1
30-Sep-81	2.4E-08
31 Dec 81	1.4E 08
31 Mar 82	2.7E-09
30 Jun 82	2.4E-08
30-Sep-82	8.9E 09
31 Dec 82	2.5E-08
31 Mar 83	1.0E 08
30 Jun 83	2.0E-08
30-Sep-83	1.4E-08
31-Dec 83	2.8E 08

Date	Data set 1
16-Aug-90	1.67E-08
13 Nov 90	1 60E 08
27 Feb 91	8 00E 09
21 May 91	1.30E 08
24-Sep 91	2.20E-08
03 Dec 91	8 10E 09
17 Mar 92	4.53E-09
11 Jun 92	9 13E 09
03 Sep 92	1.9E-08
19 Nov 92	1.12E-08

t Test: Two Sample Assuming Equal Variances

	Data set 1	Data set 2
Mean	1.706E-08	1.277E 08
Variance	0	0
Observations	10	10
Pooled Variance	0 00	
Hypothesized Mean Difference	0.00	
df	18 00	
t	1.35	
P(T<=t) one tail	0.10	
t Critical one-tail	1.73	
P(T<=t) two-tail	0.19	
t Critical two-tail	2.10	

Data set 1	
Mean	1.71E-08
Standard Error	2.64E-09
Median	1.70E 08
Mode	2.40E-08
Standard Deviation	8 36E 09
Variance	6.99E-17
Kurtosis	-1.09E+00
Skewness	-3.35E 01
Range	2.53E 08
Minimum	2 70E 09
Maximum	2.80E-08
Sum	1.71E 07
Count	10

Data set 1	
Mean	1.28E-08
Standard Error	1.76E-09
Median	1.21E 08
Mode	#N/A
Standard Deviation	5.56E 09
Variance	3.09E-17
Kurtosis	-9.33E-01
Skewness	2.46E 01
Range	1.75E-08
Minimum	4.53E-09
Maximum	2.20E-08
Sum	1.28E 07
Count	10

Sulfates "T" Test
Monitor Well MW-3

Date	*Data set 1*	*Date*	*Data set 2*
1/30/80	2100	11/3/88	3410
5/30/80	2430	3/9/89	3410
6/30/80	2625	6/21/89	3500
7/31/80	2450	9/1/89	3500
8/31/80	2975	11/15/89	2670
9/30/80	2800	2/20/90	3330
10/31/80	3050	5/8/90	3480
11/30/80	2750	8/7/90	3400
12/31/80	3068	11/13/90	3468
1/31/81	3012	2/27/91	2712

t-Test: Paired Two Sample for Means

	Data set 1	*Data set 2*
Mean	2726	3288
Variance	104184	101881
Observations	10	10
Pearson Correlation	-0.41	
Pooled Variance	-42384.67	
Hypothesized Mean Differen	0.00	
df	9.00	
t	3.30	
P(T<=t) one-tail	0.00	
t Critical one-tail	1.83	
P(T<=t) two-tail	0.01	
t Critical two-tail	2.26	

Data set 1	
Mean	2726.00
Standard Err	102.07
Median	2775.00
Mode	#N/A
Standard Dev	322.78
Variance	104184.22
Kurtosis	-0.27
Skewness	-0.74
Range	968.00
Minimum	2100.00
Maximum	3068.00
Sum	27260.00
Count	10

Data set 2	
Mean	3288.00
Standard Error	100.94
Median	3410.00
Mode	#N/A
Standard Deviation	319.19
Variance	101880.89
Kurtosis	1.19
Skewness	-1.67
Range	830.00
Minimum	2670.00
Maximum	3500.00
Sum	32880.00
Count	10

Chlorides "T" Test
Monitor Well MW-5

Date	Data set 1	Date	Data set 2
30-Nov-80	64	07-Aug-90	49
31-Dec-80	65	13-Nov-90	52
31-Jan-81	71	27-Feb-91	53
28-Feb-81	65	21-May-91	54
31-Mar-81	66	24-Sep-91	55
30-Apr-81	68	03-Dec-91	53
30-May-81	110	17-Mar-92	53
30-Jun-81	69	11-Jun-92	53
31-Aug-81	67	03-Sep-92	52
31-Dec-81	66	19-Nov-92	20

t Test: Two-Sample Assuming Equal Variances

	Variable 1	Variable 2
Mean	70.9	49.4
Variance	193	109
Observations	10	10
Pooled Variance	151.07	
Hypothesized Mean Difference	0.00	
df	18.00	
t	3.91	
P(T<=t) one-tail	0.00	
t Critical one-tail	1.73	
P(T<=t) two-tail	0.00	
t Critical two-tail	2.10	

Data set 1	
Mean	70.90
Standard Error	4.39
Median	66.00
Mode	66.00
Standard Deviation	13.89
Variance	192.99
Kurtosis	9.40
Skewness	3.04
Range	46.00
Minimum	64.00
Maximum	110.00
Sum	709.00
Count	10

Data set 2	
Mean	49.40
Standard Error	3.30
Median	53.00
Mode	53.00
Standard Deviation	10.45
Variance	109.16
Kurtosis	9.39
Skewness	3.03
Range	35.00
Minimum	20.00
Maximum	55.00
Sum	494.00
Count	10

U Nat "T" Test
Monitor Well-MW 5

Date	*Data set 1*	*Date*	*Data set 2*
30-Sep-81	1.4E-08	16-Aug-90	6.00E-10
31-Dec-81	3.0E-09	13-Nov-90	3.00E-10
31-Mar-82	6.8E-10	27-Feb-91	2.70E-10
30-Jun-82	2.7E-09	21-May-91	1.10E-09
30-Sep-82	6.7E-10	24-Sep-91	8.00E-10
31-Dec-82	6.7E-10	03-Dec-91	5.30E-10
31-Mar-83	8.0E-10	17-Mar-92	1.60E-09
30-Jun-83	6.7E-10	11-Jun-92	2.00E-10
30-Sep-83	5.6E-09	03-Sep-92	4.06E-09
31-Dec-83	6.8E-10	19-Nov-92	6.77E-10

t-Test: Two-Sample Assuming Equal Variances

	Data set 1	*Data set 2*
Mean	2.897E-09	1.014E-09
Variance	0	0
Observations	10	10
Pooled Variance	0.00	
Hypothesized Mean Difference	0.00	
df	18.00	
t	1.41	
P(T<=t) one-tail	0.09	
t Critical one-tail	1.73	
P(T<=t) two-tail	0.18	
t Critical two-tail	2.10	

Data set 1		*Data set 2*	
Mean	2.90E-09	Mean	1.01E-09
Standard Error	1.29E-09	Standard Error	3.64E-10
Median	7.40E-10	Median	6.39E-10
Mode	6.70E-10	Mode	#N/A
Standard Deviation	4.07E-09	Standard Deviation	1.15E-09
Variance	1.65E-17	Variance	1.32E-18
Kurtosis	5.90E+00	Kurtosis	6.53E+00
Skewness	2.37E+00	Skewness	2.45E+00
Range	1.28E-08	Range	3.86E-09
Minimum	6.70E-10	Minimum	2.00E-10
Maximum	1.35E-08	Maximum	4.06E-09
Sum	2.90E-08	Sum	1.01E-08
Count	10	Count	10

U Nat "T" Test
Monitor Well-MW-11

Date	Data set 1	Date	Data set 2
31-Mar-84	7.45E-09	07-Aug-90	4.67E-10
30-Jun-84	2.71E-08	13 Nov 90	6.00E-10
30-Sep-84	4.06E-10	27 Feb 91	2.00E-10
31-Dec-84	1.76E-09	21 May 91	2.30E-10
31-Mar-85	2.71E-10	24-Sep 91	7.40E-10
30-Jun-85	2.98E-10	03 Dec 91	2.40E-10
30-Sep-85	8.80E-09	17-Mar 92	2.70E-09
31-Dec-85	5.00E-10	11-Jun 92	2.00E-10
19-Jun-86	1.70E-09	03 Sep 92	3.39E-09
30 Jun 86	1.50E-09	19 Nov 92	3.18E-09

t Test: Two-Sample Assuming Equal Variances

	Data set 1	Data set 2
Mean	2.54E-09	1.195E-09
Variance	0	0
Observations	10	10
Pooled Variance	0.00	
Hypothesized Mean Difference	0.00	
df	18.00	
t	1.27	
P(T<=t) one tail	0.11	
t Critical one-tail	1.73	
P(T<=t) two-tail	0.22	
t Critical two tail	2.10	

Data set 1		Data set 2	
Mean	2.54E-09	Mean	1.19E-09
Standard Error	9.70E-10	Standard Error	4.21E-10
Median	1.60E-09	Median	5.34E-10
Mode	#N/A	Mode	2.00E-10
Standard Deviation	3.07E-09	Standard Deviation	1.33E-09
Variance	9.40E-18	Variance	1.77E-18
Kurtosis	1.12E+00	Kurtosis	-9.99E-01
Skewness	1.54E+00	Skewness	1.02E+00
Range	8.53E-09	Range	3.19E-09
Minimum	2.71E-10	Minimum	2.00E-10
Maximum	8.80E-09	Maximum	3.39E-09
Sum	2.54E-08	Sum	1.19E-08
Count	10	Count	10

Chlorides "T" Test
Monitor Well MW-11

Date	Data set 1	Date	Data set 2
31-Mar-84	31.4	07-Aug-90	33.0
30-Jun-84	32.0	13-Nov-90	34.0
30-Sep-84	33.9	27-Feb-91	31.0
31-Dec-84	31.9	21-May-91	30.0
31-Mar-85	34.0	24-Sep-91	30.0
30-Jun-85	31.0	03-Dec-91	31.0
30-Sep-85	38.0	17-Mar-92	32.0
31-Dec-85	71.0	11-Jun-92	29.0
19-Jun-86	77.0	03-Sep-92	31
30-Jun-86	70.0	19-Nov-92	41.0

t Test: Two-Sample Assuming Equal Variances

	Data set 1	Data set 2
Mean	45.016	32.2
Variance	371	12
Observations	10	10
Pooled Variance	191.46	
Hypothesized Mean Difference	0.00	
df	18.00	
t	2.07	
P(T<=t) one-tail	0.03	
t Critical one-tail	1.73	
P(T<=t) two-tail	0.05	
t Critical two-tail	2.10	

Data set 1	
Mean	45.02
Standard Error	6.09
Median	33.93
Mode	#N/A
Standard Deviation	19.27
Variance	371.19
Kurtosis	-1.08
Skewness	1.03
Range	46.00
Minimum	31.00
Maximum	77.00
Sum	450.16
Count	10

Data set 2	
Mean	32.20
Standard Error	1.08
Median	31.00
Mode	31.00
Standard Deviation	3.43
Variance	11.73
Kurtosis	5.44
Skewness	2.17
Range	12.00
Minimum	29.00
Maximum	41.00
Sum	322.00
Count	10

Chlorides "T" Test
Monitor Well MW 12

Date	Data set 1	Date	Data set 2
31-Dec-82	57.4	07-Aug-90	63.0
25-Jan-83	70	13-Nov-90	63.0
30-Jun-83	80.5	27-Feb-91	61.0
31-Dec-83	65	21-May-91	55.0
31-Mar-84	64.1	24-Sep-91	59.0
30-Jun-84	65.0	03-Dec-91	60.0
30-Sep-84	64.6	17-Mar-92	60.0
31-Dec-84	67.4	11-Jun-92	56.0
31-Mar-85	67.0	03-Sep-92	56
30-Jun-85	62.0	19-Nov-92	62.0

t-Test: Two-Sample Assuming Equal Variances

	Variable 1	Variable 2
Mean	66.301	59.5
Variance	36	9
Observations	10	10
Pooled Variance	22.46	
Hypothesized Mean Difference	0.00	
df	18.00	
t	3.21	
P(T<=t) one-tail	0.00	
t Critical one-tail	1.73	
P(T<=t) two-tail	0.00	
t Critical two-tail	2.10	

Data set 1	
Mean	66.30
Standard Error	1.90
Median	65.00
Mode	65.00
Standard Deviation	6.02
Variance	36.20
Kurtosis	3.57
Skewness	1.35
Range	23.10
Minimum	57.40
Maximum	80.50
Sum	663.01
Count	10

Data set 2	
Mean	59.50
Standard Error	0.93
Median	60.00
Mode	63.00
Standard Deviation	2.95
Variance	8.72
Kurtosis	-1.31
Skewness	-0.39
Range	8.00
Minimum	55.00
Maximum	63.00
Sum	595.00
Count	10

U Nat "T" Test
Monitor Well-MW-12

Date	Data set 1	Date	Data set 2
31-Mar-83	5.0E-08	07-Aug-90	1.07E-08
30 Jun-83	2.0E 08	13 Nov 90	1 00E 08
30-Sep-83	1.1E 08	27 Feb 91	8.80E 09
31-Dec-83	1.0E-08	21 May 91	1.00E-08
31-Mar-84	2.91E-08	24 Sep 91	1.10E-08
30-Jun 84	1.83E-08	03 Dec 91	6.80E-09
30-Sep 84	4.06E-10	17 Mar 92	1.01E 08
31-Dec-84	1.62E-08	11 Jun 92	5.53E-09
31-Mar-85	4.74E-10	03 Sep 92	1.29E-08
30-Jun-85	6.80E-09	19 Nov 92	1.39E-08

t Test: Two Sample Assuming Equal Variances

	Data set 1	Data set 2
Mean	8.47E 09	9.973E-09
Variance	0	0
Observations	10	10
Pooled Variance	0.00	
Hypothesized Mean Difference	0.00	
df	18.00	
t	-0.50	
P(T<=t) one-tail	0.31	
t Critical one-tail	1.73	
P(T<=t) two-tail	0.62	
t Critical two tail	2.10	

Data set 1	
Mean	8.47E-09
Standard Error	2.91E-09
Median	5.90E-09
Mode	#N/A
Standard Deviation	9.21E-09
Variance	8.48E-17
Kurtosis	1.81E+00
Skewness	1.44E+00
Range	2.87E-08
Minimum	4.06E-10
Maximum	2.91E-08
Sum	8.47E-08
Count	10

Data set 2	
Mean	9.97E-09
Standard Error	7.94E-10
Median	1.01E-08
Mode	1.00E-08
Standard Deviation	2.51E-09
Variance	6.31E-18
Kurtosis	7.89E-02
Skewness	-2.99E-01
Range	8.37E-09
Minimum	5.53E-09
Maximum	1.39E-08
Sum	9.97E-08
Count	10

Chlorides-mw-15 & mw-12

Date	mw-15	mw-12
15-Nov-89	49 0	63 0
20-Feb-90	44 0	63 0
08-May-90	44.0	62 0
07-Aug-90	44 0	63 0
13-Nov-90	44 0	65 0
27-Feb-91	41 0	61 0
21-May-91	38.0	55.0
24-Sep-91	38.0	59 0
03-Dec-91	38 0	60 0
17-Mar-92	40 0	60 0
11-Jun-92	35 0	56.0
03-Sep-92	37	56
19-Nov-92	39 0	62 0

t-Test: Two-Sample Assuming Unequal Variances

	mw-15	mw-12
Mean	40.84615	60.23077
Variance	15 30769	8 525641
Observations	13	13
Pearson Corr	0 813065	
Pooled Varian	3 5	
df	22 20217	
t	-14 31649	
P(T<=t) one-	6 25E-13	
t Critical one-	1 717144	
P(T<=t) two-	1 25E-12	
t Critical two	2 073875	

Mw-15		Mw-12	
Mean	40 84615	Mean	60 23077
Standard Error	1.085134	Standard Error	0 809826
Median	40	Median	61
Mode	44	Mode	63
Standard Deviatio	3.912505	Standard Devial	2 91987
Variance	15.30769	Variance	8.525641
Kurtosis	-0 154432	Kurtosis	-0 803318
Skewness	0 550588	Skewness	-0 791194
Range	14	Range	8
Minimum	35	Minimum	55
Maximum	49	Maximum	63
Sum	531	Sum	783
Count	13	Count	13

CHLORIDES-MW-14 & MW-15

Date	mw-14-1	mw-15-1	Date	mw-14-2	mw-15-2
15-Nov-89	25.0	49.0	27-Feb-91	23.0	41.0
20-Feb-90	20 0	44 0	21-May-91	21 0	38 0
08-May-90	23.0	44 0	24-Sep-91	15.0	38 0
07-Aug-90	21.0	44 0	03-Dec-91	19.0	38 0
13-Nov-90	23.0	44 0	17-Mar-92	22.0	40 0
			11-Jun-92	18 0	35 0
			03-Sep-92	20	37
			19-Nov-92	18 0	39 0

t-Test: Two-Sample Assuming Unequal Variances

	mw-14-1	mw-14-2
Mean	22.4	19 5
Variance	3 80	6 57
Observations	5	8
Pearson Correlation	#N/A	
Pooled Variance	3.5	
df	10 3862	
t	2.306074	
P(T<=t) one-tail	0.0219	
t Critical one-tail	1 812462	
P(T<=t) two-tail	0.043799	
t Critical two-tail	2.228139	

t-Test: Two-Sample Assuming Unequal Variances

	mw-15-1	mw-15-2
Mean	45.00	38 25
Variance	5	3 36
Observations	5	8
Pearson Correlation	#N/A	
Pooled Variance	3 5	
df	7.32449	
t	5.665187	
P(T<=t) one-tail	0 000381	
t Critical one-tail	1 894578	
P(T<=t) two-tail	0 000762	
t Critical two-tail	2 364623	

Chlorides Mw-14 & Mw-15

Date	mw-14	mw 15
15-Nov-89	25.0	49.0
20-Feb-90	20 0	44 0
08-May-90	23.0	44 0
07-Aug-90	21.0	44 0
13-Nov-90	23 0	44 0
27-Feb-91	23.0	41 0
21-May-91	21.0	38 0
24-Sep-91	15.0	38 0
03-Dec-91	19 0	38 0
17-Mar-92	22 0	40 0
11-Jun-92	18.0	35 0
03-Sep-92	20	37
19-Nov-92	18 0	39 0

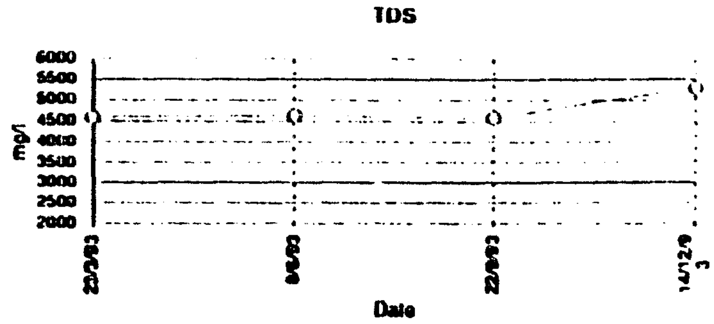
t-Test: Two-Sample Assuming Unequal Variances

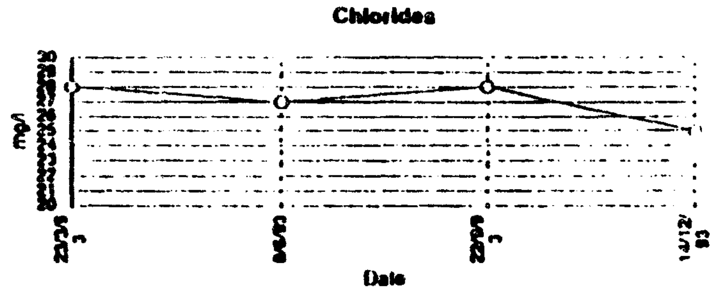
	mw-14	mw-15
Mean	20.61538	40.84615385
Variance	7 25641	15 30769231
Observations	13	13
Pearson Correlation	0 721347	
Pooled Variance	3.5	
df	21.28944	
t	-15.35589	
P(T<=t) one-tail	3 42E-13	
t Critical one-tail	1.720744	
P(T<=t) two-tail	6 84E-13	
t Critical two-tail	2.079614	

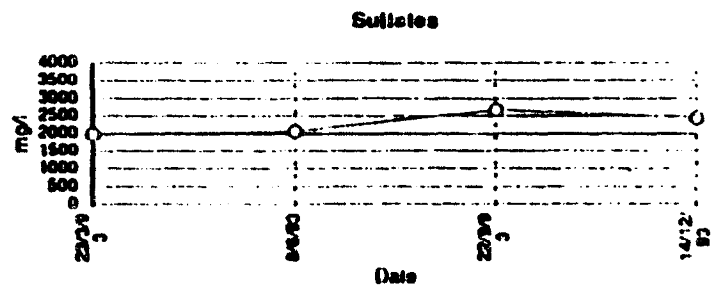
mw 14		mw 15	
Mean	20 61538	Mean	40 84615
Standard Error	0 747118	Standard Error	1 085134
Median	21	Median	40
Mode	23	Mode	44
Standard Deviation	2 693772	Standard Deviation	3 912505
Variance	7.25641	Variance	15.30769
Kurtosis	0 171462	Kurtosis	-0 154432
Skewness	-0 452377	Skewness	0 550586
Range	10	Range	14
Minimum	15	Minimum	35
Maximum	25	Maximum	49
Sum	268	Sum	531
Count	13	Count	13

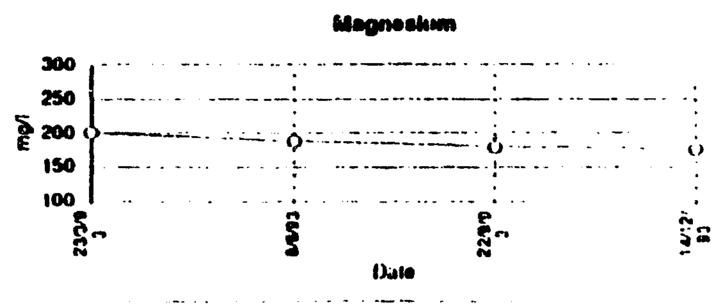
MONITOR WELL WMMW 17

Parameter	Units	LLD	23/3/93	8/6/93	22/9/93	14/12/93
			Sample Date			
Field Parameters						
Casing Elev.	Feet	0.001	5580	5580	5580	5580
Bottom Elev.	Feet	0.001				
Phreatic Elev.	Feet	0.1	5492.64	5492.41	5492.40	5494.64
Depth to Water	Feet	0.1	87.36	87.59	87.60	85.36
pH	Units	0.1	7.23	7.04	7.20	7.29
Temperature	°C	.2				
Cond. @ 25 °C	µmhos/cm	25	4480	4880	4830	6450
Soluble Data						
SAR	%	..				
DO	mg/L	0.01				
TDS	mg/L	4mg/L	4607	4636	4592	5296
Carbonate	mg/L	1mg/L				
Bicarbonate	mg/L	1mg/L	384	385	383	385
Chlorides	mg/L	1mg/L	28	27	28	25
Sulfates	mg/L	0.1mg/L	2004	2079	2678	2460
Calcium	mg/L	0.05mg/L	406	388	375	372
Fluoride	mg/L	0.1mg/L				
Nitrite/N	mg/L	0.1mg/L				
Nitrate/N	mg/L	0.1mg/L				
Ammonia/N	mg/L	0.1mg/L				
Aluminum	mg/L	0.05mg/L				
Arsenic	mg/L	0.001mg/L	0.0009		0.0009	
Antimony	mg/L	3ug/L				
Boron	mg/L	10ug/L				
Barium	mg/L	10ug/L				
Beryllium	mg/L	10ug/L	0.0009		0.00019	
Cadmium	mg/L	5ug/L	0.0009		0.0002	
Chromium	mg/L	0.01mg/L				
Cobalt	mg/L	0.01mg/L				
Copper	mg/L	0.01mg/L				
Cyanide	mg/L	0.01mg/L				
Iron	mg/L	0.02mg/L				
Lead 210	mg/l	0.02mg/L	0.7			
Lithium	mg/l	0.05mg/L				
Magnesium	mg/L	0.05mg/L	200	188	180	177
Manganese	mg/L	0.01mg/L				
Mercury	mg/L	0.2ug/L				
Molybdenum	mg/L	1…g/L	0.0009		0.0009	
Nickel	mg/L	0.05mg/L	0.0009		0.0009	
Potassium	mg/L	0.5mg/L	17.8	17.7	18.7	18.6
Selenium	mg/L	2ug/L	0.0019		0.0019	
Silver	mg/L	0.01mg/L				
Sodium	mg/L	0.05mg/L	615	641	724	688
Thallium	mg/L	0.01mg/L				
Vanadium	mg/L	0.01mg/L				
Zinc	mg/L	5ug/L				
Sol. U-Nat.	pCi/L	0.2pCi/L	2.63E-08	1.29E-08	9.48E-09	9.46E-09
Sol. Th-230	pCi/L	0.2pCi/L				
Error Term	pCi/L					
Sol. Ra-226	pCi/L	0.2pCi/L		0.9		0.7
Error Term	pCi/L					
Sol. Ra-228	pCi/L	0.9pCi/L				1.8
Error Term	pCi/L					
Gross Alpha	pCi/L	2.0pCi/L			10	
Error Term	pCi/L					
Gross Beta	pCi/L	2.0pCi/L			40	
Error Term	pCi/L					



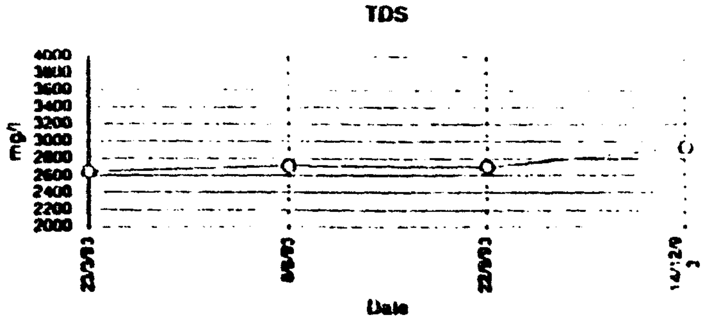


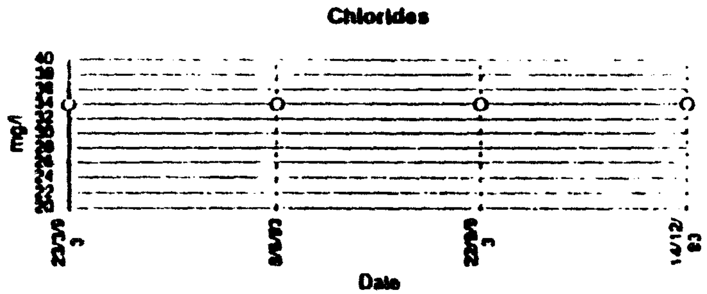


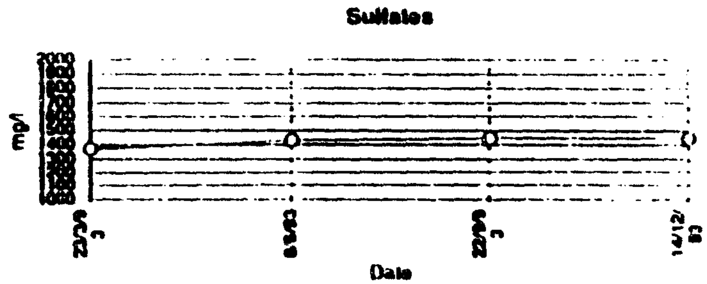


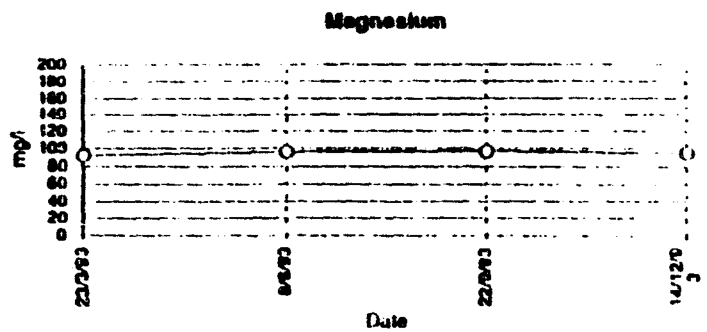
MONITOR WELL WMMW 18

Parameter	Units	LLD	Sample Date 23/3/93	8/6/93	22/9/93	14/12/93
Field Parameters						
Casing Elev.	Feet	0.001	5660.00	5660.00	5660.00	5660.00
Bottom Elev.	Feet	0.001				
Phreatic Elev.	Feet	0.1	5568.00	5567.88	5568.15	5568.16
Depth to Water	Feet	0.1	92.00	92.12	91.85	91.82
pH	Units	0.1	6.82	6.63	6.94	6.89
Temperature	°C	-2.	2800	2860	2830	3340
Cond. @ 25 °C	µmhos/cm	25				
Soluble Data						
SAR	%	.				
DO	mg/L	0.01				
TDS	mg/L	4mg/L	2655	2720	2/00	2940
Carbonate	mg/L	1mg/L				
Bicarbonate	mg/L	1mg/L	324	325	323	328
Chlorides	mg/L	1mg/L	34	34	34	34
Sulfates	mg/L	0.1mg/L	1371	1431	1446	1446
Calcium	mg/L	0.05mg/L	415	445	437	41?
Fluoride	mg/L	0.1mg/L				
Nitrite/N	mg/L	0.1mg/L				
Nitrate/N	mg/L	0.1mg/L				
Ammonia/N	mg/L	0.1mg/L				
Aluminum	mg/L	0.05mg/L				
Arsenic	mg/L	0.001mg/L	0.0009		0.0009	
Antimony	mg/L	3ug/L				
Boron	mg/L	10ug/L				
Barium	mg/L	10ug/L				
Beryllium	mg/L	10ug/L	0.0009		0.00019	
Cadmium	mg/L	5ug/L	0.0009		0.0004	
Chromium	mg/L	0.01mg/L				
Cobalt	mg/L	0.01mg/L				
Copper	mg/L	0.01mg/L				
Cyanide	mg/L	0.01mg/L				
Iron	mg/L	0.02mg/L				
Lead 210	mg/L	0.02mg/L	1		0.5	
Lithium	mg/L	0.05mg/L				
Magnesium	mg/L	0.05mg/L	92	96	97	95
Manganese	mg/L	0.01mg/L				
Mercury	mg/L	0.2ug/L				
Molybdenum	mg/L	10ug/L	0.0009		0.0009	
Nickel	mg/L	0.05mg/L	0.005		0.0009	
Potassium	mg/L	0.5mg/L	7.1	7.6	7.8	7.4
Selenium	mg/L	2ug/L	0.0019		0.0019	
Silver	mg/L	0.01mg/L				
Sodium	mg/L	0.05mg/L	185	192	108	193
Thallium	mg/L	0.01mg/L				
Vanadium	mg/L	0.01mg/L				
Zinc	mg/L	5ug/L				
Sol. U-Nat.	pCi/L	0.2pCi/L	1.22E-08	9.48E-09	8.12E-09	1.08E-08
Sol. Th-230	pCi/L	0.2pCi/L		0.2		0.3
Error Term	pCi/L					
Sol. Ra-226	pCi/L	0.2pCi/L		0.7		0.8
Error Term	pCi/L					
Sol. Ra-228	pCi/L	0.9pCi/L				1.3
Error Term	pCi/L					
Gross Alpha	pCi/L	2.0pCi/L			12	
Error Term	pCi/L					
Gross Beta	pCi/L	2.0pCi/L			13	
Error Term	pCi/L					



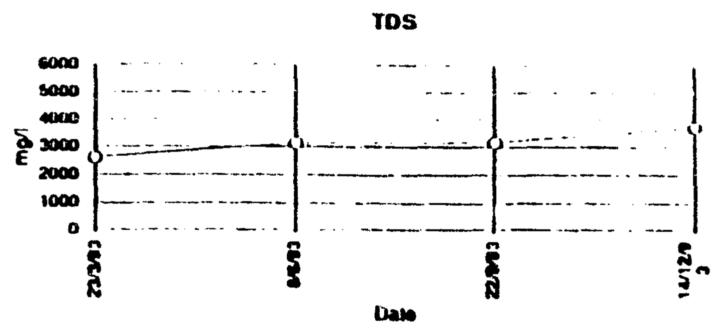


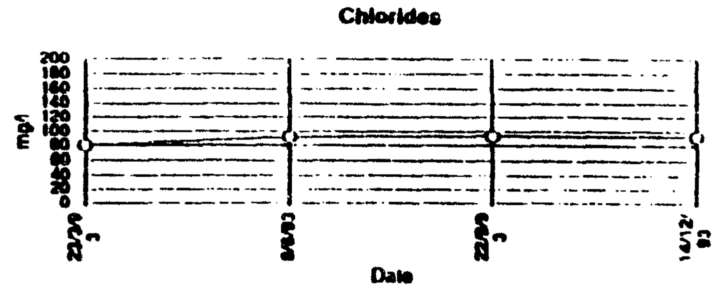


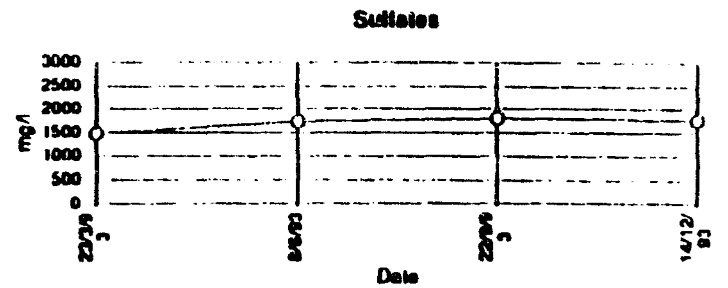


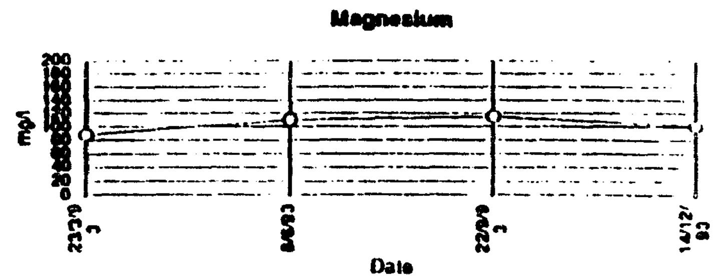
MONITOR WELL WMMW 19

Parameter	Units	LLD	23/3/93	8/6/93	22/9/93	14/12/93
			Sample Date			
Field Parameters						
Casing Elev.	Feet	0.001	5650.00	5650.00	5650.00	5650.00
Bottom Elev.	Feet	0.001				
Phreatic Elev.	Feet	0.1	5564.73	5564.51	5564.70	5564.85
Depth to Water	Feet	0.1	85.27	85.49	85.30	85.15
pH	Units	0.1	7.39	7.48	7.52	7.57
Temperature	°C	-2.	3210	3490	3580	4170
Cond. @ 25 °C	µmhos/cm	25				
Soluble Data						
SAR	%	..				
DO	mg/L	0.01				
TDS	mg/L	4mg/L	2625	3144	3172	3694
Carbonate	mg/L	1mg/L				
Bicarbonate	mg/L	1mg/L	194	205	208	206
Chlorides	mg/L	1mg/L	81	92	94	93
Sulfates	mg/L	0.1mg/L	1500	1736	1811	1783
Calcium	mg/L	0.05mg/L	245	316	305	287
Fluoride	mg/L	0.1mg/L				
Nitrite/N	mg/L	0.1mg/L				
Nitrate/N	mg/L	0.1mg/L				
Ammonia/N	mg/L	0.1mg/L				
Aluminum	mg/L	0.05mg/L				
Arsenic	mg/L	0.001mg/L	0.0009		0.0009	
Antimony	mg/L	3ug/L				
Boron	mg/L	10ug/L				
Barium	mg/L	10ug/L				
Beryllium	mg/L	10ug/L	0.0009		0.00019	
Cadmium	mg/L	5ug/L	0.0009		0.0004	
Chromium	mg/L	0.01mg/L				
Cobalt	mg/L	0.01mg/L				
Copper	mg/L	0.01mg/L				
Cyanide	mg/L	0.01mg/L				
Iron	mg/L	0.02mg/L				
Lead 210	mg/L	0.02mg/L	0.6			
Lithium	mg/L	0.05mg/L				
Magnesium	mg/L	0.05mg/L	88	111	115	102
Manganese	mg/L	0.01mg/L				
Mercury	mg/L	0.2ug/L				
Molybdenum	mg/L	10ug/L	0.007		0.004	
Nickel	mg/L	0.05mg/L	0.0009		0.004	
Potassium	mg/L	0.5mg/L	12.7	11.8	13	12.8
Selenium	mg/L	2ug/L	0.005		0.0019	
Silver	mg/L	0.01mg/L				
Sodium	mg/L	0.05mg/L	432	438	476	475
Thallium	mg/L	0.01mg/L				
Vanadium	mg/L	0.01mg/L				
Zinc	mg/L	5ug/L				
Sol. U Nat.	pCi/L	0.2pCi/L	1.00E-08	9.50E-09	8.80E-09	8.10E-09
Sol. Th-230	pCi/L	0.2pCi/L				
Error Term	pCi/L					
Sol. Ra-226	pCi/L	0.2pCi/L		0.4		0.8
Error Term	pCi/L					
Sol. Ra-228	pCi/L	0.9pCi/L				1.2
Error Term	pCi/L					
Gross Alpha	pCi/L	2.0pCi/L			7	
Error Term	pCi/L					
Gross Beta	pCi/L	2.0pCi/L			21	
Error Term	pCi/L					









APPENDIX C

HELP MODEL OF TAILINGS CELLS

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Titan Environmental

PMW 7/20/94
By: PMW, 7/20/94 EFN, #4111-001
Chkd By:

Subject: Running the HELP (Hydrologic Evaluation of Landfill Performance) Model for several scenarios at the White Mesa Tailings Facility, Blanding, Utah.

Purpose: Using the HELP model, determine the performance of the tailings caps and tailings cells under local (Blanding, UT) precipitation and temperature conditions and latitudes, and solar indexes from Milford, Utah. Water movement through tailings Cell 3 and Cell 4 were determined. Tailings within Cell 3 were considered saturated while tailings within Cell 4 were considered unsaturated. Tailings cells 3 and 4 were modeled using a PVC liner with 1% leakage and without the PVC liner (100% leakage).

Additional work: For comparison purposes, both cells were modeled using 20 years of default climate data from Grand Junction, Colorado.

Methods:

1. Input local climate data into HELP model. Five years of precipitation data was obtained from Utah State University. Temperature data was obtained from the Application for Source Material License, dated September 26, 1978. Tables 1 and 2 identify the precipitation and temperature data. The remaining climate data was input using the default parameters from the Milford, Utah area. Milford is located in southwestern Utah, in similar climates and elevation. Elevation at Milford is 5000 feet. Elevation at Blanding (southeastern Utah) is 5600 feet. The additional HELP runs used the default climate data from Grand Junction, Colorado. Grand Junction has similar climatic conditions, yet is lower in elevation (4600 feet) and has a longer growing season.

2. Identify soil layers within the cap and tailings. The cap and tailings are described in the Reclamation Plan, White Mesa Project, Blanding, UT, dated June, 1988. Default soil parameters from HELP were used for each of the 7 layers. Figures 1 and 2 identify the layers of the cap, tailings and liner. Figure 2 also identifies the individual parameters used for each of the soil layers, including the initial soil moisture, soil type number, thickness and layer number. Table 3 defines the soil types by number. Table 3 identifies the default soil types within the HELP model.

3. Calculate the area of the two cells. Figures 3 and 4 present Cells 3 and 4, respectively. Cell 3 equals 3,150,000 feet^2. Cell 4 equals 1,650,000 feet^2.

4. Run the HELP model. Several scenarios were run for each of the tailings cells. The four scenarios for Cell 3 are: 1) saturated tailings with the PVC liner at 1% leakage and Blanding climate data, 2) saturated tailings without the PVC liner (100% leakage) and

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Blanding climate data, 3) saturated tailings with the PVC liner and 20 years of simulated Grand Junction climate data, and 4) saturated tailings without the PVC liner and 20 years of simulated Grand Junction climate data. The two scenarios for Cell 4 are: 1) unsaturated tailings with the PVC liner at 1% leakage and Blanding climate data, and 2) unsaturated tailings without the PVC liner (100% leakage) and Blanding climate data. The HELP runs are presented at the end of this calculation brief.

Summary: Table 4 summarizes the HELP runs.

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Daily Precipitation Values, Station #42073807, Blanding, Utah
January, 1988 through February, 1994

Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)
1/1/88	0	1/1/90	0	1/1/91	0	1/1/92	0	1/1/93	0
1/2/88	0	1/2/90	0	1/2/91	0	1/2/92	0	1/2/93	0
1/3/88	0	1/3/90	0.2	1/3/91	0.15	1/3/92	0.04	1/3/93	0
1/4/88	0.06	1/4/90	0	1/4/91	0.96	1/4/92	0.31	1/4/93	0
1/5/88	0.19	1/5/90	0	1/5/91	0.08	1/5/92	0.02	1/5/93	0
1/6/88	0.17	1/6/90	0	1/6/91	0	1/6/92	0.42	1/6/93	0.34
1/7/88	0	1/7/90	0	1/7/91	0	1/7/92	0.03	1/7/93	0.36
1/8/88	0.01	1/8/90	0	1/8/91	0	1/8/92	0	1/8/93	1
1/9/88	0	1/9/90	0	1/9/91	0	1/9/92	0	1/9/93	0.01
1/10/88	0	1/10/90	0	1/10/91	0	1/10/92	0	1/10/93	0.51
1/11/88	0								
1/12/88	0	1/11/90	0	1/11/91	0	1/11/92	0	1/11/93	0.41
1/13/88	0	1/12/90	0	1/12/91	0	1/12/92	0	1/12/93	0
1/14/88	0	1/13/90	0.04	1/13/91	0.01	1/13/92	0	1/13/93	0.21
1/15/88	0	1/14/90	0	1/14/91	0	1/14/92	0	1/14/93	0.2
1/16/88	0	1/15/90	0.14	1/15/91	0.02	1/15/92	0	1/15/93	0
1/17/88	0.89	1/16/90	0.03	1/16/91	0	1/16/92	0	1/16/93	0.49
1/18/88	0.71	1/17/90	0.06	1/17/91	0	1/17/92	0	1/17/93	0.16
1/19/88	0	1/18/90	0.29	1/18/91	0	1/18/92	0	1/18/93	0.88
1/20/88	0	1/19/90	0.32	1/19/91	0	1/19/92	0	1/19/93	0.31
1/21/88	0	1/20/90	0	1/20/91	0	1/20/92	0	1/20/93	0
1/22/88	0	1/21/90	0	1/21/91	0	1/21/92	0	1/21/93	0
1/23/88	0	1/22/90	0	1/22/91	0	1/22/92	0	1/22/93	0
1/24/88	0	1/23/90	0	1/23/91	0	1/23/92	0	1/23/93	0
1/25/88	0	1/24/90	0	1/24/91	0	1/24/92	0	1/24/93	0
1/26/88	0	1/25/90	0	1/25/91	0	1/25/92	0	1/25/93	0
1/27/88	0	1/26/90	0	1/26/91	0	1/26/92	0	1/26/93	0
1/28/88	0	1/27/90	0	1/27/91	0	1/27/92	0	1/27/93	0
1/29/88	0	1/28/90	0	1/28/91	0	1/28/92	0	1/28/93	0
1/30/88	0	1/29/90	0	1/29/91	0	1/29/92	0	1/29/93	0
1/31/88	0	1/30/90	0	1/30/91	0	1/30/92	0	1/30/93	0.22
2/1/88	0	1/31/90	0.03	1/31/91	0	1/31/92	0	1/31/93	0.21
2/2/88	0.4	2/1/90	0.06	2/1/91	0	2/1/92	0	2/1/93	0.16
2/3/88	0.06	2/2/90	0.03	2/2/91	0	2/2/92	0	2/2/93	0
2/4/88	0	2/3/90	0	2/3/91	0	2/3/92	0	2/3/93	0
2/5/88	0	2/4/90	0	2/4/91	0	2/4/92	0.01	2/4/93	0
2/6/88	0	2/5/90	0	2/5/91	0	2/5/92	0	2/5/93	0
2/7/88	0	2/6/90	0	2/6/91	0	2/6/92	0	2/6/93	0
2/8/88	0	2/7/90	0	2/7/91	0	2/7/92	0	2/7/93	0
2/9/88	0	2/8/90	0	2/8/91	0	2/8/92	0.02	2/8/93	1.16
2/10/88	0	2/9/90	0	2/9/91	0	2/9/92	0	2/9/93	0.48
2/11/88	0	2/10/90	0	2/10/91	0	2/10/92	0.3	2/10/93	0.02
2/12/88	0	2/11/90	0	2/11/91	0	2/11/92	0.27	2/11/93	0
2/13/88	0	2/12/90	0	2/12/91	0	2/12/92	0.05	2/12/93	0
2/14/88	0	2/13/90	0	2/13/91	0	2/13/92	0.66	2/13/93	0
2/15/88	0	2/14/90	0.16	2/14/91	0	2/14/92	0	2/14/93	0.01
2/16/88	0	2/15/90	0.06	2/15/91	0	2/15/92	0	2/15/93	0.01
2/17/88	0	2/16/90	0	2/16/91	0.03	2/16/92	0.23	2/16/93	0.08
2/18/88	0	2/17/90	0	2/17/91	0.02	2/17/92	0	2/17/93	0
2/19/88	0	2/18/90	0.03	2/18/91	0	2/18/92	0	2/18/93	0.05
2/20/88	0	2/19/90	0.01	2/19/91	0	2/19/92	0	2/19/93	0.62
2/21/88	0	2/20/90	0.03	2/20/91	0	2/20/92	0	2/20/93	0.7
2/22/88	0	2/21/90	0	2/21/91	0	2/21/92	0	2/21/93	0
2/23/88	0	2/22/90	0	2/22/91	0	2/22/92	0	2/22/93	0
2/24/88	0	2/23/90	0	2/23/91	0	2/23/92	0	2/23/93	0
2/25/88	0	2/24/90	0	2/24/91	0	2/24/92	0	2/24/93	0.4
2/26/88	0	2/25/90	0	2/25/91	0	2/25/92	0	2/25/93	0.04
2/27/88	0.04	2/26/90	0	2/26/91	0	2/26/92	0	2/26/93	0
2/28/88	0	2/27/90	0	2/27/91	0	2/27/92	0	2/27/93	0
2/29/88	0	2/28/90	0	2/28/91	0.4	2/28/92	0	2/28/93	0
3/1/88	0	3/1/90	0.02	3/1/91	0.9	2/29/92	0	3/1/93	0
3/2/88	0	3/2/90	0	3/2/91	0	3/1/92	0	3/2/93	0
3/3/88	0	3/3/90	0	3/3/91	0	3/2/92	0	3/3/93	0
3/4/88	0	3/4/90	0	3/4/91	0	3/3/92	0.34	3/4/93	0

TABLE 1

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Daily Precipitation Values, Station #42073807, Blanding, Utah
January, 1988 through February, 1994

Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)
3/5/88	0	3/5/90	0	3/5/91	0	3/4/92	0	3/5/93	0
3/6/88	0.01	3/6/90	0.01	3/6/91	0	3/5/92	0	3/6/93	0
3/7/88	0	3/7/90	0	3/7/91	0	3/6/92	0	3/7/93	0
3/8/88	0	3/8/90	0	3/8/91	0	3/7/92	0	3/8/93	0
3/9/88	0	3/9/90	0	3/9/91	0	3/8/92	0.25	3/9/93	0
3/10/88	0.01	3/10/90	0.02	3/10/91	0	3/9/92	0.03	3/10/93	0
3/11/88	0	3/11/90	0.15	3/11/91	0	3/10/92	0	3/11/93	0
3/12/88	0	3/12/90	0.23	3/12/91	0	3/11/92	0	3/12/93	0
3/13/88	0	3/13/90	0.06	3/13/91	0	3/12/92	0	3/13/93	0
3/14/88	0	3/14/90	0	3/14/91	0.06	3/13/92	0	3/14/93	0
3/15/88	0	3/15/90	0	3/15/91	0.01	3/14/92	0	3/15/93	0
3/16/88	0.01	3/16/90	0	3/16/91	0	3/15/92	0	3/16/93	0
3/17/88	0	3/17/90	0	3/17/91	0	3/16/92	0	3/17/93	0
3/18/88	0	3/18/90	0	3/18/91	0	3/17/92	0	3/18/93	0.19
3/19/88	0	3/19/90	0	3/19/91	0.03	3/18/92	0	3/19/93	0
3/20/88	0	3/20/90	0	3/20/91	0	3/19/92	0	3/20/93	0
3/21/88	0	3/21/90	0	3/21/91	0.14	3/20/92	0	3/21/93	0
3/22/88	0	3/22/90	0	3/22/91	0	3/21/92	0.03	3/22/93	0
3/23/88	0	3/23/90	0	3/23/91	0	3/22/92	0.02	3/23/93	0
3/24/88	0	3/24/90	0	3/24/91	0	3/23/92	0.05	3/24/93	0
3/25/88	0	3/25/90	0	3/25/91	0	3/24/92	0.02	3/25/93	0
3/26/88	0	3/26/90	0	3/26/91	0.26	3/25/92	0	3/26/93	0.06
3/27/88	0	3/27/90	0	3/27/91	0	3/26/92	0	3/27/93	0.47
3/28/88	0	3/28/90	0	3/28/91	0	3/27/92	0.5	3/28/93	0
3/29/88	0	3/29/90	0	3/29/91	0	3/28/92	0.37	3/29/93	0.01
3/30/88	0	3/30/90	0.08	3/30/91	0	3/29/92	0	3/30/93	0
3/31/88	0	3/31/90	0	3/31/91	0	3/30/92	0.13	3/31/93	0
4/1/88	0	4/1/90	0	4/1/91	0	3/31/92	0.11	4/1/93	0
4/2/88	0	4/2/90	0	4/2/91	0	4/1/92	0.05	4/2/93	0
4/3/88	0	4/3/90	0	4/3/91	0	4/2/92	0	4/3/93	0
4/4/88	0.02	4/4/90	0	4/4/91	0	4/3/92	0	4/4/93	0.03
4/5/88	0	4/5/90	0	4/5/91	0	4/4/92	0	4/5/93	0.04
4/6/88	0	4/6/90	0	4/6/91	0	4/5/92	0	4/6/93	0.5
4/7/88	0	4/7/90	0.06	4/7/91	0	4/6/92	0	4/7/93	0
4/8/88	0	4/8/90	0.11	4/8/91	0	4/7/92	0	4/8/93	0
4/9/88	0	4/9/90	0	4/9/91	0	4/8/92	0	4/9/93	0
4/10/88	0	4/10/90	0	4/10/91	0	4/9/92	0	4/10/93	0
4/11/88	0	4/11/90	0	4/11/91	0	4/10/92	0	4/11/93	0
4/12/88	0	4/12/90	0	4/12/91	0	4/11/92	0	4/12/93	0
4/13/88	0	4/13/90	0	4/13/91	0	4/12/92	0	4/13/93	0
4/14/88	0.06	4/14/90	0	4/14/91	0	4/13/92	0	4/14/93	0
4/15/88	0.2	4/15/90	0	4/15/91	0	4/14/92	0	4/15/93	0
4/16/88	0.16	4/16/90	0	4/16/91	0	4/15/92	0.03	4/16/93	0.02
4/17/88	0.2	4/17/90	0	4/17/91	0	4/16/92	0.03	4/17/93	0
4/18/88	0.02	4/18/90	0	4/18/91	0	4/17/92	0	4/18/93	0
4/19/88	0	4/19/90	0	4/19/91	0	4/18/92	0	4/19/93	0
4/20/88	0	4/20/90	0	4/20/91	0	4/19/92	0	4/20/93	0
4/21/88	0.01	4/21/90	0	4/21/91	0	4/20/92	0	4/21/93	0
4/22/88	0.08	4/22/90	0	4/22/91	0	4/21/92	0	4/22/93	0
4/23/88	0.01	4/23/90	0	4/23/91	0.01	4/22/92	0	4/23/93	0
4/24/88	0.02	4/24/90	0.48	4/24/91	0	4/23/92	0	4/24/93	0
4/25/88	0	4/25/90	0	4/25/91	0	4/24/92	0	4/25/93	0
4/26/88	0	4/26/90	0	4/26/91	0	4/25/92	0	4/26/93	0
4/27/88	0	4/27/90	0	4/27/91	0	4/26/92	0	4/27/93	0
4/28/88	0	4/28/90	0	4/28/91	0	4/27/92	0	4/28/93	0
4/29/88	0	4/29/90	0.09	4/29/91	0	4/28/92	0	4/29/93	0
4/30/88	0	4/30/90	0.06	4/30/91	0	4/29/92	0	4/30/93	0
5/1/88	0	5/1/90	0.83	5/1/91	0	4/30/92	0	5/1/93	0
5/2/88	0	5/2/90	0	5/2/91	0	5/1/92	0	5/2/93	0
5/3/88	0	5/3/90	0	5/3/91	0	5/2/92	0	5/3/93	0
5/4/88	0	5/4/90	0	5/4/91	0	5/3/92	0	5/4/93	0.05
5/5/88	0	5/5/90	0	5/5/91	0	5/4/92	0.07	5/5/93	0.5
5/6/88	0	5/6/90	0	5/6/91	0	5/5/92	0	5/6/93	0
5/7/88	0	5/7/90	0	5/7/91	0	5/6/92	0	5/7/93	0.06

Table 1 (cont)

JEL
7/22/97

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Daily Precipitation Values, Station #42073807, Blanding, Utah
January, 1988 through February, 1994

Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)
5/8/88	0	5/8/90	0	5/8/91	0	5/7/92	0.19	5/8/93	0.15
5/9/88	0	5/9/90	0	5/9/91	0	5/8/92	0	5/9/93	0
5/10/88	0	5/10/90	0	5/10/91	0	5/9/92	0.96	5/10/93	0
5/11/88	0	5/11/90	0	5/11/91	0	5/10/92	0	5/11/93	0
5/12/88	0	5/12/90	0	5/12/91	0	5/11/92	0	5/12/93	0
5/13/88	0	5/13/90	0	5/13/91	0	5/12/92	0	5/13/93	0
5/14/88	0	5/14/90	0	5/14/91	0	5/13/92	0	5/14/93	0
5/15/88	0	5/15/90	0	5/15/91	0.06	5/14/92	0	5/15/93	0.02
5/16/88	0	5/16/90	0	5/16/91	0	5/15/92	0	5/16/93	0.08
5/17/88	0.64	5/17/90	0	5/17/91	0	5/16/92	0	5/17/93	0.35
5/18/88	0.3	5/18/90	0	5/18/91	0	5/17/92	0	5/18/93	0
5/19/88	0.15	5/19/90	0	5/19/91	0	5/18/92	0	5/19/93	0
5/20/88	0	5/20/90	0	5/20/91	0	5/19/92	0.06	5/20/93	0.01
5/21/88	0	5/21/90	0	5/21/91	0	5/20/92	0.05	5/21/93	0
5/22/88	0	5/22/90	0	5/22/91	0	5/21/92	0.06	5/22/93	0
5/23/88	0	5/23/90	0	5/23/91	0	5/22/92	0.36	5/23/93	0
5/24/88	0	5/24/90	0	5/24/91	0	5/23/92	0.02	5/24/93	0
5/25/88	0	5/25/90	0	5/25/91	0	5/24/92	0.2	5/25/93	0.05
5/26/88	0	5/26/90	0	5/26/91	0	5/25/92	0.15	5/26/93	0.11
5/27/88	0	5/27/90	0	5/27/91	0	5/26/92	0.13	5/27/93	0.19
5/28/88	0	5/28/90	0	5/28/91	0	5/27/92	0.05	5/28/93	0.05
5/29/88	0.17	5/29/90	0.02	5/29/91	0	5/28/92	0	5/29/93	0
5/30/88	0.01	5/30/90	0	5/30/91	0	5/29/92	0.03	5/30/93	0
5/31/88	0	5/31/90	0	5/31/91	0.43	5/30/92	0	5/31/93	0
6/1/88	0	6/1/90	0	6/1/91	0	5/31/92	0	6/1/93	0
6/2/88	0	6/2/90	0	6/2/91	0	6/1/92	0	6/2/93	0
6/3/88	0	6/3/90	0	6/3/91	0	6/2/92	0	6/3/93	0
6/4/88	0	6/4/90	0	6/4/91	0	6/3/92	0	6/4/93	0
6/5/88	0	6/5/90	0	6/5/91	0	6/4/92	0.01	6/5/93	0
6/6/88	0	6/6/90	0	6/6/91	0	6/5/92	0.03	6/6/93	0.01
6/7/88	0	6/7/90	0	6/7/91	0	6/6/92	0	6/7/93	0.01
6/8/88	0	6/8/90	0	6/8/91	0	6/7/92	0	6/8/93	0.06
6/9/88	0	6/9/90	0.04	6/9/91	0	6/8/92	0.16	6/9/93	0
6/10/88	0	6/10/90	1.09	6/10/91	0	6/9/92	0	6/10/93	0
6/11/88	0	6/11/90	0	6/11/91	0	6/10/92	0	6/11/93	0
6/12/88	0	6/12/90	0	6/12/91	0	6/11/92	0	6/12/93	0
6/13/88	0	6/13/90	0	6/13/91	0	6/12/92	0	6/13/93	0
6/14/88	0	6/14/90	0	6/14/91	0.05	6/13/92	0	6/14/93	0
6/15/88	0	6/15/90	0	6/15/91	0	6/14/92	0	6/15/93	0
6/16/88	0	6/16/90	0	6/16/91	0	6/15/92	0	6/16/93	0
6/17/88	0	6/17/90	0	6/17/91	0	6/16/92	0	6/17/93	0.04
6/18/88	0	6/18/90	0	6/18/91	0	6/17/92	0	6/18/93	0
6/19/88	0	6/19/90	0	6/19/91	0	6/18/92	0	6/19/93	0
6/20/88	0	6/20/90	0	6/20/91	0	6/19/92	0	6/20/93	0
6/21/88	0	6/21/90	0	6/21/91	0	6/20/92	0	6/21/93	0
6/22/88	0.02	6/22/90	0	6/22/91	0	6/21/92	0	6/22/93	0
6/23/88	0.01	6/23/90	0	6/23/91	0	6/22/92	0	6/23/93	0
6/24/88	0.05	6/24/90	0	6/24/91	0	6/23/92	0	6/24/93	0
6/25/88	0.27	6/25/90	0	6/25/91	0	6/24/92	0	6/25/93	0
6/26/88	0.11	6/26/90	0	6/26/91	0	6/25/92	0.08	6/26/93	0
6/27/88	0.52	6/27/90	0	6/27/91	0	6/26/92	0	6/27/93	0
6/28/88	0.42	6/28/90	0	6/28/91	0	6/27/92	0	6/28/93	0
6/29/88	0	6/29/90	0	6/29/91	0	6/28/92	0.01	6/29/93	0
6/30/88	0	6/30/90	0	6/30/91	0	6/29/92	0	6/30/93	0
7/1/88	0	7/1/90	0	7/1/91	0	6/30/92	0	7/1/93	0
7/2/88	0	7/2/90	0	7/2/91	0	7/1/92	0	7/2/93	0
7/3/88	0	7/3/90	0	7/3/91	0	7/2/92	0	7/3/93	0
7/4/88	0	7/4/90	0	7/4/91	0	7/3/92	0	7/4/93	0
7/5/88	0	7/5/90	0	7/5/91	0	7/4/92	0	7/5/93	0
7/6/88	0	7/6/90	0	7/6/91	0	7/5/92	0	7/6/93	0
7/7/88	0	7/7/90	0.78	7/7/91	0	7/6/92	0	7/7/93	0
7/8/88	0	7/8/90	0.73	7/8/91	0.1	7/7/92	0	7/8/93	0
7/9/88	0	7/9/90	0.02	7/9/91	0.45	7/8/92	0.4	7/9/93	0
7/10/88	0	7/10/90	0	7/10/91	0.01	7/9/92	0	7/10/93	0

Table 1 (cont)

SFL 7/28/94

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Daily Precipitation Values, Station #42073807, Blanding, Utah
January, 1988 through February, 1994

Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)
7/11/88	0	7/11/90	0	7/11/91	0	7/10/92	0	7/11/93	0
7/12/88	0	7/12/90	0	7/12/91	0	7/11/92	0	7/12/93	0
7/13/88	0	7/13/90	0	7/13/91	0	7/12/92	1.33	7/13/93	0
7/14/88	0	7/14/90	0.05	7/14/91	0	7/13/92	0.02	7/14/93	0
7/15/88	0	7/15/90	0	7/15/91	0	7/14/92	0	7/15/93	0
7/16/88	0	7/16/90	0	7/16/91	0	7/15/92	0	7/16/93	0
7/17/88	0.05	7/17/90	0	7/17/91	0	7/16/92	0	7/17/93	0
7/18/88	0	7/18/90	0.01	7/18/91	0	7/17/92	0	7/18/93	0
7/19/88	0	7/19/90	0	7/19/91	0	7/18/92	0.08	7/19/93	0
7/20/88	0	7/20/90	0	7/20/91	0.28	7/19/92	0	7/20/93	0
7/21/88	0	7/21/90	0.03	7/21/91	0	7/20/92	0	7/21/93	0
7/22/88	0	7/22/90	0	7/22/91	0	7/21/92	0	7/22/93	0
7/23/88	0	7/23/90	0.01	7/23/91	0.04	7/22/92	0.1	7/23/93	0
7/24/88	0	7/24/90	0.02	7/24/91	0.23	7/23/92	0.08	7/24/93	0.01
7/25/88	0	7/25/90	0.05	7/25/91	0.08	7/24/92	0	7/25/93	0
7/26/88	0.16	7/26/90	0	7/26/91	0.01	7/25/92	0.17	7/26/93	0
7/27/88	0	7/27/90	0	7/27/91	0	7/26/92	0	7/27/93	0
7/28/88	0	7/28/90	0.02	7/28/91	0	7/27/92	0	7/28/93	0
7/29/88	0.13	7/29/90	0	7/29/91	0	7/28/92	0.02	7/29/93	0
7/30/88	0.05	7/30/90	0.19	7/30/91	0	7/29/92	0	7/30/93	0
7/31/88	0.12	7/31/90	0	7/31/91	0	7/30/92	0	7/31/93	0
8/1/88	0.13	8/1/90	0	8/1/91	0.03	7/31/92	0	8/1/93	0
8/2/88	0	8/2/90	0.25	8/2/91	0.04	8/1/92	0	8/2/93	0
8/3/88	0	8/3/90	0	8/3/91	0.08	8/2/92	0	8/3/93	0
8/4/88	0	8/4/90	0	8/4/91	0	8/3/92	0	8/4/93	0.01
8/5/88	0.38	8/5/90	0	8/5/91	0.01	8/4/92	0	8/5/93	0
8/6/88	0.02	8/6/90	0	8/6/91	0.56	8/5/92	0.02	8/6/93	0.03
8/7/88	0	8/7/90	0	8/7/91	0	8/6/92	0.01	8/7/93	0.03
8/8/88	0	8/8/90	0	8/8/91	0	8/7/92	0	8/8/93	0.03
8/9/88	0	8/9/90	0	8/9/91	0	8/8/92	0	8/9/93	0.03
8/10/88	0	8/10/90	0	8/10/91	0	8/9/92	0.03	8/10/93	0.01
8/11/88	0.04	8/11/90	0.04	8/11/91	0	8/10/92	0	8/11/93	0
8/12/88	0.07	8/12/90	0	8/12/91	0.36	8/11/92	0.04	8/12/93	0
8/13/88	0	8/13/90	0.15	8/13/91	0	8/12/92	0	8/13/93	0
8/14/88	0	8/14/90	0.07	8/14/91	0	8/13/92	0	8/14/93	0
8/15/88	0.09	8/15/90	0.05	8/15/91	0.01	8/14/92	0	8/15/93	0
8/16/88	0.05	8/16/90	0.24	8/16/91	0	8/15/92	0	8/16/93	0
8/17/88	0	8/17/90	0	8/17/91	0	8/16/92	0	8/17/93	0
8/18/88	0	8/18/90	0	8/18/91	0.06	8/17/92	0.19	8/18/93	0
8/19/88	0	8/19/90	0	8/19/91	0	8/18/92	0	8/19/93	0.03
8/20/88	0.24	8/20/90	0	8/20/91	0	8/19/92	0	8/20/93	0
8/21/88	0.15	8/21/90	0	8/21/91	0	8/20/92	0	8/21/93	0.02
8/22/88	0	8/22/90	0	8/22/91	0	8/21/92	0	8/22/93	0
8/23/88	0	8/23/90	0	8/23/91	0	8/22/92	0.37	8/23/93	0
8/24/88	0	8/24/90	0	8/24/91	0	8/23/92	0.16	8/24/93	0
8/25/88	0	8/25/90	0	8/25/91	0	8/24/92	0	8/25/93	0.08
8/26/88	0	8/26/90	0	8/26/91	0	8/25/92	0	8/26/93	0.74
8/27/88	0	8/27/90	0	8/27/91	0.01	8/26/92	0	8/27/93	0
8/28/88	0	8/28/90	0	8/28/91	0	8/27/92	0	8/28/93	0.73
8/29/88	0	8/29/90	0	8/29/91	0	8/28/92	0	8/29/93	0
8/30/88	0.18	8/30/90	0	8/30/91	0	8/29/92	0	8/30/93	0
8/31/88	0.47	8/31/90	0	8/31/91	0.02	8/30/92	0.28	8/31/93	0.05
9/1/88	0.01	9/1/90	0.01	9/1/91	0	8/31/92	0.16	9/1/93	0
9/2/88	0	9/2/90	0.32	9/2/91	0	9/1/92	0	9/2/93	0
9/3/88	0	9/3/90	0.1	9/3/91	0	9/2/92	0	9/3/93	0
9/4/88	0	9/4/90	0	9/4/91	0	9/3/92	0	9/4/93	0
9/5/88	0	9/5/90	0.08	9/5/91	0	9/4/92	0	9/5/93	0
9/6/88	0	9/6/90	0.1	9/6/91	0.93	9/5/92	0	9/6/93	0
9/7/88	0	9/7/90	0	9/7/91	0.25	9/6/92	0	9/7/93	0
9/8/88	0	9/8/90	0	9/8/91	0	9/7/92	0	9/8/93	0
9/9/88	0	9/9/90	0	9/9/91	0	9/8/92	0	9/9/93	0
9/10/88	0.32	9/10/90	0	9/10/91	0	9/9/92	0	9/10/93	0
9/11/88	0.05	9/11/90	0	9/11/91	0.13	9/10/92	0	9/11/93	0
9/12/88	0.58	9/12/90	0	9/12/91	0	9/11/92	0	9/12/93	0.01

Table 1 (cont)

JCL
7/28/94

7/15

Daily Precipitation Values, Station #42073807, Blanding, Utah
January, 1988 through February, 1994

Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)
9/13/88	0	9/13/90	0	9/13/91	0.01	9/12/92	0	9/13/93	0.6
9/14/88	0	9/14/90	0	9/14/91	0	9/13/92	0	9/14/93	0
9/15/88	0	9/15/90	0	9/15/91	0	9/14/92	0	9/15/93	0
9/16/88	0	9/16/90	0	9/16/91	0	9/15/92	0.13	9/16/93	0
9/17/88	0	9/17/90	0	9/17/91	0	9/16/92	0	9/17/93	0
9/18/88	0	9/18/90	0.63	9/18/91	0	9/17/92	0	9/18/93	0.22
9/19/88	0	9/19/90	0	9/19/91	0	9/18/92	0.22	9/19/93	0
9/20/88	0	9/20/90	0.16	9/20/91	0	9/19/92	0.47	9/20/93	0
9/21/88	0.08	9/21/90	0	9/21/91	0	9/20/92	0.08	9/21/93	0
9/22/88	0	9/22/90	0	9/22/91	0	9/21/92	0	9/22/93	0
9/23/88	0	9/23/90	0.06	9/23/91	0	9/22/92	0	9/23/93	0
9/24/88	0	9/24/90	0	9/24/91	0	9/23/92	0	9/24/93	0
9/25/88	0	9/25/90	0	9/25/91	0	9/24/92	0	9/25/93	0
9/26/88	0	9/26/90	0	9/26/91	0	9/25/92	0	9/26/93	0
9/27/88	0.03	9/27/90	0	9/27/91	0	9/26/92	0	9/27/93	0
9/28/88	0	9/28/90	0.23	9/28/91	0	9/27/92	0	9/28/93	0
9/29/88	0	9/29/90	0	9/29/91	0	9/28/92	0	9/29/93	0
9/30/88	0	9/30/90	0	9/30/91	0	9/29/92	0	9/30/93	0
10/1/88	0	10/1/90	0.01	10/1/91	0	9/30/92	0	10/1/93	0
10/2/88	0	10/2/90	1.1	10/2/91	0	10/1/92	0	10/2/93	0
10/3/88	0	10/3/90	0.02	10/3/91	0	10/2/92	0	10/3/93	0
10/4/88	0	10/4/90	0	10/4/91	0	10/3/92	0	10/4/93	0
10/5/88	0	10/5/90	0	10/5/91	0	10/4/92	0	10/5/93	0
10/6/88	0.02	10/6/90	0	10/6/91	0	10/5/92	0	10/6/93	0.61
10/7/88	0.04	10/7/90	0.1	10/7/91	0	10/6/92	0	10/7/93	0.21
10/8/88	0.02	10/8/90	0	10/8/91	0	10/7/92	0	10/8/93	0.19
10/9/88	0	10/9/90	0	10/9/91	0	10/8/92	0	10/9/93	0
10/10/88	0	10/10/90	0	10/10/91	0	10/9/92	0	10/10/93	0.01
10/11/88	0	10/11/90	0	10/11/91	0	10/10/92	0	10/11/93	0.1
10/12/88	0	10/12/90	0	10/12/91	0	10/11/92	0	10/12/93	0
10/13/88	0	10/13/90	0	10/13/91	0	10/12/92	0	10/13/93	0
10/14/88	0	10/14/90	0	10/14/91	0	10/13/92	0	10/14/93	0
10/15/88	0	10/15/90	0	10/15/91	0	10/14/92	0	10/15/93	0
10/16/88	0	10/16/90	0	10/16/91	0	10/15/92	0	10/16/93	0.09
10/17/88	0	10/17/90	0	10/17/91	0	10/16/92	0	10/17/93	0.2
10/18/88	0	10/18/90	0.2	10/18/91	0	10/17/92	0	10/18/93	0.02
10/19/88	0	10/19/90	0.28	10/19/91	0	10/18/92	0	10/19/93	0
10/20/88	0	10/20/90	0.11	10/20/91	0	10/19/92	0	10/20/93	0
10/21/88	0	10/21/90	0	10/21/91	0	10/20/92	0	10/21/93	0
10/22/88	0	10/22/90	0	10/22/91	0.02	10/21/92	0.11	10/22/93	0
10/23/88	0	10/23/90	0	10/23/91	0	10/22/92	0	10/23/93	0
10/24/88	0	10/24/90	0	10/24/91	0.08	10/23/92	0	10/24/93	0
10/25/88	0	10/25/90	0	10/25/91	0	10/24/92	0.37	10/25/93	0
10/26/88	0	10/26/90	0	10/26/91	0	10/25/92	0.15	10/26/93	0
10/27/88	0	10/27/90	0	10/27/91	0.69	10/26/92	0	10/27/93	0
10/28/88	0	10/28/90	0	10/28/91	0.26	10/27/92	0.04	10/28/93	0
10/29/88	0	10/29/90	0	10/29/91	0.26	10/28/92	0.26	10/29/93	0
10/30/88	0.02	10/30/90	0	10/30/91	0.1	10/29/92	0.12	10/30/93	0
10/31/88	0	10/31/90	0	10/31/91	0	10/30/92	0.22	10/31/93	0
11/1/88	0	11/1/90	0	11/1/91	0	10/31/92	0.19	11/1/93	0
11/2/88	0	11/2/90	0.35	11/2/91	0	11/1/92	0	11/2/93	0
11/3/88	0	11/3/90	0.37	11/3/91	0	11/2/92	0	11/3/93	0
11/4/88	0	11/4/90	0	11/4/91	0	11/3/92	0	11/4/93	0
11/5/88	0	11/5/90	0	11/5/91	0	11/4/92	0	11/5/93	0
11/6/88	0	11/6/90	0.01	11/6/91	0	11/5/92	0	11/6/93	0
11/7/88	0	11/7/90	0.12	11/7/91	0	11/6/92	0	11/7/93	0
11/8/88	0	11/8/90	0	11/8/91	0	11/7/92	0	11/8/93	0
11/9/88	0	11/9/90	0	11/9/91	0	11/8/92	0	11/9/93	0
11/10/88	0	11/10/90	0	11/10/91	0.03	11/9/92	0	11/10/93	0
11/11/88	0.56	11/11/90	0	11/11/91	0	11/10/92	0.14	11/11/93	0.64
11/12/88	0	11/12/90	0	11/12/91	0	11/11/92	0	11/12/93	0.3
11/13/88	0	11/13/90	0	11/13/91	0	11/12/92	0	11/13/93	0.14
11/14/88	0	11/14/90	0	11/14/91	0.49	11/13/92	0	11/14/93	0
11/15/88	0.25	11/15/90	0	11/15/91	0.95	11/14/92	0	11/15/93	0

Table 1 (cont.)

JFL
7/22/94

Flum
9/20/94

8/15

Daily Precipitation Values, Station #42073807, Blanding, Utah
January, 1988 through February, 1994

Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)
11/16/88	0	11/16/90	0	11/16/91	0.03	11/15/92	0	11/16/93	0
11/17/88	0.02	11/17/90	0	11/17/91	0	11/16/92	0	11/17/93	0
11/18/88	0	11/18/90	0	11/18/91	0.07	11/17/92	0	11/18/93	0
11/19/88	0	11/19/90	0	11/19/91	0	11/18/92	0.01	11/19/93	0
11/20/88	0	11/20/90	0.09	11/20/91	0	11/19/92	0	11/20/93	0
11/21/88	0	11/21/90	0	11/21/91	0	11/20/92	0.12	11/21/93	0
11/22/88	0	11/22/90	0	11/22/91	0	11/21/92	0	11/22/93	0
11/23/88	0	11/23/90	0	11/23/91	0	11/22/92	0	11/23/93	0
11/24/88	0	11/24/90	0	11/24/91	0	11/23/92	0	11/24/93	0
11/25/88	0.07	11/25/90	0	11/25/91	0	11/24/92	0	11/25/93	0
11/26/88	0.11	11/26/90	0.48	11/26/91	0	11/25/92	0	11/26/93	0
11/27/88	0	11/27/90	0.01	11/27/91	0	11/26/92	0	11/27/93	0
11/28/88	0	11/28/90	0	11/28/91	0	11/27/92	0	11/28/93	0
11/29/88	0	11/29/90	0	11/29/91	0	11/28/92	0	11/29/93	0
11/30/88	0	11/30/90	0	11/30/91	0.01	11/29/92	0	11/30/93	0
12/1/88	0.03	12/1/90	0	12/1/91	0	11/30/92	0	12/1/93	0
12/2/88	0	12/2/90	0	12/2/91	0	12/1/92	0	12/2/93	0
12/3/88	0	12/3/90	0	12/3/91	0	12/2/92	0	12/3/93	0
12/4/88	0	12/4/90	0	12/4/91	0	12/3/92	0	12/4/93	0
12/5/88	0	12/5/90	0	12/5/91	0	12/4/92	0.13	12/5/93	0
12/6/88	0	12/6/90	0	12/6/91	0	12/5/92	0.81	12/6/93	0
12/7/88	0	12/7/90	0	12/7/91	0	12/6/92	0	12/7/93	0
12/8/88	0	12/8/90	0	12/8/91	0	12/7/92	-99999	12/8/93	0
12/9/88	0	12/9/90	0	12/9/91	0	12/8/92	0.28	12/9/93	0
12/10/88	0	12/10/90	0	12/10/91	0.02	12/9/92	0	12/10/93	0
12/11/88	0	12/11/90	0	12/11/91	0.26	12/10/92	0	12/11/93	0
12/12/88	0	12/12/90	0.27	12/12/91	0	12/11/92	0	12/12/93	0.07
12/13/88	0	12/13/90	0.04	12/13/91	0	12/12/92	0.5	12/13/93	0
12/14/88	0	12/14/90	0	12/14/91	0	12/13/92	0	12/14/93	0
12/15/88	0	12/15/90	0.06	12/15/91	0	12/14/92	0	12/15/93	0.07
12/16/88	0	12/16/90	0.11	12/16/91	0	12/15/92	0	12/16/93	0.18
12/17/88	0	12/17/90	0	12/17/91	0	12/16/92	0	12/17/93	0
12/18/88	0	12/18/90	0	12/18/91	0.54	12/17/92	0	12/18/93	0
12/19/88	0	12/19/90	0.06	12/19/91	0.43	12/18/92	0.2	12/19/93	0
12/20/88	0.05	12/20/90	0.36	12/20/91	0	12/19/92	0	12/20/93	0
12/21/88	0.38	12/21/90	0	12/21/91	0	12/20/92	0	12/21/93	0
12/22/88	0	12/22/90	0	12/22/91	0	12/21/92	0	12/22/93	0
12/23/88	0.2	12/23/90	0	12/23/91	0	12/22/92	0	12/23/93	0
12/24/88	0.13	12/24/90	0	12/24/91	0	12/23/92	0	12/24/93	0
12/25/88	0.09	12/25/90	0	12/25/91	0	12/24/92	0	12/25/93	0
12/26/88	0	12/26/90	0	12/26/91	0	12/25/92	0	12/26/93	0
12/27/88	0	12/27/90	0	12/27/91	0	12/26/92	0	12/27/93	0.1
12/28/88	0	12/28/90	0	12/28/91	0	12/27/92	0	12/28/93	0
12/29/88	0	12/29/90	0	12/29/91	0.05	12/28/92	0.3	12/29/93	0
12/30/88	0	12/30/90	0	12/30/91	0.11	12/29/92	0	12/30/93	0
12/31/88	0	12/31/90	0	12/31/91	0.02	12/30/92	0.07	12/31/93	0
						12/31/92	0		

Notes: Source: Utah Climet Center, Utah State University, Logan, UT

Table 1 (cont.)

JFZ
7/22/94
FMW
8/20/94

PLATE 2.2-1

MONTHLY MEANS AND EXTREMES OF TEMPERATURES BLANDING, UTAH

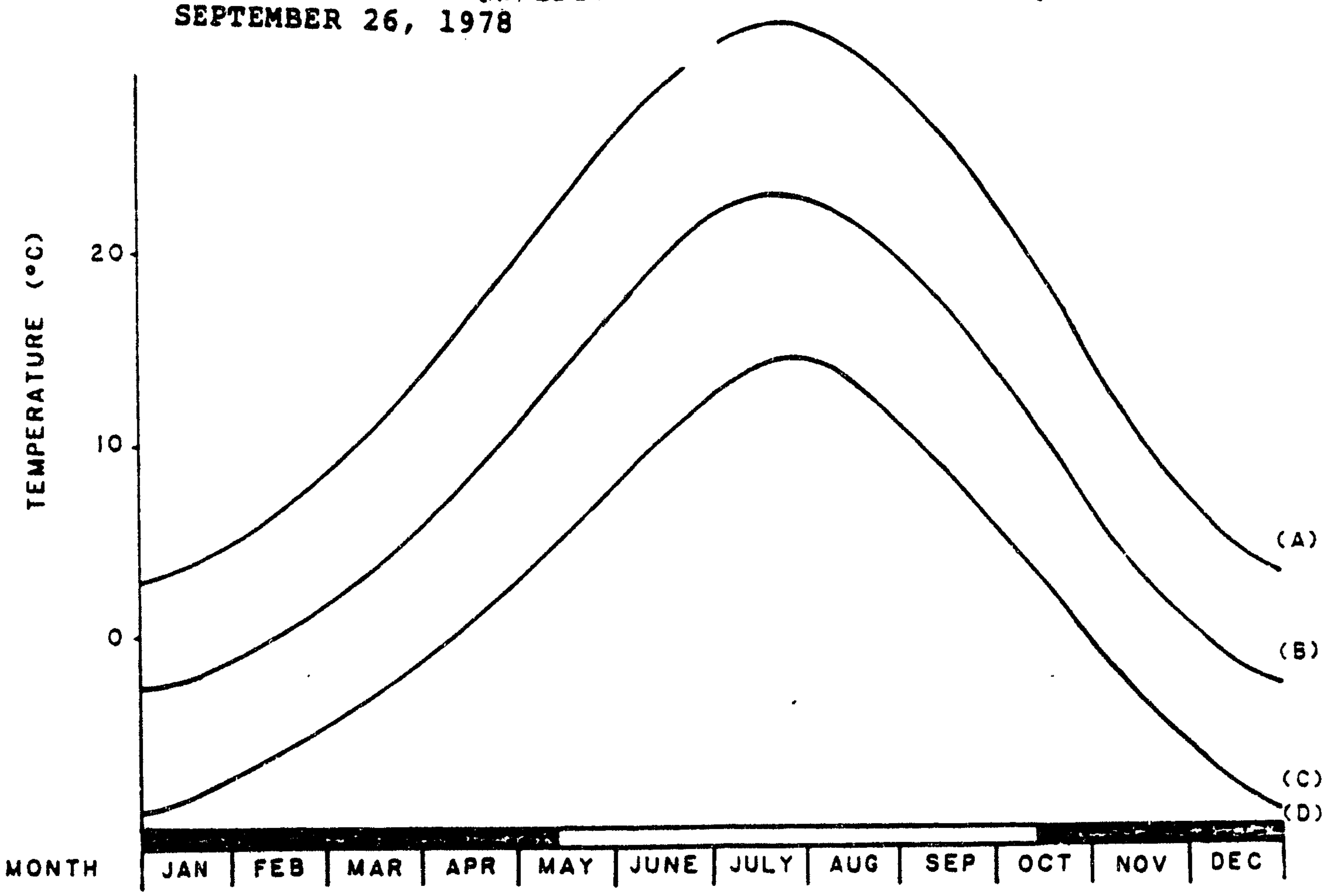
9/15

Source

APPLICATION FOR SOURCE MATERIAL LICENSE

REVISED
SEPTEMBER 26, 1978

ANNUAL MEAN: 9.9°C



MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
EXTREME MAX.	16	18	24	27	33	38	38	37	34	29	21	15
MEAN MAX.	3.8	6.9	10.9	16.3	22.8	28.7	31.9	30.2	26.0	18.8	10.2	4.5
°F MEAN	27.5	32.9	38.1	47.1	57.4	66.9	73.6	70.9	63.0	51.6	38.5	28.9
°C MEAN	-2.5	0.5	3.4	8.4	14.1	19.4	23.1	21.6	17.2	10.9	3.6	-1.7
MEAN MIN.	-8.8	-5.9	-3.2	0.4	5.4	10.1	14.2	13.1	8.4	2.9	-3.2	-7.8
EXTREME MIN.	-29	-22	-15	-11	-6	-1	8	3	-5	-12	-19	-22

(A) MEAN DAILY MAXIMUM
(B) MEAN MONTHLY
(C) MEAN DAILY MINIMUM
(D) FREEZE DATES

TABLE 2

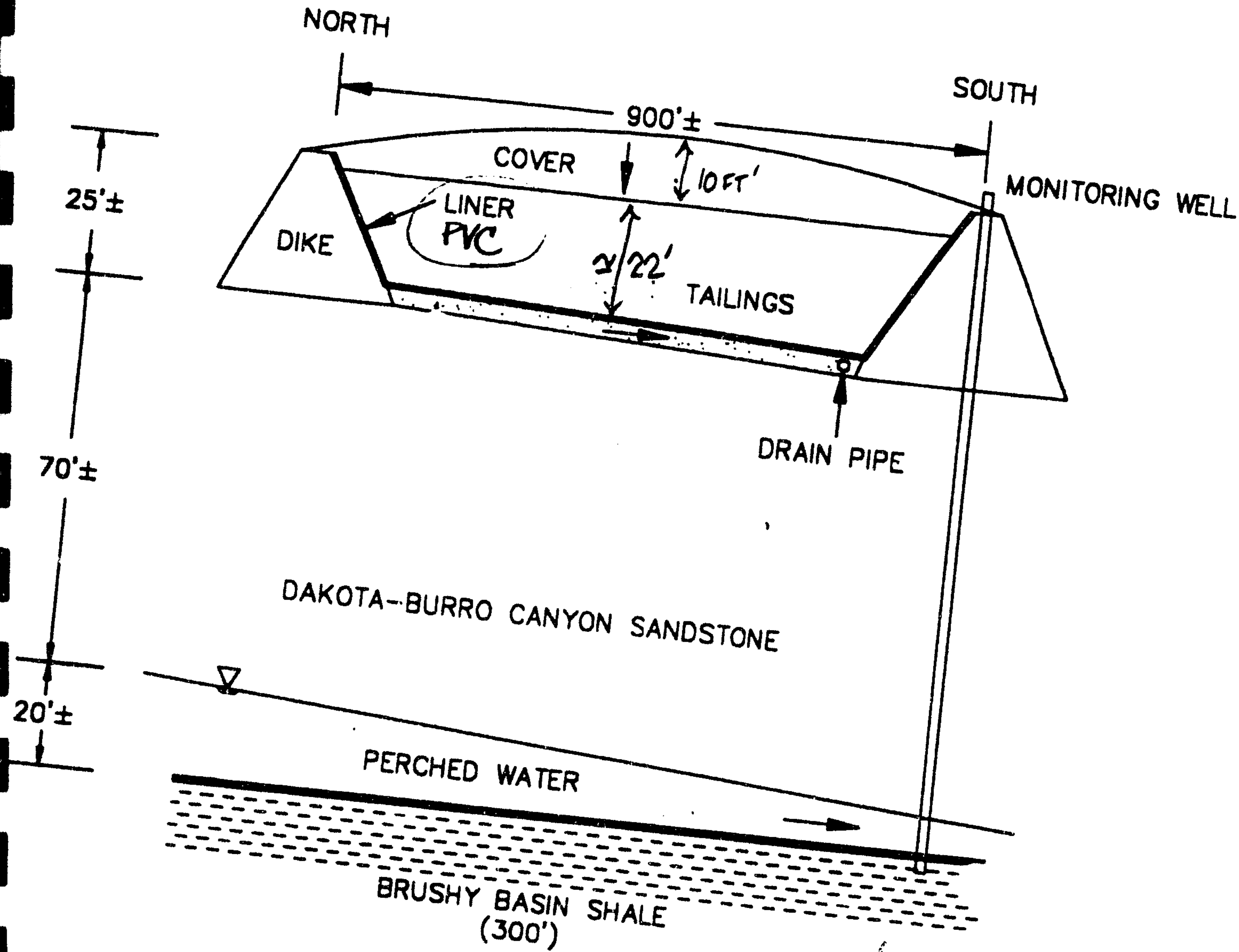
DAMES & MOORE

JFL
7/22/94

10/15

7/20/94

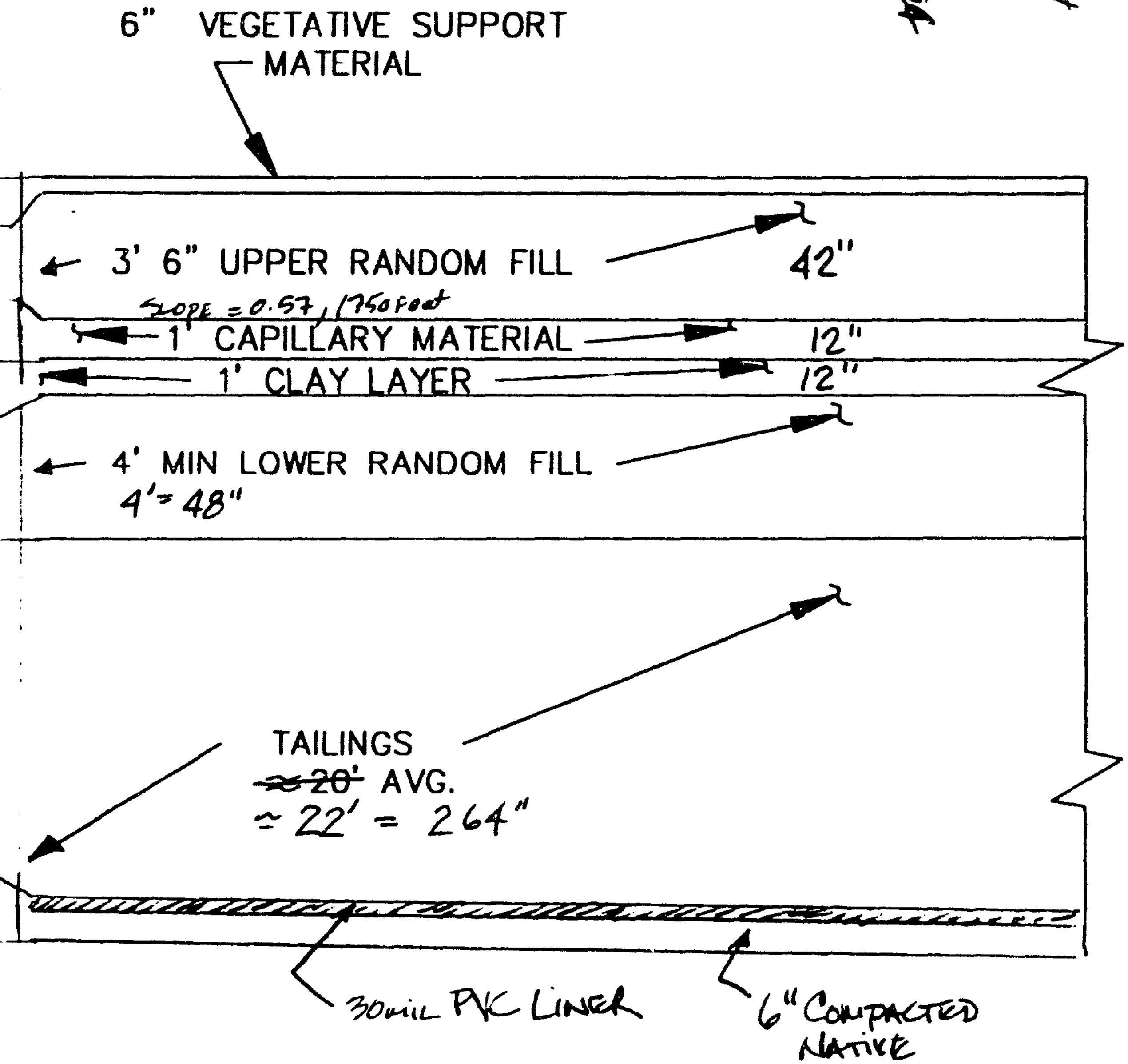
CELLS 3/4, SCHEMATIC
NTS



~~K = feet per year~~
~~Q = cubic feet per year per square foot~~
~~V = feet per year~~
~~T = years~~

FIGURE 1

Soil Layer #	Initial Soil Moisture (vol/vol)	HELP Soil #	Drainage Type
1	0.14	#9	Vertical
2	0.14	#10	Vertical
3	0.06	#5	Lateral
4	0.43	#16	Barrier
5	0.14	#10	Vertical
6	Cell 4 = 0.14 Unsaturated Cell 3 = 0.33 Saturated	#10	Vertical
7	0.43	#16	Barrier Liner



RECLAMATION COVER

FIGURE 2

5/15

Soil Types Available in HELP V2.0

JSL 7/22/94

PMW 7/20/94

12/15

Table 3

DEFAULT, UNVEGETATED, UNCOMPACTED SOIL CHARACTERISTICS

SOIL TEXTURE			DIMENSIONLESS			SAT. HYD.
HELP	USDA	USCS	POROSITY	FIELD CAPACITY	WILTING POINT	CONDUCTIVITY (CM/SEC)
1	CoS	GS	0.417	0.045	0.018	1.0E-02
2	S	SW	0.437	0.062	0.024	5.8E-03
3	FS	SM	0.457	0.083	0.033	3.1E-03
4	LS	SM	0.437	0.105	0.047	1.7E-03
5	LFS	SM	0.457	0.131	0.058	1.0E-03
6	SL	SM	0.453	0.190	0.085	7.2E-04
7	FSL	SM	0.473	0.222	0.104	5.2E-04
8	L	ML	0.463	0.232	0.116	3.7E-04
9	SiL	ML	0.501	0.284	0.135	1.9E-04
10	SCL	SC	0.398	0.244	0.136	1.2E-04
11	CL	CL	0.464	0.310	0.187	6.4E-05
12	SiCL	CL	0.471	0.342	0.210	4.2E-05
13	SC	CH	0.430	0.321	0.221	3.3E-05

ENTER RETURN TO VIEW THE REST OF THE SOIL TYPES.

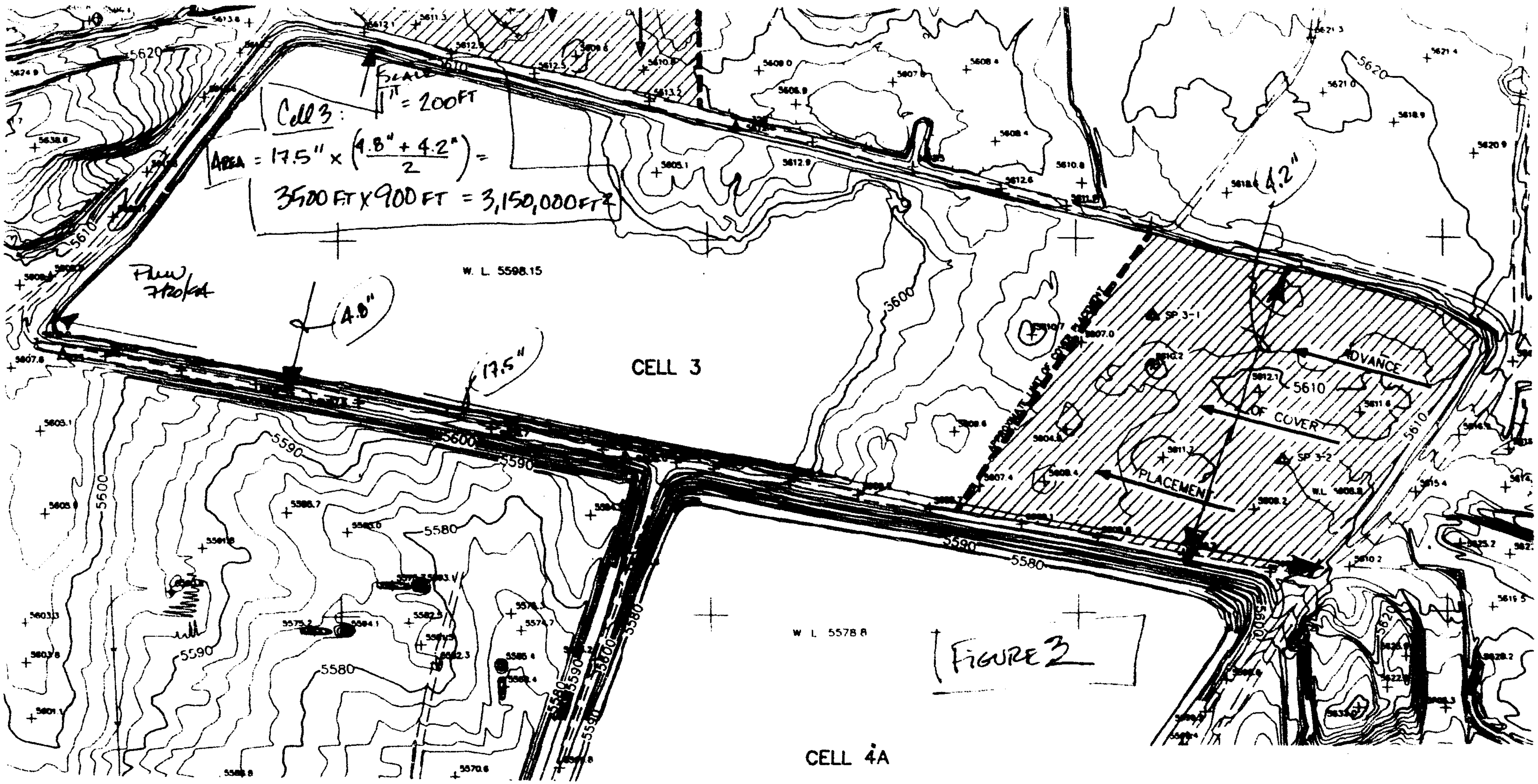
11	CL	CL	0.464	0.310	0.187	6.4E-05
12	SiCL	CL	0.471	0.342	0.210	4.2E-05
13	SC	CH	0.430	0.321	0.221	3.3E-05

ENTER RETURN TO VIEW THE REST OF THE SOIL TYPES.

SOIL TEXTURE			DIMENSIONLESS			SAT. HYD.
HELP	USDA	USCS	POROSITY	FIELD CAPACITY	WILTING POINT	CONDUCTIVITY (CM/SEC)
14	SiC	CH	0.479	0.371	0.251	2.5E-05
15	C	CH	0.475	0.378	0.265	1.7E-05
→ 16	Liner Soil		0.430	0.366	0.280	1.0E-07
17	Liner Soil		0.400	0.356	0.290	1.0E-08
18	Mun. Waste		0.520	0.294	0.140	2.0E-04
19	USER SPECIFIED SOIL CHARACTERISTICS					
20	USER SPECIFIED SOIL CHARACTERISTICS					

5.9 ENTER SOIL TEXTURE OF SOIL LAYER 1.

TABLE 3


Cell 3:
Scale 1" = 200FT
Area = 17.5" × ((4.8" + 4.2")/2) =
3500 FT × 900 FT = 3,150,000 FT2
4.8"
17.5"
4.2"
W. L. 5598.15
CELL 3
W. L. 5578.8
CELL 4A
ADVANCE
OF COVER
PLACEMENT
SP 3-1
SP 3-2
5620
5610
5600
5590
5580
FIGURE 3

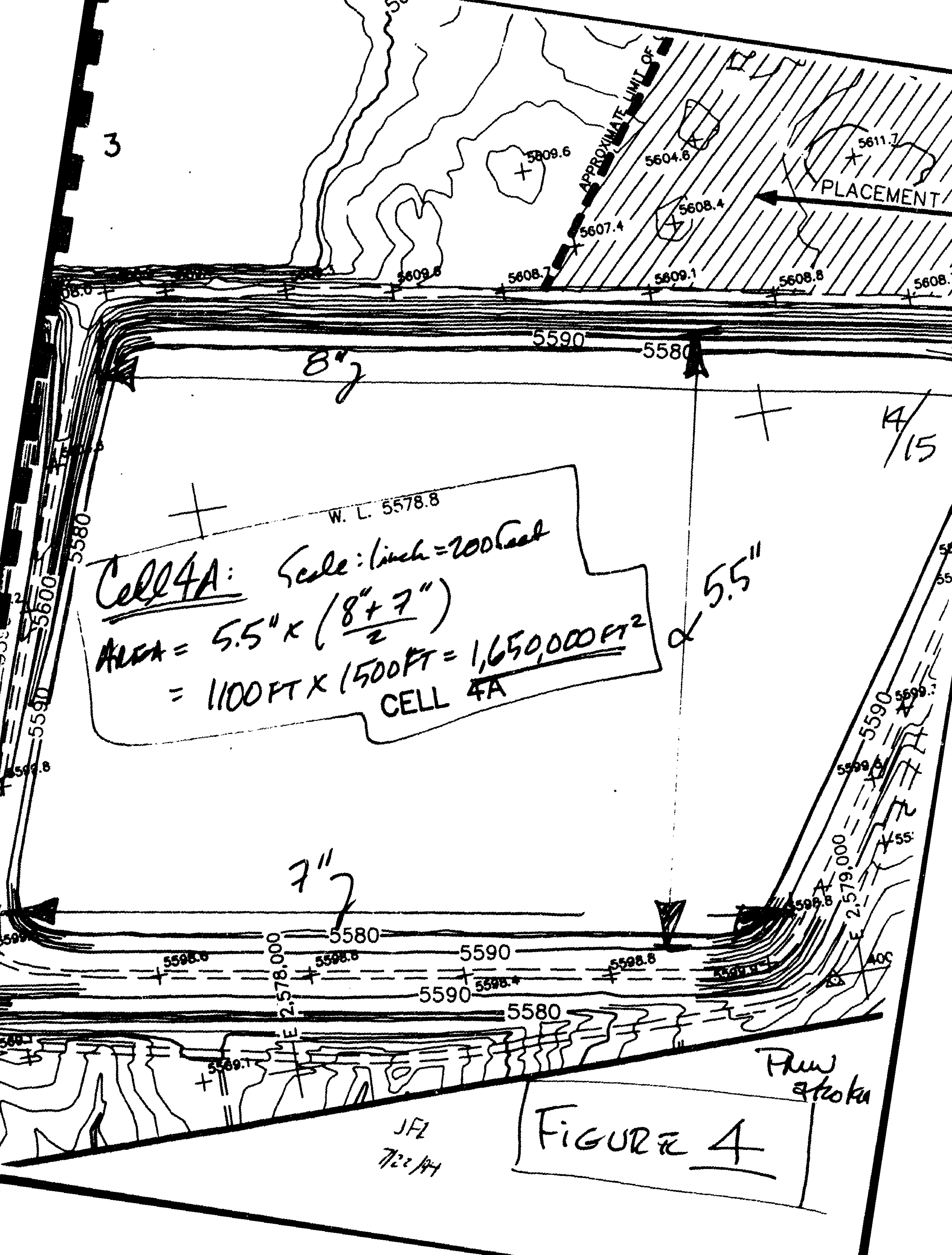

3
APPROXIMATE LIMIT OF
5609.6
5604.6
5611.7
5608.4
5607.4
PLACEMENT
5609.8
5608.7
5609.1
5608.8
5590
5580
8"
14/15
W. L. 5578.8
Cell 4A: Scale: 1inch = 200feet
AREA = 5.5" x ((8"+7")/2)
= 1100FT x 1500FT = 1,650,000 FT²
CELL 4A
5.5"
7"
5580
5590
5598.6
5598.8
5598.4
5590
5580
E 2,578,000
E 2,579,000
5589.1
5599.1
5599.6
5598.8

FIGURE 4

JFZ 7/22/94

Table 4
HELP Model Summaries for Cells 3 and 4
White Mesa Tailings Facility, Blanding, Utah

HELP Run	Precipitation (inches)	Runoff (inches)	Evapotranspiration (inches)	Lateral Drainage from Layer 3 (ft^3)	Percolation from Layer 4 (ft^3)	Percolation from Layer 7 (ft^3)	Change in Water Storage
Cell 3, saturated with PVC liner, Blanding climate data	13.77	0.2	12.67	26	64989	137415	99352
Cell 3, saturated, no liner, Blanding climate data	13.77	0.2	12.67	26	64989	1562025	-1325258
Cell 3, saturated, with PVC liner and 20 yrs Grand Junction climate data	7.94	0	7.93	0	0	120661	-117348
Cell 3, saturated, no liner and 20 yrs Grand Junction climate data	7.94	0	7.93	0	0	390507	-387194
Cell 4, unsaturated with PVC liner, Blanding climate data	13.77	0.2	12.67	14	34060	0	124099
Cell 4, unsaturated, no liner, Blanding climate data	13.77	0.2	12.67	14	34060	0	124099

4 yrs of data

PNW 7/20/94

****

WHITE MESA TAILINGS FACILITY
CELL 3, WET, INCLUDING LAYER 7, PVC LINER
BLANDING CLIMATE DATA

****

POOR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS = 6.00 INCHES
POROSITY = 0.5010 VOL/VOL
FIELD CAPACITY = 0.2837 VOL/VOL
WILTING POINT = 0.1353 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000342000014 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS = 42.00 INCHES
POROSITY = 0.3325 VOL/VOL
FIELD CAPACITY = 0.2173 VOL/VOL
WILTING POINT = 0.1361 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000006000000 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS = 12.00 INCHES
POROSITY = 0.3573 VOL/VOL
FIELD CAPACITY = 0.1127 VOL/VOL
WILTING POINT = 0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0600 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000050000002 CM/SEC
SLOPE = 0.57 PERCENT
DRAINAGE LENGTH = 1750.0 FEET

LAYER 4

BARRIER SOIL LINER

THICKNESS = 12.00 INCHES
POROSITY = 0.4300 VOL/VOL
FIELD CAPACITY = 0.3663 VOL/VOL
WILTING POINT = 0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000000100000 CM/SEC

LAYER 5

VERTICAL PERCOLATION LAYER

THICKNESS = 48.00 INCHES
POROSITY = 0.3325 VOL/VOL

FIELD CAPACITY = 0.2173 VOL/VOL
WILTING POINT = 0.1361 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000006000000 CM/SEC

LAYER 6

VERTICAL PERCOLATION LAYER
THICKNESS = 264.00 INCHES
POROSITY = 0.3325 VOL/VOL
FIELD CAPACITY = 0.2173 VOL/VOL
WILTING POINT = 0.1361 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.3300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000006000000 CM/SEC

LAYER 7

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER
THICKNESS = 6.00 INCHES
POROSITY = 0.4300 VOL/VOL
FIELD CAPACITY = 0.3663 VOL/VOL
WILTING POINT = 0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000000100000 CM/SEC
LINER LEAKAGE FRACTION = 0.01000000

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER = 87.21
TOTAL AREA OF COVER = 3150000. SQ FT
EVAPORATIVE ZONE DEPTH = 28.00 INCHES
UPPER LIMIT VEG. STORAGE = 10.3210 INCHES
INITIAL VEG. STORAGE = 3.9200 INCHES
INITIAL SNOW WATER CONTENT = 0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN
SOIL AND WASTE LAYERS = 109.0200 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

USER SPECIFIED RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR MILFORD UTAH

MAXIMUM LEAF AREA INDEX = 1.60
START OF GROWING SEASON (JULIAN DATE) = 138
END OF GROWING SEASON (JULIAN DATE) = 276

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
26.40	32.10	38.20	46.30	55.90	65.80
74.30	72.10	62.60	50.30	36.80	28.20

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MONTHLY TOTALS FOR YEAR 1988

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.60	0.50	0.02	0.78	1.27	1.40
	0.64	1.70	1.06	0.10	1.04	0.85
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	1.003	1.175	0.020	0.276	0.569	2.174
(INCHES)	0.834	1.644	1.388	0.100	0.306	0.395
LATERAL DRAINAGE FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 4 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0459	0.0434	0.0463	0.0447	0.0461	0.0446
LAYER 7 (INCHES)	0.0460	0.0459	0.0444	0.0458	0.0442	0.0457

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
AVG. DAILY HEAD ON	258.07	257.68	257.30	256.90	256.51	256.11
LAYER 7 (INCHES)	255.72	255.32	254.93	254.54	254.15	253.76
STD. DEV. OF DAILY HEAD	0.12	0.00	0.11	0.18	0.15	0.13
ON LAYER 7 (INCHES)	0.00	0.10	0.12	0.00	0.17	0.13

ANNUAL TOTALS FOR YEAR 1988

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	10.96	2877001.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	9.885	2594779.	90.19
LATERAL DRAINAGE FROM LAYER 3	0.0000	0.	0.00
PERCOLATION FROM LAYER 4	0.0000	0.	0.00
PERCOLATION FROM LAYER 7	0.5430	142529.	4.95
CHANGE IN WATER STORAGE	0.532	139691.	4.86

SOIL WATER AT START OF YEAR 109.02 28617752.

SOIL WATER AT END OF YEAR 109.55 28757442.

SNOW WATER AT START OF YEAR 0.00 0.

SNOW WATER AT END OF YEAR 0.00 0.

ANNUAL WATER BUDGET BALANCE 0.00 2. 0.00

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MONTHLY TOTALS FOR YEAR 1990

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.11	0.38	0.57	0.80	0.85	1.13
	1.91	0.80	1.69	1.82	1.43	0.90
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.007	0.027
	0.000	0.000	0.000	0.029	0.000	0.000
EVAPOTRANSPIRATION	0.788	1.136	0.566	0.413	1.864	0.758
(INCHES)	2.272	0.908	1.597	1.707	1.245	0.648
LATERAL DRAINAGE FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 4 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0456	0.0411	0.0455	0.0439	0.0453	0.0438
LAYER 7 (INCHES)	0.0452	0.0451	0.0436	0.0450	0.0435	0.0448

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
AVG. DAILY HEAD ON	253.36	252.98	252.61	252.22	251.83	251.45
LAYER 7 (INCHES)	251.06	250.67	250.28	249.90	249.51	249.13
STD. DEV. OF DAILY HEAD	0.11	0.11	0.13	0.08	0.18	0.15
ON LAYER 7 (INCHES)	0.11	0.06	0.12	0.13	0.10	0.09

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ANNUAL TOTALS FOR YEAR 1990

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	13.39	3514875.	100.00
RUNOFF	0.063	16508.	0.47

EVAPOTRANSPIRATION	13.902	3649268.	103.82
LATERAL DRAINAGE FROM LAYER 3	0.0000	0.	0.00
PERCOLATION FROM LAYER 4	0.0000	0.	0.00
PERCOLATION FROM LAYER 7	0.5323	139735.	3.98
CHANGE IN WATER STORAGE	-1.107	-290634.	-8.27
SOIL WATER AT START OF YEAR	109.55	28757442.	
SOIL WATER AT END OF YEAR	108.44	28466808.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	-1.	0.00

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MONTHLY TOTALS FOR YEAR 1991

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.22	0.45	1.40	0.01	0.49	0.05
	1.20	1.18	1.32	1.41	1.58	1.43
RUNOFF (INCHES)	0.018	0.000	0.008	0.000	0.000	0.000
	0.000	0.000	0.008	0.000	0.040	0.000
EVAPOTRANSPIRATION	1.306	0.588	1.407	0.366	0.094	0.384
(INCHES)	0.822	1.620	1.312	0.266	1.047	0.858
LATERAL DRAINAGE FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 4 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0448	0.0404	0.0446	0.0431	0.0445	0.0430
LAYER 7 (INCHES)	0.0444	0.0443	0.0428	0.0442	0.0427	0.0440

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
AVG. DAILY HEAD ON	248.74	248.37	248.00	247.62	247.24	246.86
LAYER 7 (INCHES)	246.48	246.10	245.72	245.34	244.97	244.59

STD. DEV. OF DAILY HEAD	0.16	0.03	0.12	0.10	0.12	0.16
ON LAYER 7 (INCHES)	0.07	0.11	0.09	0.13	0.11	0.16

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ANNUAL TOTALS FOR YEAR 1991

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	11.74	3081750.	100.00
RUNOFF	0.074	19552.	0.63
EVAPOTRANSPIRATION	10.071	2643531.	85.78
LATFRAL DRAINAGE FROM LAYER 3	0.0000	0.	0.00
PERCOLATION FROM LAYER 4	0.0000	0.	0.00
PERCOLATION FROM LAYER 7	0.5228	137247.	4.45
CHANGE IN WATER STORAGE	1.072	281420.	9.13
SOIL WATER AT START OF YEAR	108.44	28466808.	
SOIL WATER AT END OF YEAR	109.40	28718424.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.11	29804.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 1992

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
ECIPITATION (INCHES)	0.82	1.54	1.85	0.11	2.33	0.29
	2.20	1.26	0.90	1.24	0.27	2.29
RUNOFF (INCHES)	0.000	0.001	0.000	0.000	0.017	0.000
	0.075	0.000	0.000	0.000	0.000	0.002
EVAPOTRANSPIRATION	0.843	1.590	1.879	1.221	1.556	1.144
(INCHES)	3.022	0.935	1.227	0.370	0.440	1.062
LATERAL DRAINAGE FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 4 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0440	0.0411	0.0438	0.0424	0.0437	0.0422
LAYER 7 (INCHES)	0.0436	0.0435	0.0420	0.0434	0.0419	0.0433

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
AVG. DAILY HEAD ON	244.21	243.84	243.47	243.10	242.72	242.35
LAYER 7 (INCHES)	241.98	241.60	241.23	240.86	240.49	240.12
STD. DEV. OF DAILY HEAD	0.15	0.16	0.10	0.07	0.09	0.15
ON LAYER 7 (INCHES)	0.17	0.13	0.09	0.11	0.10	0.14

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ANNUAL TOTALS FOR YEAR 1992

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	15.10	3963750.	100.00
RUNOFF	0.095	25025.	0.63
EVAPOTRANSPIRATION	15.290	4013554.	101.26
LATERAL DRAINAGE FROM LAYER 3	0.0000	0.	0.00
PERCOLATION FROM LAYER 4	0.0000	0.	0.00
PERCOLATION FROM LAYER 7	0.5149	135170.	3.41
CHANGE IN WATER STORAGE	-0.800	-209997.	-5.30
SOIL WATER AT START OF YEAR	109.40	28718424.	
SOIL WATER AT END OF YEAR	108.71	28536844.	
SNOW WATER AT START OF YEAR	0.11	29804.	
SNOW WATER AT END OF YEAR	0.01	1387.	
ANNUAL WATER BUDGET BALANCE	0.00	-1.	0.00

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MONTHLY TOTALS FOR YEAR 1993

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	5.31	3.73	0.73	0.59	1.62	0.12
	0.01	1.79	0.83	1.43	1.08	0.42
RUNOFF (INCHES)	0.283	0.489	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.950	1.452	1.732	1.304	0.833	0.995
(INCHES)	1.476	1.276	1.050	1.533	1.219	0.368

LATERAL DRAINAGE FROM	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001
LAYER 3 (INCHES)	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0654	0.1240	0.1348	0.1326
LAYER 4 (INCHES)	0.1370	0.1356	0.1291	0.1308	0.1238	0.1249
PERCOLATION FROM	0.0432	0.0390	0.0431	0.0416	0.0429	0.0415
LAYER 7 (INCHES)	0.0428	0.0427	0.0413	0.0426	0.0412	0.0425

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.00	0.64	2.62	3.36	3.59
LAYER 4 (INCHES)	3.59	3.42	3.17	2.87	2.55	2.20
STD. DEV. OF DAILY HEAD	0.00	0.00	0.69	0.35	0.12	0.03
ON LAYER 4 (INCHES)	0.03	0.06	0.08	0.09	0.10	0.10
AVG. DAILY HEAD ON	239.74	239.38	239.03	238.66	238.29	237.93
LAYER 7 (INCHES)	237.56	237.19	236.83	236.46	236.10	235.73
STD. DEV. OF DAILY HEAD	0.09	0.12	0.07	0.11	0.12	0.15
ON LAYER 7 (INCHES)	0.10	0.07	0.10	0.14	0.00	0.13

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ANNUAL TOTALS FOR YEAR 1993

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	17.66	4635750.	100.00
RUNOFF	0.772	202776.	4.37
EVAPOTRANSPIRATION	14.187	3724166.	80.34
LATERAL DRAINAGE FROM LAYER 3	0.0005	131.	0.00
PERCOLATION FROM LAYER 4	1.2379	324945.	7.01
PERCOLATION FROM LAYER 7	0.5044	132397.	2.86
CHANGE IN WATER STORAGE	2.195	576280.	12.43
SOIL WATER AT START OF YEAR	108.71	28536844.	
SOIL WATER AT END OF YEAR	110.91	29114510.	
SNOW WATER AT START OF YEAR	0.01	1387.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1988 THROUGH 1993

JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC

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PRECIPITATION

TOTALS 2.01 1.32 0.91 0.46 1.31 0.60
1.19 1.35 1.16 1.20 1.08 1.18

STD. DEVIATIONS 1.86 1.43 0.72 0.37 0.71 0.62
0.90 0.40 0.35 0.65 0.51 0.72

RUNOFF

TOTALS 0.060 0.098 0.002 0.000 0.005 0.005
0.015 0.000 0.002 0.006 0.008 0.000

STD. DEVIATIONS 0.125 0.219 0.004 0.000 0.007 0.012
0.034 0.000 0.003 0.013 0.018 0.001

EVAPOTRANSPIRATION

TOTALS 0.978 1.188 1.121 0.716 0.983 1.091
1.685 1.277 1.315 0.795 0.851 0.666

STD. DEVIATIONS 0.202 0.385 0.798 0.502 0.723 0.670
0.954 0.355 0.202 0.761 0.446 0.298

LATERAL DRAINAGE FROM LAYER 3

TOTALS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

STD. DEVIATIONS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

PERCOLATION FROM LAYER 4

TOTALS 0.0000 0.0000 0.0131 0.0248 0.0270 0.0265
0.0274 0.0271 0.0258 0.0262 0.0248 0.0250

STD. DEVIATIONS 0.0000 0.0000 0.0293 0.0554 0.0603 0.0593
0.0613 0.0606 0.0577 0.0585 0.0554 0.0559

PERCOLATION FROM LAYER 7

TOTALS 0.0447 0.0410 0.0447 0.0432 0.0445 0.0430
0.0444 0.0443 0.0428 0.0442 0.0427 0.0441

STD. DEVIATIONS 0.0011 0.0016 0.0013 0.0012 0.0013 0.0012
0.0013 0.0013 0.0012 0.0013 0.0012 0.0013

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1988 THROUGH 1993

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	13.77 (2.695)	3614625.	100.00

RUNOFF	0.201	(0.321)	52772.	1.46
EVAPOTRANSPIRATION	12.667	(2.510)	3325060.	91.99
LATERAL DRAINAGE FROM LAYER 3	0.0001	(0.0002)	26.	0.00
PERCOLATION FROM LAYER 4	0.2476	(0.5536)	64989.	1.80
PERCOLATION FROM LAYER 7	0.5235	(0.0150)	137415.	3.80
CHANGE IN WATER STORAGE	0.378	(1.360)	99352.	2.75

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PEAK DAILY VALUES FOR YEARS 1988 THROUGH 1993

	(INCHES)	(CU. FT.)
PRECIPITATION	1.33	349125.0
RUNOFF	0.209	54815.7
LATERAL DRAINAGE FROM LAYER 3	0.0000	0.5
PERCOLATION FROM LAYER 4	0.0044	1162.2
HEAD ON LAYER 4	3.6	
PERCOLATION FROM LAYER 7	0.0015	393.2
HEAD ON LAYER 7	258.3	
SNOW WATER	2.53	665421.9

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3469

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1354

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FINAL WATER STORAGE AT END OF YEAR 1993

LAYER	(INCHES)	(VOL/VOL)
1	0.92	0.1529
2	7.95	0.1892
3	1.85	0.1539
4	5.16	0.4300
5	7.96	0.1658
6	84.50	0.3201
7	2.58	0.4300
SNOW WATER	0.00	

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WHITE MESA TAILINGS FACILITY
CELL 3, WET, WITHOUT THE LAYER 7 PVC LINER
BLANDING CLIMATE DATA

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POOR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS = 6.00 INCHES
POROSITY = 0.5010 VOL/VOL
FIELD CAPACITY = 0.2837 VOL/VOL
WILTING POINT = 0.1353 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000342000014 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS = 42.00 INCHES
POROSITY = 0.3325 VOL/VOL
FIELD CAPACITY = 0.2173 VOL/VOL
WILTING POINT = 0.1361 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000006000000 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS = 12.00 INCHES
POROSITY = 0.3573 VOL/VOL
FIELD CAPACITY = 0.1127 VOL/VOL
WILTING POINT = 0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0600 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000050000002 CM/SEC
SLOPE = 0.57 PERCENT
DRAINAGE LENGTH = 1750.0 FEET

LAYER 4

BARRIER SOIL LINER

THICKNESS = 12.00 INCHES
POROSITY = 0.4300 VOL/VOL
FIELD CAPACITY = 0.3663 VOL/VOL
WILTING POINT = 0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000000100000 CM/SEC

LAYER 5

VERTICAL PERCOLATION LAYER

THICKNESS = 48.00 INCHES
POROSITY = 0.3325 VOL/VOL

FIELD CAPACITY = 0.2173 VOL/VOL
WILTING PC NT = 0.1361 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000006000000 CM/SEC

LAYER 6

VERTICAL PERCOLATION LAYER

THICKNESS = 264.00 INCHES
POROSITY = 0.3325 VOL/VOL
FIELD CAPACITY = 0.2173 VOL/VOL
WILTING POINT = 0.1361 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.3300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000006000000 CM/SEC

LAYER 7

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

THICKNESS = 6.00 INCHES
POROSITY = 0.4300 VOL/VOL
FIELD CAPACITY = 0.3663 VOL/VOL
WILTING POINT = 0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000000100000 CM/SEC
LINER LEAKAGE FRACTION = 1.00000000

GENERAL SIMULATION DATA

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SCS RUNOFF CURVE NUMBER = 87.21
TOTAL AREA OF COVER = 3150000. SQ FT
EVAPORATIVE ZONE DEPTH = 28.00 INCHES
UPPER LIMIT VEG. STORAGE = 10.3210 INCHES
INITIAL VEG. STORAGE = 3.9200 INCHES
INITIAL SNOW WATER CONTENT = 0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN
SOIL AND WASTE LAYERS = 109.0200 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

USER SPECIFIED RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR MILFORD UTAH
MAXIMUM LEAF AREA INDEX = 1.60
START OF GROWING SEASON (JULIAN DATE) = 138
END OF GROWING SEASON (JULIAN DATE) = 276

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
26.40	32.10	38.20	46.30	55.90	65.80
74.30	72.10	62.60	50.30	36.80	28.20

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MONTHLY TOTALS FOR YEAR 1988

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.60	0.50	0.02	0.78	1.27	1.40
	0.64	1.70	1.06	0.10	1.04	0.85
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	1.003	1.175	0.020	0.276	0.569	2.174
(INCHES)	0.834	1.644	1.388	0.100	0.306	0.395
LATERAL DRAINAGE FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 4 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	4.2828	3.4955	3.2217	2.6811	2.3827	1.9828
LAYER 7 (INCHES)	1.7622	1.5117	1.2580	1.1180	0.9304	0.8268

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
AVG. DAILY HEAD ON	239.42	205.56	176.41	150.86	128.91	110.01
LAYER 7 (INCHES)	93.77	79.59	67.60	57.30	48.43	40.82
STD. DEV. OF DAILY HEAD	11.02	8.91	8.20	6.83	6.07	5.05
ON LAYER 7 (INCHES)	4.49	3.85	3.20	2.85	2.37	2.10

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ANNUAL TOTALS FOR YEAR 1988

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	10.96	2877001.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	9.885	2594779.	90.19
LATERAL DRAINAGE FROM LAYER 3	0.0000	0.	0.00
PERCOLATION FROM LAYER 4	0.0000	0.	0.00
PERCOLATION FROM LAYER 7	25.4537	6681596.	232.24
CHANGE IN WATER STORAGE	-24.379	-6399377.	******
SOIL WATER AT START OF YEAR	109.02	28617752.	

SOIL WATER AT END OF YEAR	84.64	22218374.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	3.	0.00

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MONTHLY TOTALS FOR YEAR 1990

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.11	0.38	0.57	0.80	0.85	1.13
	1.91	0.80	1.69	1.82	1.43	0.90
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.007	0.027
	0.000	0.000	0.000	0.029	0.000	0.000
EVAPOTRANSPIRATION	0.788	1.136	0.566	0.413	1.864	0.758
(INCHES)	2.272	0.908	1.597	1.707	1.245	0.648
LATERAL DRAINAGE FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 4 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.7093	0.5536	0.5298	0.4409	0.3918	0.3261
LAYER 7 (INCHES)	0.2898	0.2486	0.2069	0.1839	0.1530	0.1360

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
AVG. DAILY HEAD ON	34.16	28.70	24.00	19.80	16.19	13.08
LAYER 7 (INCHES)	10.41	8.08	6.10	4.41	2.95	1.70
STD. DEV. OF DAILY HEAD	1.81	1.41	1.35	1.12	1.00	0.83
ON LAYER 7 (INCHES)	0.74	0.63	0.53	0.47	0.39	0.35

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ANNUAL TOTALS FOR YEAR 1990

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	13.39	3514875.	100.00
RUNOFF	0.063	16508.	0.47
EVAPOTRANSPIRATION	13.902	3649268.	103.82

LATERAL DRAINAGE FROM LAYER 3	0.0000	0.	0.00
PERCOLATION FROM LAYER 4	0.0000	0.	0.00
PERCOLATION FROM LAYER 7	4.1697	1094534.	31.14
CHANGE IN WATER STORAGE	-4.745	-1245433.	-35.43
SOIL WATER AT START OF YEAR	84.64	22218374.	
SOIL WATER AT END OF YEAR	79.90	20972942.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	-1.	0.00

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MONTHLY TOTALS FOR YEAR 1991

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.22	0.45	1.40	0.01	0.49	0.05
	1.20	1.18	1.32	1.41	1.58	1.43
RUNOFF (INCHES)	0.018	0.000	0.008	0.000	0.000	0.000
	0.000	0.000	0.008	0.000	0.040	0.000
EVAPOTRANSPIRATION	1.306	0.588	1.407	0.366	0.094	0.384
(INCHES)	0.822	1.620	1.312	0.266	1.047	0.858
LATERAL DRAINAGE FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 4 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.1166	0.0128	0.0000	0.0000	0.0000	0.0000
LAYER 7 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
AVG. DAILY HEAD ON	0.60	0.01	0.00	0.00	0.00	0.00
LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.30	0.02	0.00	0.00	0.00	0.00
ON LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

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ANNUAL TOTALS FOR YEAR 1991

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	11.74	3081750.	100.00
RUNOFF	0.074	19552.	0.63
EVAPOTRANSPIRATION	10.071	2643531.	85.78
LATERAL DRAINAGE FROM LAYER 3	0.0000	0.	0.00
PERCOLATION FROM LAYER 4	0.0000	0.	0.00
PERCOLATION FROM LAYER 7	0.1295	33984.	1.10
CHANGE IN WATER STORAGE	1.465	384684.	12.48
SOIL WATER AT START OF YEAR	79.90	20972942.	
SOIL WATER AT END OF YEAR	81.25	21327820.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.11	29804.	
ANNUAL WATER BUDGET BALANCE	0.00	-1.	0.00

MONTHLY TOTALS FOR YEAR 1992

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	0.82	1.54	1.85	0.11	2.33	0.29
	2.20	1.26	0.90	1.24	0.27	2.29
RUNOFF (INCHES)	0.000	0.001	0.000	0.000	0.017	0.000
	0.075	0.000	0.000	0.000	0.000	0.002
EVAPOTRANSPIRATION	0.843	1.590	1.879	1.221	1.556	1.144
(INCHES)	3.022	0.935	1.227	0.370	0.440	1.062
LATERAL DRAINAGE FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 4 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 7 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

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ANNUAL TOTALS FOR YEAR 1992

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	15.10	3963750.	100.00
RUNOFF	0.095	25025.	0.63
EVAPOTRANSPIRATION	15.290	4013554.	101.[illegible]
LATERAL DRAINAGE FROM LAYER 3	0.0000	0.	0.00
PERCOLATION FROM LAYER 4	0.0000	0.	0.00
PERCOLATION FROM LAYER 7	0.0000	1.	0.00
CHANGE IN WATER STORAGE	-0.285	-74830.	-1.89
SOIL WATER AT START OF YEAR	81.25	21327820.	
SOIL WATER AT END OF YEAR	81.07	21281408.	
SNOW WATER AT START OF YEAR	0.11	29804.	
SNOW WATER AT END OF YEAR	0.01	1387.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 1993

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	5.31	3.73	0.73	0.59	1.62	0.12
	0.01	1.79	0.83	1.43	1.08	0.42
RUNOFF (INCHES)	0.283	0.489	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.950	1.452	1.732	1.304	0.833	0.995
(INCHES)	1.476	1.276	1.050	1.533	1.219	0.368
LATERAL DRAINAGE FROM	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001
LAYER 3 (INCHES)	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000

PERCOLATION FROM	0.0000	0.0000	0.0654	0.1240	0.1348	0.1326
LAYER 4 (INCHES)	0.1370	0.1356	0.1291	0.1308	0.1238	0.1249
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 7 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.00	0.64	2.62	3.36	3.59
LAYER 4 (INCHES)	3.59	3.42	3.17	2.87	2.55	2.20
STD. DEV. OF DAILY HEAD	0.00	0.00	0.69	0.35	0.12	0.03
ON LAYER 4 (INCHES)	0.03	0.06	0.08	0.09	0.10	0.10
AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

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ANNUAL TOTALS FOR YEAR 1993

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	17.66	4635750.	100.00
RUNOFF	0.772	202776.	4.37
EVAPOTRANSPIRATION	14.187	3724166.	80.34
LATERAL DRAINAGE FROM LAYER 3	0.0005	131.	0.00
PERCOLATION FROM LAYER 4	1.2379	324945.	7.01
PERCOLATION FROM LAYER 7	0.0000	11.	0.00
CHANGE IN WATER STORAGE	2.700	708667.	15.29
SOIL WATER AT START OF YEAR	81.07	21281408.	
SOIL WATER AT END OF YEAR	83.78	21991462.	
SNOW WATER AT START OF YEAR	0.01	1387.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	-1.	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1988 THROUGH 1993

JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC

PRECIPITATION

TOTALS 2.01 1.32 0.91 0.46 1.31 0.60
1.19 1.35 1.16 1.20 1.08 1.18

STD. DEVIATIONS 1.86 1.43 0.72 0.37 0.71 0.62
0.90 0.40 0.35 0.65 0.51 0.72

RUNOFF

TOTALS 0.060 0.098 0.002 0.000 0.005 0.005
0.015 0.000 0.002 0.006 0.008 0.000

STD. DEVIATIONS 0.125 0.219 0.004 0.000 0.007 0.012
0.034 0.000 0.003 0.013 0.018 0.001

EVAPOTRANSPIRATION

TOTALS 0.978 1.188 1.121 0.716 0.983 1.091
1.685 1.277 1.315 0.795 0.851 0.666

STD. DEVIATIONS 0.202 0.385 0.798 0.502 0.723 0.670
0.954 0.355 0.202 0.761 0.446 0.298

LATERAL DRAINAGE FROM LAYER 3

TOTALS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

STD. DEVIATIONS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

PERCOLATION FROM LAYER 4

TOTALS 0.0000 0.0000 0.0131 0.0248 0.0270 0.0265
0.0274 0.0271 0.0258 0.0262 0.0248 0.0250

STD. DEVIATIONS 0.0000 0.0000 0.0293 0.0554 0.0603 0.0593
0.0613 0.0606 0.0577 0.0585 0.0554 0.0559

PERCOLATION FROM LAYER 7

TOTALS 1.0218 0.8124 0.7503 0.6244 0.5549 0.4618
0.4104 0.3521 0.2930 0.2604 0.2167 0.1926

STD. DEVIATIONS 1.8466 1.5186 1.4005 1.1655 1.0358 0.8619
0.7660 0.6571 0.5469 0.4860 0.4044 0.3594

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1988 THROUGH 1993

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	13.77 (2.695)	3614625.	100.00
RUNOFF	0.201 (0.321)	52772.	1.46

EVAPOTRANSPIRATION	12.667	(2.510)	3325060.	91.99
LATERAL DRAINAGE FROM LAYER 3	0.0001	(0.0002)	26.	0.00
PERCOLATION FROM LAYER 4	0.2476	(0.5536)	64989.	1.80
PERCOLATION FROM LAYER 7	5.9506	(11.0482)	1562025.	43.21
CHANGE IN WATER STORAGE	-5.049	(11.168)	-1325258.	-36.66

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PEAK DAILY VALUES FOR YEARS 1988 THROUGH 1993

	(INCHES)	(CU. FT.)
PRECIPITATION	1.33	349125.0
RUNOFF	0.209	54815.7
LATERAL DRAINAGE FROM LAYER 3	0.0000	0.5
PERCOLATION FROM LAYER 4	0.0044	1162.2
HEAD ON LAYER 4	3.6	
PERCOLATION FROM LAYER 7	0.1481	38869.1
HEAD ON LAYER 7	257.9	
SNOW WATER	2.53	665421.9

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3469

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1354

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FINAL WATER STORAGE AT END OF YEAR 1993

LAYER	(INCHES)	(VOL/VOL)
1	0.92	0.1529
2	7.95	0.1892
3	1.85	0.1539
4	5.16	0.4300
5	7.96	0.1658
6	57.37	0.2173
7	2.58	0.4300
SNOW WATER	0.00	

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WHITE MESA TAILINGS FACILITY
CELL 3, WET, INCLUDING LAYER 7, PVC LINER
20 YEARS GRAND JUNCTION CLIMATE DATA

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POOR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS = 6.00 INCHES
POROSITY = 0.5010 VOL/VOL
FIELD CAPACITY = 0.2837 VOL/VOL
WILTING POINT = 0.1353 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000342000014 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS = 42.00 INCHES
POROSITY = 0.3325 VOL/VOL
FIELD CAPACITY = 0.2173 VOL/VOL
WILTING POINT = 0.1361 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000006000000 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS = 12.00 INCHES
POROSITY = 0.3573 VOL/VOL
FIELD CAPACITY = 0.1127 VOL/VOL
WILTING POINT = 0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0600 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000050000002 CM/SEC
SLOPE = 0.57 PERCENT
DRAINAGE LENGTH = 1750.0 FEET

LAYER 4

BARRIER SOIL LINER

THICKNESS = 12.00 INCHES
POROSITY = 0.4300 VOL/VOL
FIELD CAPACITY = 0.3663 VOL/VOL
WILTING POINT = 0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000000100000 CM/SEC

LAYER 5

VERTICAL PERCOLATION LAYER

THICKNESS = 48.00 INCHES
POROSITY = 0.3325 VOL/VOL

FIELD CAPACITY = 0.2173 VOL/VOL
WILTING POINT = 0.1361 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000006000000 CM/SEC

LAYER 6

VERTICAL PERCOLATION LAYER

THICKNESS = 264.00 INCHES
POROSITY = 0.3325 VOL/VOL
FIELD CAPACITY = 0.2173 VOL/VOL
WILTING POINT = 0.1361 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.3300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000006000000 CM/SEC

LAYER 7

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

THICKNESS = 6.00 INCHES
POROSITY = 0.4300 VOL/VOL
FIELD CAPACITY = 0.3663 VOL/VOL
WILTING POINT = 0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000000100000 CM/SEC
LINER LEAKAGE FRACTION = 0.01000000

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER = 87.21
TOTAL AREA OF COVER = 3150000. SQ FT
EVAPORATIVE ZONE DEPTH = 28.00 INCHES
UPPER LIMIT VEG. STORAGE = 10.3210 INCHES
INITIAL VEG. STORAGE = 3.9200 INCHES
INITIAL SNOW WATER CONTENT = 0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN
SOIL AND WASTE LAYERS = 109.0200 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR GRAND JUNCTION COLORADO

MAXIMUM LEAF AREA INDEX = 1.60
START OF GROWING SEASON (JULIAN DATE) = 116
END OF GROWING SEASON (JULIAN DATE) = 288

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
25.50	33.50	41.90	51.70	62.10	72.30
78.90	75.90	67.10	54.90	39.60	28.30

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.72	0.54	0.60	0.73	0.57	0.39
	0.52	0.96	0.73	0.88	0.73	0.56
STD. DEVIATIONS	0.40	0.26	0.28	0.44	0.43	0.22
	0.37	0.42	0.71	0.44	0.42	0.36
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.001	0.001	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.555	0.718	0.704	0.747	0.736	0.577
	0.513	0.907	0.719	0.697	0.517	0.539
STD. DEVIATIONS	0.192	0.260	0.285	0.467	0.411	0.327
	0.327	0.440	0.668	0.482	0.239	0.194
LATERAL DRAINAGE FROM LAYER 3						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM LAYER 7						
TOTALS	0.0393	0.0358	0.0392	0.0379	0.0391	0.0378
	0.0390	0.0389	0.0376	0.0388	0.0375	0.0387
STD. DEVIATIONS	0.0041	0.0038	0.0042	0.0040	0.0042	0.0040
	0.0041	0.0041	0.0040	0.0041	0.0040	0.0041

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

(INCHES) (CU. FT.) PERCENT

PRECIPITATION	7.94	(1.572)	2084906.	100.00
RUNOFF	0.000	(0.001)	122.	0.01
EVAPOTRANSPIRATION	7.929	(1.452)	2081472.	99.84
LATERAL DRAINAGE FROM LAYER 3	0.0000	(0.0000)	0.	0.00
PERCOLATION FROM LAYER 4	0.0000	(0.0000)	0.	0.00
PERCOLATION FROM LAYER 7	0.4597	(0.0487)	120661.	5.79
CHANGE IN WATER STORAGE	-0.447	(0.832)	-117348.	-5.63

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	0.91	238875.0
RUNOFF	0.006	1572.3
LATERAL DRAINAGE FROM LAYER 3	0.0000	0.0
PERCOLATION FROM LAYER 4	0.0000	0.0
HEAD ON LAYER 4	0.0	
PERCOLA[illegible]ROM LAYER 7	0.0015	393.2
HEAD O[illegible]/ER 7	258.3	
SNOW WATER	0.67	175610.8
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2232	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1356	

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	1.18	0.1961
2	5.80	0.1380
3	0.72	0.0600
4	5.16	0.4300
5	6.72	0.1400
6	77.93	0.2952
7	2.58	0.4300
SNOW WATER	0.00	

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WHITE MESA TAILINGS FACILITY
CELL 3, WET, WITHOUT PVC LAYER 7
20 YEARS GRAND JUNCTION CLIMATE DATA

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POOR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS = 6.00 INCHES
POROSITY = 0.5010 VOL/VOL
FIELD CAPACITY = 0.2837 VOL/VOL
WILTING POINT = 0.1353 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000342000014 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS = 42.00 INCHES
POROSITY = 0.3325 VOL/VOL
FIELD CAPACITY = 0.2173 VOL/VOL
WILTING POINT = 0.1361 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000006000000 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS = 12.00 INCHES
POROSITY = 0.3573 VOL/VOL
FIELD CAPACITY = 0.1127 VOL/VOL
WILTING POINT = 0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0600 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000050000002 CM/SEC
SLOPE = 0.57 PERCENT
DRAINAGE LENGTH = 1750.0 FEET

LAYER 4

BARRIER SOIL LINER

THICKNESS = 12.00 INCHES
POROSITY = 0.4300 VOL/VOL
FIELD CAPACITY = 0.3663 VOL/VOL
WILTING POINT = 0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000000100000 CM/SEC

LAYER 5

VERTICAL PERCOLATION LAYER

THICKNESS = 48.00 INCHES
POROSITY = 0.3325 VOL/VOL

FIELD CAPACITY = 0.2173 VOL/VOL
WILTING POINT = 0.1361 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000006000000 CM/SEC

LAYER 6

VERTICAL PERCOLATION LAYER
THICKNESS = 264.00 INCHES
POROSITY = 0.3325 VOL/VOL
FIELD CAPACITY = 0.2173 VOL/VOL
WILTING POINT = 0.1361 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.3300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000006000000 CM/SEC

LAYER 7

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER
THICKNESS = 6.00 INCHES
POROSITY = 0.4300 VOL/VOL
FIELD CAPACITY = 0.3663 VOL/VOL
WILTING POINT = 0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000000100000 CM/SEC
LINER LEAKAGE FRACTION = 1.00000000

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER = 87.21
TOTAL AREA OF COVER = 3150000. SQ FT
EVAPORATIVE ZONE DEPTH = 28.00 INCHES
UPPER LIMIT VEG. STORAGE = 10.3210 INCHES
INITIAL VEG. STORAGE = 3.9200 INCHES
INITIAL SNOW WATER CONTENT = 0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN
SOIL AND WASTE LAYERS = 109.0200 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.
CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR GRAND JUNCTION COLORADO

MAXIMUM LEAF AREA INDEX = 1.60
START OF GROWING SEASON (JULIAN DATE) = 116
END OF GROWING SEASON (JULIAN DATE) = 288

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
25.50	33.50	41.90	51.70	62.10	72.30
78.90	75.90	67.10	54.90	39.60	28.30

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.72	0.54	0.60	0.73	0.57	0.39
	0.52	0.96	0.73	0.88	0.73	0.56
STD. DEVIATIONS	0.40	0.26	0.28	0.44	0.43	0.22
	0.37	0.42	0.71	0.44	0.42	0.36
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.001	0.001	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.555	0.718	0.704	0.747	0.736	0.577
	0.513	0.907	0.719	0.697	0.517	0.539
STD. DEVIATIONS	0.192	0.260	0.285	0.467	0.411	0.327
	0.327	0.440	0.668	0.482	0.239	0.194
LATERAL DRAINAGE FROM LAYER 3						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM LAYER 7						
TOTALS	0.2556	0.1978	0.1885	0.1569	0.1394	0.1160
	0.1031	0.0885	0.0736	0.0654	0.0544	0.0484
STD. DEVIATIONS	0.9613	0.7599	0.7275	0.6054	0.5380	0.4477
	0.3979	0.3413	0.2841	0.2525	0.2101	0.1867

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)	PERCENT

PRECIPITATION	7.94	(1.572)	2084906.	100.00
RUNOFF	0.000	(0.001)	122.	0.01
EVAPOTRANSPIRATION	7.929	(1.452)	2081472.	99.64
LATERAL DRAINAGE FROM LAYER 3	0.0000	(0.0000)	0.	0.00
PERCOLATION FROM LAYER 4	0.0000	(0.0000)	0.	0.00
PERCOLATION FROM LAYER 7	1.4876	(5.7122)	390507.	18.73
CHANGE IN WATER STORAGE	-1.475	(5.662)	-387194.	-18.57

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	0.91	238875.0
RUNOFF	0.006	1572.3
LATERAL DRAINAGE FROM LAYER 3	0.0000	0.0
PERCOLATION FROM LAYER 4	0.0000	0.0
HEAD ON LAYER 4	0.0	
PERCOLATION FROM LAYER 7	0.1481	38869.1
HEAD ON LAYER 7	257.9	
SNOW WATER	0.67	175610.8

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.2232

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1356

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	1.18	0.1961
2	5.80	0.1380
3	0.72	0.0600
4	5.16	0.4300
5	6.72	0.1400
6	57.37	0.2173
7	2.58	0.4300
SNOW WATER	0.00	

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WHITE MESA TAILINGS FACILITY
CELL 4, DRY, INCLUDING LAYER 7, PVC LINER
BLANDING CLIMATE DATA

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POOR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS = 6.00 INCHES
POROSITY = 0.5010 VOL/VOL
FIELD CAPACITY = 0.2837 VOL/VOL
WILTING POINT = 0.1353 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000342000014 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS = 42.00 INCHES
POROSITY = 0.3325 VOL/VOL
FIELD CAPACITY = 0.2173 VOL/VOL
WILTING POINT = 0.1361 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000006000000 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS = 12.00 INCHES
POROSITY = 0.3573 VOL/VOL
FIELD CAPACITY = 0.1127 VOL/VOL
WILTING POINT = 0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0600 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000050000002 CM/SEC
SLOPE = 0.57 PERCENT
DRAINAGE LENGTH = 1750.0 FEET

LAYER 4

BARRIER SOIL LINER

THICKNESS = 12.00 INCHES
POROSITY = 0.4300 VOL/VOL
FIELD CAPACITY = 0.3663 VOL/VOL
WILTING POINT = 0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000000100000 CM/SEC

LAYER 5

VERTICAL PERCOLATION LAYER

THICKNESS = 48.00 INCHES
POROSITY = 0.3325 VOL/VOL

FIELD CAPACITY = 0.2173 VOL/VOL
WILTING POINT = 0.1361 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000006000000 CM/SEC

LAYER 6

VERTICAL PERCOLATION LAYER

THICKNESS = 264.00 INCHES
POROSITY = 0.3325 VOL/VOL
FIELD CAPACITY = 0.2173 VOL/VOL
WILTING POINT = 0.1361 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000006000000 CM/SEC

LAYER 7

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

THICKNESS = 6.00 INCHES
POROSITY = 0.4300 VOL/VOL
FIELD CAPACITY = 0.3663 VOL/VOL
WILTING POINT = 0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000000100000 CM/SEC
LINER LEAKAGE FRACTION = 0.01000000

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER = 87.21
TOTAL AREA OF COVER = 1650000. SQ FT
EVAPORATIVE ZONE DEPTH = 28.00 INCHES
UPPER LIMIT VEG. STORAGE = 10.3210 INCHES
INITIAL VEG. STORAGE = 3.9200 INCHES
INITIAL SNOW WATER CONTENT = 0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN
SOIL AND WASTE LAYERS = 58.8600 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

USER SPECIFIED RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR MILFORD UTAH

MAXIMUM LEAF AREA INDEX = 1.60
START OF GROWING SEASON (JULIAN DATE) = 138
END OF GROWING SEASON (JULIAN DATE) = 276

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
26.40	32.10	38.20	46.30	55.90	65.80
74.30	72.10	62.60	50.30	36.80	28.20

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MONTHLY TOTALS FOR YEAR 1988

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.60	0.50	0.02	0.78	1.27	1.40
	0.64	1.70	1.06	0.10	1.04	0.85
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	1.003	1.175	0.020	0.276	0.569	2.174
(INCHES)	0.834	1.644	1.388	0.100	0.306	0.395
LATERAL DRAINAGE FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 4 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 7 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

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ANNUAL TOTALS FOR YEAR 1988

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	10.96	1507000.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	9.885	1359170.	90.19
LATERAL DRAINAGE FROM LAYER 3	0.0000	0.	0.00
PERCOLATION FROM LAYER 4	0.0000	0.	0.00
PERCOLATION FROM LAYER 7	0.0000	0.	0.00
CHANGE IN WATER STORAGE	1.075	147830.	9.81

SOIL WATER AT START OF YEAR	58.86	8093250.	
SOIL WATER AT END OF YEAR	59.94	8241080.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	1.	0.00

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MONTHLY TOTALS FOR YEAR 1990

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.11	0.38	0.57	0.80	0.85	1.13
	1.91	0.80	1.69	1.82	1.43	0.90
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.007	0.027
	0.000	0.000	0.000	0.029	0.000	0.000
EVAPOTRANSPIRATION	0.788	1.136	0.566	0.413	1.864	0.758
(INCHES)	2.272	0.908	1.597	1.707	1.245	0.648
LATERAL DRAINAGE FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 4 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 7 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

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ANNUAL TOTALS FOR YEAR 1990

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	13.39	1841125.	100.00
RUNOFF	0.063	8647.	0.47

EVAPOTRANSPIRATION	13.902	1911521.	103.82
LATERAL DRAINAGE FROM LAYER 3	0.0000	0.	0.00
PERCOLATION FROM LAYER 4	0.0000	0.	0.00
PERCOLATION FROM LAYER 7	0.0000	0.	0.00
CHANGE IN WATER STORAGE	-0.575	-79043.	-4.29
SOIL WATER AT START OF YEAR	59.94	8241080.	
SOIL WATER AT END OF YEAR	59.36	8162037.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 1991

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.22	0.45	1.40	0.01	0.49	0.05
	1.20	1.18	1.32	1.41	1.58	1.43
RUNOFF (INCHES)	0.018	0.000	0.008	0.000	0.000	0.000
	0.000	0.000	0.008	0.000	0.040	0.000
EVAPOTRANSPIRATION	1.306	0.588	1.407	0.366	0.094	0.384
(INCHES)	0.822	1.620	1.312	0.266	1.047	0.858
LATERAL DRAINAGE FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 4 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 7 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00

ON LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

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ANNUAL TOTALS FOR YEAR 1991

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	11.74	1614250.	100.00
RUNOFF	0.074	10242.	0.63
EVAPOTRANSPIRATION	10.071	1384707.	85.78
LATERAL DRAINAGE FROM LAYER 3	0.0000	0.	0.00
PERCOLATION FROM LAYER 4	0.0000	0.	0.00
PERCOLATION FROM LAYER 7	0.0000	0.	0.00
CHANGE IN WATER STORAGE	1.595	219302.	13.59
SOIL WATER AT START OF YEAR	59.36	8162037.	
SOIL WATER AT END OF YEAR	60.84	8365727.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.11	15612.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 1992

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	0.82	1.54	1.85	0.11	2.33	0.29
	2.20	1.26	0.90	1.24	0.27	2.29
RUNOFF (INCHES)	0.000	0.001	0.000	0.000	0.017	0.000
	0.075	0.000	0.000	0.000	0.000	0.002
EVAPOTRANSPIRATION	0.843	1.590	1.879	1.221	1.556	1.145
(INCHES)	3.021	0.936	1.226	0.371	0.440	1.060
LATERAL DRAINAGE FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 4 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 7 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON 0.00 0.00 0.00 0.00 0.00 0.00
LAYER 4 (INCHES) 0.00 0.00 0.00 0.00 0.00 0.00

STD. DEV. OF DAILY HEAD 0.00 0.00 0.00 0.00 0.00 0.00
ON LAYER 4 (INCHES) 0.00 0.00 0.00 0.00 0.00 0.00

AVG. DAILY HEAD ON 0.00 0.00 0.00 0.00 0.00 0.00
LAYER 7 (INCHES) 0.00 0.00 0.00 0.00 0.00 0.00

STD. DEV. OF DAILY HEAD 0.00 0.00 0.00 0.00 0.00 0.00
ON LAYER 7 (INCHES) 0.00 0.00 0.00 0.00 0.00 0.00

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ANNUAL TOTALS FOR YEAR 1992

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	15.10	2076250.	100.00
RUNOFF	0.095	13106.	0.63
EVAPOTRANSPIRATION	15.290	2102365.	101.26
LATERAL DRAINAGE FROM LAYER 3	0.0000	0.	0.00
PERCOLATION FROM LAYER 4	0.0000	0.	0.00
PERCOLATION FROM LAYER 7	0.0000	0.	0.00
CHANGE IN WATER STORAGE	-0.285	-39220.	-1.89
SOIL WATER AT START OF YEAR	60.84	8365727.	
SOIL WATER AT END OF YEAR	60.66	8341379.	
SNOW WATER AT START OF YEAR	0.11	15612.	
SNOW WATER AT END OF YEAR	0.01	740.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 1993

JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC

PRECIPITATION (INCHES) 5.31 3.73 0.73 0.59 1.62 0.12
0.01 1.79 0.83 1.43 1.08 0.42

RUNOFF (INCHES) 0.284 0.490 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.000

EVAPOTRANSPIRATION 0.950 1.449 1.728 1.303 0.837 0.996
(INCHES) 1.475 1.277 1.048 1.531 1.219 0.369

LATERAL DRAINAGE FROM 0.0000 0.0000 0.0000 0.0000 0.0001 0.0001

LAYER 3 (INCHES)	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0655	0.1240	0.1349	0.1326
LAYER 4 (INCHES)	0.1371	0.1357	0.1292	0.1309	0.1239	0.1250
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 7 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.00	0.64	2.62	3.36	3.60
LAYER 4 (INCHES)	3.59	3.43	3.18	2.88	2.55	2.21
STD. DEV. OF DAILY HEAD	0.00	0.00	0.69	0.35	0.12	0.03
ON LAYER 4 (INCHES)	0.03	0.06	0.08	0.09	0.10	0.10
AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

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ANNUAL TOTALS FOR YEAR 1993

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	17.66	2428250.	100.00
RUNOFF	0.774	106369.	4.38
EVAPOTRANSPIRATION	14.183	1950185.	80.31
LATERAL DRAINAGE FROM LAYER 3	0.0005	69.	0.00
PERCOLATION FROM LAYER 4	1.2386	170301.	7.01
PERCOLATION FROM LAYER 7	0.0000	0.	0.00
CHANGE IN WATER STORAGE	2.703	371627.	15.30
SOIL WATER AT START OF YEAR	60.66	8341379.	
SOIL WATER AT END OF YEAR	63.37	8713746.	
SNOW WATER AT START OF YEAR	0.01	740.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1988 THROUGH 1993

JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC

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PRECIPITATION							
TOTALS		2.01	1.32	0.91	0.46	1.31	0.60
		1.19	1.35	1.16	1.20	1.08	1.18
STD. DEVIATIONS		1.86	1.43	0.72	0.37	0.71	0.62
		0.90	0.40	0.35	0.65	0.51	0.72
RUNOFF							
TOTALS		0.060	0.098	0.002	0.000	0.005	0.005
		0.015	0.000	0.002	0.006	0.008	0.000
STD. DEVIATIONS		0.125	0.219	0.004	0.000	0.007	0.012
		0.034	0.000	0.003	0.013	0.018	0.001
EVAPOTRANSPIRATION							
TOTALS		0.978	1.188	1.120	0.716	0.984	1.091
		1.685	1.277	1.315	0.795	0.852	0.666
STD. DEVIATIONS		0.202	0.385	0.798	0.502	0.722	0.670
		0.954	0.355	0.202	0.761	0.446	0.298
LATERAL DRAINAGE FROM LAYER 3							
TOTALS		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM LAYER 4							
TOTALS		0.0000	0.0000	0.0131	0.0248	0.0270	0.0265
		0.0274	0.0271	0.0258	0.0262	0.0248	0.0250
STD. DEVIATIONS		0.0000	0.0000	0.0293	0.0555	0.0603	0.0593
		0.0613	0.0607	0.0578	0.0585	0.0554	0.0559
PERCOLATION FROM LAYER 7							
TOTALS		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1988 THROUGH 1993

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	13.77	(2.695)	1893375.	100.00

RUNOFF	0.201	(0.322)	27673.	1.46
EVAPOTRANSPIRATION	12.666	(2.509)	1741590.	91.98
LATERAL DRAINAGE FROM LAYER 3	0.0001	(0.0002)	14.	0.00
PERCOLATION FROM LAYER 4	0.2477	(0.5539)	34060.	1.80
PERCOLATION FROM LAYER 7	0.0000	(0.0000)	0.	0.00
CHANGE IN WATER STORAGE	0.903	(1.355)	124099.	6.55

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PEAK DAILY VALUES FOR YEARS 1988 THROUGH 1993

	(INCHES)	(CU. FT.)
PRECIPITATION	1.33	182875.0
RUNOFF	0.209	28712.2
LATERAL DRAINAGE FROM LAYER 3	0.0000	0.3
PERCOLATION FROM LAYER 4	0.0044	609.1
HEAD ON LAYER 4	3.6	
PERCOLATION FROM LAYER 7	0.0000	0.0
HEAD ON LAYER 7	0.0	
SNOW WATER	2.53	348554.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3469

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1354

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FINAL WATER STORAGE AT END OF YEAR 1993

LAYER	(INCHES)	(VOL/VOL)
1	0.92	0.1529
2	7.95	0.1892
3	1.85	0.1541
4	5.16	0.4300
5	7.96	0.1658
6	36.96	0.1400
7	2.58	0.4300
SNOW WATER	0.00	

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WHITE MESA TAILINGS FACILITY
CELL 4, DRY, WITHOUT LAYER 7 PVC LINER
BLANDING CLIMATE DATA

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POOR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS = 6.00 INCHES
POROSITY = 0.5010 VOL/VOL
FIELD CAPACITY = 0.2837 VOL/VOL
WILTING POINT = 0.1353 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000342000014 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS = 42.00 INCHES
POROSITY = 0.3325 VOL/VOL
FIELD CAPACITY = 0.2173 VOL/VOL
WILTING POINT = 0.1361 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000006000000 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS = 12.00 INCHES
POROSITY = 0.3573 VOL/VOL
FIELD CAPACITY = 0.1127 VOL/VOL
WILTING POINT = 0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0600 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000050000002 CM/SEC
SLOPE = 0.57 PERCENT
DRAINAGE LENGTH = 1750.0 FEET

LAYER 4

BARRIER SOIL LINER

THICKNESS = 12.00 INCHES
POROSITY = 0.4300 VOL/VOL
FIELD CAPACITY = 0.3663 VOL/VOL
WILTING POINT = 0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000000100000 CM/SEC

LAYER 5

VERTICAL PERCOLATION LAYER

THICKNESS = 48.00 INCHES

POROSITY = 0.3325 VOL/VOL
FIELD CAPACITY = 0.2173 VOL/VOL
WILTING POINT = 0.1361 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000006000000 CM/SEC

LAYER 6

VERTICAL PERCOLATION LAYER

THICKNESS = 264.00 INCHES
POROSITY = 0.3325 VOL/VOL
FIELD CAPACITY = 0.2173 VOL/VOL
WILTING POINT = 0.1361 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000006000000 CM/SEC

LAYER 7

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

THICKNESS = 6.00 INCHES
POROSITY = 0.4300 VOL/VOL
FIELD CAPACITY = 0.3663 VOL/VOL
WILTING POINT = 0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000000100000 CM/SEC
LINER LEAKAGE FRACTION = 1.00000000

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER = 87.21
TOTAL AREA OF COVER = 1650000. SQ FT
EVAPORATIVE ZONE DEPTH = 28.00 INCHES
UPPER LIMIT VEG. STORAGE = 10.3210 INCHES
INITIAL VEG. STORAGE = 3.9200 INCHES
INITIAL SNOW WATER CONTENT = 0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN
SOIL AND WASTE LAYERS = 58.8600 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

USER SPECIFIED RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR MILFORD UTAH

MAXIMUM LEAF AREA INDEX = 1.60
START OF GROWING SEASON (JULIAN DATE) = 138
END OF GROWING SEASON (JULIAN DATE) = 276

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
26.40	32.10	38.20	46.30	55.90	65.80
74.30	72.10	62.60	50.30	36.80	28.20

MONTHLY TOTALS FOR YEAR 1988

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.60	0.50	0.02	0.78	1.27	1.40
	0.64	1.70	1.06	0.10	1.04	0.85
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	1.003	1.175	0.020	0.276	0.569	2.174
(INCHES)	0.834	1.644	1.388	0.100	0.306	0.395
LATERAL DRAINAGE FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 4 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 7 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 1988

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	10.96	1507000.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	9.885	1359170.	90.19
LATERAL DRAINAGE FROM LAYER 3	0.0000	0.	0.00
PERCOLATION FROM LAYER 4	0.0000	0.	0.00
PERCOLATION FROM LAYER 7	0.0000	0.	0.00
CHANGE IN WATER STORAGE	1.075	147830.	9.81

SOIL WATER AT START OF YEAR 58.86 8093250.

SOIL WATER AT END OF YEAR 59.94 8241080.

SNOW WATER AT START OF YEAR 0.00 0.

SNOW WATER AT END OF YEAR 0.00 0.

ANNUAL WATER BUDGET BALANCE 0.00 1. 0.00

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MONTHLY TOTALS FOR YEAR 1990

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.11	0.38	0.57	0.80	0.85	1.13
	1.91	0.80	1.69	1.82	1.43	0.90
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.007	0.027
	0.000	0.000	0.000	0.029	0.000	0.000
EVAPOTRANSPIRATION	0.788	1.136	0.566	0.413	1.864	0.758
(INCHES)	2.272	0.908	1.597	1.707	1.245	0.648
LATERAL DRAINAGE FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 4 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 7 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

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ANNUAL TOTALS FOR YEAR 1990

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	13.39	1841125.	100.00
RUNOFF	0.063	8647.	0.47

EVAPOTRANSPIRATION	13.902	1911521.	103.82
LATERAL DRAINAGE FROM LAYER 3	0.0000	0.	0.00
PERCOLATION FROM LAYER 4	0.0000	0.	0.00
PERCOLATION FROM LAYER 7	0.0000	0.	0.00
CHANGE IN WATER STORAGE	-0.575	-79043.	-4.29
SOIL WATER AT START OF YEAR	59.94	8241080.	
SOIL WATER AT END OF YEAR	59.36	8162037.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 1991

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.22	0.45	1.40	0.01	0.49	0.05
	1.20	1.18	1.32	1.41	1.58	1.43
RUNOFF (INCHES)	0.018	0.000	0.008	0.000	0.000	0.000
	0.000	0.000	0.008	0.000	0.040	0.000
EVAPOTRANSPIRATION	1.306	0.588	1.407	0.366	0.094	0.384
(INCHES)	0.822	1.620	1.312	0.266	1.047	0.858
LATERAL DRAINAGE FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 4 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 7 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

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ANNUAL TOTALS FOR YEAR 1991

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	11.74	1614250.	100.00
RUNOFF	0.074	10242.	0.63
EVAPOTRANSPIRATION	10.071	1384707.	85.78
LATERAL DRAINAGE FROM LAYER 3	0.0000	0.	0.00
PERCOLATION FROM LAYER 4	0.0000	0.	0.00
PERCOLATION FROM LAYER 7	0.0000	0.	0.00
CHANGE IN WATER STORAGE	1.595	219302.	13.59
SOIL WATER AT START OF YEAR	59.36	8162037.	
SOIL WATER AT END OF YEAR	60.84	8365727.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.11	15612.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 1992

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	0.82	1.54	1.85	0.11	2.33	0.29
	2.20	1.26	0.90	1.24	0.27	2.29
RUNOFF (INCHES)	0.000	0.001	0.000	0.000	0.017	0.000
	0.075	0.000	0.000	0.000	0.000	0.002
EVAPOTRANSPIRATION	0.843	1.590	1.879	1.221	1.556	1.145
(INCHES)	3.021	0.936	1.226	0.371	0.440	1.060
LATERAL DRAINAGE FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 4 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 7 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 1992

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	15.10	2076250.	100.00
RUNOFF	0.095	13106.	0.63
EVAPOTRANSPIRATION	15.290	2102365.	101.26
LATERAL DRAINAGE FROM LAYER 3	0.0000	0.	0.00
PERCOLATION FROM LAYER 4	0.0000	0.	0.00
PERCOLATION FROM LAYER 7	0.0000	0.	0.00
CHANGE IN WATER STORAGE	-0.285	-39220.	-1.89
SOIL WATER AT START OF YEAR	60.84	8365727.	
SOIL WATER AT END OF YEAR	60.66	8341379.	
SNOW WATER AT START OF YEAR	0.11	15612.	
SNOW WATER AT END OF YEAR	0.01	740.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 1993

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	5.31	3.73	0.73	0.59	1.62	0.12
	0.01	1.79	0.83	1.43	1.08	0.42
RUNOFF (INCHES)	0.284	0.490	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.950	1.449	1.728	1.303	0.837	0.996
(INCHES)	1.475	1.277	1.048	1.531	1.219	0.369

LATERAL DRAINAGE FROM	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001
LAYER 3 (INCHES)	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000
PERCOLATION FROM	0.0000	0.0000	0.0655	0.1240	0.1349	0.1326
LAYER 4 (INCHES)	0.1371	0.1357	0.1292	0.1309	0.1239	0.1250
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 7 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.00	0.64	2.62	3.36	3.60
LAYER 4 (INCHES)	3.59	3.43	3.18	2.88	2.55	2.21
STD. DEV. OF DAILY HEAD	0.00	0.00	0.69	0.35	0.12	0.03
ON LAYER 4 (INCHES)	0.03	0.06	0.08	0.09	0.10	0.10
AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 7 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 7 (INCHES)	0.00	0.00	0.00	0.0	0.00	0.00

****

ANNUAL TOTALS FOR YEAR 1993

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	17.66	2428250.	100.00
RUNOFF	0.774	106369.	4.38
EVAPOTRANSPIRATION	14.183	1950185.	80.31
LATERAL DRAINAGE FROM LAYER 3	0.0005	69.	0.00
PERCOLATION FROM LAYER 4	1.2386	170301.	7.01
PERCOLATION FROM LAYER 7	0.0000	0.	0.00
CHANGE IN WATER STORAGE	2.703	371627.	15.30
SOIL WATER AT START OF YEAR	60.66	8341379.	
SOIL WATER AT END OF YEAR	63.37	8713746.	
SNOW WATER AT START OF YEAR	0.01	740.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0	0.00

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1988 THROUGH 1993

JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC

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PRECIPITATION

TOTALS 2.01 1.32 0.91 0.46 1.31 0.60
1.19 1.35 1.16 1.20 1.08 1.18

STD. DEVIATIONS 1.86 1.43 0.72 0.37 0.71 0.62
0.90 0.40 0.35 0.65 0.51 0.72

RUNOFF

TOTALS 0.060 0.098 0.002 0.000 0.005 0.005
0.015 0.000 0.002 0.006 0.008 0.000

STD. DEVIATIONS 0.125 0.219 0.004 0.000 0.007 0.012
0.034 0.000 0.003 0.013 0.018 0.001

EVAPOTRANSPIRATION

TOTALS 0.978 1.188 1.120 0.716 0.984 1.091
1.685 1.277 1.315 0.795 0.852 0.666

STD. DEVIATIONS 0.202 0.385 0.798 0.502 0.722 0.670
0.954 0.355 0.202 0.761 0.446 0.298

LATERAL DRAINAGE FROM LAYER 3

TOTALS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

STD. DEVIATIONS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

PERCOLATION FROM LAYER 4

TOTALS 0.0000 0.0000 0.0131 0.0248 0.0270 0.0265
0.0274 0.0271 0.0258 0.0262 0.0248 0.0250

STD. DEVIATIONS 0.0000 0.0000 0.0293 0.0555 0.0603 0.0593
0.0613 0.0607 0.0578 0.0585 0.0554 0.0559

PERCOLATION FROM LAYER 7

TOTALS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

STD. DEVIATIONS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1988 THROUGH 1993

(INCHES) (CU. FT.) PERCENT

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PRECIPITATION	13.77	(2.695)	1893375.	100.00
RUNOFF	0.201	(0.322)	27673.	1.46
EVAPOTRANSPIRATION	12.666	(2.509)	1741590.	91.98
LATERAL DRAINAGE FROM LAYER 3	0.0001	(0.0002)	14.	0.00
PERCOLATION FROM LAYER 4	0.2477	(0.5539)	34060.	1.80
PERCOLATION FROM LAYER 7	0.0000	(0.0000)	0.	0.00
CHANGE IN WATER STORAGE	0.903	(1.355)	124099.	6.55

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PEAK DAILY VALUES FOR YEARS 1988 THROUGH 1993

	(INCHES)	(CU. FT.)
PRECIPITATION	1.33	182875.0
RUNOFF	0.209	28712.2
LATERAL DRAINAGE FROM LAYER 3	0.0000	0.3
PERCOLATION FROM LAYER 4	0.0044	609.1
HEAD ON LAYER 4	3.6	
PERCOLATION FROM LAYER 7	0.0000	0.0
HEAD ON LAYER 7	0.0	
SNOW WATER	2.53	348554.3
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3469	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1354	

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FINAL WATER STORAGE AT END OF YEAR 1993

LAYER	(INCHES)	(VOL/VOL)
1	0.92	0.1529
2	7.95	0.1892
3	1.85	0.1541
4	5.16	0.4300
5	7.96	0.1658
6	36.96	0.1400
7	2.58	0.4300
SNOW WATER	0.00	

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APPENDIX D

PERCHED WATER SEEPAGE VELOCITY, TRAVEL TIME, FLUX CALCULATIONS

TITAN Environmental

By JFL Date 7/20/94 Subject MOISTURE RETENTION Sheet No 1 of 2
Chkd by RWW Date 7/22/94 BENEATH WET CELL Proj No 4111-001
1/5" x 1/5"

OBJECTIVE TO ESTIMATE THE AMOUNT OF MOISTURE STORAGE IN THE UNSATURATED PORTION OF THE DAKOTA/ BURRO CANYON SANDSTONE BENEATH A WET TAILINGS DISPOSAL CELL. ALSO, GIVEN THE HELP MODEL RESULTS, AN ESTIMATE OF TIME FOR CONSTITUENTS TO MIGRATE FROM THE BOTTOM OF A CELL TO THE PERCHED WATER TABLE CAN BE MADE.

TABLE 1 PRESENTS THE RESULTS OF MOISTURE RETENTION TESTS FOR THE DAKOTA / BURRO CANYON. THIS TABLE INDICATES THAT 5.48 % MOISTURE IS RETAINED BY THESE UNITS UNDER GRAVITY DRAINAGE.

FIGURES 1 THRU 3 ARE WELL LOGS FOR WELLS WMMW-17, -18, AND -19. THESE DATA INDICATE THAT THE UNSATURATED ZONE HAS THE FOLLOWING THICKNESS:

WELL #	SURFACE ELEVATION	WATER ELEVATION	UNSATURATED THICKNESS
WMMW-17	5575.06	5488.56	86.5 Ft
WMMW-18	5657.58	5565.58	92.0 Ft.
WMMW-19	5655.05	5505.05	150 Ft.
		AVG:	109.5 Ft

AS SHOWN IN THE HELP MODEL - THE AREA OF THE WET CELL (CELL #3) IS APPROXIMATELY: 3,150,000 Ft^2. THE TOTAL VOLUME OF OF MOISTURE STORAGE BENEATH THIS CELL WOULD BE ESTIMATED AT:

$$3{,}150{,}000\ Ft^2 \times 109.5\ Ft \times 0.0548 = \underline{18{,}901{,}890\ Ft^3}$$

BASED ON THE HELP MODEL RESULTS (TABLE 2) THE ESTIMATED INFILTRATION INTO THE UNSATURATED ZONE FOR A WET CELL (USING 20 YEAR SIMULATION DATA FOR GRAND JUNCTION, CO). IS:

CELL W/ LEAKY LINER : 120,661 Ft^3/yr. (AVG)

CELL W/O LINER : 390,507 Ft^3/yr. (AVG)

TITAN Environmental

By JFL Date 7/20/94 Subject MOISTURE RETENTION Sheet No 2 of 2
Chkd by RLM Date 7/22/94 BENEATH WET CELL Proj No 4111-001
1/5" x 1/5"

THE ESTIMATE TIME TO FILL THE AVAILABLE STORAGE IN THE DAKOTA/BURRO CANYON SANDSTONE (18,901,890 Ft^3) IS:

CELL W/ LEAKY LINER: $\frac{18,901,890 \ Ft^3}{120,661 \ Ft^3/yr} = \sim 156$ YEARS

CELL W/O LINER $\frac{18,901,890 \ Ft^3}{390,507 \ Ft^3/yr} = \sim 48$ YEARS.

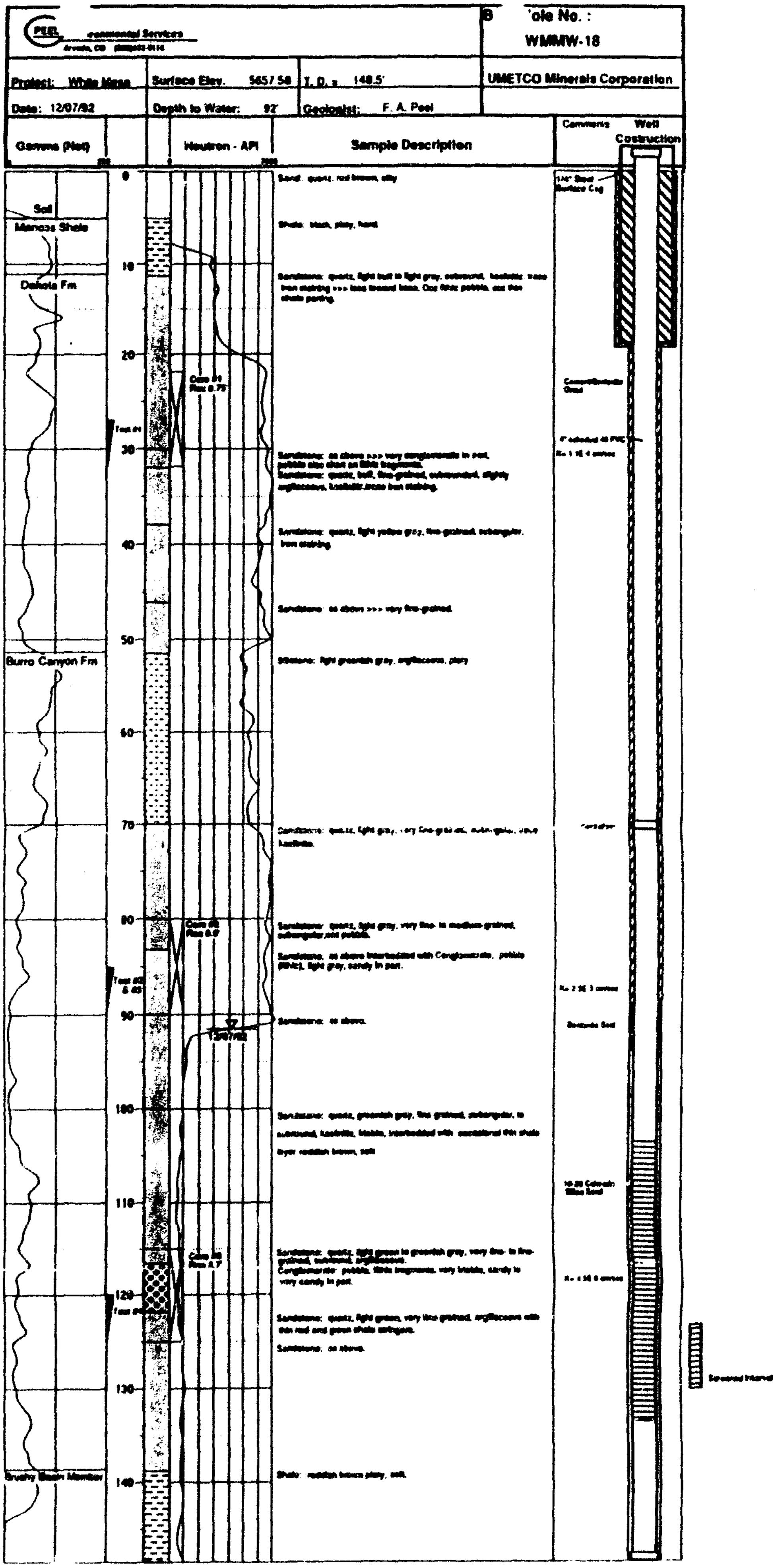
THEREFORE THE ESTIMATE TIME TO REACH THE PERCHED WATER OF THE DAKOTA/BURRO CANYON RANGES FROM 50 TO 150 YEARS.

Table 1

Properties of the Dakota/Burro Canyon Sandstones

Well No. and Sample Interval		Moisture Content (Percent)	Moisture Content Volumetric	Dry Unit Weight (lbs/cu ft)	Porosity (Percent)	Particle Sp. Gr.	Saturation (Percent)	Retained Moisture	Liquid Limit	Plastic Limit	Plasticity Index	Rock Type	Formation
WMMW-16	25.4' - 38.4'	1.51	3.3	135.2	17.9	2.64	18.2	5.1				Sandstone	Dakota
WMMW-16	37.8' - 38.4'	0.4	0.8	127.4	22.4	63	3.7	6.3				Sandstone	Dakota
WMMW-16	45.0' - 45.5'	5.6	12.6	140.9	16.4	2.7	77.2		29.6	15.4	14.2	Sandy Mudstone	Burro Canyon
WMMW-16	47.5' - 48.0'	2.56	5.9	142.8	12	2.6	48.9	4.37				Sandstone	Burro Canyon
WMMW-16	53.5' - 54.1'	0.68	1.4	129	19.9	2.58	7.1	6.38				Sandstone	Burro Canyon
WMMW-16	60.5' - 61.0'	0.11	0.2	117.9	27.3	2.61	0.8	9.89				Sandstone	Burro Canyon
WMMW-16	65.5' - 66.0'	2.62	5.5	131.5	19.3	2.62	28.2	7.13				Sandstone	Burro Canyon
WMMW-16	73.0' - 73.5'	0.13	0.3	130.3	20.6	2.63	1.3	5.5				Sandstone	Burro Canyon
WMMW-16	82.0' - 82.4'	0.05	0.1	134.3	18.5	2.64	0.6	4.78				Sandstone	Burro Canyon
WMMW-16	90.0' - 90.7	0.12	0.3	161.5	2	2.64	12.8	0.85				Sandstone	Burro Canyon
WMMW-16	91.1' - 91.4'	5.2	9.8	118.1	29.1	2.67	33.8		33.7	16.2	17.5	Claystone	Burro Canyon
WMMW-17	27.0' - 27.5'	0.29	0.6	138.8	13.4	2.57	4.8	5.11				Sandstone	Dakota
WMMW-17	49.0' - 49.5	3.62	7.1	121.9	26	2.64	27.2	9.6				Sandstone	Dakota
WMMW-17	104.0' - 104.5'	0.17	0.4	161.4	1.7	2.67	26.6	0.81				Sandstone	Burro Canyon
Average:		1.65	3.4	135	17.6	2.63	21	5.48					

Figure 1



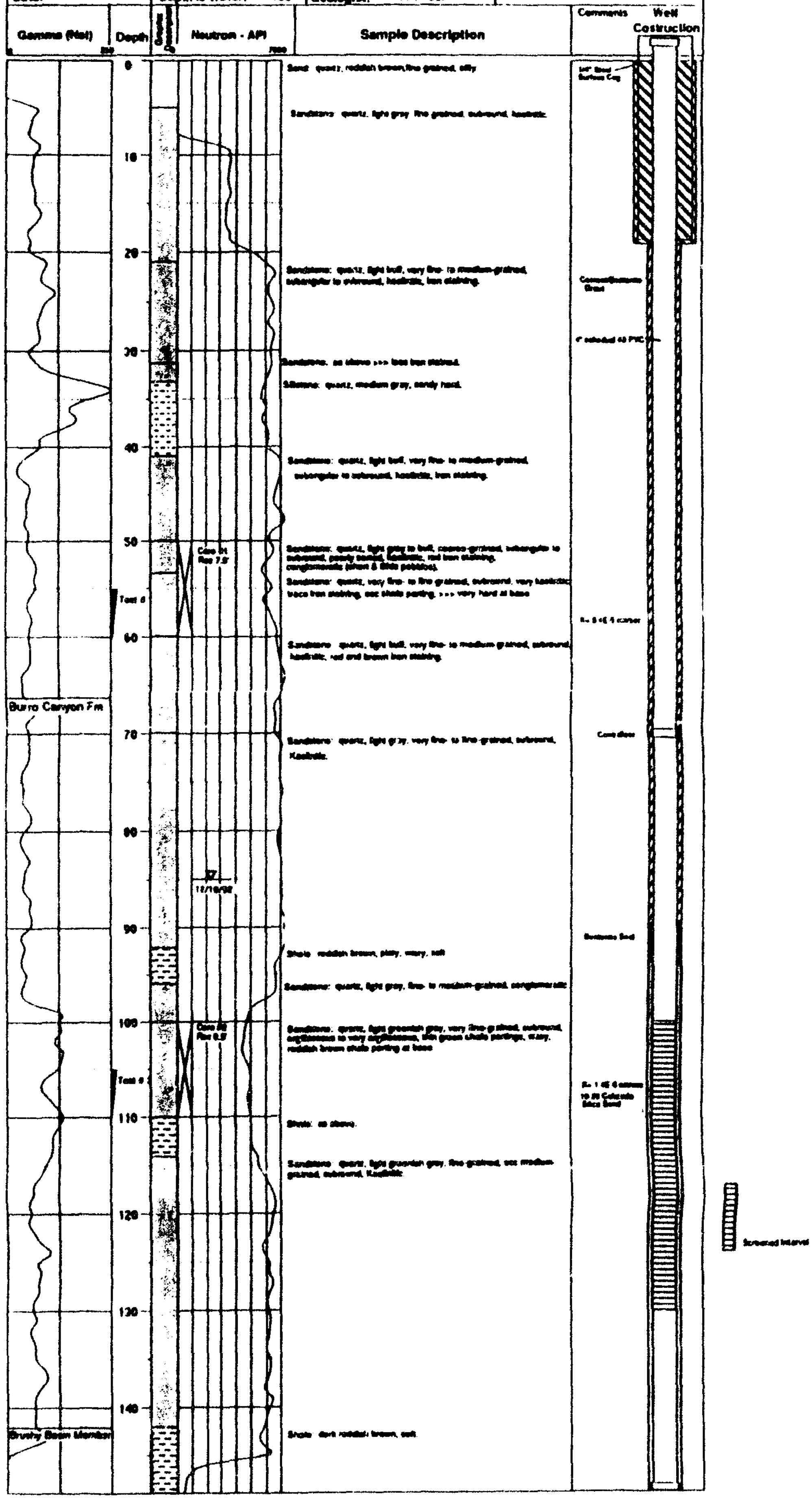
✓ FAW 7/22/94

FIGURE 2

✓ FAW 7/22/94

PEEL Environmental Services

Project: White Mesa	**Surface Elev.** 5655.05	**T.D. =** 149	**Borehole No.:** WMMW-19
Date: 12/07/92	**Depth to Water:** 150	**Geologist:** F. A. Peel	**UMETCO Minerals Corporation**



Note: well was logged before the well recharged

Figure 3

7/22/94

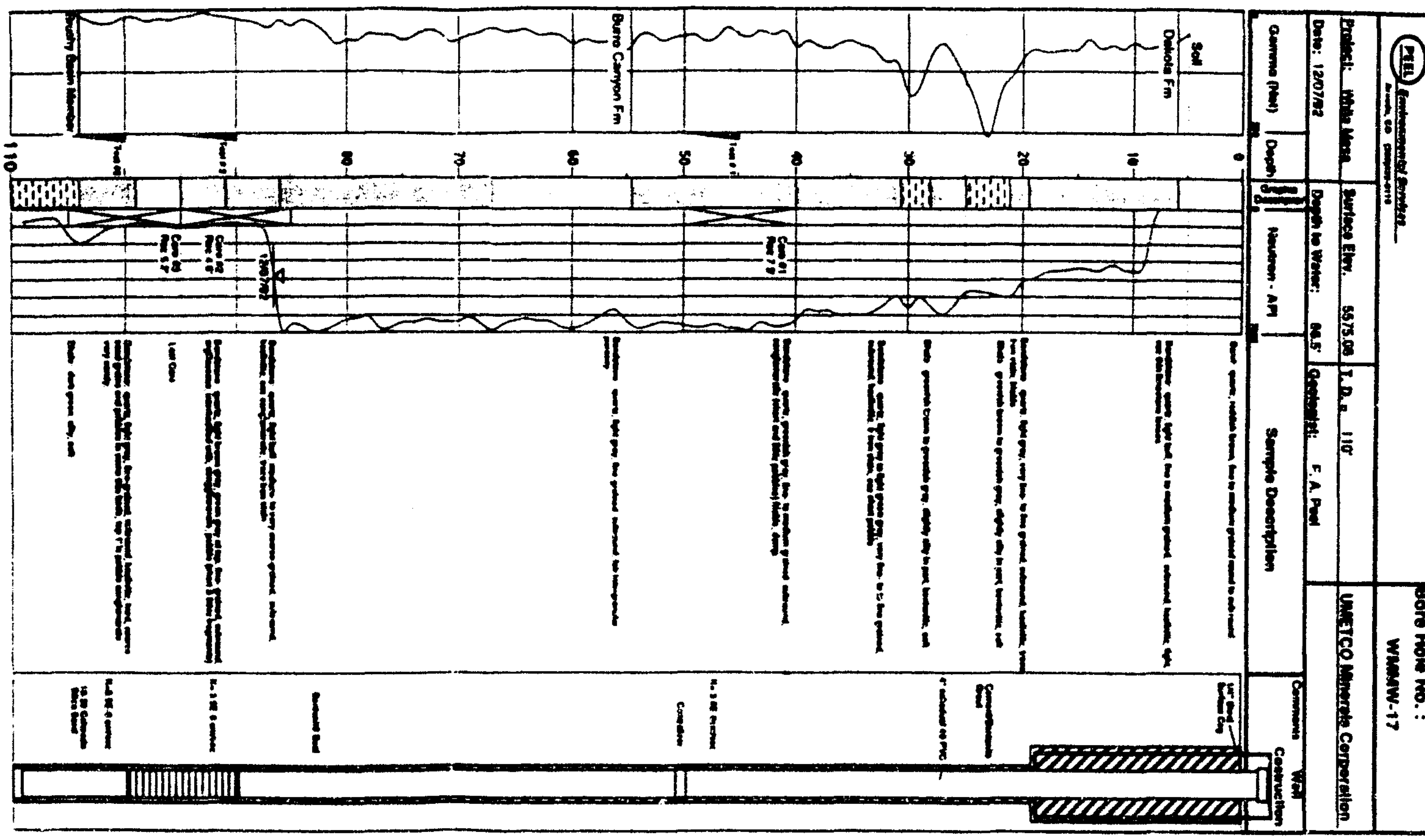


Table 2
HELP Model Summaries for Cells 3 and 4
White Mesa Tailings Facility, Blanding, Utah

HELP Run	Precipitation (inches)	Runoff (inches)	Evapotranspiration (inches)	Lateral Drainage from Layer 3 (ft^3)	Percolation from Layer 4 (ft^3)	Percolation from Layer 7 (ft^3)	Change in Water Storage
Cell 3, saturated with PVC liner, Blanding climate data	13.77	0.2	12.67	26	64989	137415	99352
Cell 3, saturated, no liner, Blanding climate data	13.77	0.2	12.67	26	64989	1562025	-1325258
Cell 3, saturated, with PVC liner and 20 yrs Grand Junction climate data	7.94	0	7.93	0	0	120661	-117348
Cell 3, saturated, no liner and 20 yrs Grand Junction climate data	7.94	0	7.93	0	0	390507	-387194
Cell 4, unsaturated with PVC liner, Blanding climate data	13.77	0.2	12.67	14	34060	0	124099
Cell 4, unsaturated, no liner, Blanding climate data	13.77	0.2	12.67	14	34060	0	124099

4 yrs of data

✓ TAM 7/22/94

CELLSUMXLS/07/20/94/pmw

TITAN Environmental

By JFL Date 7/20/94 Subject BURRO CANYON - SEEPAGE VELOCITY, TRAVEL TIME, FLUX Sheet No 1 of 3
Chkd by [initials] Date 7/22/94 Proj No 4111-001
1/5" × 1/5"

OBJECTIVE: TO CALCULATE SEEPAGE VELOCITY IN SATURATED PORTION OF BURRO CANYON FORMATION. ALSO, USE SEEPAGE VELOCITY TO ESTIMATE TRAVEL TIME FROM WHITE MESA SITE TO EDGE OF MESA, AND FLUX UNDER THE SITE.

SEEPAGE VELOCITY CALCULATION:

TABLE 1 SUMMARIZES HYDRAULIC CONDUCTIVITY FOR BURRO CANYON FORMATION. THE GEOMETRIC MEAN FOR THE BURRO CANYON HYDRAULIC CONDUCTIVITY IS 1.01E-5 cm/sec OR 10.5 FEET/YEAR.

TABLE 2 SUMMARIZES THE PHYSICAL PROPERTIES FOR THE BURRO CANYON. AS SHOWN, THE AVERAGE POROSITY IS 17.6 PERCENT.

FIGURE 1 PRESENTS A PERCHED WATER LEVEL MAP. BASED ON THIS FIGURE, THE HYDRAULIC GRADIENT WITHIN THE BURRO CANYON UNDER THE SITE IS 0.015 FEET/FOOT.

USING DARCY'S LAW:

$$\text{SEEPAGE VELOCITY} = \frac{Ki}{n}$$

K: HYDRAULIC CONDUCTIVITY

i = HYDRAULIC GRADIENT

n = POROSITY (EFFECTIVE)

BASED ON SITE DATA:

$$\text{SEEPAGE VELOCITY} = \frac{(10.5)(0.015)}{0.176} = \underline{0.89 \text{ FEET/YEAR}}$$

TITAN Environmental

By JTL Date 7/20/94 Subject Burro Canyon - Seepage Sheet No 2 of 3
Chkd by [initials] Date 7/22/94 Velocity, Travel Time, Flux Proj No 4111-001
1/5" x 1/5"

FLUX ESTIMATE

THE FLUX (VOLUMETRIC FLOW) WITHIN THE SATURATED PORTION OF THE BURRO CANYON CAN BE ESTIMATED USING THE AVERAGE VELOCITY (V=Ki) AND THE SATURATED FLOW FACE AREA BENEATH THE SITE.

THE SATURATED FLOW FACE AREA IS EQUAL TO THE SITE WIDTH (PERPENDICULAR TO FLOW) MULTIPLIED BY SATURATED THICKNESS.

FIGURE 2 SHOWS THE SATURATED THICKNESS OF THE PERCHED WATER WITHIN THE BURRO CANYON. IN THE CENTER OF THE SITE, THE SITE WIDTH IS 3800 FEET. THE SATURATED THICKNESS IS APPROXIMATELY 23 FEET (ESTIMATED OFF MAP)

THE FLOW FACE AREA IS : $3800 \times 23 = 87{,}400 \text{ Ft}^2$

THE AVERAGE FLOW VELOCITY IS $(V=Ki)$: $(10.5)(.015) = 0.16 \text{ Ft/yr}$

THE FLUX = $87{,}400 \times 0.16 = \underline{13{,}765.5 \text{ Ft}^3/\text{yr}}$

$= \underline{102{,}966 \text{ gallons/yr}}$

$= \underline{0.2 \text{ gallons/minute (gpm)}}$

TITAN Environmental

By JFL Date 7/20/94 Subject Burro Canyon - Seepage Velocity, Sheet No 3 of 3
Chkd by [signature] Date 7/22/94 Travel Time, Flux Proj No 4111 - 001
1/5" x 1/5"

TRAVEL TIME ESTIMATE:

TRAVEL TIME THROUGH THE SATURATED PORTION OF THE BURRO CANYON FROM THE WHITE MESA SITE TO THE ADJACENT CANYONS CAN BE ESTIMATED USING SEEPAGE VELOCITY AND DISTANCE FROM SITE TO CANYONS.

FIGURE 2 SHOWS THE SITE LAYOUT WITH RESPECT TO ADJACENT CORRAL & WESTWATER CANYONS. FIGURE 2 ALSO SHOWS DISTANCES FROM THE CENTER OF CELL #3 AT THE SITE TO DOWNGRADIENT EDGES OF CANYONS.

AS SHOWN THE DOWNGRADIENT DISTANCES FROM THE SITE RANGE FROM 8,000 TO 12,000 FEET.

TRAVEL TIME CAN BE ESTIMATED AS:

$$\text{TRAVEL TIME: GWTT} = \frac{\text{DISTANCE}}{\text{SEEPAGE VELOCITY}}$$

USING A SEEPAGE VELOCITY OF 0.89 FEET/YR.,

GWTT RANGES FROM ± 8,900 TO ± 13,400 YEARS.

Table ~~1~~ 2 — HYDRAULIC

✓ Prm 7/22/98

Summary of ~~Hydrologic~~ Properties
White Mesa Tailings Facility, Blanding, Utah

Boring/Well Location	Test Type	Interval (ft-ft)		Document Referenced		Hydraulic Conductivity (ft/yr)	Hydraulic Conductivity (cm/sec)
Soils							
6	Laboratory Test	9		D&M		1.2E+01	1.[illegible]E-05
7	Laboratory Test	4.5		D&M		1.0E+01	1.0E-05
10	Laboratory Test	4		D&M		1.2E+01	1.2E-05
12	Laboratory Test	9		D&M		1.4E+02	1.4E-04
16	Laboratory Test	4.5		D&M		2.2E+01	2.1E-05
17	Laboratory Test	4.5		D&M		9.3E+01	9.0E-05
19	Laboratory Test	4		D&M		7.0E+01	6.8E-05
22	Laboratory Test	4		D&M		3.9E+00	3.8E-06
				Geometric Mean		2.45E+01	2.37E-05
Dakota Sandstone							
No. 3	Injection Test	28-33		D&M	1	5.68E+02	5.49E-04
No. 3	Injection Test	33-42.5		D&M		2.80E+00	2.71E-06
No. 12	Injection Test	16-22.5		D&M		5.10E+00	4.93E-06
No. 12	Injection Test	22.5-37.5		D&M		7.92E+01	7.66E-05
No. 19	Injection Test	26-37.5		D&M		7.00E+00	6.77E-06
No. 19	Injection Test	37.5-52.5		D&M		9.44E+02	9.12E-04
				Geometric Mean		4.03E+01	3.89E-05
Burro Canyon Formation							
No. 3	Injection Test	42.5-52.5		D&M		5.80E+00	5.61E-06
No. 3	Injection Test	52.5-63		D&M		1.62E+01	1.57E-05
No. 3	Injection Test	63-72.5		D&M		5.30E+00	5.13E-06
No. 3	Injection Test	72.5-92.5		D&M		3.20E+00	3.09E-06
No. 3	Injection Test	92.5-107.5		D&M		4.90E+00	4.74E-06
No. 3	Injection Test	122.5-142		D&M		6.00E-01	5.80E-07
No. 9	Injection Test	27.5-42.5		D&M		2.70E+00	2.61E-06
No. 9	Injection Test	42.5-59		D&M		2.00E+00	1.93E-06
No. 9	Injection Test	59-82.5		D&M		7.00E-01	6.77E-07
No. 9	Injection Test	82.5-107.5		D&M		1.10E+00	1.06E-06
No. 9	Injection Test	107.5-132		D&M		3.00E-01	2.90E-07
No. 12	Injection Test	37.5-57.5		D&M		9.01E-01	8.70E-07
No. 12	Injection Test	57.5-82.5		D&M		1.40E+00	1.[illegible]E-06
No. 12	Injection Test	82.5-102.5		D&M		1.07E+01	1.03E-05
No. 28	Injection Test	76-87.5		D&M		4.30E+00	4.16E-06
No. 28	Injection Test	87.5-107.5		D&M		3.00E-01	2.90E-07
No. 28	Injection Test	107.5-132.5		D&M		2.00E-01	1.93E-07
WMMW1	7 Recovery	92-112		Peel	2	3.00E+00	2.9[illegible]E-06
WMMW3	7 Recovery	67-87		Peel		2.97E+00	2.87E-06
WMMW5	7 Recovery	95.5-133.5		H-E		1.3[illegible]E+01	1.2[illegible]E-05
WMMW5	7 Recovery	95.5-133.5		Peel		2.10E+01	2.03E-05
WMMW11	7 Recovery	90.7-130.4		H-E	3	1.23E+03	1.19E-03
WMMW11	7 Single well drawdown	90.7-130.4		Peel		1.63E+03	1.58E-03
WMMW12	7 Recovery	84-124		H-E		6.84E+01	6.61E-05
WMMW12	7 Recovery	84-124		Peel		6.84E+01	6.61E-05
WMMW14	Single well drawdown	90-120	5	H-E		1.21E+03	1.16E-03
WMMW14	Single well drawdown	90-120	6	H-E		4.02E+02	3.88E-04
WMMW15	Single well drawdown	99-129		H-E		3.65E+01	3.53E-05
WMMW15	7 Recovery	99-129		Peel		2.58E+01	2.19E-05

Table 4 Hydraulic

Summary of Hydrologic Properties
White Mesa Tailings Facility, Blanding, Utah
(Continued)

Ann 7/22/94

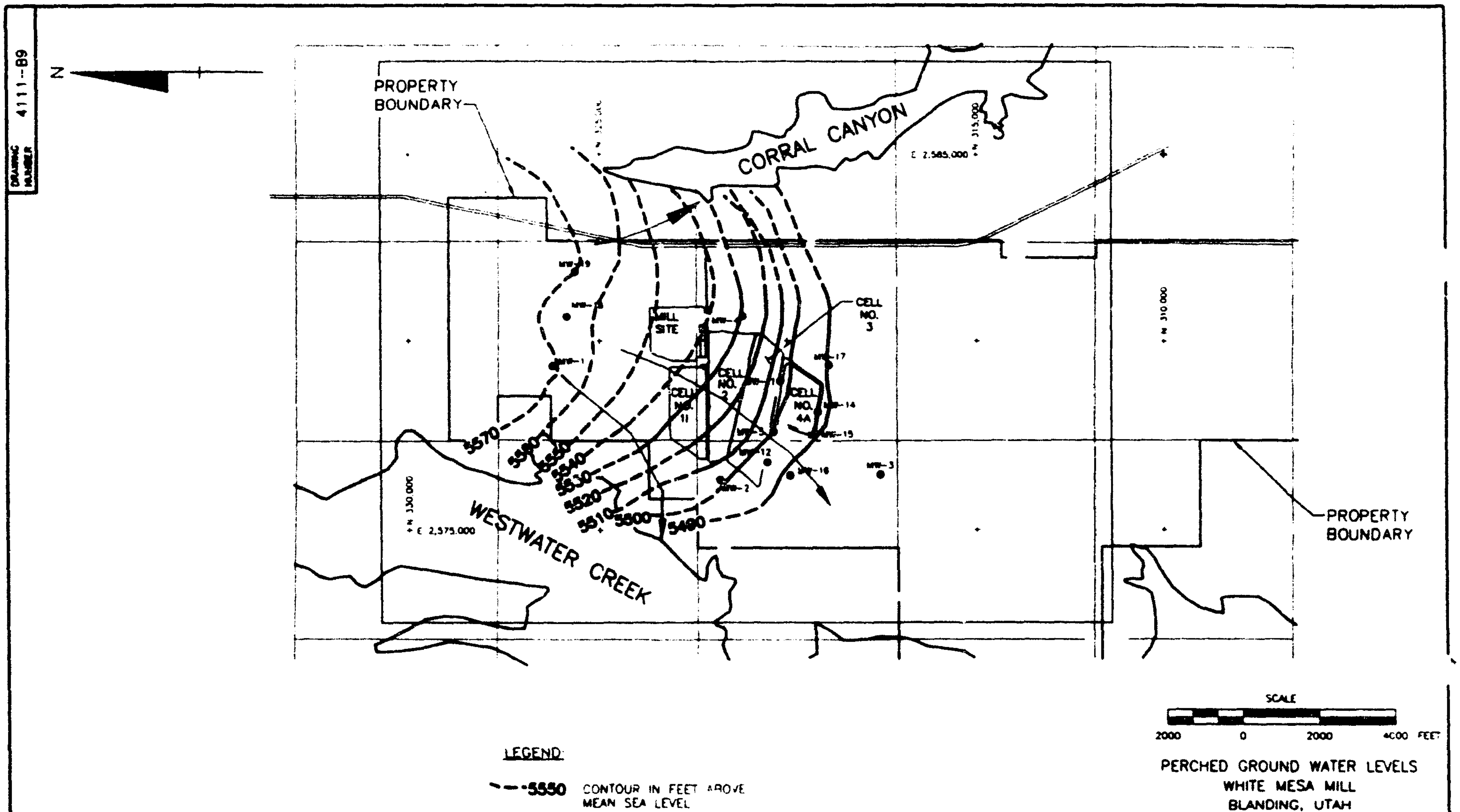
Boring/Well Location	Test Type	Interval (ft-ft)	Document Referenced	Hydraulic Conductivity (ft/yr)	Hydraulic Conductivity (cm/sec)
WMMW16	Injection Test	28.5-31.5	Peel	9.42E+02	9.10E-04
WMMW16	Injection Test	45.5-51.5	Peel	5.28E+01	5.10E-05
WMMW16	Injection Test	65.5-71.5	Peel	8.07E+01	7.80E-05
WMMW16	Injection Test	85.5-91.5	Peel	3.00E+01	2.90E-05
WMMW17	Injection Test	45-50	Peel	3.10E+00	3.00E-06
WMMW17	Injection Test	90-95	Peel	3.62E+00	3.50E-06
WMMW17	Injection Test	100-105	Peel	5.69E+00	5.50E-06
WMMW18	Injection Test	27-32	Peel	1.14E+02	1.10E-04
WMMW18	Injection Test	85-90	Peel	2.59E+01	2.50E-05
WMMW18	Injection Test	85-90	Peel	2.69E+01	2.60E-05
WMMW18	Injection Test	120-125	Peel	4.66E+00	4.50E-06
WMMW19	Injection Test	55-60	Peel	8.69E+00	8.40E-06
WMMW19	Injection Test	95-100	Peel	1.45E+00	1.40E-06
			Geometric mean	1.05E+01	1.01E-05
Brushy Basin Member					
Garfield County, Utah	Injection Test	NA	D'Appolonia (4b)	2.07E+00	2.00E-06
	Injection Test	NA	D'Appolonia	2.07E+01	2.00E-05
	Injection Test	NA	D'Appolonia	9.30E+00	9.00E-06
	Injection Test	NA	D'Appolonia	2.69E+01	2.60E-05
	Injection Test	NA	D'Appolonia	5.17E+01	5.00E-05
	Injection Test	NA	D'Appolonia	5.27E+01	5.10E-05
	Injection Test	NA	D'Appolonia	3.21E+01	3.10E-05
	Injection Test	NA	D'Appolonia	4.24E+01	4.10E-05
	Injection Test	NA	D'Appolonia	1.00E+00	1.00E-06
	Injection Test	NA	D'Appolonia	2.89E+01	2.80E-05
			Geometric Mean	1.65E+01	1.60E-05
Entrada/Navajo Sandstones					
WW-1	Recovery		D'Appolonia (4a)	3.80E+02	3.67E-04
WW-1	Multi-well drawdown		" "	4.66E+02	4.50E-04
WW-1,2,3	Multi-well drawdown		" "	4.24E+02	4.10E-04
			Geometric Mean	4.22E+02	4.08E-04

Notes:
(1) D&M = Dames & Moore, Environmental Report, White Mesa Uranium Project, January, 1978.
(2) Peel = Peel Environmental Services, UMETCO Minerals Corp., Ground Water Study, White Mesa Facility, June, 1994.
(3) H-E = Hydro-Engineering, Groundj-Water Hydrology at the White Mesa Tailings Facility, July, 1991.
(4a) D'Appolonia, Assessment of the Water Supply System, White Mesa Project, Feb. 1981
(4b) D'Appolonia, Geotechnical Site Evaluation, Farley Project, Garfield Co., Utah, June, 1984.
(5) Early test data.
(6) Late test data.
(7) Test data reanalyzed by TEC.

Table 2

Properties of the Dakota/Burro Canyon Sandstones

Well No. and	Sample Interval	Moisture Content (Percent)	Moisture Content Volumetric	Dry Unit Weight (lbs/cu ft)	Porosity (Percent)	Particle Sp. Gr.	Saturation (Percent)	Retained Moisture	Liquid Limit	Plastic Limit	Plasticity Index	Rock Type	Formation
WMMW-16	26.4' - 38.4'	1.51	3.3	135.2	17.9	2.64	18.2	5.1				Sandstone	Dakota
WMMW-16	37.8' - 38.4'	0.4	0.8	127.4	22.4	63	3.7	6.3				Sandstone	Dakota
WMMW-16	45.0' - 45.5'	5.6	12.6	140.9	16.4	2.7	77.2		29.6	15.4	14.2	Sandy Mudstone	Burro Canyon
WMMW-16	47.5' - 48.0'	2.56	5.9	142.8	12	2.6	48.9	4.37				Sandstone	Burro Canyon
WMMW-16	53.5' - 54.1'	0.68	1.4	129	19.9	2.58	7.1	6.38				Sandstone	Burro Canyon
WMMW-16	60.5' - 61.0'	0.11	0.2	117.9	27.3	2.61	0.8	9.89				Sandstone	Burro Canyon
WMMW-16	65.5' - 66.0'	2.62	5.5	131.5	19.3	2.62	28.2	7.13				Sandstone	Burro Canyon
WMMW-16	73.0' - 73.5'	0.13	0.3	130.3	20.6	2.63	1.3	5.5				Sandstone	Burro Canyon
WMMW-16	82.0' - 82.4'	0.05	0.1	134.3	18.5	2.64	0.6	4.78				Sandstone	Burro Canyon
WMMW-16	90.0' - 90.7	0.12	0.3	161.5	2	2.64	12.8	0.85				Sandstone	Burro Canyon
WMMW-16	91.1' - 91.4'	5.2	9.8	118.1	29.1	2.67	33.8		33.7	16.2	17.5	Claystone	Burro Canyon
WMMW-17	27.0' - 27.5'	0.29	0.6	138.8	13.4	2.57	4.8	5.11				Sandstone	Dakota
WMMW-17	49.0' - 49.5	3.62	7.1	121.9	26	2.64	27.2	9.6				Sandstone	Dakota
WMMW-17	104.0' - 104.5'	0.17	0.4	161.4	1.7	2.67	26.6	0.81				Sandstone	Burro Canyon
Average:		1.65	3.4	135	17.6	2.63	21	5.48					



PERCHED GROUND WATER LEVELS
WHITE MESA MILL
BLANDING, UTAH
PREPARED FOR
ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

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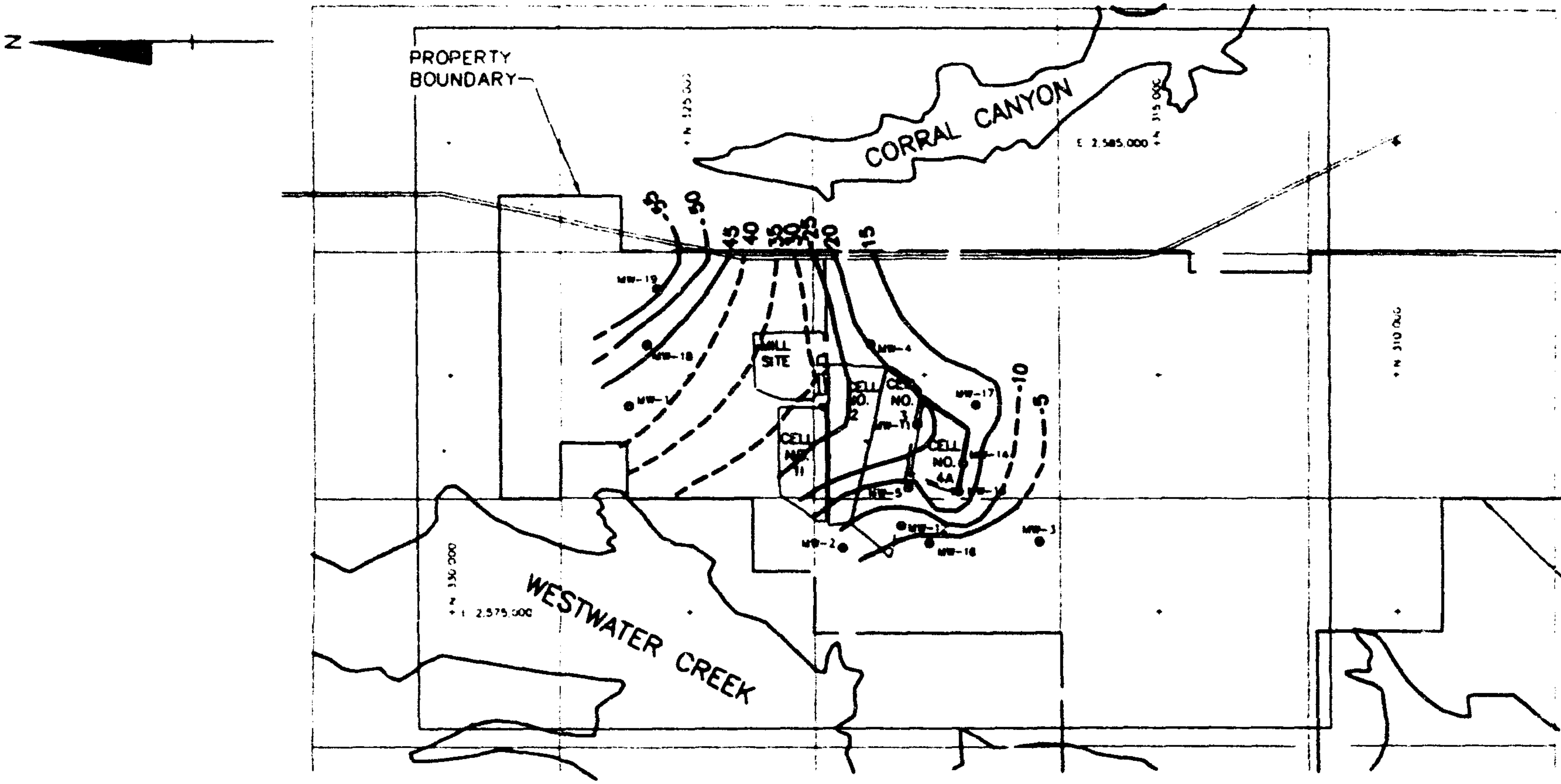
DATE 7-18-94
SCALE AS SHOWN
FIGURE 2.4
DRAWING NUMBER 4111-B9



SCALE

2000 0 2000 4000 FEET

LEGEND:

5 SATURATED THICKNESS IN FEET

SATURATED THICKNESS
BURRO CANYON FORMATION
WHITE MESA MILL
BLANDING, UTAH

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

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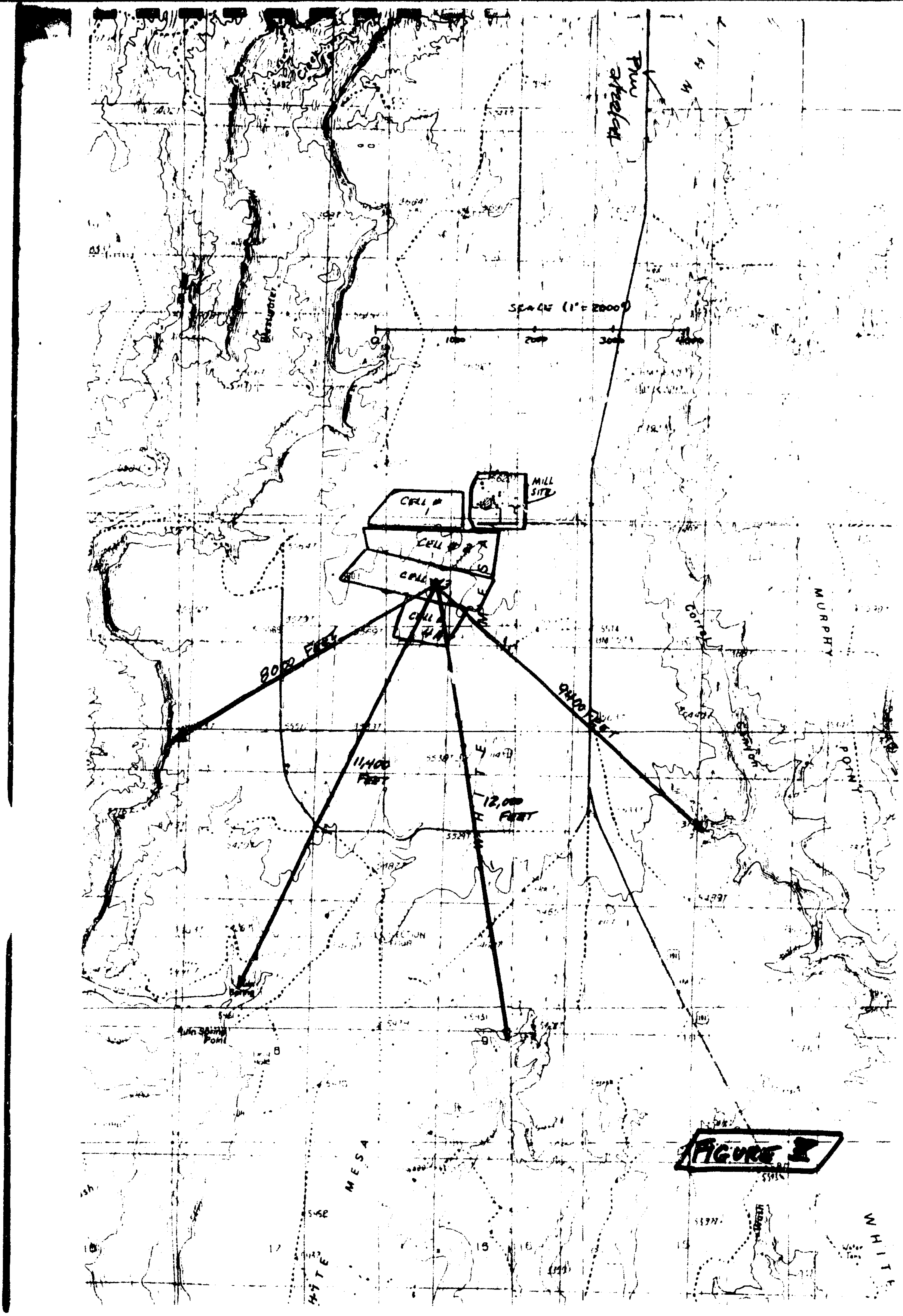
△		ISSUED FOR DRAFT SUBMITTAL	TMG		

DATE 7-18-94 | SCALE AS SHOWN | FIGURE 2.5 | DRAWING NUMBER 4111-B8

DRAWING NUMBER 4111-B8


SCALE (1" = 2000')
0
1000
2000
3000
4000
MILL SITE
CELL # 1
CELL # 2
CELL # 3
CELL # 4
8000 FEET
11,400 FEET
12,000 FEET
9400 FEET
MURPHY POINT
MESA
FIGURE

APPENDIX E

VADOSE ZONE MONITORING EVALUATION

VADOSE ZONE MONITORING EVALUATION

This appendix presents results of an evaluation performed by Energy Fuels on methods to monitor the vadose zone. The methods evaluated include:

1. Conventional Monitoring Wells,
2. Suction Lysimeters,
3. Vacuum Pressure Lysimeters,
4. Neutron Probe Method, and
5. Transient Electromagnetic Geophysical Surveying.

1. Conventional Monitoring Wells

Conventional shallow wells were evaluated to collect solutions in the unsaturated bedrock (Figure E1). The bedrock has a high negative matrix potential (suction) which would prohibit solution from flowing into the well. The only condition under which the wells would produce solution is the case where a massive failure of the liner would occur, thus producing saturated flow conditions directly underneath the cells and outside the perimeter of the cells.

2. Suction Lysimeters

These devices can collect fluids in the vadose zone via a ceramic-type cup. These cups, if properly placed, would become an extension of the pore space in the bedrock. Consequently, the water content in the lysimeter would become equilibrated at the existing bedrock-pore water pressure. A sample of fluid can be collected by applying a vacuum to the cup (Figure E2). These units are generally effective up to six feet below the ground surface. Below this depth, detection of a migrating contaminant plume would be impossible.

3. Vacuum Pressure Lysimeters

This device is a modification of the suction lysimeter in that pressure can be applied to extract the fluid (Figure E3). The disadvantage is that forcing pressure into the cup would also force fluids back into the bedrock, thus limiting the amount of the sample that could be obtained. This condition is exacerbated with depth and becomes ineffective below depths of a maximum of 30

feet. Consequently, this method is also not useful where the devices are placed at the edge of a tailings disposal cell.

4. Neutron Probe Method

Use of the neutron probe (Figure E4) to determine the moisture profile in a borehole has proven to be a reliable indirect method of obtaining a subsurface moisture distribution. The prime disadvantage of using this technique is that moisture measurements are limited to a few inches from the borehole. This method also does not provide data on the quality of seepage. Therefore, information from this method will be nonconclusive.

5. Transient Electromagnetic Geophysical Surveying

General - The following describes the basic concepts of the method transient electromagnetic (TEM) geophysical surveying, which will be considered in applying the method at White Mesa Mill.

Electromagnetic techniques are used for measuring the electrical resistivity of the ground, with the electrical resistivity being derived by determining resistance to flow of electrical current. With TEM, current driven through a transmitter (Tx) loop laid on the ground surface creates a primary magnetic field. At the instant the current is turned off an electromagnetic induction is established by the primary magnetic field. This electromagnetic induction in turn results in eddy current flow in the subsurface. The intensity of these eddy currents at certain time, and depth, depends on ground resistivity. Immediately after turnoff, the eddy currents are concentrated near the surface. With increasing time, the eddy currents diffuse down and out, which can be illustrated as a "smoke ring" pattern. Eddy currents generate a secondary magnetic field whose lines of force are opposite those of the primary magnetic field. The receiver (Rx) measures the electromagnetic forces (EMF) due to the secondary magnetic field. A schematic of the resistivity loop is shown on Figure E5.

Eddy Currents - At early time when the eddy currents are concentrated near the surface, the EMF's measure will reflect the electrical resistivity of near-surface layers. With increasing time, the EMF measured will progressively be more influenced by physical properties of deeper layers.

In a uniform layered environment the secondary magnetic field produced by the eddy currents is symmetric about the Tx loop center. The behavior of the EMF due to the vertical magnetic field (Bz) is relatively flat about the center, so that measurements of the EMF due to Bz are relatively insensitive to errors in surveying the center of the loop. The EMF due to Bz has a maxima in the center of the loop, has a zero crossing on both sides of the center, and passes through a minimum before decaying to zero with increasing distance. The EMF due to the horizontal magnetic fields (Bx and By) has a zero crossing in the center of the loop, passes through a minimum and maximum outside the loop and decays to zero with increasing distance. The position of the minimum and maximum for Bx and By is a strong function of the geoelectric section of the ground. Measurements made inside the loop will exhibit a maximum Bz component with a weak-to-no Bx and/or By component as opposed to measurements made outside the loop which will have a weak Bz component and maximum Bx and/or By component response.

Coupling - The term used in electromagnetic theory for how well a body can be detected is "coupling", or how well is the target energized. The target must have a different resistivity than the host rock to be detected. It is advantageous if the target is a better conductor. The direction of the electromagnetic field varies with position. Electromagnetic coupling is a crucial concept for planning a survey, as even good conductors can be missed. Coupling depends on the location and must be considered any time one is planning a survey using electromagnetic methods. It is of particular importance for conducting resistivity surveys.

Asymmetry in the component profiles in regards to geometry and/or magnitude is an indicator of two-dimensional (2-D) and three-dimensional (3-D) conductors. The induced EMF in the conductor(s) will produce a secondary magnetic field whose amplitude and decay rate are dependent on the quality of the conductor. In TEM, the depth and size of the conductor are reflected primarily in the amplitude of the secondary field, whereas the quality of the conductor is reflected mainly in the rate of decay of the secondary magnetic field, a good conductor having a long decay and a poor conductor having a short decay.

With 2-D conductors the vertical and horizontal component asymmetry will be restricted to measurements taken orthogonal to strike of body, i.e. an E-W striking fault will exhibit change in both the Bz and Bx component response along a N-S transect, but little variance in measurements made parallel to strike.

With 3-D conductors, symmetry in component profile will exist about the Tx loop center when the Tx loop is positioned directly over the body (similar to a uniform half-space response). However, EMF magnitudes for the conductor will be much higher, perhaps one order of magnitude than the response of the surrounding half-space. Asymmetry in profiles will exist when the Tx loops are offset from the conductor. Shape and magnitude will be indicators of strike, dip and plunge.

Downdropping of surface and subsurface strata, increased fracturing and interstitial water content, increased silicification and argillization, depletion of carbonates and anhydrides and increased salinity are factors contributing to the EMF response of the pipe environment. Variations in one or all of the factors can alter the measured EMF from one target to the next.

Depth of Investigation - Depth depends on several factors. The later in time a measurement is taken, the deeper the response. It is important to note, that in some cases near surface conductive responses can obscure any response from depth. The near surface responses can be cultural, fences or drill pipe, or surface geologic structures. Separation between the transmitter loop and the receiver loop is also important especially with slingram or profiling. A greater separation increase the depth of penetration.

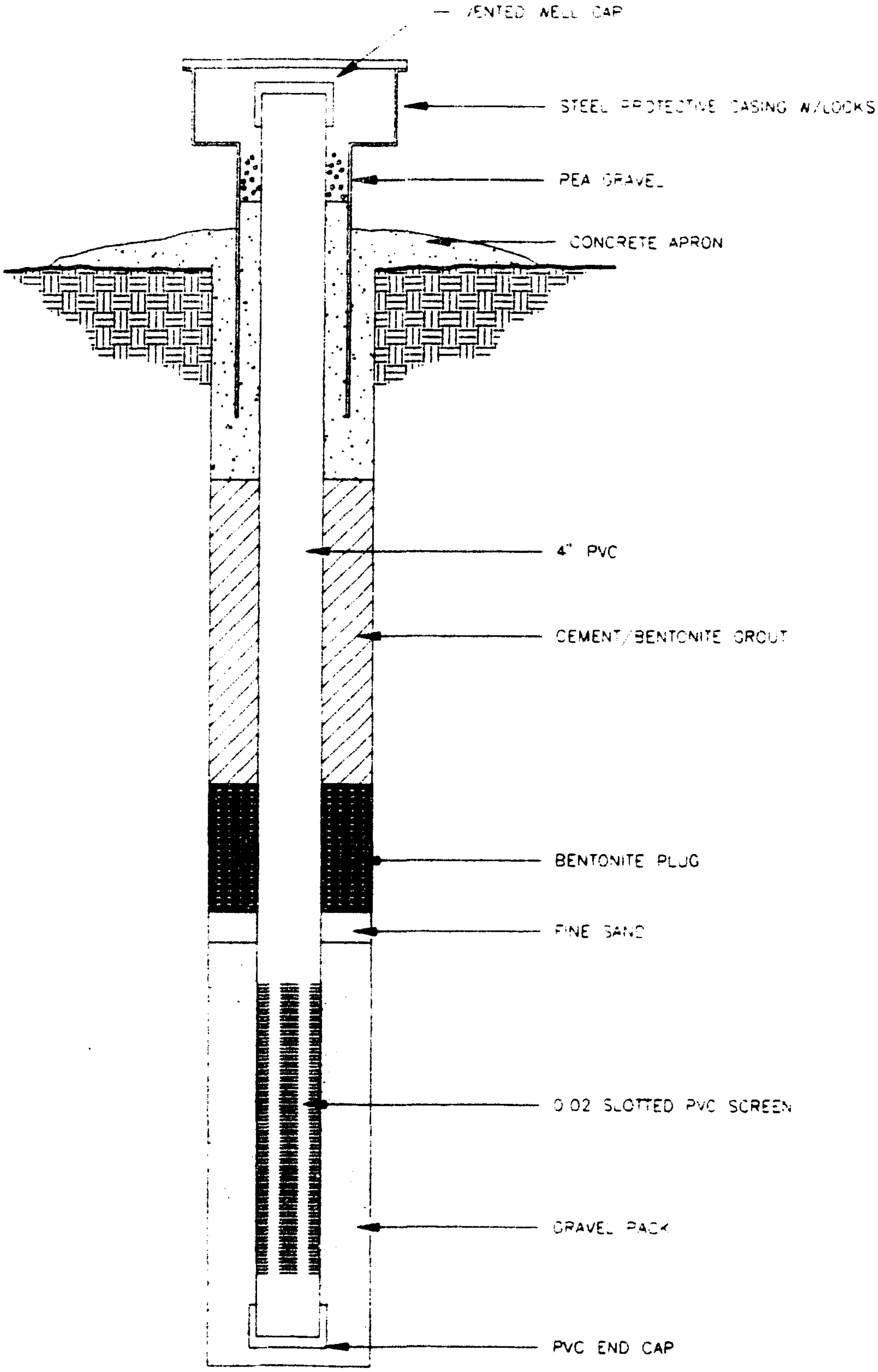
Depth of penetration also depends on the resistivity of the rock. Through a resistive basalt it may be possible to see several thousand feet, through a conductive shale the depth of penetration may be limited to several hundred feet. Survey design is critical.

Induced Polarization Response - In almost all situations, current flow in the earth is carried in the solutions filling the pore spaces of the rocks. The current flow is actually maintained by charged ions in the solutions (electrolyte). Ions in fluid-filled pore space within the rock are driven by eddy currents, conceptually creating an additional current flowing in the same direction as the eddy currents. This additional current is termed the induced polarization (IP) current which is a result of additional charge carriers supplied by the pore-space electrolyte.

After the initial ionic movement has ended with ions "stacking up" at boundaries of regions of different ion mobility, the charged state of a conductor is achieved. When the eddy currents decay sufficiently, the ions want to return to the equilibrium position that existed prior to the induction of the eddy currents. This ion flow again constitutes a polarization current, now in the opposite direction to that of the rapidly decaying eddy currents.

This reversed polarization current may be large enough to dominate the eddy currents, causing the secondary magnetic field and EMF to decay faster than normal, and possibly reverses completely. In general the amplitude of the polarization current depends on the chargeability and resistivity of the medium. Increasing resistivity decreases the strength of the eddy currents allowing the polarization current to dominate earlier in time, while increasing the chargeability increase the amplitude of the polarization current.

While in the conventional IP frequency range a small increase in IP response (few milliradians) may not be detected, at the higher EM frequencies these small changes can have a strong influence on the measured response. The IP response will be strongest near the Tx loop wire where the current density is greatest.



CONVENTIONAL MONITORING WELL

PREPARED FOR

ENERGY FUELS NUCLEAR
DENVER, COLORADO

TITAN Environmental

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1		ISSUED FOR DRAFT SUBMITTAL	T.M.G.		

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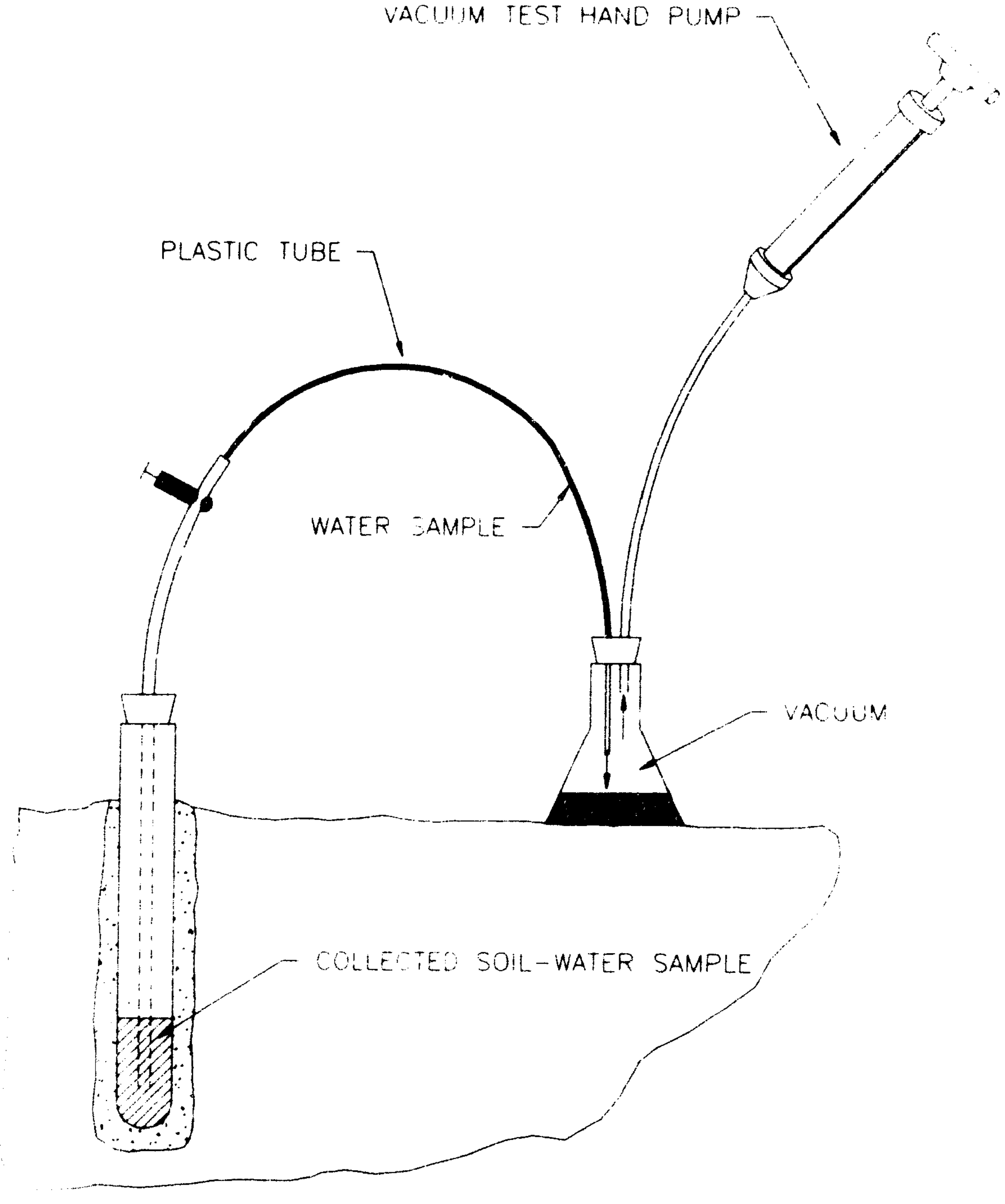
SCALE: N.T.S.

FIGURE E1

DRAWING NUMBER 4111-A21

△1



DRAWING NUMBER 4111-A22

SUCTION LYSIMETER

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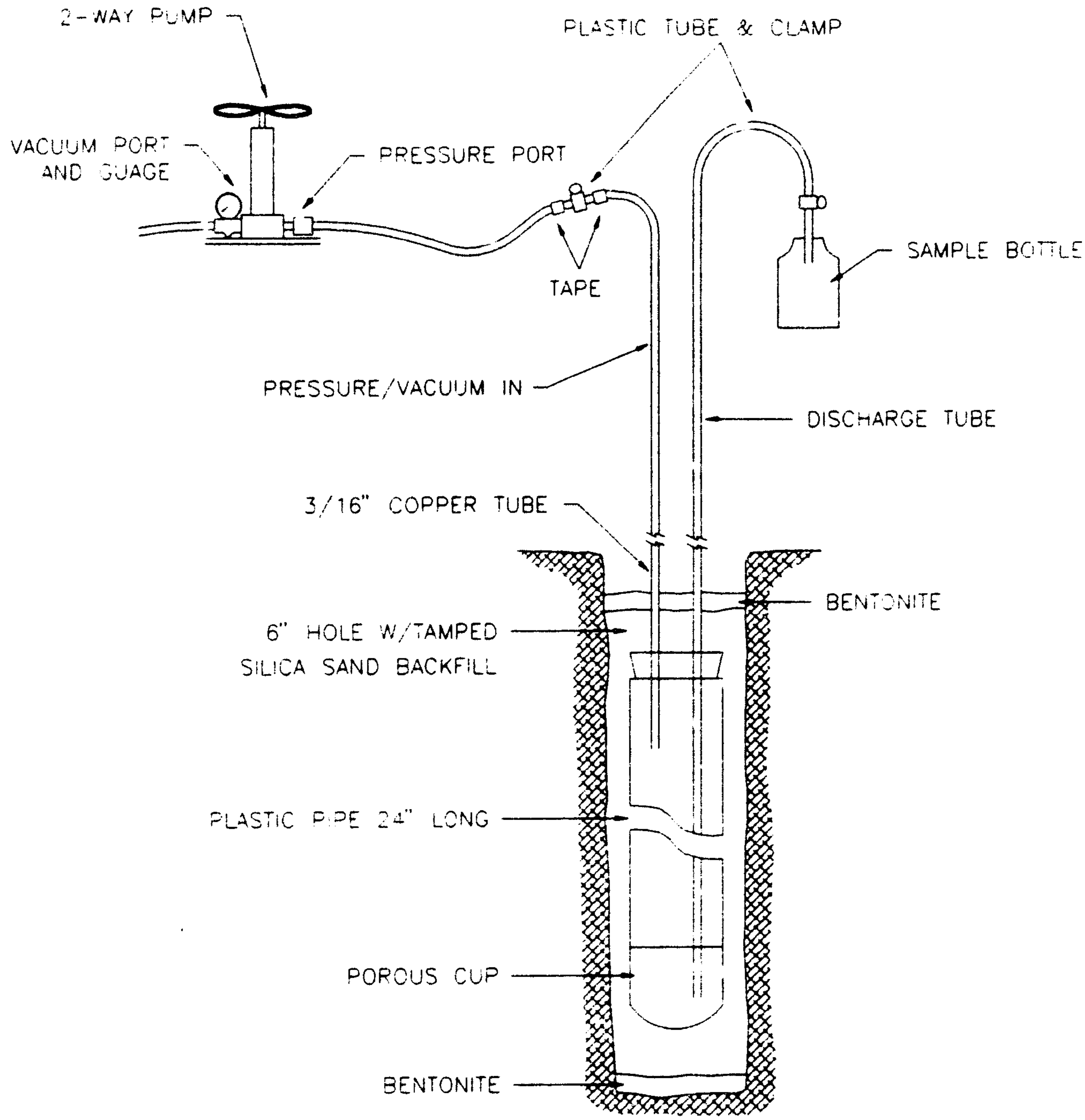
FIGURE E2

DRAWING NUMBER 4111-A22

1



DRAWING NUMBER 4111-A24

VACUUM PRESSURE LYSIMETER

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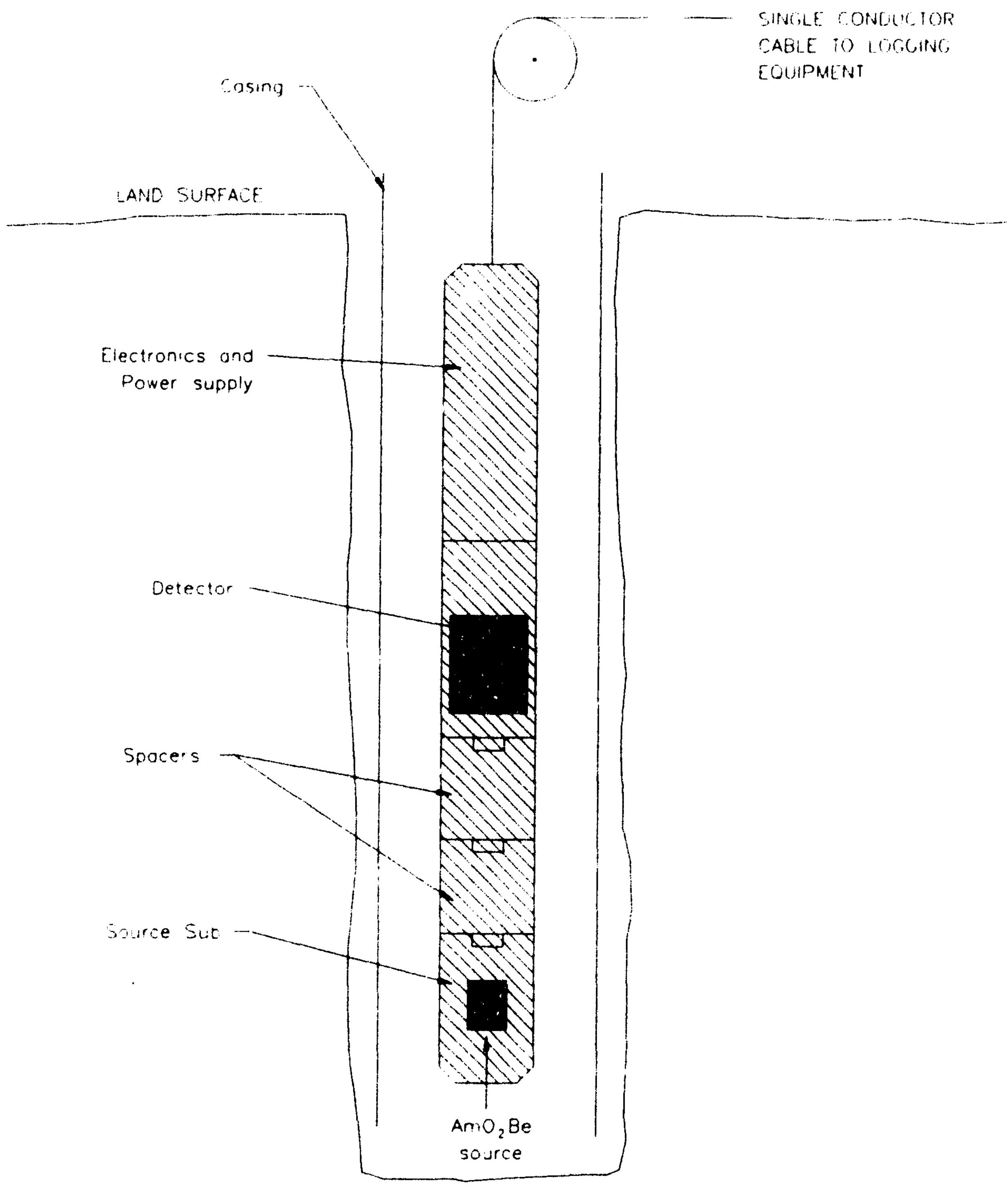
DATE: 7-19-94
SCALE: N.T.S.

FIGURE E3

DRAWING NUMBER 4111-A24

1

DRAWING NUMBER 4111-A25



Average energy loss per collision

hydrogen 63%

oxygen 12%

NEUTRON PROBE

PREPARED FOR

ENERGY FUELS NUCLEAR
DENVER, COLORADO

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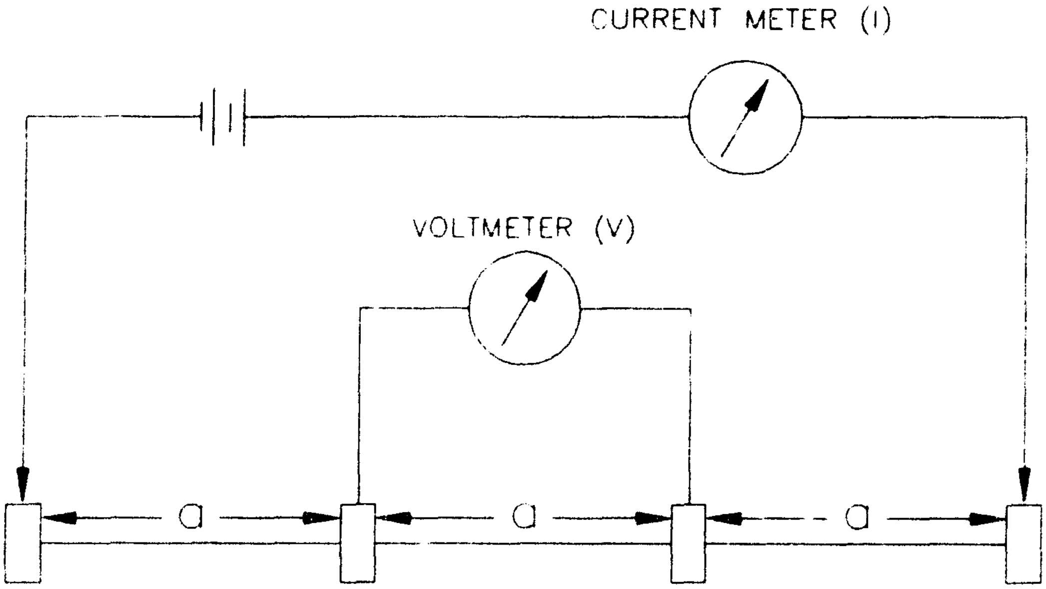
⚠1		ISSUED FOR DRAFT SUBMITTAL	T.M.G.					
						DATE: 7-19-94 SCALE: N.T.S.	FIGURE E4	DRAWING NUMBER 4111-A25

⚠1

DRAWING NUMBER 4111-A26



$$\rho_a = 2\pi \frac{V}{I} a$$

RESISTIVITY SURVEY LAYOUT

PREPARED FOR

ENERGY FUELS NUCLEAR
DENVER, COLORADO

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FIGURE E5

DRAWING NUMBER 4111-A26

1

APPENDIX F

EFNI RESPONSE TO NRC AND EPA COMMENTS

RESPONSE TO NRC LETTER OF MARCH 31, 1994

In the NRC letter dated March 31, 1994, the NRC requested a response to specific questions so that they could proceed with the review of the license renewal and the Monticello amendment request. For clarity, the specific requests of the NRC are included in italics immediately before the corresponding reply:

NRC REQUEST:

A. Please propose modifications to enhance the tailings cell leak detection system to provide prompt detection of a major cell leak.

ENERGY FUELS NUCLEAR RESPONSE:

Leak detection systems are currently in place at Cell 3 and Cell 4-A and are monitored to identify excursions should they occur. The leak detection systems in the cells cannot be modified. However, additional monitoring of the vadose zone can be conducted. This additional monitoring for both Cell 3 and Cell 4-A is described below in response to NRC Request B and in Section 4 of the main report.

NRC REQUEST:

B. Please propose additional detection monitoring points for the vadose zone lying beneath or adjacent to the tailings cells, since the nonuniform plume migration can occur in this zone.

ENERGY FUELS NUCLEAR RESPONSE:

Energy Fuels has researched several methods of measuring the development of a wetting front beneath the tailings disposal cells and movement through the unsaturated zone to the perched water. These methods include conventional monitor wells, suction lysimeters, vacuum pressure lysimeters, neutron probes, and geophysical surveys. Results of this research are presented in Section 4.5 of this report.

Energy Fuels proposes to monitor fluid movement in the unsaturated zone through the use of transient electromagnetic (TEM) geophysical surveys. Discussions of TEM surveys are presented in Section 4.5 and Appendix E of this report. We propose to monitor a line that would detect excursions to the west, the south or the east of the tailings impoundments. Initial surveys will be obtained to establish a "baseline" moisture profile with depth at the survey locations.

The TEM survey information will be evaluated to determine if a wetting front has occurred and contaminants are advancing downward in the vadose zone. The data and yearly evaluation will be presented in the "Annual Technical Evaluation of White Mesa Mill Tailings Management System." If the evaluation indicates that significant seepage is occurring from the cells, Energy Fuels will develop an appropriate contingency plan.

NRC REQUEST:

C. Please propose additional detection monitor wells in the saturated Burro Canyon Formation. Umetco indicated this formation, not the Dakota Sandstone, is the uppermost aquifer at the White Mesa facility. Currently, water quality in the southerly, downgradient direction is monitored only at Monitor Well MW-3. The areal extent of the tailings cells and, therefore, the potential source of tailings seepage, requires an enhanced ground water monitoring network.

ENERGY FUELS NUCLEAR REPLY:

Monitor Wells MW-5, MW-12, MW-14, MW-15 and MW-3 are currently used to detect changes in water quality in the saturated zone of the Burro Canyon Formation. Energy Fuels feels that this saturated zone is not an aquifer by virtue of its inability to sustain any reasonable production rates.

Notwithstanding the above, a drilling program is proposed to install three new monitoring wells in areas downgradient of the tailings cells. These wells will be used to monitor water quality within the saturated Burro Canyon and to provide information on the saturated thickness. This program is set forth in Section 4.0 and locations of the borings are shown on Figure 4.1.

NRC REQUESTS:

D. You have indicated that the variable quality of ground water necessitates developing (baseline) standards on a well-by-well basis. To justify your position, please demonstrate that the reported water quality is representative of only one aquifer. One way to demonstrate that your ground water samples are from an hydraulically-connected aquifer, for example, would be to perform a pressure test comprising pumping one monitor well and measuring the effects on sensors positioned in the other monitor wells. The necessary time for performing this test would be based on aquifer hydraulic properties and the various distances between sensor-equipped monitor wells and the pumping well. In addition, please provide documentation such as well logs, electric logs, or other borehole data to verify well screen positioning.

ENERGY FUELS NUCLEAR REPLY:

The available site data suggest that the perched water within the Burro Canyon is continuous beneath the site. Site data shown on Figures 2.4 and 2.5 indicate the perched water has limited saturated thickness but is continuous beneath the site.

The variable quality of the subsurface water is likely the result of the slow-moving nature of the water, as demonstrated by on-site permeability and gradient measurements and the very limited direct-recharge of the perched system. The ground water quality is characteristic of slow-moving water circulation with high total dissolved solids. The variable nature of waters in the slow-moving system may be the result of local variations in the availability of gypsum near the contact between the Burro Canyon and Brushy Basin units.

1.0 ENCLOSURE 1

NRC COMMENTS:

1. Please provide the laboratory analytical results for monitored, ground water constituents from four quarterly sampling events for Monitor Wells MW-17, MW-18 and MW-19. These wells will provide additional data for establishing background ground water quality.

ENERGY FUELS NUCLEAR REPLY:

The data requested is included in Appendix B of this report. Data from sampling events to December 1993 are included.

NRC COMMENT:

2. *Please discuss alternative corrective action programs (CAP) that could be implemented in the event of detected seepage from your tailings cells. The purpose of this discussion is to enable the NRC to conclude that feasible and practical corrective actions are available.*

ENERGY FUELS NUCLEAR REPLY:

Alternative corrective action programs that could be considered for implementation at the White Mesa Facility include: 1) increased site monitoring, 2) reduction of head on the synthetic liner, 3) collection of water in the leak detection system, or 4) treatment of the liquids within the cell or cells. If necessary, one or a combination of these or other technologies could be employed at the site to achieve or maintain compliance with the ground water protection standard.

Increased Site Monitoring - Increased site monitoring could potentially entail collection and analysis of additional water samples from the site, drilling and sampling of additional wells, and conducting additional resistivity survey measurements. These actions could be used to assess the potential, long-term impact to the Entrada/Navajo aquifer and to determine if additional corrective actions are necessary.

Reduction of Head in the Cells - Reduction of the head on the cell liner could possibly be accomplished by transfer of free liquids from the top of the cells to the evaporation impoundment and a withdrawal of liquids from the tailings material by pumping the slimes drain system.

Collection of Water from the Leak Detection System - Water accumulating in the seepage collection system beneath the synthetic liner could be removed to minimize the flux of tailings liquids into the subsurface materials. Most likely, a combination of head reduction on the liner and removal of liquids from the underdrain system would provide a feasible, practical approach to mitigating contaminant flux to the environment.

Treatment of Liquids within the Cells - Liquids within the cells could potentially be neutralized to lessen the migration of contaminants from the impoundment. The addition of lime or hydrated lime to the tailings liquids has been proven to be an effective technology in the control of contaminant migration. NUREG/CR-3030 "Evaluation of Selected Neutralizing Agents for the Treatment of Uranium Tailings Leachates" and NUREG/CR-3449 "Laboratory Evaluation of Limestone and Lime Neutralization of Acidic Uranium Mill Tailings Solution" can be consulted for an assessment of the potential benefits of tailings liquid neutralization. It should be noted that these are laboratory studies only, and not scaled-up to the real world of 3.5 MM tons of tailings and solutions.

NRC COMMENT:

3. Based on your evaluation of the ground water monitoring and leak detection programs, as well as geologic and hydrogeologic information, please provide an analysis of the rate of plume migration through the Dakota/Burro Canyon Formation and Brushy Basin to the underlying Entrada Sandstone Aquifer, if a tailings cell leaks.

ENERGY FUELS NUCLEAR REPLY:

Potential rates of plume migration from the disposal cells are proposed in Section 3.2 of the main report. As discussed there, travel time through the Dakota-Burro Canyon Sandstones to the top of the Brushy Basin is conservatively estimated on the order of 50 to 150 years. Based on existing information, which will be enhanced with the proposed field investigations, it is assumed that the Brushy Basin is in an effective aquitard and will prevent migration downward to the underlying Entrada/Navajo Aquifer. The function of the Brushy Basin in preventing downward migration is further enhanced by the 850-foot hydrostatic head pressure within the Entrada/Navajo Aquifer.

NRC COMMENT:

4. Please provide a technical analysis of, or a reference to, a previous submittal which describes the anticipated impact of the low pH raffinate on the clay liner integrity and potential ensuring consequences.

ENERGY FUELS NUCLEAR REPLY:

The effect of low pH solutions on the clay liner is addressed in NUREG/CR-2946, "The Long-Term Stability of Earthen Materials in Contact with Acidic Tailings Solutions," NUREG/CR-3124, "Laboratory Measurements of Contaminant Attenuation of Uranium Mill Tailing Leachates by Sediments and Clay Liners," and NUREG/CR-2494, "Interaction of Uranium Mill Tailings with Soils and Clay Liners." These reports indicate that clay liner permeability decreases over time when low pH, high TDS solutions contact natural earth materials. This decrease in permeability is due to the precipitation of hydroxides and amorphous members of the alunite mineral group. These reactions are likely to occur at the White Mesa facility because the raffinate solutions and clay materials are similar to those used in the studies.

NRC COMMENT:

5. At the February 9, 1994 meeting, you stated you were going to perform a drilling program at the White Mesa site. Therefore, please provide the results of the angle-hole drilling, packer tests, and any other analyses you performed to determine the presence of a subsurface fracture system. Based on information you presented, in the event of a liner failure, tailings seepage could reach the Brushy Basin. The angle-hole drilling program should, therefore, incorporate penetration and analyses of this strata. This is necessary to evaluate whether a fracture system exists which could provide a conduit for seepage migration through the Dakota Sandstone, Burro Canyon Formation, and Brushy Basin, to impact the Entrada Sandstone. It is our understanding that the drilling program will comprise two sets of boreholes, and that each borehole will be 100 feet in length. Based on available information for the thickness of the overlying strata, this would allow as much as 20 feet of penetration into the Brushy Basin unit. Each borehole set would include one borehole perpendicular to the previously identified, primary joint system. We understand these boreholes would be at approximately 30 degrees to the vertical. The accompanying borehole would be perpendicular to the secondary joint system. At a minimum, the following information for the vadose zone (Dakota Sandstone), Burro Canyon Formation, and the uppermost 20 feet of the Brushy Basin strata should be provided: A) Characterization of subsurface structure (fracture systems), and b) A quantitative analyses of the rate and direction of effluent migration through the system in both horizontal and vertical, cross and downgradient directions.

ENERGY FUELS NUCLEAR REPLY:

Observational data presented in the Environmental Report (Dames and Moore, 1978) indicate that jointing is common in the exposed Dakota/Burro Canyon Formations along the mesa's rim with primary joints parallel to the cliff faces and secondary joints almost perpendicular to the primary joints. Umetco (1991) also mapped surface fractures along the canyon rim and found a primary joint vector with strike of N11E, and a secondary joint vector with a strike of N47W.

Investigations are proposed to determine whether the surficially-mapped joint sets are present in the subsurface Dakota/Burro Canyon Formations beneath Tailings Disposal Cells No. 3 and No. 4A at the site and whether their presence, if any, is causing an increase in the rock mass permeability.

The scope of investigations to identify subsurface joint sets consists of advancing four angled borings into the Dakota/Burro Canyon Formations and at least 25 feet into the Brushy Basin Member beneath Tailings Disposal Cells No. 3 and No. 4A. Figure 4.1 of this report presents the location of the angled borings. At each location, one angled boring will be advanced parallel to the strike of the primary joints mapped on the surface. A second boring will be advanced perpendicular to the strike of the primary joints. This method should intersect the maximum number of potential subsurface fractures, if present. Each boring will be fully-cored with an NX or NWQL double-core barrel. Cores will be logged with particular attention given to fractures, specifically, their orientation, spacing, aperture, and any evidence of flow (e.g., staining, mineral redeposition or presence of clay).

Permeability pressure (packer) tests will be conducted in each borehole in five- or ten-foot increments throughout the entire length of the borehole. Upon completion, borings will be grouted with cement/bentonite grout from the bottom up.

NRC COMMENT:

6. Please provide the geologic and hydrogeologic information necessary to characterize that the Brushy Basin acts as an aquitard between the Burro Canyon and the Entrada Sandstone. This information should include the vertical and horizontal conductivities characterized at the site, verification of the effective porosity, and thickness of this unit. Also, please provide this information for any wells constructed in the Entrada Sandstone.

ENERGY FUELS NUCLEAR REPLY:

As discussed in Section 4.3 of the main report, the primary objective of the Brushy Basin Member investigation is to quantify the hydraulic properties of the unit and evaluate its effectiveness as an aquitard. For the sake of expediting the investigations, borings from which the above information will be obtained will be converted into observation wells to further define the extent of saturation in the Burro Canyon Formation.

The proposed Brushy Basin Member investigation includes:

- Drilling three exploratory borings into the Brushy Basin Member. Each boring will penetrate 20 feet into the unit. The boring data will also be used to define the Brushy Basin-Burro Canyon Member contact. The proposed locations of the borings are presented on Figure 4.1.

- From each boring, collecting two 5-foot sections of the core from the Brushy Basin Member.

- Conducting packer permeability tests in each boring within the section of the hole in the Brushy Basin Member.

- Conducting laboratory liquid permeability tests on vertically-oriented cores from the Brushy Basin Member. These tests will be necessary to quantify the vertical permeability which is expected to be orders of magnitude lower than the horizontal permeabilities from the field packer tests (horizontal permeability will be calculated from packer tests).

All borings advanced within the Brushy Basin Member will be converted into the observation wells screened in the Burro Canyon Formation.

As discussed in Section 3.0 of the main report, not only the Brushy Basin but the Westwater, Recapture and Salt Wash of the Morrison Formation as well as the Summerville Formation are effective aquitards because the Entrada/Navajo is a confined aquifer under artesian pressure.

No wells have been constructed in the Entrada Sandstone; however, driller's logs of the Navajo water supply wells constructed at the site and geophysical logs for these wells have been included as an attachment to Appendix A.

NRC COMMENT:

7. In consideration of both stratigraphy and structure, please provide a quantitative assessment of horizontal and vertical effluent travel times within the Dakota Sandstone, Burro Canyon Formation and Brushy Basin.

ENERGY FUELS NUCLEAR REPLY:

Calculations for travel time within the Dakota Sandstone, Burro Canyon Formation and Brushy Basin are provided in Section 3.0. Travel times could range from 50 to 150 years from the base of the cell to the top of the saturated zone in the Burro Canyon.

Ground water velocity calculations for the perched water in the Burro Canyon are presented in Appendix D. Using Darcy's equation, ground water velocity is estimated to be 0.89 feet per year in a southerly direction in the Burro Canyon.

Site-specific data for the Br hy Basin have not been collected yet but will be the focus of the current drilling program.

NRC COMMENT:

8. Please provide well log, geophysical data, piezometric data, or other data to justify your interpretation of the southerly pinch-out of the saturated thickness of the Burro Canyon Formation that was presented in the referenced meeting. As discussed in the meeting, the unit thickness isopachs are somewhat speculative in the region downgradient of the tailings cells. It is not clear whether the downgradient direction is actually south, southwest, or southeast. Please include isopach maps and a map depicting the bottom surface of the Burro Canyon Formation.

ENERGY FUELS NUCLEAR RESPONSE:

Figure 2.5 in the main report is a map of the Burro Canyon saturated thickness. The thickness of saturation is greatest in the northern and central sections of the site and reduces toward the south.

The topography of the Brushy Basin Member which defines the bottom of the perched water is included in the report at Figure 2.6.

The general direction of ground water flow is toward the south, with southeast and southwest components, as depicted in Figure 2.4.

NRC COMMENT:

9. During the meeting, four piezometric wells were noted as being constructed southwest of the tailings cells. Please identify these wells and include any piezometric and subsurface structural or stratigraphic information collected during this drilling program, such as that from electric logs or core samples, to enhance site characterization.

ENERGY FUELS NUCLEAR RESPONSE:

The four piezometers are located on a site map (Figure F1). The piezometers are west of Cell 1-1. They are designated as #9-1, #9-2, #10-1 and #10-2. The depths of these piezometers are as follows:

Piezometer	Depth
#9-1	30.0'
#9-2	59.7'
#10-1	31.3'
#10-2	59.2'

These piezometers have been monitored annually and were dry at all sampling events. More information about these piezometers is available in D'Appolonia's February 1982 report, "Ground Water Monitoring Program," which is on file at the White Mesa Mill site.

NRC COMMENT:

10. Please provide piezometric data to characterize the Burro Canyon formation and Entrada Sandstone aquifers.

ENERGY FUELS NUCLEAR RESPONSE:

The occurrence of perched water in the Burro Canyon Sandstone is discussed in Section 2.0 of the main report. Levels of perched water are presented on Figure 2.4 of the main report.

Ground water level data for the Entrada/Navajo Aquifer based on drillers' logs are presented in Table 3.1 of the report. These data indicate artesian pressures up to 850 feet of head exist within the aquifer.

2.0 **ENCLOSURE 2** - EPA COMMENTS AND QUESTIONS CONCERNING THE UMETCO MINERAL CORPORATION, WHITE MESA FACILITY

EPA COMMENT:

EPA believes, based on the data which we have received and reviewed, the Umetco, White Mesa facility is not in violation of any applicable Federal or State of Utah regulations. However EPA is concerned the U.S. Nuclear Regulatory Commission (NRC) and Umetco have not agreed upon a Point of Compliance (POC) for the White Mesa facility. EPA will not allow the facility to receive the Monticello Mill tailings until such time as a POC is established and "constituent" levels have been determined, which, if exceeded, will indicate a release has occurred.

After reviewing the design of cells 3 and 4A, especially the leak detection systems (LDS), we would concur with Umetco, the LDSs, as designed and constructed, will only detect minor leaks positioned almost directly over the detection system unless a major breakthrough were to occur. For this reason, we are not certain what is gained by making the LDS the POC. Based on the data presented, we would agree that the "saturated" Burro Canyon-Dakota Formation would be suitable as the POC. If NRC accepts the Burro Canyon Formation as the POC, additional hydrogeological characterization of the Burro Canyon Formation needs to be conducted. Since the Brushy Basin Member of this Morrison Formation is considered to be the geological unit providing protection of potable water in the underlying Entrada Formation aquifer, the characterization effort should extend into the Brushy Basin. Additional comments addressing some of the necessary characterization efforts of the Brushy Basin Member are attached.

EPA requests that NRC and Umetco explain how background levels for constituents of concern will be determined. If it is eventually determined that "site-wide" constituent background and compliance levels cannot be developed, how will appropriate compliance levels be established for the individual wells? It might be appropriate to determine, if possible, why there is such a variation in constituent levels in the upgradient wells (i.e., could well construction, completion, and development, sampling procedures, or other factors account for this variability?) It may be appropriate to initially set constituent levels for several of the mobile constituents, while further sampling and analyses is conducted to determine if "site-wide" background levels can be

established. EPA would note if a State of Utah Ground Water Discharge Permit (GWDP) is required or if Umetco intends to gather the data required to substantially meet the intent for obtaining the GWDP, it may be appropriate to discuss with the State of Utah, Division of Water Quality any additional requirements that they may have.

ENERGY FUELS NUCLEAR REPLY:

The spatial variability of water within the Burro Canyon formation is presented in Section 2.2 of this report. Upgradient wells and wells across the site show variability in water chemistries as demonstrated by sulfate and chloride concentrations. This variability may be related to the dissolution of minerals near the Brushy Basin Shale and Burro Canyon Sandstone contact by very slow-moving (0.89 feet per year) ground water. Because of the variable ground water chemistry, comparison of well chemistries to single or multiple background wells may not be an appropriate means of detection for cell seepage or ground water contamination. Rather, it may be appropriate to establish water quality baseline values on a well-by-well basis with appropriate compliance level values set for selected compliance monitor wells.

The existing well construction and water quality data, and additional data gathering programs will be further evaluated. Energy Fuels will then propose methods for developing background and compliance levels for constituents of concern.

As EPA has suggested, it may be appropriate to initially set constituent levels for particular mobile constituents, while conducting further sampling and analyses to determine the appropriate approach to background determination. The collection of additional data will provide insight into the means of selecting proper point(s) of compliance.

EPA COMMENT:

Our review of the Student T test ("T") analyses contained in the documents indicates that some of the data were excluded. Furthermore, the use of the "T" test may be inappropriate since the data are not normally distributed. However, we concur with Umetco that if a significant leak were to occur, the chlorides would be one of the first constituents to break through and that the chloride constituent levels would be elevated significantly above background.

ENERGY FUELS NUCLEAR RESPONSE:

The statistical analysis was an attempt to determine whether a small population (10 samples) collected during the early period of sampling was statistically similar to a similar size population for the most recent sampling periods. This analysis indicated, in the case of the chlorides (the more critical of the indicator solutes), that the means of the two populations not only differed but indicate a decrease in the mean chloride concentration over time. This suggests that the ground water has not been impacted by fluids from the ponds.

Energy Fuels recognizes the need to consider the distribution of the data in selection of statistical text. In the future, Energy Fuels will refer to guidance, such as "Statistical Analysis of Ground Water Monitoring Data at RCRA Facilities," (EPA, 1989) for selecting appropriate statistical analysis of ground water data.

EPA COMMENT:

EPA believes if a major leak occurs it will migrate through joint fractures and along preferential pathways and not be held in the pore space of the matrix, especially if the matrix is well-cemented, as is generally assumed by many proponents of flow mechanisms through unsaturated sediments. Water level fluctuations in excess of 1.5 feet have been observed in several wells over a 5-month period. This suggests that the ground water table responds relatively quickly to influx. We did not evaluate or prepare detailed ground water table maps to determine if any trends could be established; however, it might be useful to do so.

ENERGY FUELS NUCLEAR RESPONSE:

Although joints have been observed and mapped on the edge of the mesa, no significant joints have been documented in the subsurface from over 45 wells and borings at the site. In addition, hydraulic tests conducted at the site do not indicate the presence of extensive jointing.

A review of the hydrographs of the monitoring wells showed that the majority of the recorded water-level fluctuations greater than 1.5 feet are in a negative direction to the mean water surface elevation in that well. This may suggest a lowering of the water table. The few measured, positive water-level fluctuations were sporadic, single-well fluctuations with no trend. In many cases these water-level fluctuations occurred in one sampling event, followed by a similar fluctuation in the reverse direction. These fluctuations probably were due to measuring error.

The majority of these errors occurred prior to 1989, at which time new equipment was purchased. The present sampler also started at that time and has had a better understanding of quality control. In addition, Energy Fuels has prepared a new quality assurance plan which will include an updated Standard Operating Procedure (SOP) for water level measurements. The SOP is currently under review.

EPA COMMENT:

We concur with Umetco's statement that they need to confirm that the saturated thickness of sediments in the Burro Canyon is pinching out. Review of the well logs suggests that the reason Well No. 16 is dry is that the bottom of the well was screened at the bottom of the Burro Canyon Formation at an elevation of 5,497 feet above sea level. Water elevations in Wells 5 and 12 were at approximately 5,501 feet. Based on the assumed phreatic surface gradient, the linear distance between Well 16 and Wells 5 and 12, and the fact that the Burro Canyon Formation is unconformable over the Brushy Basin Member, water at that elevation would not be detected. EPA's review and analysis of the existing well logs suggests that the bottom of the Burro Canyon-Dakota Formation is generally dipping to the southeast with the possible exception of a topographic high at Well 4.

ENERGY FUELS NUCLEAR RESPONSE:

Data from MW-16 indicate the elevation of the top of the Brushy Basin is at 4,597 feet. The projected phreatic surface at this location is approximately 4,590 feet (see Figure 2.4 of this report). Therefore, the projected perched water level is below the top of the Brushy Basin. This would indicate the saturated thickness of the perched water approaches zero at this location.

EPA COMMENT:

We concur with Umetco that additional exploratory borings are needed to be made and additional piezometers constructed when water is encountered. Additional compliance monitoring wells may need to be constructed based on the results of further characterization. Additional characterization efforts should extend southerly, from a line formed by extending the common wall/dike between cells 2 and 3, east and west to the mesa edge to confirm that the saturated thickness of Burro sediment pinches out. Data from the existing wells and any additional data collected from further characterization efforts can be utilized to prepare a geologic map depicting

the bottom of the Burro Canyon Formation and an isopach map depicting the thickness of the formation and saturated intervals.

ENERGY FUELS NUCLEAR RESPONSE:

All data gathered during the drilling program will be added to existing data to update maps and cross sections. The vertical borings completed during this program will be developed as monitoring wells and will become part of the ground water monitoring program. These data will be included in the Semi-annual Effluent Reports that are submitted to the NRC.

EPA COMMENT:

During the meeting, Umetco indicated that the hydraulic conductivity of the Brushy Basin Member was approximately 10^{-8} and that the effective porosity was approximately 15 percent. Is there any site-specific data supporting these assumptions at the Umetco site? Can Umetco provide reasonable assurance that if a significant release occurs there will be time to put in place a contingency plan (e.g., a pump-and-treat system) to avoid contamination from moving horizontally offsite or vertically through the Brushy Basin Member? The angle holes, core recovery, and the packer testing should extend into the Brushy Basin Member so that confirmation of the assumed hydraulic conductivities in the Brushy Basin Member can be obtained.

ENERGY FUELS NUCLEAR RESPONSE:

Effective hydraulic conductivity of the Brushy Basin Shale has not been measured at the site. However, hydraulic conductivity values for mudstone and claystone in the Burro Canyon Formation, reported in Table 2.2 of the report, range from 1.58E-03 to 1.93E-07 cm/sec.

The slow-moving nature of water in the saturated zone of the Burro Canyon Formation (0.89 feet per year) and the low permeability of the underlying Brushy Basin Shale allows for the implementation of a contingency plan if a significant release were to occur from the disposal cells. Horizontal migration offsite, a distance of over 8,000 feet, would take over 8,000 years and vertical migration through the Morrison Formation would be negligible.

The proposed field program is designed to penetrate into the Brushy Basin Shale so that packer tests can be conducted to provide site-specific values for the hydraulic conductivity of the Brushy Basin Shale.

EPA COMMENT:

Some of the wells logs and any test data from the culinary wells may be useful to respond to or support eh above concern. Can the culinary well locations be placed on the map, and the well logs be made available to EPA for review? As a minimum, the lithologic logs for the culinary wells should provide a good estimate of the thickness of the formations from the surface down to the Entrada.

ENERGY FUELS NUCLEAR RESPONSE:

Drillers' logs of site water supply wells are included in Appendix A. Thicknesses of the formations were inferred from these logs as:

Unit	Thickness
Dakota	81'
Burro Canyon	65'
Morrison	672'
Summerville	37'
Entrada	365'

EPA COMMENT:

EPA also requests that all additional compliance monitoring wells be constructed in accordance with the Handbook of Suggested Practices for the Design and Installation of ground Water Monitoring Wells (EPA 1991 Document No. EPA/600/4-89/034) or be functionally equivalent.

ENERGY FUELS NUCLEAR RESPONSE:

This document was used to design MW-16 through MW-19 and is the basis for the design of any future monitoring wells.

EPA COMMENT:

EPA also requests the results of any packer tests which were completed in the vadose zone. Please provide EPA with any packer and pump/slug tests that may have been conducted and were not included or referenced in the February 1993 Ground Water Study, White Mesa Facility, Blanding, Utah.

ENERGY FUELS NUCLEAR RESPONSE:

The results of all packer tests conducted in the vadose zone are included in this report in Table 2.2

EPA COMMENT:

EPA would like to have the confidence and assurance that field sampling techniques and laboratory quality assurance and quality control procedures are in place to validate data. We would like to see in place, a system which would preclude questionable "hits" based on sampling techniques and analytical methods.

ENERGY FUELS NUCLEAR RESPONSE:

Energy Fuels has prepared an updated Quality Assurance Project Plan (QAPP) for the White Mesa Mill ground water compliance monitoring program. The QAPP is included as Appendix G to the main report. The current version addresses data quality objectives, quality assurance objectives, sample and document custody procedures, quality control procedures, data evaluation methods, and analytical procedures. The QAPP presents the organization structure to ensure conformance to the Quality Assurance Plan. The SOPs to be attached to the QAPP are currently being revised from the SOPs that were used previously.

3.0 ATTACHMENT

EPA COMMENT:

If the Burro Canyon-Dakota Formation is used as a point of compliance, the Brushy Basin Member of the Morrison Formation must also be characterized since it is the geologic unit separating the Burro Canyon aquifer from the underlying aquifer in the Entrada Formation.

Characterization of the Brushy Basin Member should verify the assumption that it is acting as an "aquitard." Characterization of the Brushy Basin Member should include, but not be limited to:

- *lithologic and geophysical logs for the culinary wells previously installed into the Entrada Formation,*
- *thickness of the unit,*
- *any fractures observed in the unit,*
- *packer tests at different depth intervals,*
- *other data related to horizontal and vertical hydraulic conductivity, including laboratory tests conducted on samples,*
- *verification of 15 percent effective porosity of the Brushy Basin underlying the White Mesa area or laboratory data from tests conducted for effective porosity on samples collected from the Brushy Basin Member underlying the site, and*
- *any other data pertinent to characterizing the Brushy Basin Member which supports the assumption that the Brushy Basin is an aquitard.*

EPA believes by extending the proposed characterization effort into the Brushy Basin Member, Umetco should be able to provide answers to our questions and comments. The minimum apparent depth of penetration into the competent Brushy Basin Member would be 20 feet. Based on the assumption that a 30-degree angle from the vertical is used for angle drilling, the total length of core would be 25 feet and the horizontal distance would be 15 feet. The decision of the actual depth occurred can be made on criteria observed in the field such as lithology, the occurrence, spacing, and orientation of joints and fractures observed in the Dakota/Burro Formation. The core should be recovered for observation and laboratory analyses. Packer testing intervals should be determined after observation of the core.

ENERGY FUELS NUCLEAR RESPONSE:

The Brushy Basin Member of the Morrison Formation will be investigated in the additional characterization studies proposed for the White Mesa Facility. These studies, described in Section 4.0 of this report, include penetration of at least 25 feet of Brushy Basin in the angle boring, core sampling, lithologic and geophysical logging, and permeability testing. Laboratory analysis of the shale will also be conducted to estimate the effective permeability of the Brushy Basin.

4.0 ENCLOSURE

EPA COMMENT:

Various types of leaks may occur through the bottom of Cell 4A. EPA would like to see various leakage scenarios to assess the possible leakage rates that may occur through the cell lining. Leak scenarios that examine a range of leakage rates, types of leakage that may occur through the bottom of the cell using reasonable assumptions about the subsurface characteristics directly below the cell are appropriate.

These leakage rates should include the following scenarios:

1. *areal leakage though the bottom of the cell equal to the expected flux of water infiltrating the cover,*
2. *areal leakage through the bottom of the liner 10- to 100-times the expected flux of water infiltrating the cover,*
3. *a scenario that simulates a major liner failure.*

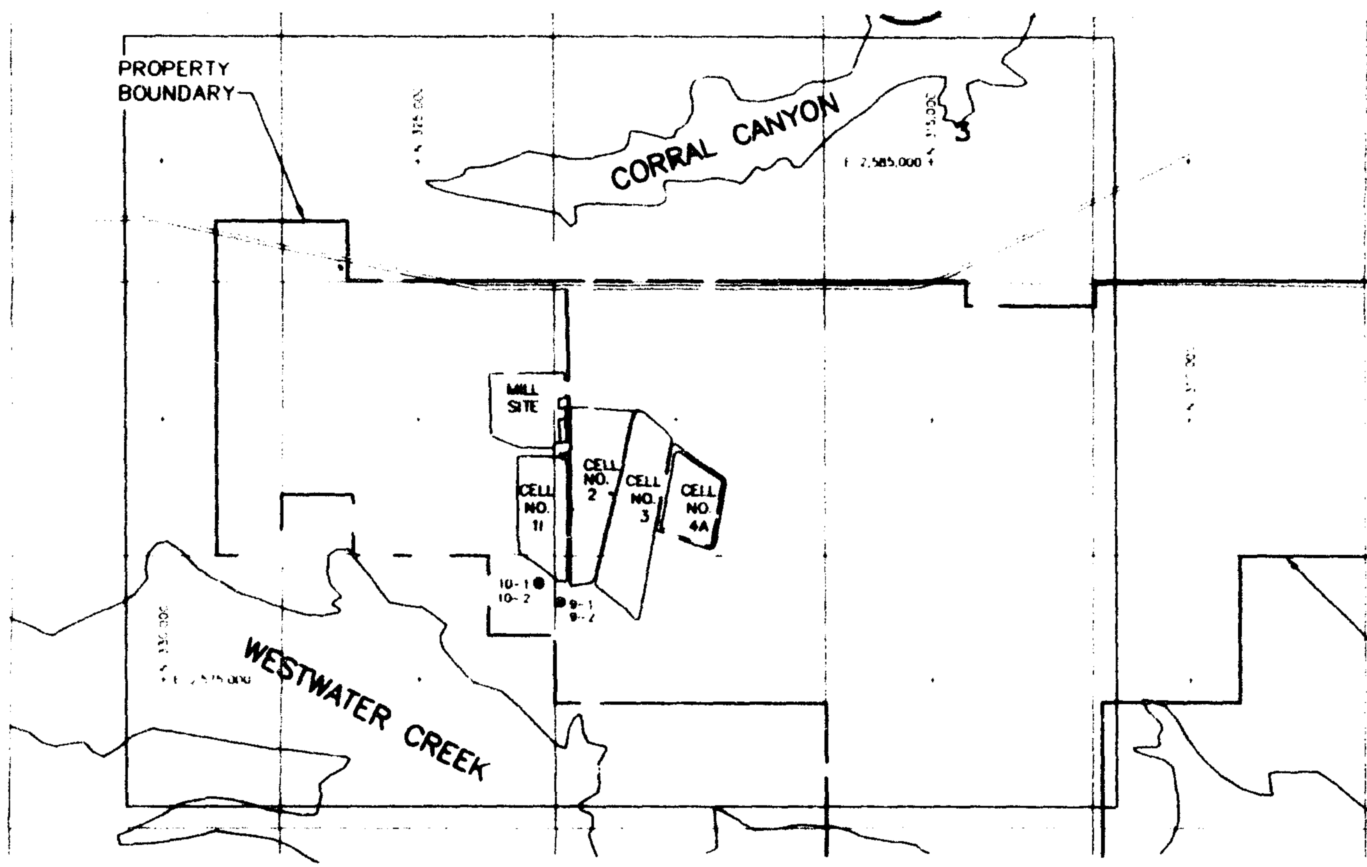
Based on Umetco's figure titled "Cell 4A Schematic" from the February 9, 1994 meeting at NRC. the cover flux is projected at 0.01 $ft^3/yr/ft^2$. This flux may be considered as an areal flux through the bottom of the liner ($Q^{in} = Q^{out}$). The three-dimensional extent of leakage can be calculated using this flux rate, assuming that the leakage occurs throughout the bottom of the cell and making some <u>*reasonable*</u> *assumptions about the in situ material characteristics directly below the cell clay liner. These assumptions would include flow through the matrix and the potential for fracture flow in the subsurface. If a major leak occurs, the movement of fluid will be primarily in the open fractures, if fractures are present, and not within the matrix of the sedimentary units. The cover may fail and, therefore, the second scenario, leakage through the bottom of the liner at 10- to 100-times the expected cover flux (0.1 to 1.0 $ft^3/yr/ft^2$), should be calculated. Finally, a worse-case scenario that assumes a major liner failure should be calculated. For this worse-case scenario, assumptions may include the maximum water level expected in the cell, a leak in the southwest corner of the cell, and a significant leakage rate of at least 10^{-5} cm/sec.*

ENERGY FUELS NUCLEAR RESPONSE:

Analyses of infiltration through the bottom of wet and dry tailings disposal cells are discussed in Section 3.1 of the main report. The analyses were conducted using the EPA HELP Model

(Version 2.0) using site-specific soil data and climatological data from Blanding, Utah and Grand Junction, Colorado. The results of the HELP Model are presented in Appendix C of this report.

The results of the analyses indicate that zero net infiltration would occur through the dry tailings cell. An infiltration rate of 0.04 to 0.12 feet per year was predicted for the wet tailings cell assuming a partially- and fully-leaking bottom liner.



DRAWING NUMBER 4111-B28

LEGEND:

● 9-1 / 9-2 SHALLOW PIEZOMETERS (DRY)

REFERENCE:
Umetco 1992 AND 1988

SHALLOW PIEZOMETER LOCATIONS
WHITE MESA MILL
BLANDING, UTAH

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

TITAN Environmental

No	DATE	ISSUE / REVISION		
		ISSUED FOR DRAFT SUBMITTAL		

DATE 7-18-94
SCALE AS SHOWN
FIGURE F1
DRAWING NUMBER 4111-B28

APPENDIX G

QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN

FOR GROUND WATER MONITORING

WHITE MESA MILL

BLANDING, UTAH

Energy Fuels Nuclear, Inc.
P.O. Box 789
Blanding, Utah

28 July 1994

Note: Standard Operating Procedures are under revision.

TABLE OF CONTENTS

WHITE MESA MILL'S GROUND WATER QUALITY ASSURANCE PROJECT PLAN

1.0 INTRODUCTION

This quality assurance program is based on U.S EPA Guideline SW-846, U.S NRC Regulatory Guide 4.14 and 4.15, and is designed to provide specific guidance and quality assurance requirements for White Mesa Mill's environmental sampling activities. This quality assurance (QA) program presents the purpose, organization, and Standard Operating Procedures (SOPs) pertinent to conduct sampling in a manner consistent with specific quality assurance goals.

These quality assurance goals focus on precision, accuracy, completeness, representativeness, and comparability. The QA program addresses data quality objectives (DQOs), quality assurance objectives, sample and document custody proc[illegible]es, quality control procedures, data evaluation procedures, and analytical procedures.

2.0 DESCRIPTION AND OVERALL DATA QUALI[illegible] OBJECTIVES

2.1 INTRODUCTION

The overall intent of the environmental sampling activities is for compliance purposes under the NRC Material License SUA 1358.

2.2 ANALYTICAL OBJECTIVES

The data quality objective process described in U.S EPA Guideline SW-846 is used as a basis for development of the analytical objectives. For analysis of the ground water samples, analytical objectives have been developed and are described in detail in Sections 4.0 and 8.0.

Analytical objectives include criteria for precision, accuracy, representativeness, completeness, and comparability of the ground water data. Analytical methods used vary according to the analyses required and according to the methods used by the laboratory. Procedures regarding review of data and data validation are included in Appendix A, Part 2, Standard Operating Procedure (SOP) No. 6.

2.3 DATA MANAGEMENT OBJECTIVES

Procedures are given to document sample quality. Procedures include all SOPs for ground water monitoring well sampling activities. Field logbooks will be kept as described in Appendix A, Part 2, SOP No. 1. Sample analyses from the in-house laboratory and from the contract laboratory will be retained in the monitoring wells file. All ground water analyses shall be summarized and included in the semi-annual effluent reports.

2.4 PROJECT SCHEDULE

The ground water project schedule is discussed in Section 1.0 of Appendix A, Part 1, Ground Water Monitoring Plan.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

3.1 PROJECT ORGANIZATION

Project organization consists of the environmental coordinator reporting to the Department Head of EA/HS. The Department Head of EA/HS has the overall responsibility for assuring that the QA program is being followed and that QC measures are adequate. The environmental technician reports to the environmental coordinator on the progress of ground water sampling activities and any problems incurred. In addition, both the in-house chemist and the laboratory project chemist send all ground water analyses to the environmental coordinator for review. An organizational chart is included in Table 1.0.

3.2 RESPONSIBILITIES OF EFN PERSONNEL

The environmental technician is responsible for sample collection, sample storage, sample management, and equipment calibration. The technician is required to follow all SOPs relating to ground water sampling activities. The in-house chemist is responsible for performing ground water analyses for chemical analytes specified by EFN.

The chemist is also responsible for following US EPA analytical methods in Guideline SW-846. In addition, White Mesa Mill's environmental coordinator is responsible for directing and coordinating all environmental sampling activities. The Department Head of EA/HS will supervise all QA/QC measures to assure proper adherence to the QA program and will determine corrective measures to be taken when deviations from the program occur.

3.3 RESPONSIBILITIES OF CONTRACT LABORATORY

The contract laboratory is responsible for providing sample analyses for ground water monitoring and for reviewing all analytical data to assure that data are valid and of sufficient quality. The laboratory is also responsible for data validation in which 10% of the data is checked in reference to data quality objectives.

In addition, the laboratory must adhere to the specified guidelines EFN is requiring the laboratory to meet. The guidelines the contract laboratory is expected to follow are US EPA Guideline SW-846, and US NRC Regulatory Guide 4.14 and 4.15.

The contract laboratory will be chosen based on the following criteria: (1) experience in analyzing environmental samples with detail for precision and accuracy, (2) experience with similar matrix analyses, (3) operation of a stringent internal quality assurance program meeting EFN's specifications, (4) ability to satisfy radionuclide requirements as stipulated in NRC Regulatory Guide 4.14, and (5) audit and approval of the laboratory by EFN. Details of quality assurance/ quality control (QA/QC) requirements for laboratory performance are addressed in Sections 6.0 and 15.0 respectively.

4.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT OF DATA

The primary QA objective for all White Mesa Mill's ground water sampling activities is to identify and implement procedures for field sampling, laboratory analyses, data management, and reporting that will provide data of sufficient quality to meet ground water monitoring objectives.

Project objectives are previously discussed in Section 2.0. The quality assurance objectives are to document data quality in terms of precision, accuracy, representativeness, completeness, and comparability.

4.1 QUALITY ASSURANCE PARAMETERS

4.1.1 PRECISION

Precision is defined as the measure of variability that exists between individual sample measurements of the same property under identical conditions. Precision is measured through the use of sample splits taken at specified regular intervals. Split samples are prepared during laboratory analysis and must contain identical concentrations of the parameters of concern.

Analysis of sample splits generates an estimate of overall precision in sampling and analysis. Laboratory split analyses express precision as a relative percent difference (%RPD). Field and laboratory split analyses are evaluated during data validation as discussed in Section 9.0.

4.1.2 ACCURACY

Accuracy is defined as a measure of bias in a system or as the degree of agreement between a measured value and an accepted or measured value. The accuracy of laboratory analyses is evaluated based on analyzing standards of known concentration both before and during analysis. Accuracy is also measured by spiking samples with a known concentration of reagent and measuring the actual versus expected recovery in analysis.

Blank analysis also notes bias that may have occurred due to cross-contamination. Analytical QC samples which will be used to control analytical accuracy are discussed in Section 4.3. Accuracy is moreover measured and evaluated through the Standard Operating Procedures(SOPs). SOPs are provided in Part 2, Appendix A.

Accuracy is evaluated through the use of blanks. Blanks may be field blanks of equipment rinsate blanks which may demonstrate the bias resulting from contamination. Such contamination may be due to sampling equipment, sample containers, or sample handling. Section 4.2 addresses quality control samples collected in the field to be used to evaluate the accuracy of sampling activities. The impact of bias encountered during sampling will be evaluated during data validation as discussed in Section 9.0.

4.1.3 REPRESENTATIVENESS

Representativeness is defined as the degree to which a set of data accurately represents the characteristics of a population, parameter conditions at a sampling point, or an environmental condition. Representativeness is controlled by collecting QC samples and performing all sampling in compliance with the applicable procedures. Detailed sampling procedures are provided in Appendix A. QC samples collected in the field to control data representativeness are discussed in Section 4.2.

4.1.4 COMPLETENESS

Completeness refers to the amount of valid data obtained from a measurement system in reference to the amount that could be obtained under ideal conditions. Laboratory completeness is a measure of the number of samples submitted for analysis compared to the number of analyses found acceptable after review of the analytical data.

4.1.5 COMPARABILITY

Comparability refers to the confidence with which one set of data can be compared to another measuring the same property. Data can be prepared based on accuracy, precision, and representativeness. Data are comparable if sampling conditions, collection techniques, measurement procedures, methods, and reporting units are consistent for all samples within a sample set.

Data subject to quality assurance/quality control (QA/QC) measures are deemed more reliable than data without any QA/QC measures. Quality control samples which help evaluate comparability are discussed in Section 4.3.

4.2 FIELD AND LABORATORY QUALITY CONTROL

4.2.1 FIELD QC CHECKS

Field QC checks consist of field duplicates and rinsate blanks collected and submitted to the analytical laboratory in order to assess the quality of data resulting from the field sampling program. Field duplicates will be analyzed to determine the reproducibility of sampling and laboratory results.

Equipment rinsate blanks will serve as a check for cross-contamination that may have occurred during the sampling process. The Standard Operating Procedures address the topics of equipment decontamination and sampling procedures to be followed. Equipment rinsate blanks provide a check for cross-contamination by sampling equipment. The frequency for collection of equipment rinsate blanks is described in Part 1, Appendix A, Ground Water Monitoring Plan.

Field blanks will be analyzed to evaluate data accuracy through presentation of possible bias.

4.2.2 FIELD QC CHECK PROCEDURES

Field QC check procedures will include peer review and approval of field procedures by the Department Head of EA/HS. All procedures must be signed off by the Department Head of EA/HS in order to be properly implemented and documented. For field QC check procedures, instrument calibration of all field instruments involved in the sampling process will done prior to each day of sampling. Procedures for instrument calibration are contained in the SOP No 1.

4.3 LABORATORY QC CHECKS

The QC checks for the in-house and contract analytical laboratory will meet or exceed the quality control measures set forth in the analytical methods used by the laboratory. Laboratory QC samples will assess the accuracy and precision of the environmental analyses. The following describes the type of QC samples which will be used to assess the quality of the data.

4.3.1 MATRIX SPIKE

A matrix spike is an environmental sample to which known concentrations have been added. The spike is taken through the entire analytical procedure and the recovery of the analytes is calculated. Results are expressed as percent recovery of the known amount spiked. The matrix spike serves as a check evaluating the effect of the sample matrix on the accuracy of analysis.

Matrix spike analyses will be documented in the field logbook and the Chain-of Custody form by the environmental technician using a sample identification number. Extra sample volume may be collected as needed. A minimum of 1 in 20 samples shall be designated for spike analysis. The same minimum will hold true for the in-house laboratory as well as the contract laboratory.

The amount of spiked reagent to add to a sample can be determined from the following formula:

$(N1)(V1)= (N2)(V2)$ where N1 is the concentration of sample water and where N2 is the concentration of the spike reagent ; V1 is the volume of the sample water. V2 is the volume of reagent that needs to be added. When solving the equation V2 can be determined.

4.3.2 LABORATORY DUPLICATES

A laboratory duplicate is taken as a split from an environmental sample. A duplicate is prepared and analyzed by identical methods to the original sample. Duplicates serve to check precision of the analysis. Results are expressed as a relative percent difference (%RPD) between analytical results for the split and the original sample. Both the in-house and the contract lab will analyze duplicates.

4.3.3 LABORATORY AND PREPARATION BLANKS

A laboratory blank is prepared and analyzed in an identical manner to the environmental sample. A preparation blank consists of analyte-free deionized water analyzed in a manner identical to the environmental sample. Contamination detected in analysis of laboratory or preparation blanks will be used to evaluate any laboratory contamination of ground water samples which may have occurred.

4.4 MEASUREMENT GOALS

The objective of quality assurance is to assess the accuracy and precision of sampling activities and laboratory methodology, and to provide quantifiable data with known accuracy and precision limits.

Field activity QA objectives will be fulfilled by the approved sampling and sample handling procedures described in the Ground Water Monitoring Plan and the Ground Water SOPs.

The accuracy and precision of laboratory analyses will be determined by analysis of laboratory spiked samples, laboratory duplicates, and sample blanks collected and analyzed with frequency as described below. Accuracy is measured as the percent recovery (%R) of a known standard or spiked amount for method-specific calibration standards and spiked field samples. Precision is measured as relative percent difference (%RPD) for field duplicates.

The frequency of the duplicates is 1 for every 20 samples submitted. The frequency for blanks is 1 for every 20 samples submitted. Equipment rinsate blanks will be collected each day ground water sampling is conducted and submitted with the quarterly samples. Furthermore, a spike should be performed for every 20 samples submitted.

QA measurement of the representativeness of data is achieved through analysis of field duplicates assuming that comparable sampling and analysis procedures have been followed. QA measurement of data comparability is also achieved through analytical methods and laboratory quality assurance programs.

Laboratory quality assurance provides a means for establishing consistency in the performance of analytical procedures and assuring adherence to analytical methods utilized. Laboratory quality control programs include traceability of measurements to independence reference materials and internal controls. QA measurement of completeness will be evaluated during data validation as discussed in Section 9.0. Completeness goals for ground water are addressed in Section 4.14.

4.5 FIELD MEASUREMENTS

Measurement data will be generated for all ground water sampling activities and will include a description of weather conditions during the time of sample collection. QA objective for the data will be achieved by recording field instrument calibrations and by following preventive maintenance procedures addressed in Part 2, Appendix A, SOP No. 1

5.0 SAMPLING PROCEDURES

Sampling procedures are specified in Part 2, Appendix A, Ground Water Standard Operating Procedures. These procedures include procedures for preparation of sampling equipment, sample designation, sample preservation, and decontamination.

6.0 SAMPLE AND DOCUMENT CUSTODY PROCEDURES

Sample and document custody procedures are addressed in Part 2, Appendix A, SOP No. 2. Procedures will include sample handling, labeling, shipping, Chain-of-Custody documents, field documentation, and project documentation. Verifiable sample custody will be an integral part of all field and laboratory operations related to ground water monitoring. Traceable steps will be taken in the field and laboratory to document that all samples have been properly acquired, preserved, and identified.

7.0 CALIBRATION AND FREQUENCY PROCEDURES

Calibration and frequency procedures are addressed in the Part 2, Appendix A, SOP No. 1. Procedures include calibration of field and laboratory equipment, and frequency of calibration. A fundamental requirement for collection of valid data is the proper calibration of all analytical instruments. Calibration documents that analytical equipment is operating properly and that data produced are within defined calibration ranges.

8.0 ANALYTICAL PROCEDURES

8.1 LABORATORY PROCEDURES

The analytical procedures to be used by the in-house laboratory and contract laboratory will depend on the analysis being done. Methods will vary depending on the laboratory contracted. All compliance analyses will be performed at the contract laboratory. However, both labs are to meet the specifications as outlined by EFN.

These specifications require both the in-house and contract laboratory to follow US NRC Regulatory Guide 4.14 and US EPA Guideline SW-846. The ground water limits for radionuclides are given in NRC Regulatory Guide 4.14 and the contract laboratory is expected to meet these limits. Analytical procedures are discussed in section 11.0 and SOP No. 6.

8.2 PHYSICAL TESTS AND FIELD PROCEDURES

Parameters such as pH and specific conductance will be measured upon sample collection with appropriate instruments in accordance with the procedures defined in the SOP No 1.

The contract lab will be required to meet the guidelines specified for LLD values for radionuclides in ground water and may deviate from the LLD values provided that the standard error is not greater than 10% of the estimated value of the sample.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

The analytical data generated by the contract laboratory will be evaluated for precision, completeness, accuracy, and representativeness using specific data validation procedures. All ground water data will go through two levels of data review and validation. The first level of review will be by the contract laboratory. A data validation specialist will validate all analyses for the contract lab.

Full validation will include recalculation of raw data for a minimum of one or more analytes for ten percent of the samples analyzed. The remaining 90% of all data will undergo a QC review which will include validating holding times and QC samples. Overall data assessment will be a part of the validation process as well.

The laboratory reviewer will evaluate the quality of the data based on US NRC Guide 4.14 and on analytical methods used. The reviewer will check the following: (1) sample preparation information is correct and complete, (2) analysis information is correct and complete, (3) appropriate laboratory SOPs are being followed, (4) analytical results are correct and complete, (5) QC samples are within established control limits, (6) blanks are within QC limits, (7) special sample preparation and analytical requirements have been met, (8) documentation complete.

The laboratory will prepare and retain full QC and analytical documentation. The laboratory will report the data as a group of 20 or less, along with the QA/QC data. The contract laboratory will provide the following information: (1) cover sheet listing samples included in report with a narrative, (2) results of compounds identified and quantified, (3) dilution factors, and (4) reporting limits for all analytes. Also to be included are the QA/QC analytical results.

The second level of review will be the responsibility of the environmental coordinator. The review will be objective and independent since the coordinator is not directly involved in the analysis of the ground water samples. Additional chemical analyses for ground water samples will be provided by the in-house laboratory. Other areas of interest for validation purposes will include the review of sampling procedures, rinsate blanks, laboratory blanks, laboratory duplicates, and spikes. Laboratory analyses will also be checked for completeness upon receipt from the contract laboratory. Re-runs will be required for samples not meeting reporting limits or LLD values.

In addition, the holding time for ground water samples vary according to the analyte being analyzed. As part of the data validation process, the holding time will be compared to the date of the laboratory sample analyses and the date of sample collection to assure validity of the analyses.

10.0 INTERNAL LABORATORY CHECKS

Laboratory QA procedures will be followed to ensure proper handling and tracking of analytical accuracy and precision. Accuracy will be evaluated using spikes, blanks, and duplicates. All out-of-compliance results will be logged by the laboratory QA officer with corrective actions described as well as the results of the corrective actions taken. All raw and reduced data will be stored according to the laboratory's record keeping procedures and QA program. All records will be available for on-site inspection at any time during the course of investigation.

The contract laboratory will follow specific SOPs and analytical methods used by the laboratory. SOPs will be available for on-site review by non-laboratory personnel during the course of investigation.

If re-runs occur with increasing frequency, the QA officer and the project chemist will be consulted to establish more appropriate analytical approaches to problem samples.

11.0 SYSTEM AND PERFORMANCE AUDITS

System audits are conducted to verify documentation and implementation of the QA program. The audits also evaluate the effectiveness of the established QA program and identify any weakness within the program needing improvement. Audits identify deviations from the QA program and verify correction of such deviations. The Department Head of EA/HS will be responsible for initiating and overseeing system audits.

Performance audits are used to assess the accuracy of measurement data through the use of laboratory performance evaluation and blind check samples. Blind performance evaluation samples will be submitted to the contract laboratory for analysis.

11.1 AUDIT PROCEDURE

The system audits will be conducted by EFN staff or by other qualified and approved persons. System audits will review field and laboratory operations including sampling equipment, laboratory equipment, sampling procedures, and equipment calibrations to evaluate the effectiveness of the QA program and to identify any weaknesses that may exist.

11.2 FOLLOW-UP ACTIONS

Response to the system audits is required when deviations are found and corrective action is required. The Department Head of EA/HS in coordination with the environmental coordinator will respond to each Audit Finding Report by completing the Corrective Action Reply section on each form. The response is to be completed within 20 days of receipt and is to state the corrective measures taken for each finding. The response will include the corrective action, the date of implementation, and include corrective action to prevent recurrence.

11.3 AUDIT RECORDS

Audit records for all audits conducted to date will be retained in Central Files. These records will contain audit reports, written replies, records of completion for corrective actions, and any other documents associated with the audits supporting audit findings or corrective actions.

12.0 PREVENTIVE MAINTENANCE

Preventive maintenance concerns the proper maintenance and care of field and laboratory instruments. Preventive maintenance helps ensure that ground water data generated will be of sufficient quality to meet QA objectives. Both field and laboratory instruments have a set maintenance schedule to ensure proper functioning of the instruments. Both field and laboratory instruments will be maintained as per the manufacturer's specifications and established sampling practice.

Field instruments will be checked and calibrated prior to use. Batteries will be charged and checked daily or as needed. All equipment out of service will be immediately replaced. Field instruments will be protected from adverse weather conditions during sampling activities. Instruments will be stored properly at the end of each working day. Calibration and maintenance problems encountered will be recorded in the field logbook. Calibration and maintenance procedures are specified in SOP No. 1.

Both the in-house and the contract laboratory are responsible for the maintenance of their instruments. Preventive maintenance will be performed on a scheduled basis to minimize downtime and the potential interruption of analytical work.

13.0 DATA ASSESSMENT PROCEDURES

Data assessment and review will be accomplished by the project chemist in conjunction with data validation and QC review described in Section 9.0 and SOP No. 6. A summary of this assessment of chemical data quality will be reviewed by the environmental coordinator. Any problems regarding sample collection, shipping, handling, or analysis will be taken into consideration when evaluating the quality of the data.

Both precision and accuracy of the data will be evaluated to assess the quality of the data. Assessment of data with respect to the quality assurance objectives will be accomplished through the joint efforts of the project chemist, environmental coordinator, and the Department Head of EA/HS. The assessment will evaluate sample collection, sample handling, field data, validated blank values, and any other data flags or qualifiers.

14.0 CORRECTIVE ACTION

Both the field technician and project chemist are responsible for following procedures in accordance with the protocols established in the Quality Assurance Project Plan.

Corrective action should be taken for any procedure deficiencies or deviations noted in the ground water monitoring program. All deviations from field sampling procedures will be noted in the field logbook. Any QA/QC problems that arise will be brought to the immediate attention of the environmental coordinator. Laboratory deviations will be recorded by the QA officer in a logbook as well.

Corrective actions will be made and documented when procedures are not strictly in compliance with the established protocol. Data associated with these deviations is considered suspect. Additional samples or measurements will be taken in the field to replace data considered suspect. Upon implementation of corrective action, a memorandum documenting the field corrective action will be placed in the monitoring well files and in Central Files.

Corrective action for laboratory deviations will be the responsibility of both the environmental coordinator and lab supervisor. Any deviation apparent during analysis will be addressed and corrective action will be taken when deemed necessary. All corrective measures will be documented and filed.

15.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

The environmental technician will report to the environmental coordinator regularly regarding progress of the ground water sampling. The technician will also brief the coordinator on any QA/QC issues associated with ground water sampling activities. Refer to Section 3.0 and Table 1.0.

The in-house and contract laboratory maintain detailed procedures for laboratory record keeping. Each data set report submitted to the environmental coordinator will contain the laboratory's certification of the analytical methods performed and identify all QA/QC measures not within the established control limits. Any QA/QC problems will be brought to the environmental coordinator's attention as soon as possible.

After sampling has been completed and final analyses are completed and reviewed, a brief data evaluation summary report will be prepared. The report will summarize the data validation efforts and provide an evaluation of the data quality in regard to precision, accuracy, and completeness. The final summary will be prepared by the project chemist for the contract lab and by the staff chemist at the in-house lab. The final summary will be reviewed by the environmental coordinator and incorporated into the ground water semi-annual effluent report.

16.0 REFERENCES

1. U.S Environmental Protection Agency (EPA). 1986. Test Methods for Evaluating Solid Waste. SW-846, Third Edition. November.

2. U.S Environmental Protection Agency (EPA). 1987. Data Quality Objectives for Remedial Response Activities, Development Process, EPA/540/g-87/003; and Data Quality Objectives for Remedial Response Activities, Example Scenario; RI/FS Activities at a Site with Contaminated Soils, and Groundwater, EPA/540/G-87/004.

3. U.S Environmental Protection Agency (EPA). 1988a. Laboratory Validation Functional Guidelines for Evaluating Organic Analyses. February.

4. U.S Environmental Protection Agency (EPA). 1988b. Laboratory Data Evaluation Functional Guidelines for Evaluating Inorganic Analysis. July 1.

5. U.S Environmental Protection Agency (EPA). 1990. National Functional Guidelines for Organic Data Review. Revised June.

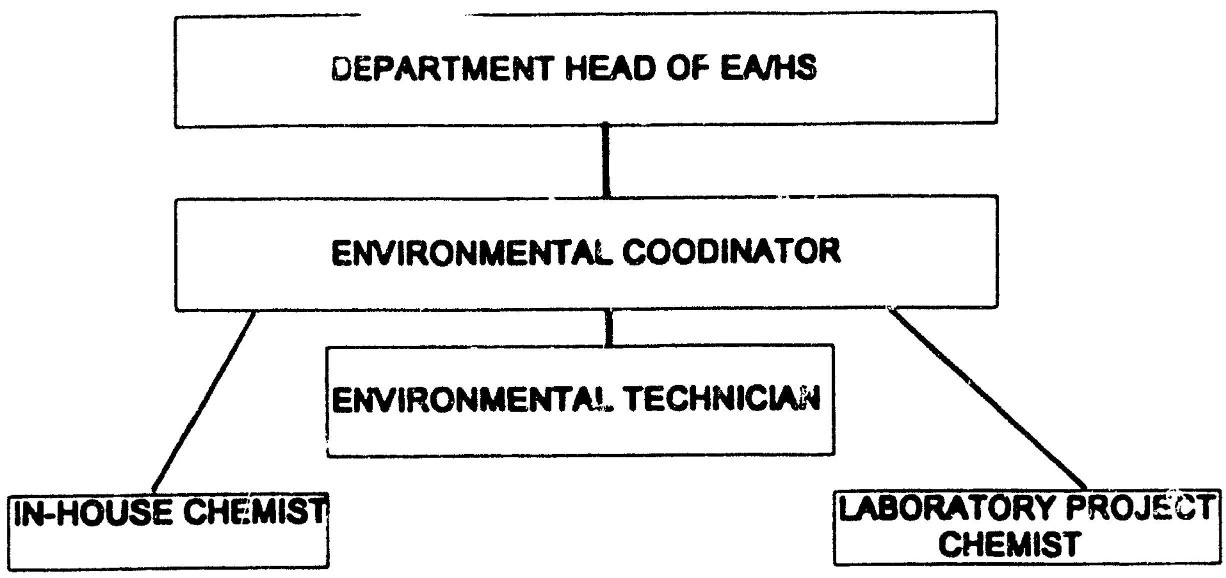
6. U.S Nuclear Regulatory Commission (NRC'. 1980. Radiological Effluent and Environmental Monitoring At Uranium Mills. Regulatory Guide 4.14. April.

7. U.S Nuclear Regulatory Commission (NRC). 1979. Quality Assurance for Radiological Monitoring Programs - Effluent Streams And The Environment. Regulatory Guide 4.15. February.

8. Umetco White Mesa Mill. 1990. White Mesa Procedures Manual for Groundwater Hydrology.

TABLE 1.0

ORGANIZATIONAL STRUCTURE



POINTS OF COMPLIANCE

WHITE MESA URANIUM MILL, SEPTEMBER 1994

FOR

RECLAMATION

OF

WHITE MESA FACILITIES

BLANDING, UTAH

PREPARED BY

TITAN ENVIRONMENTAL

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Points of Compliance
White Mesa Uranium Mill

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October 5, 1994

Ms. Sandra Wastler, Senior Project Manager
U. S. Nuclear Regulatory Commission
2 White Flint North, Mail Stop 7J9
11545 Rockville Pike
Rockville, MD 20852

Dear Ms. Wastler:

Re: White Mesa Mill, Blanding, Utah, License SUA-1358
Transmittal of Points of Compliance for
White Mesa Mill

Enclosed are five copies of a report which presents the rationale for location and compliance criteria for groundwater Points of Compliance (POCs) for the Energy Fuels Nuclear, Inc. (EFNI), White Mesa Uranium Mill. The purpose of the POCs is to provide timely detection of potential leakage from the tailings disposal cells at the mill site and to assure protection of the underlying Entrada/Navaho Aquifer.

The report has been developed based on a re-evaluation of existing groundwater quality data and incorporates NRC's comments from our meeting of August 11, 1994, and NRC's site visit of September 20, 1994. We have also enclosed one copy of each of the two guidance documents prepared by the U. S. Environmental Protection Agency (EPA) concerning groundwater monitoring and statistical analysis of groundwater data which were used in this report.

If you or your staff have any questions concerning this report, please call me at (801) 678-2221 or Michelle Rehmann at (303) 623-8317.

Sincerely,

D. K. Sparling
Manager of Uranium Processing

DKS/gp
Enclosures

xc: Mr. Charles L. Cain
Ms. Michelle R. Rehmann
Mr. Rick A. Van Horn
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Points of Compliance
White Mesa Uranium Mill

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September 1994

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1.0 INTRODUCTION

This report presents the rationale for location, and compliance criteria for ground water Points of Compliance (POCs) for the Energy Fuels Nuclear Inc. (EFNI) White Mesa Uranium Mill. The purpose of the POCs is to provide timely detection of potential leakage from the tailings disposal cells at the mill site, and to assure protection of the underlying Entrada/Navajo Aquifer.

The POCs for the mill site are existing monitoring wells WMMW-5, WMMW-11, WMMW-12, WMMW-14, and WMMW-15. In addition, a proposed POC monitoring well will be located adjacent to tailings cell No. 4A. The POC monitoring wells are located hydraulically downgradient of tailings disposal cells No. 3 and No. 4A and screened in the ground water perched zone of the Burro Canyon Formation. These wells will be monitored quarterly for the indicator constituents chloride, potassium, and nickel. Approved statistical methods, as per the Environmental Protection Agency (EPA, 1989), will be employed to evaluate whether the perched ground water zone has been affected by cell leakage.

2.0 CURRENT SITE CONDITIONS

This section presents a summary of the current site hydrogeologic conditions as they pertain to POC issues.

2.1 Site Hydrogeology

Ground water occurrence within the proximity of the White Mesa Uranium Mill has been documented in three strata: the Dakota Sandstone, the Burro Canyon Formation, and the Entrada/Navajo Sandstones. An evaluation of the occurrence of ground water at the mill site is presented by EFNI (1994a).

Dakota Sandstone and Burro Canyon Formation

The ground water occurrence within Dakota Sandstone and Burro Canyon Formation in proximity of the mill site is in the form of a single perched ground water zone. The ground water is perched above the Brushy Basin Member of the Morrison Formation which consists of

bentonitic mudstones and claystones. The saturated thickness of the perched ground water zone varies from 55 feet north of the site and thins to less than 5 feet to the south where it discharges into the adjacent canyons as evidenced by springs and productive vegetation patterns.

Downgradient of the mill, (i.e. between the mill and dissecting canyons) the ground water in the perched zone cannot be used for irrigation or domestic consumption because of the natural poor quality of the water (Section 2.2) and low yield rates of the perched zone. Documented pumping rates from on-site wells completed in the Burro Canyon Formation are less than 0.5 gallons-per-minute (gpm). Even at these low rates, the wells are typically pumped dry within a couple of hours.

At the mill site, the tailings disposal cells are sited within the unsaturated, Dakota Sandstone. If cell leakage were to occur from the tailings cells, tailings-related constituents would have to migrate through approximately 110 feet of unsaturated material before reaching the perched ground water zone. The travel time for constituents to reach the perched ground water zone has been estimated to range from 50 to 150 years (EFNI, 1994a).

In terms of compliance monitoring, the perched ground water zone provides the earliest horizon for detection of tailings cell leakage because it is closest to the potential release point. Although the perched ground water zone cannot be classified as a useable aquifer, it would be considered a pathway for constituents (EPA, 1992), and under 40 CFR § 264.97 can be used for POC monitoring.

Entrada/Navajo Sandstone Aquifer

The ground water present within the Entrada/Navajo Sandstones is the first useable aquifer of significance documented within the mill area. The Entrada/Navajo Sandstone aquifer (Entrada/Navajo Aquifer) is an artesian aquifer and is used regionally for irrigation and domestic consumption.

At the mill site, the Entrada/Navajo Aquifer is separated from the perched ground water zone within the Dakota Sandstone and Burro Canyon Formation by more than 1,200 feet of unsaturated, low permeability formations. The combination of low permeability, thick unsaturated strata and the artesian pressure within the aquifer provides a positive natural physical and hydraulic barrier that will protect the Entrada/Navajo Aquifer from being impacted by potential tailings cell leakage.

In terms of compliance monitoring, the Entrada/Navajo Aquifer would not be included in POC monitoring for the following reasons:

- Timely detection of tailings cell leakage and protection of the Entrada/Navajo Aquifer can be accomplished by monitoring the overlying perched ground water zone within the Dakota Sandstone and Burro Canyon Formation; and

- Timely detection of tailings cell leakage cannot be accomplished by monitoring the Entrada/Navajo Aquifer because it is separated from the tailings cells by more than 1,200 feet of low permeability, unsaturated strata.

2.2 Perched Water Quality

Water quality data has been collected at the White Mesa facility since 1979 and is presented in Appendix A of this report. Evaluation of the data indicates that in the perched zone:

- Water quality is poor and variable, and
- Operations at the White Mesa Uranium Mill have not impacted water quality.

Figure 1, which presents Stiff diagrams for wells upgradient of the tailings facility, demonstrate that water quality at the White Mesa Mill is variable in the perched ground water zone. Examination of the Stiff diagrams indicates that sulfate is the dominant anion but the dominant cation varies for the wells. At the Windmill and Jet Pump Well, magnesium is the dominant cation; at well WMMW-18, calcium is the dominant cation; at well WMMW-19, sodium is the dominant cation; and at well WMMW-1, calcium and sodium are present in approximately equal (milliequivalent) proportions. Figures 2 and 3 show that the cation variability continues throughout the mill site.

Water quality variability is likely the result of several factors, including:

- Slow ground water velocities that allow water to equilibrate with local mineralogy,
- Mineralogic variability within the Burro Canyon Formation,
- Partial penetration of some wells into the top of the underlying Brushy Basin Member, and
- The decrease in saturated thickness of the perched zone south of the site.

As discussed below, the interaction of these factors leads to variability of water type (dominant cation) and also variability of other constituents.

A discussion of the water velocity within the perched ground water zone is presented by EFNI (1994a). Water velocity is expected to decrease as the saturated perched zone thickness decreases south of the site. Along the edges of the saturated zone, ground water likely becomes stagnant. Large calcium, alkalinity and sulfate concentrations at wells located at the edge of the perched zone indicate that the perched water probably is saturated with calcite, and possibly with gypsum, which is a result of stagnant or very slow movement of water in the perched zone.

The mudstones of the Brushy Basin Member are expected to be a source of minor concentrations of trace metals. In general, large concentrations of trace metals such as arsenic, molybdenum and selenium, are found in shales, as compared to sandstones (Parker, 1967). According to boring and well completion logs (EFNI, 1994a), several wells were screened across the Burro Canyon Formation/Brushy Basin Member contact, including WMMW-2, WMMW-3, WMMW-4, WMMW-5, WMMW-11, WMMW-12, and WMMW-15. Small concentrations of arsenic, molybdenum, and selenium are occasionally detected in these wells.

Thinning of saturated thickness and related slow ground water velocities also account for the generally poor quality of the water. For example, the average total dissolved solids (TDS) concentrations for site wells in the perched water zone range from 1271 to 5052 milligrams-per-liter (mg/l) and average sulfate concentrations range from 656 to 2956 mg/l. These ranges of concentrations also have been documented in sandstone and shale units in other semi-arid regions (Hem, 1989) with natural poor water quality. According to Utah Administrative Code, R448-6, ground water with TDS of 3,000 to 10,000 mg/l is classified as Class III - Limited Use. A number of upgradient, transgradient and downgradient wells, including wells WMMW-3, WMMW-4, WMMW-12, WMMW-14, WMMW-15, WMMW-17 and WMMW-19, would fall into this classification, indicating the poor quality of the perched water. Because of the poor quality of the water and low well yield of the water within the Burro Canyon Formation, its expect future uses are minimal.

3.0 POINTS OF COMPLIANCE

This section presents the compliance monitoring program, including location and rationale for the POCs, indicator constituents, and data evaluation protocol.

3.1 Location and Rationale of POCs

Lateral POC Location

The POCs for the White Mesa Uranium Mill are the existing monitoring wells WMMW-5, WMMW-11, WMMW-12, WMMW-14, and WMMW-15. In addition, a proposed monitoring well will be located adjacent to tailings cell No. 4A. The locations of the POC wells are shown in Figure 4.

The POC locations were chosen based on the guidance set forth in the document entitled "RCRA Ground-Water Monitoring: Draft Technical Guidance" (EPA, 1992)." The POC monitoring wells are located hydraulically downgradient of and adjacent to tailings disposal cells No. 3 and No. 4A, and are screened in the perched ground water zone. The ground water levels and flow directions present in the perched water zone are also shown in Figure 4.

Cross-gradient, the lateral spacing between the POC monitoring wells ranges from approximately 500 to 700 feet. This spacing will be adequate for POC monitoring because naturally occurring hydraulic, physical, and kinetic mechanisms are present that will result in lateral spreading of constituents should cell leakage occur. The lateral spreading of constituents will facilitate cell leakage detection at the POCs.

The mechanisms causing lateral spreading include:

- Potential leakage from a tailings disposal cell will first enter the unsaturated Dakota Sandstone where it will spread laterally as well as vertically aided by the presence of low permeability layers (stringers) and capillary suction; and

- The flow regime within the perched water zone of the Burro Canyon Formation is one of flow through a porous media. As such, constituents entering the ground water will be subject to transport processes of advection, dispersion, and diffusion. While advection (ground water flow) will transport constituents downgradient, both dispersion and diffusion mechanisms will cause lateral spreading of constituents in the ground water. Diffusion will cause lateral spreading set up by constituent concentration gradients within the ground water. Hydraulic dispersion will cause lateral spreading due to flow through pore channels. The magnitude of dispersion spreading is scale dependent and may range several orders of magnitude for various geologic media (Neuman, 1990).

Lateral spreading of constituents by naturally occurring mechanisms will increase the likelihood of detection at the POCs. Therefore, the POCs monitoring wells will provide timely detection of leakage from the tailings disposal cell.

Vertical POC Location

The POC monitoring wells are completed in the perched ground water zone of the Burro Canyon Formation. POC monitoring wells are not proposed for the Entrada/Navajo Aquifer because more than 1,200 feet of unsaturated, low permeability formations isolates the aquifer from the tailings cells, and because this aquifer is not the first occurrence of ground water to be affected should leakage from the tailings cells occur.

As presented in Section 2.1, the perched ground water zone is considered a potential constituent pathway, and it is located closest to the tailings cells. Therefore, monitoring of the Burro Canyon Formation perched ground water zone will provide timely detection of tailings cell leakage, if it occurs, and will be protective of the water quality of the Entrada/Navajo Aquifer.

Detection

3.2 Compliance Monitoring Program

detection

The compliance monitoring program will consist of quarterly sampling of the POC monitoring wells. Each sampling event will consist of ground water sampling and ground water elevation determination. Ground water sampling will be conducted using the procedures set forth in the Ground Water Monitoring Plan (EFNI, 1994c) and the Quality Assurance Project Plan (EFNI, 1994b).

Indicator Constituents

Potential leakage from the tailings cells will be evaluated by analyzing the perched zone ground water for indicator constituents present in the tailings. For the purpose of POC monitoring, the slimes drain water is considered representative of liquids associated with the tailings. Water quality indicator constituents were chosen based on the following criteria:

- High concentrations in tailings slimes drain water,
- Low concentrations in site ground water,
- Conservative chemical characteristics, and
- Representation of chemical classes; that is, a cation, an anion, and a trace metal.

Constituents that meet these criteria are chloride, potassium and nickel. Table 1 lists average concentrations of chloride, potassium and nickel for the POC wells, in addition to concentrations in tailings cell No. 2 slimes drain water. As shown in Table 1, the concentrations in slimes drain water of chloride (3191 to 2573 mg/l), potassium (251 to 286 mg/l) and nickel (7.2 to 12 mg/l) are one to three orders of magnitude larger than concentrations in the POC wells.

In addition to the high concentrations in the slimes drain water, chloride, potassium and nickel were chosen as indicator constituents for the following reasons:

- Chloride has been used as a conservative tracer for a number of years (Davis and others, 1985) and has been shown to travel at the same rate as water (Kaufman and Orlob, 1956). Conservative tracers, such as chloride, do not readily adsorb onto soil materials or precipitate unless present in very large concentrations. Evidence of the conservative nature of chloride is that chloride is the dominant anion in ocean water.

- Potassium is somewhat conservative, depending on the presence of clays. Potassium is subject to adsorption by illite clay and to cation exchange by most clays. Potassium has been used as a tracer when it is a component of leachate (Davis and others, 1985) and to determine transport properties (Leonhart and others, 1985). The tailings cells are underlain by sandstone, so potassium retardation due to reaction with clays should be minor.

- Nickel was selected as an indicator constituent as representative of trace metals in the slimes drain water. Nickel is not considered to be conservative; however, it is less readily adsorbed and therefore, travels more readily in solution than other metals, such as lead, copper and zinc (Kinniburgh and Jackson, 1981). Nickel adsorption by clay is decreased by the presence of sulfate (Bansal, 1985), and sulfate is plentiful in slimes drain water and perched ground water. Hence, adsorption of nickel should be minor.

Other constituents, such as pH, sodium, magnesium, calcium, sulfate and arsenic, were not included as water quality indicators for a number of reasons. For example, pH is affected by soil constituents, such as calcareous materials. Calcareous materials react with low pH solutions, resulting in pH increase. Boring logs (EFNI, 1994a) indicated the presence of calcareous stringers and zones underlying the site. The presence of these materials in the unsaturated zone provides a protective geochemical barrier to potential movement of trace metals from the tailings cells. However, potential movement of solutions from the tailings cells would be recognized sooner by monitoring chloride, which is less affected by reactions with soil materials.

In addition to potassium and chloride, slimes drain water contains other major cations and anions, including sodium, magnesium, calcium and sulfate. These parameters were not chosen as potential tracers because they also are major constituents in the perched ground water, as discussed in Section 2.2.

Arsenic occurs as an anion in solution and, therefore, has different chemical behavior than most metals. For example, arsenic adsorbs readily at a pH of about 4.5 but desorbs at higher pH values, whereas most metals do not adsorb until the pH is much higher than 4.5. The slimes drain water pH typically is in the range of 1.5 to 3. If this water were to percolate into the underlying materials, the pH would gradually increase as suggested above. The result would be that arsenic in percolating water would tend to adsorb well before other metals, such as nickel. Therefore, arsenic is not considered to be useful as an indicator parameter.

3.3 Statistical Analysis of Monitoring Data

Statistical methods will be employed to analyze the ground water monitoring data at the POCs and to evaluate compliance. The statistical analysis will be conducted using recommended EPA intra-well comparison techniques for RCRA facilities (EPA, 1989). Intra-well comparison techniques will be employed because, as discussed in Section 2.2, the spatial variability of the ground water quality precludes definition of background ground water quality over the large areal extent of the mill site.

The intra-well comparison technique used will be a control chart based method. Control chart methods are widely used as a statistical tool in industry because they are relatively simple to use and they provide a visual tool for detecting trends and abrupt changes in concentration levels.

3.3.1 Compliance Evaluation

The control chart method used for evaluating compliance will be the combined Shewhart-CUSUM control chart method. The combined Shewhart-CUSUM control chart method consists of plotting standardized constituent concentration data versus time. Compliance is then evaluated by comparing the standardized concentrations against predefined upper bounds which are based on standard deviations. Combined Shewhart-CUSUM control charts for the POC monitoring wells and the indicator constituents are presented in Appendix B. The calculations used to develop these charts are presented in Appendix C. The control charts presented in Appendix B were constructed using the water quality data presented in Appendix A. All of the charts were constructed with a starting sampling date of March 24, 1994 so that each chart would

cover the same time period. Water quality data collected prior to March 24, 1994 were used to calculate the population mean and standard deviation used in control chart construction.

To construct a combined Shewhart-CUSUM control chart, the constituent concentration data must first be standardized. The constituent concentration data is standardized using the following equation:

$$Z_i = (\overline{X_i} - \mu) \frac{\sqrt{n_i}}{\sigma}$$

where:

Z_i = standardized mean,
X_i = average concentration of sample event,
μ = mean population concentration,
σ = population standard deviation, and
n_i = number of measurements during sample event.

In addition to the standardized mean, the cumulative sum for the standardized data must also be calculated. The cumulative sum is equal to:

$$S_i = \max[0, (Z_i - k) + S_{i-1}]$$

where:

S_i = present cumulative sum,
S_{i-1} = previous cumulative sum,
Z_i = standardized mean, and
k = reference value = 1 (EPA, 1989)

Once the concentration data is standardized, the data is plotted versus time. Two upper bounds are also plotted with the data, h and SCL. The upper bound h is a statistical upper bound for the cumulative sum data, while SCL is an upper bound for the standardized mean data. EPA (1989) recommends setting h equal to 5 and SCL equal to 4.5 for ground water monitoring.

Compliance is evaluated by comparing the cumulative sum data to the upper bound h, and the standardized mean data to the SCL upper bound. If the cumulative sum data exceeds the h upper bound or the standardized mean data exceeds the SCL upper bound, this would indicate a

statistically significant increase in constituent concentration. For the White Mesa Uranium Mill, this would indicate potential cell leakage.

The control charts presented in Appendix B show that based on water quality data taken after March 24,1994 the POC monitoring wells do not show impact from mill operations. As future quarterly water quality data is collected, the control charts in Appendix B will be updated and compliance evaluated. If sampling of a POC monitoring well indicates exceedance of the h upper bound or the SCL upper bound using the combined Shewhart-CUSUM control charts, a confirmatory sampling program will be initiated. The confirmatory sampling program will consist of monthly sampling of the affected well for a minimum period of six months. The minimum sampling period of six months was chosen to provide a statistically significant population for evaluating outliers and seasonality.

After the confirmatory sampling program is complete, the POC ground water quality data will be analyzed using an Analysis of Variance (ANOVA) as per EPA (1989) guidance. The ANOVA would be used to determine if the water quality data collected during the confirmatory sampling program are statistically different from the water quality data collected before the confirmatory sampling program. If the data are significantly different, a corrective action plan will be prepared.

monitoring program will be initiated

Water Quality Data Adjustments

During the water quality monitoring period, the control charts for each POC well will be updated after each sampling round. However, before the control charts are updated, the water quality data may need to be adjusted to account for seasonal trends and non-detection values. Although the site water quality data does not exhibit a consistent trend of seasonality, methods to adjust the water quality data for seasonality and the presence of non-detect values are presented by the EPA (1989), and will be used, if appropriate, for the POC control charts at the mill site.

4.0 CONCLUSIONS

The POCs for the White Mesa Uranium Mill are existing monitoring wells WMMW-5, WMMW-11, WMMW-12 WMMW-14, and WMMW-15. In addition, a proposed POC monitoring well will be located adjacent to the southeast corner of tailings cell No. 4A. The POC monitoring wells are located along the southern (downgradient) edge of tailings disposal cells No. 3 and No. 4A, and are screened in the perched ground water zone within the Burro

Canyon Formation. The perched ground water zone cannot be classified as a useable aquifer, however, monitoring of the perched ground water zone will be protective of the Entrada/Navajo Aquifer because it will allow timely detection of tailings cell leakage, should it occur.

The POC monitoring program will employ approved EPA statistical methods to evaluate whether the perched ground water zone has been affected by tailings cell leakage. The statistical methods used will be based on intra-well methods because the natural spatial variability of the site ground water quality precludes definition of a background water quality.

The intra-well statistical method will be based on combined Shewhart-CUSUM control charts. Control charts have been constructed for three indicator constituents, chloride, potassium, and nickel for the site. Selection of these indicator constituents was based on constituent concentrations present in the tailings cell No. 2 slimes drain water.

Compliance within the perched ground water zone will be evaluated quarterly by plotting standardized concentration data on the control charts and comparing the data to upper bounds as defined by the method. If sampling of a POC monitoring well indicates exceedance of an upper bound using the Shewhart-CUSUM control charts, this would trigger a 6-month confirmatory sampling program to determine if the data are statistically significant. If the data are significantly different, a corrective action plan will be prepared.

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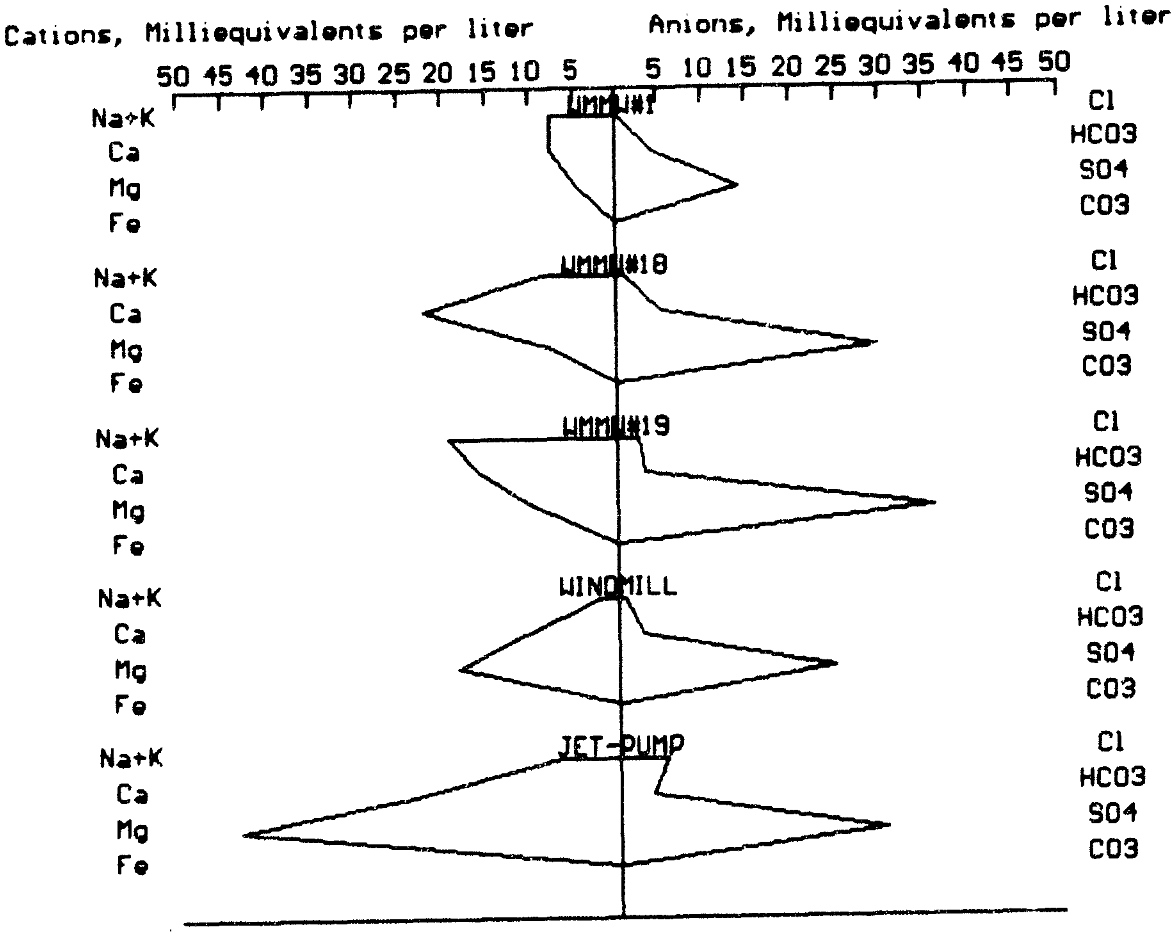
TABLE 1
AVERAGE CONCENTRATIONS OF INDICATOR PARAMETERS
(milligrams per liter)

Location	Chloride	Potassium	Nickel
Cell No. 2 Slimes Drain Water (May, 1991)	3191	251	7.2
Cell No. 2 Slimes Drain Water (Sept., 1991)	2573	286	12.0
WMMW-5	55	9	0.007
WMMW-11	35	9	0.008
WMMW-12	66	14	0.016
WMMW-14	20	13	0.016
WMMW-15	40	11	0.016

DRAWING NUMBER 4111-A29



STIFF DIAGRAMS FOR JET PUMP WELL, WINDMILL, WMMW-1, WMMW-18 AND WMMW-19

PREPARED FOR

ENERGY FUELS NUCLEAR
DENVER, COLORADO

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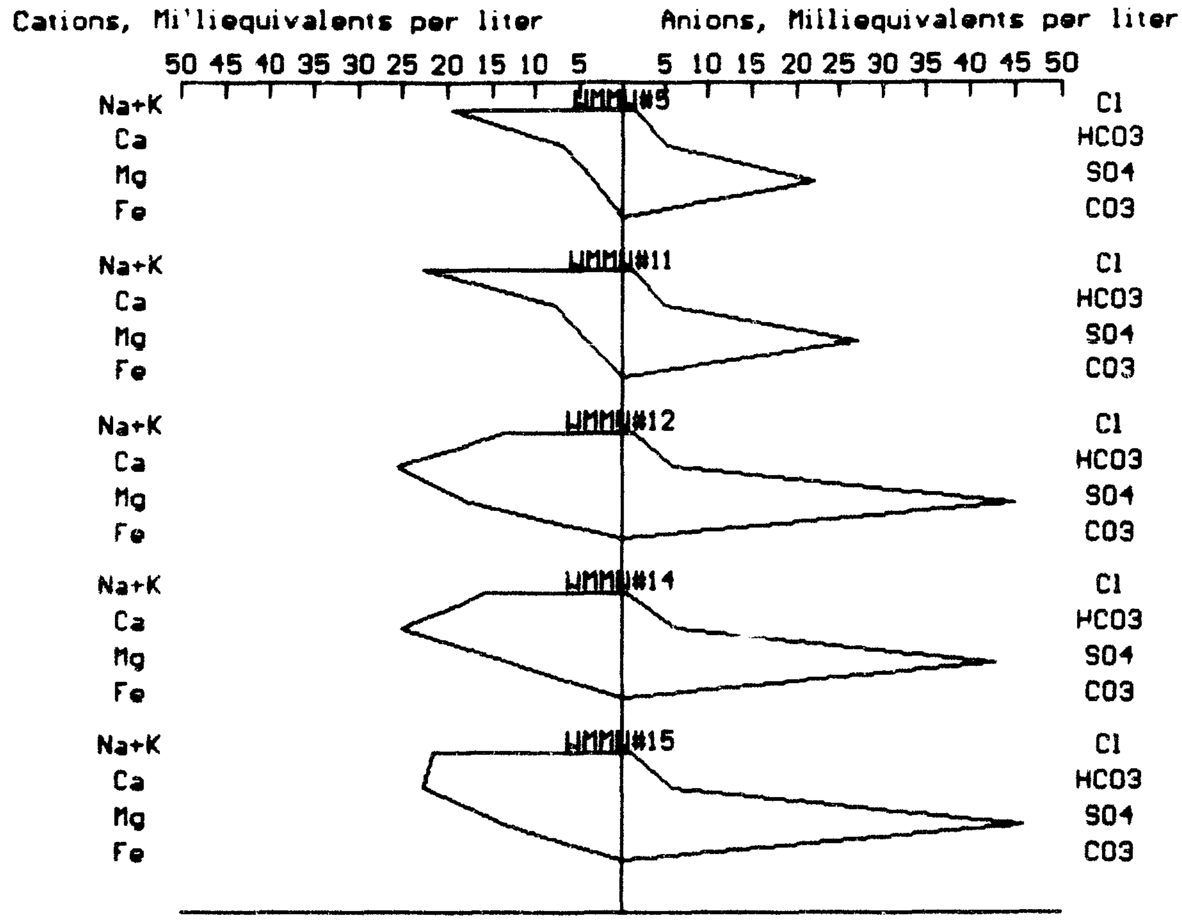
No.	DATE	ISSUE / REVISION	DRN.	CHK'D	APP'D			
1		ISSUED FOR FINAL SUBMITTAL	T.M.G.			DATE: 9-15-94 / SCALE: N.T.S.	FIGURE 1	DRAWING NUMBER 4111-A29

DRAWING NUMBER 4111-A30



STIFF DIAGRAMS FOR
WMMW-5, WMMW-11, WMMW-12
WMMW-14 AND WMMW-15

PREPARED FOR

ENERGY FUELS NUCLEAR
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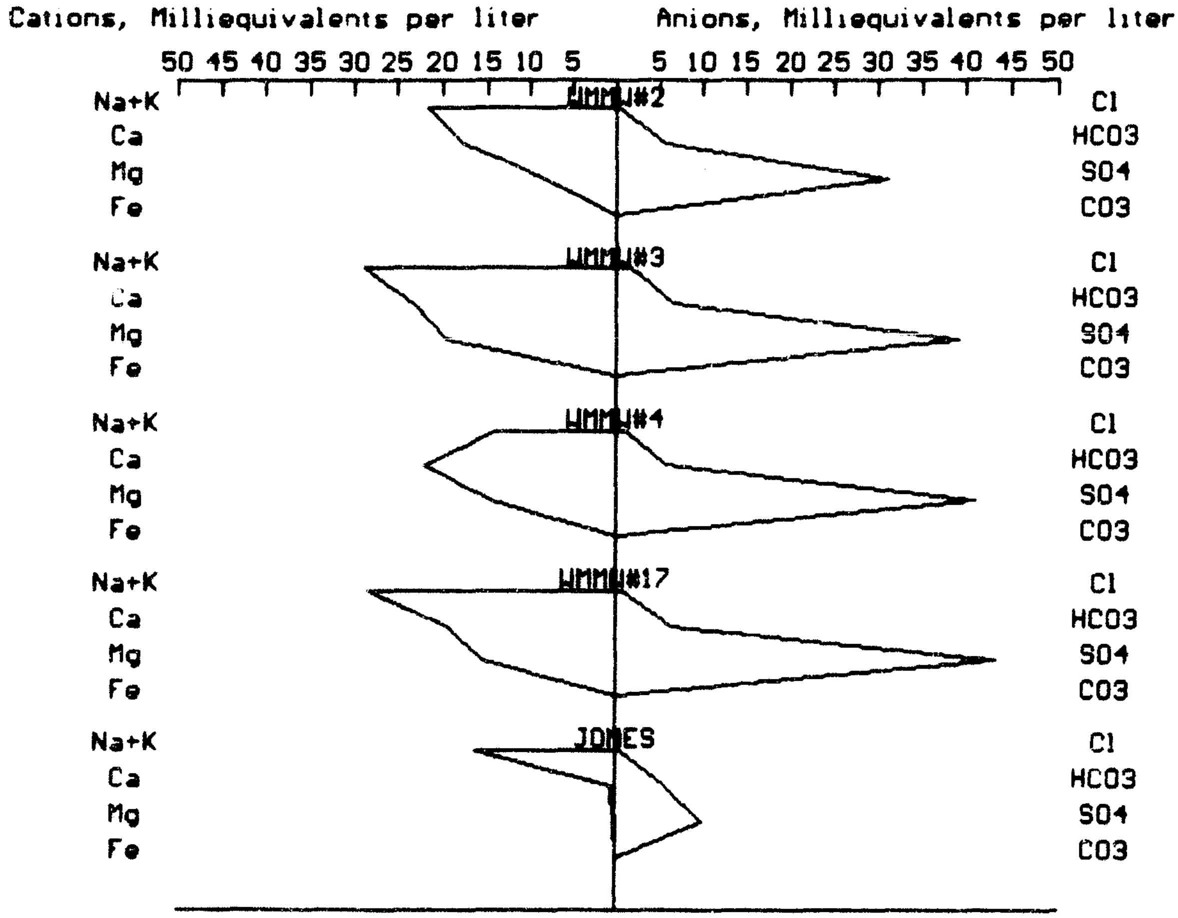
No.	DATE	ISSUE / REVISION	DWN.	CHK'D	APP'D			
1		[illegible]	T.M.G.			DATE: 9-15-94 SCALE: N.T.S.	FIGURE 2	DRAWING NUMBER 4111-A30

1

DRAWING NUMBER 4111-A31



STIFF DIAGRAMS FOR
WMMW-2, WMMW-3, WMMW-4
WMMW-17 AND JONES WELL

PREPARED FOR

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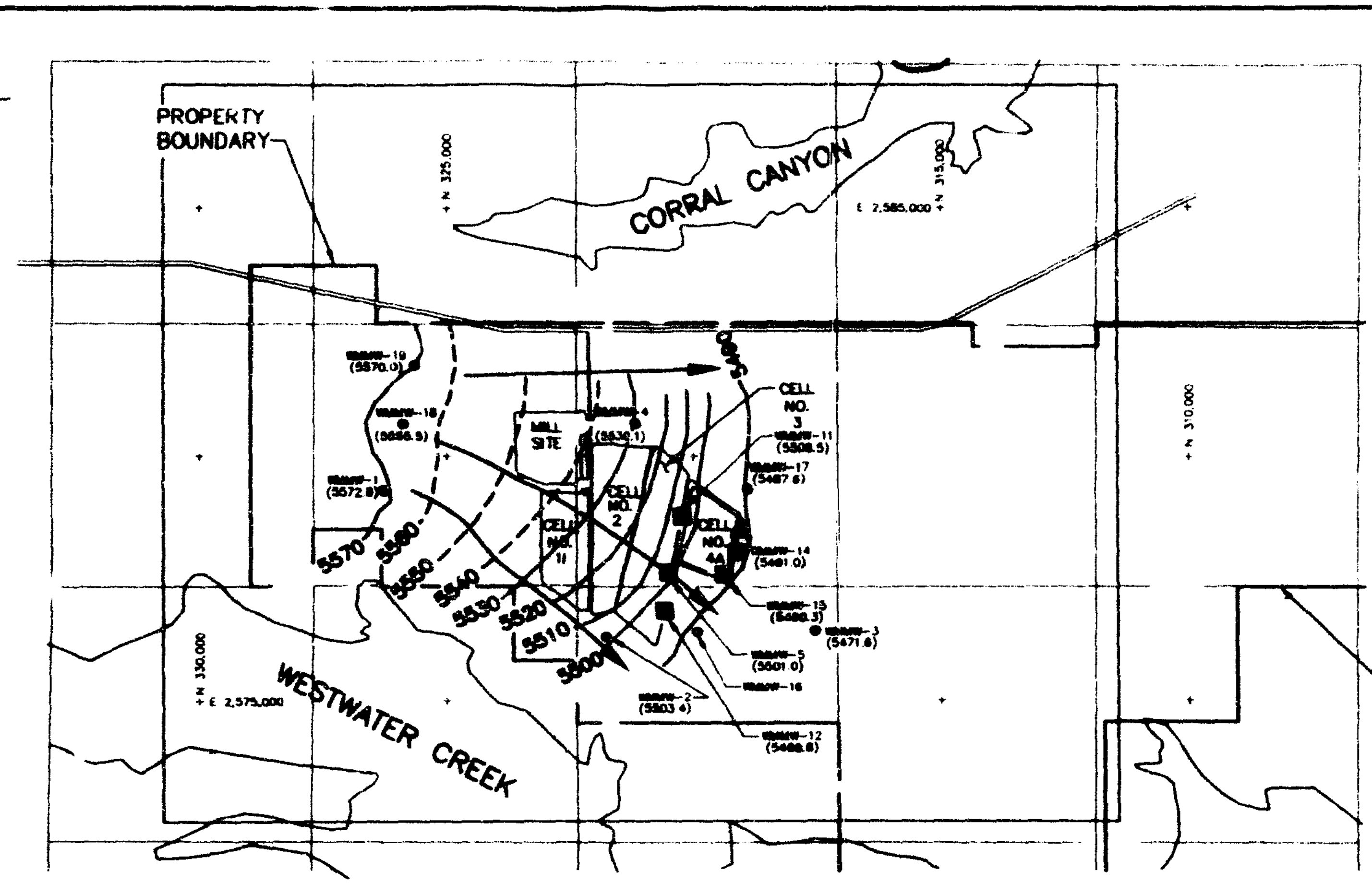
1		ISSUED FOR FINAL SUBMITTAL	T.M.G.			DATE: 9-15-94 SCALE: N.T.S.	FIGURE 3	DRAWING NUMBER 4111-A31

1



LEGEND:

5550 CONTOUR IN FEET ABOVE MEAN SEA LEVEL

GROUND WATER FLOW DIRECTION

EXISTING POINT OF COMPLIANCE MONITORING WELL

PROPOSED POINT OF COMPLIANCE MONITORING WELL

(5570.0) EXISTING MONITORING WELL

SCALE

2000 0 2000 4000 FEET

LOCATION MAP
POINTS OF COMPLIANCE
WHITE MESA MILL
BLANDING, UTAH

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

TITAN Environmental

No.	DATE	ISSUE / REVISION
△		ISSUED FOR FINAL SUBMITTAL

DATE 7-18-94
SCALE AS SHOWN

FIGURE 4

DRAWING NUMBER 4111-B9

APPENDIX A

WHITE MESA GROUND WATER QUALITY

W_QUAL

	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15				
U-Nat	uCi/ml														
	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19	QC (13A)
30-Sep-81	2.7E-09	3.2E-08	?.4E-08	1.5E-08	1.4E-08				6.8E-10						
31-Dec-81	6.5L-10	3.0E-09	I.4E-08	2.0E-09	3.0E-09				6.9E-10						
31-Mar-82	6.5E-10	2.0E-09	2.7E-09	6.9E-10	6.8E-10				6.9E-10						
30-Jun-82	1.4E-09	4.7E-09	2.4E-08	1.3E-09	2.7E-09				7.0E-10						
30-Sep-82	6.8E-10	2.7E-09	8.9E-09	6.8E-10	6.7E-10				4.5E-09						
31-Dec-82	6.8E-10	6.6E-10	2.5E-08	6.7E-10	6.7E-10				6.6E-10						
31-Mar-83	7.4E-09	2.0E-08	1.0E-08	5.5E-09	8.0E-10	3.4E-10	5.0E-09	4.1E-09							
30-Jun-83	6.7E-10	3.4E-09	2.0E-08	6.8E-10	6.7E-10	6.8E-10	2.0E-09	4.0E-09							
30-Sep-83	2.3E-09	2.3E-09	1.4E-08	2.3E-09	5.6E-09	8.5E-09	1.1E-08	6.8E-09							
31-Dec-83	2.3E-09	6.0E-09	2.8E-08	6.7E-10	6.8E-10	6.9E-10	1.0E-08	1.4E-08							
31-Mar-84	2.71E-09	1.35E-09	1.49E-08	1.35E-09	1.35E-09	7.45E-09	2.91E-08	5.24E-09	3.25E-08						
30-Jun-84	2.71E-09	2.71E-09	1.29E-08	2.71E-09	2.71E-09	2.71E-09	1.83E-08	1.83E-08	2.71E-09						
30-Sep-84	8.12E-10	4.06E-10	1.22E-09	4.06E-10	4.06E-10	4.06E-10	4.06E-10	4.06E-10	4.06E-10						
31-Dec-84	4.06E-10	0.00E+00	1.49E-09	8.12E-10	0.00E+00	1.76E-09	1.62E-09	1.49E-09	1.35E-09						
31-Mar-85	1.76E-09	1.90E-09	1.56E-09	4.20E-09	6.09E-10	2.71E-10	4.74E-10	2.30E-09	2.0E-10						
30-Jun-85	7.99E-10	6.20E-09	1.08E-09	9.00E-10	6.03E-10	2.98E-10	6.80E-09	2.50E-09	1.50E-09						
30-Sep-85	1.35E-09	1.69E-08	3.05E-08	1.35E-09	3.39E-09	8.80E-09	3.39E-09	2.03E-09	1.66E-09						
31-Dec-85	1.70E-09	9.40E-09	2.06E-08	1.60E-09	5.00E-10	5.00E-10	6.60E-09	1.35E-08	2.15E-09						
31-Mar-86	1.90E-09	8.80E-09	1.90E-08	2.20E-09	1.10E-09	1.70E-09	9.60E-09	1.48E-08							
30-Jun-86	1.90E-09	6.40E-09	1.50E-08	1.80E-09	5.00E-09	1.50E-09	9.60E-09	1.10E-08	1.00E-09						
04-Sep-86	2.30E-09	5.80E-09	1.67E-08	1.00E-09	7.00E-10	4.00E-10	9.00E-09	1.17E-08	2.00E-09						
10-Dec-86	2.90E-09	8.20E-09	1.21E-08	1.90E-10	1.60E-09	1.90E-10	1.29E-08	1.17E-08	2.20E-09						
20-Feb-87	1.90E-10	3.50E-09	1.10E-08	1.90E-10	1.90E-10	1.90E-10	9.10E-09	7.00E-09	1.90E-10						
29-Apr-87	1.50E-09	3.10E-09	1.26E-08	1.30E-09	9.00E-10	3.00E-10	1.05E-08	9.50E-09	7.00E-10						
19-Aug-87	2.40E-09	6.20E-09	2.30E-08	1.50E-09	2.10E-09	7.00E-10	9.00E-09	1.20E-08	5.00E-10						
20-Nov-87	1.30E-09	4.10E-09	1.60E-08	9.00E-10	3.00E-10	5.00E-10	9.40E-09	1.20E-08	3.00E-10						
26-Jan-88	1.80E-09	4.10E-09	2.00E-08	1.60E-09	1.00E-09	1.90E-10	8.90E-09	1.20E-08	3.00E-10						
01-Jun-88	7.00E-10	4.70E-09	1.84E-08	1.40E-09	9.00E-10	5.00E-10	1.23E-08	1.43E-08	8.00E-10						
23-Aug-88	7.20E-09	1.10E-09	1.50E-09	5.40E-10	1.20E-10	5.00E-11	1.00E-09	1.20E-09	2.20E-10						
03-Nov-88	1.22E-09	4.94E-09	1.48E-07	3.60E-12	1.08E-09	2.71E-10	1.20E-07	1.23E-07	1.62E-09						
09-Mar-89	1.02E-09	6.00E-09	2.20E-08	1.40E-09	1.50E-09	9.00E-10	1.00E-08	0.00E+00	1.90E-09						
21-Jun-89	2.00E-09	6.80E-09	2.30E-08	1.20E-09	6.00E-10	6.00E-10	1.10E-08	0.00E+00	6.00E-10						
01-Sep-89	9.00E-10	8.80E-09	2.20E-08	2.60E-09	1.10E-09	1.60E-09	1.10E-08	0.00E+00	9.00E-10						
20-Nov-89	2.00E-10	9.50E-09	1.90E-08	9.00E-10	4.00E-10	6.00E-10	5.60E-09		0.00E+00	2.7E-08	4.4E-08				5.0E-10
16-Feb-90	2.40E-09	7.40E-09	1.40E-08	1.60E-09	7.00E-[illegible]	7.00E-10	8.80E-09		3.00E-10	3.2E-08	3.0E-08				5.0E-10
08-May-90	7.00E-10	8.00E-09	2.30E-08	1.60E-09	7.00E-10	8.00E-10	1.00E-08		3.00E-10	3.3E-08	3.0E-08				6.0E-10
16-Aug-90	4.67E-10	5.87E-09	1.67E-08	1.27E-09	6.00E-10	4.67E-10	1.07E-08		4.00E-10	3.3E-08	2.5E-08				3.3E-10
13-Nov-90	5.00E-10	7.20E-09	1.60E-08	1.20E-09	3.00E-10	6.00E-10	1.00E-08		5.00E-10	3.3E-08	2.4E-08				4.1E-10
27-Feb-91	2.20E-10	3.50E-09	8.00E-09	1.30E-09	2.70E-10	2.00E-10	8.80E-09		2.00E-10	2.4E-08	2.0E-08				1.6E-09
21-May-91	9.10E-10	4.30E-09	1.30E-08	7.70E-10	1.10E-09	2.30E-10	1.00E-08		8.60E-10	2.2E-08	1.8E-08				3.9E-10
24-Sep-91	8.20E-10	7.60E-09	2.20E-08	9.00E-10	8.00E-10	7.40E-10	1.10E-08		9.90E-10	3.1E-08	3.3E-08				2.0E-10
03-Dec-91	4.30E-10	9.50E-09	8.10E-09	7.40E-10	5.30E-10	2.40E-10	6.80E-09		2.40E-10	3.0E-08	2.3E-08				2.0E-10
17-Mar-92	4.54E-10	7.07E-09	4.53E-09	1.02E-09	1.80E-09	2.70E-09	1.01E-08		1.46E-09	3.03E-08	2.37E-08				7.2E-10
11-Jun-92	2.76E-09	4.66E-09	9.13E-09	2.00E-10	2.00E-10	2.00E-10	5.53E-09		2.00E-10	2.6E-08	1.9E-08				2.0E-10
03-Sep-92	2.0E-09	1.2E-08	1.9E-08	4.1E-09	4.1E-09	3.4E-09	1.3E-08		2.0E-09	4.3E-08	2.8E-08				
19-Nov-92	5.42E-10	1.02E-08	1.12E-08	1.42E-07	6.77E-10	3.18E-09	1.39E-08		1.83E-09	4.3E-08	2.7E-08				2.0E-09
24-Mar-93	2.00E-10	1.15E-09	1.42E-08	1.35E-09	1.35E-09	2.03E-09	1.02E-08		1.35E-09	2.5E-09	1.2E-08	2.0E-08	1.2E-08	1.0E-08	6.1E-09
08-Jun-93	2.03E-09	8.80E-09	1.42E-08	2.71E-09	2.03E-09	2.71E-09	8.80E-09		3.39E-09	2.9E-08	2.3E-08	1.3E-08	9.5E-09	9.5E-09	2.0E-09
22-Sep-93	1.4E-09	6.8E-09	1.2E-08	1.2E-08	1.4E-09	1.4E-09	6.1E-09		2.0E-10	2.8E-08	1.7E-08	9.5E-09	8.1E-09	8.8E-09	2.0E-10
14-Dec-93	2.00E-10	7.45E-09	8.80E-08	1.35E-09	2.00E-10	2.00E-10	9.48E-09		6.77E-10	3.0E-08	2.3E-08	9.5E-09	1.1E-08	8.1E-09	2.0E-10
24-Mar-94	2.10E-09	7.80E-09	1.50E-08	1.30E-09	2.00E-10	2.00E-10	8.90E-09		3.30E-08	2.6E-08	1.7E-08	9.6E-09	7.7E-09	6.7E-09	5.4E-10

15-Jun-94	2.00E-10	2.50E-09	2.80E-09	2.00E-10	2.00E-10	8.10E-10	2.20E-09		8.80E-10	6.0E-09	4.9E-09	3.1E-09	1.8E-09	5.9E-09	2.0E-10
U-Nat	1.49E-09	6.33E-09	1.86E-08	4.54E-09	1.43E-09	1.39E-09	1.13E-08	1.17E-08	1.69E-09	2.81E-08	2.38E-08	1.07E-08	8.34E-09	7.32E-09	9.30E-10
uCi/ml	1.42E-09	5.22E-09	2.20E-08	1.94E-08	2.06E-09	2.01E-09	1.69E-08	2.25E-08	4.63E-09	9.61E-09	8.02E-09	5.18E-09	3.31E-09	2.96E-09	1.38E-08
	1.90E-10	0.00E+00	1.08E-09	3.60E-12	0.00E+00	5.00E-11	4.06E-10	0.00E+00	0.00E+00	2.51E-09	4.90E-09	3.10E-09	1.80E-09	1.43E-09	2.00E-10
	7.40E-09	3.20E-08	1.48E-07	1.42E-07	1.35E-08	8.80E-09	1.20E-07	1.23E-07	3.25E-08	4.27E-08	4.40E-08	2.03E-08	1.22E-08	1.02E-08	6.09E-09

Conductance

	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19
31-Oct-79	948	1270	3260	3360										
30-May-80	1500	2413	3915	3205	2660									
30-Jun-80	1367	3031	4276	3196	2372									
31-Jul-80	1469	2500	4386	3264	2371									
31-Aug-80	1565	2712	4537	3233	2440									
30-Sep-80	1547	2791	4768	2791	2559									
31-Oct-80	1578	2930	4846	3268	2479									
30-Nov-80	1509	2688	4782	3289	2568									
31-Dec-80	1568	2730	4828	3254	2412									
31-Jan-81	1682	3190	5398	3435	2282									
28-Feb-81	1723	3089	5054	3370	2268									
31-Mar-81	1472		5153	3391	2638									
30-Apr-81	1425	3097	4893	3363	2589									
30-May-81	1543	2985	49 8	3064	2422									
30-Jun-81	1303	2806	4433	3106	2699									
14-Aug-81	1716	3702	5632	3963	3077									
27-Jan-82	1450	3450	5100	3370	3050									
07-Apr-82	1635	3402	5489	3630	3275				459					
07-Jul-82	1570	3340	5170	3380	2790				573					
10-Dec-82	1320	2720	4390	3030	2220	2102	3280	3360	530					
25-Jan-83	1310	2680	4260	2910	2150	1630	3130	3290	439					
30-Apr-83	1320	2800	4820	3420	2490	2330	3400	3970	450					
07-Sep-83	1390	2810	4490	2970	2130	2260	3250	3160	412					
26-Oct-83	1680	3560	5550	3700	2840	2600	4000	4380	470					
20-Mar-84	1200	2380	4200	2340	2150	1500	3050	3200	312					
14-Jun-84	1200	2400	4500	2500	2300	1800	3200	3200	370					
05-Dec-84	1100	2275	3975	2325	2000	1900	3000	3050	238					
21-Feb-85	1300	2800	4000	2700	2100	1900	4000	3200	380					
25-Jun-85	1100	2600	4200	2800	2200	1850	3300	3150	300					
30-Sep-85	1500	2500	5000	3300	2800	2350	3800	3800	470					
15-Dec-85	3000	3200	4700	3000	2200	3100	2600	3600						
27-Mar-86	1350	2650	4000	2800	2300	1900	3100	3000	500					
26-Jun-86	1900	3800	5600	3600	3800	3400	5400	4400	700					
04-Sep-86	1800	3700	6000	4100	3250	2700	5500	5000	550					
10-Dec-86	2200	3200	4600	3400	2400	1500	3300	3600	800					
20-Feb-87	1800	3800	5600	3200	2800	3400	5500	4400	460					
29-Apr-87	1800	5000	5600	2600	3700	3250	4400	3900	500					
19-Aug-87	1500	3300	5400	3800	2700	2800	3300	4200	500					
20-Nov-87	1600	3400	5000	3700	2600	2300	3900	4000	600					
27-Jan-88	1300	2600	4500		1900	1800	3000	3050	265					
01-Jun-88	1350	2800	4500	2850	2100	2000	3250	3400	340					
23-Aug-88	1550	3400	4500	3100	2200	1800	3400	3350	310					
03-Nov-88	1250	2850	4400		2000	1950	3000	3300						
09-Mar-89	1300	2800	4200	2700	2100	2000	3200	3150						
21-Jun-89	1694	3680	5680	3690	2710	2520	4000		550					
01-Sep-89	1670	3670	5550	3670	2740	2560	4010		575	3860	4560			
15-Nov-89	1680	3620	5590	3640	2750	2510	4020		693	3880	4450			
20-Feb-90	1695	3630	5550	3630	2780	2750	3980		684	3830	4300			
08-May-90	1694	3630	5650	3650	2750	2550	4000		700	3880	4360			
07-Aug-90	1667	3560	5480	3550	2860	2530	3880		688	3710	4240			
13-Nov-90	1040	2060	4010	2070	2000	1090	3000		550	2080	3030			
27-Feb-91	1700	3720	5530	3730	2640	2680	4120		449	3960	4360			
21-May-91	1705	3680	5660	3670	2650	2620	4040		448	3880	4400			

24-Sep-91	1726	3660	5570	3660	2650	2690	4030		447	3840	4310			
03-Dec-91	1705	3650	5560	3610	2630	2610	4100		442	3900	4220			
17-Mar-92	1702	3600	5490	3670	2620	2630	4070		440	3890	4320			
11-Jun-92	1669	3640	5480	3620	2600	2600	4000		447	3850	4380			
03-Sep-92	1694	3620	5590	3610	2600	2630	4000		411	3810	4200			
19-Nov-92	1690	3660	5710	3650	2680	2630	4070		407	3850	4270			
24-Mar-93	1683	3570	5450	3620	2630	2900	3990		409	3780	4210	4490	2800	3210
08-Jun-93	1364	3580	5530	3630	2680	3060	3850		408	3770	4180	4880	2860	3490
22-Sep-93	1678	3570	5460	3630	2650	3070	3860		409	3760	4180	4830	2830	3580
14-Dec-93	2020	3820	6280	4200	2730	2830	4240		420	4180	4540	6450	3340	4170
24-Mar-94	1370	3650	5680	3670	2630	2640	4030		390	3650	4240	2770	3150	4960
15-Jun-94	1720	3640	5650	3660	2750	2830	3980		404	3830	4240	4950	2670	2760
Conductance	1558	3172	4999	3322	2561	2414	3772	3604	473	3760	4250	4728	2875	3695
umhos/cm	292	575	632	432	364	520	625	530	122	399	300	1075	200	706
	948	1270	3260	2070	1900	1090	2600	3000	238	2080	3030	2770	2800	2760
	3000	5000	6280	4200	3800	3400	5500	5000	800	4180	4560	6450	3340	4960

pH

	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19
31-Oct-79	8.6	7.2	7.3	7.1										
31-Jan-80	7.4	7.2	6.8	7.1										
30-May-80	7.3	7.4	7.2	7.2	7.6									
30-Jun-80	7.5	7.4	7.2	7.3	7.6									
31-Jul-80	7.4	7.5	7.2	7.3	7.7									
31-Aug-80	7.2	7.2	6.9	7.1	7.4									
30-Sep-80	7.6	7.6	7.6	7.7	7.7									
31-Oct-80	7.4	7.3	7.2	7.8	7.6									
30-Nov-80	7.5	7.4	7.1	7.3	7.7									
31-Dec-80	7.4	7.4	7.1	7.2	7.2									
31-Jan-81	7.2	7.2	7	7.1	7.4									
28-Feb-81	7.2	7.1	6.8	7	7.3									
31-Mar-81	7.5	7.15	7	7.7	7.7									
30-Apr-81	7.5	7.2	7.1	7.5	7.5									
30-May-81	7	7	6.5	6.8	7.2									
30-Jun-81	7.3	7.2	6.8	7.3	7.3									
31-Aug-81	7.4	7.4	6.9	7.2	7.8									
31-Dec-81	7.5	7.7	7.3	7.7	7.7									
31-Jan-82	7.3	7.2	6.7	7.1	7.35									
30-Apr-82	7.7	7.5	7.2	7.3	7.8									
31-Aug-82	7.8	7.7	7.5	7.8	8									
31-Dec-82	7.8	7.7	7.5	7.6	8	8.2	7.8	7.85						
31-Mar-83	7.6	7.5	7.2	7.3	8.05	7.4	6.7	7.4						
30-Jun-83	7.8	7.7	7.5	7.7	8.12	8	7.4	8						
31-Dec-83	7.6	7.55	7.4	7.55	7.7	7.2	7.2	7.6						
31-Mar-84	7.7	7.0	6.8	7.8	7.9	7.8	7.2	7.0	7.6					
30-Jun-84	7.6	7.2	7.4	7.8	7.8	7.2	7.8	7.5	8.2					
30-Sep-84	7.5	7.1	6.6	7.0	7.5	7.9	6.8	7.0	7.8					
31-Dec-84	7.7	7.1	6.8	6.8	7.8	7.9	6.7	7.1	8.3					
31-Mar-85	7.8	7.6	6.9	7.1	7.8	7.9	7.1	7.4	8.0					
30-Jun-85	7.6	7.0	6.8	6.7	7.9	8.0	6.8	7.2	7.8					
30-Sep-85	6.8	7.1	6.4	6.3	7.0	7.9	6.9	6.5	7.4					
31-Dec-85	7.3	7.3	6.8	6.9	8.1	7.1	7.7	7.1						
31-Mar-86	7.0	7.0	6.6	6.9	7.0	7.0	6.7	6.9	7.0					
30-Jun-86	7.5	7.0	6.7	7.0	7.5	7.9	6.7	6.9						
04-Sep-86	7.3	6.9	6.7	6.8	7.6	7.9	6.8	7.0	7.0					
10-Dec-86	7.7	6.9	6.5	7.0	7.1	7.9	7.1	7.1	7.6					
20-Feb-87	7.4	7.1	6.5	7.0	7.6	7.9	6.9	7.0	8.5					
29-Apr-87	7.6	6.7	6.5	6.9	7.6	7.8	6.9	7.0	7.6					
19-Aug-87	7.6	6.7	6.6	7.9	7.4	7.5	7.0	7.1	7.4					
20-Nov-87	7.8	7.4	7.2	7.2	8.0	7.8	7.3	7.4	7.4					
27-Jan-88	8.0	7.4	6.8		7.7	7.0	7.1	7.1	7.7					
01-Jun-88	8.1	7.2	7.0	7.1	7.6	7.9	7.1	7.3	8.2					
23-Aug-88	7.6	7.1	6.7	6.8	7.8	7.7	6.7	6.9	7.8					
03-Nov-88	7.5	7.2	6.7		7.5	8.0	6.6	7.0	7.8					
09-Mar-89	7.4	7.1	6.7	7.3	7.6	7.9	6.9	6.8						
21-Jun-89	8.0	7.1	6.7	6.9	7.4	7.8	6.8		7.7					
01-Sep-89	7.3	7.4	6.9	7.0	7.7	7.8	6.8		7.7					
15-Nov-89	7.5	7.0	6.5	6.8	7.8	7.8	7.1		7.6	6.9	6.9			
20-Feb-90	7.8	7.5	6.8	7.0	8.0	8.1	7.2		8.0	6.87	7.46			
08-May-90	7.5	7.1	6.6	7.0	7.6	7.8	6.8		7.9	6.8	7.07			
07-Aug-90	7.5	7.0	6.8	7.7	7.7	7.4	7.0		7.8	6.87	7.18			
13-Nov-90	7.9	7.5	6.6	7.7	8.0	8.0	7.5		8.2	6.47	7.06			

27-Feb-91	7.9	7.5	6.6	7.7	8.0	8.0	7.5		8.2	6.47	7.06			
21-May-91	7.4	7.1	6.3	6.8	7.4	7.9	7.0		7.1	6.82	7.06			
24-Sep-91	7.7	7.0	6.7	7.0	7.4	8.0	6.8		7.3	6.69	6.94			
03-Dec-91	7.6	7.3	6.8	6.9	7.7	7.9	6.9		7.8	6.8	7			
17-Mar-92	6.7	7.2	5.8	6.9	7.6	7.9	7.0		7.1	7	7.21			
11-Jun-92	7.1	6.9	6.1	6.7	7.2	7.4	6.6		7.7	6.6	7.33			
03-Sep-92	8.1	7.9	6.7	7.0	7.6	7.9	7.4		7.6	6.89	7.03			
19-Nov-92	7.5	7.8	7.1	6.9	7.8	6.2	8.1		7.7	6.83	7.16			
23-Mar-93	7.6	7.2	6.6	6.9	7.4	7.3	7.0		7.7	6.85	7.08	7.23	6.82	7.39
08-Jun-93	7.5	7.3	6.7	7.1	7.7	7.5	6.9		7.8	6.83	7.03	7.04	6.63	7.48
22-Sep-93	7.6	7.6	6.9	7.3	7.6	7.6	7.1		7.9	6.95	7.19	7.2	6.94	7.52
14-Dec-93	7.7	7.2	6.7	7.2	7.9	7.9	7.1		7.1	6.92	7.26	7.29	6.89	7.57
24-Mar-94	6.7	7.2	6.6	6.9	7.4	7.2	6.8		7.4	6.82	6.89	6.15	7.38	6.17
15-Jun-94	7.2	7.2	6.7	7.0	7.7	7.7	7.0		7.3	6.88	7.02	7.08	6.99	7.61
pH	7.5	7.3	6.8	7.2	7.6	7.7	7.0	7.2	7.7	6.8	7.1	7.0	6.9	7.3
	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.4	0.1	0.1	0.4	0.2	0.5
	6.7	6.7	5.8	6.3	7.0	6.2	6.6	6.5	7.0	6.5	6.9	6.2	6.6	6.2
	8.6	7.9	7.6	7.9	8.1	8.2	8.1	8.0	8.5	7.0	7.5	7.3	7.4	7.6

Cl	mg/l														
	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19	QC (13A)
31-Oct-79	2.5	5	12.6	20.1											
31-Jan-80	14	18	25	35											
30-May-80	20	18	50	44	60										
30-Jun-80	16	15	51	43	57										
31-Jul-80	20	20	62	48	60										
31-Aug-80	18	16	65	56	60										
30-Sep-80	13	15	62	43	51										
31-Oct-80	30	20	65	50	55										
30-Nov-80	12	8	64	38	49										
31-Dec-80	13	10	65	41	52										
31-Jan-81	15	11	71	48	53										
28-Feb-81	14	9	65	41	54										
31-Mar-81	14	10	66	40	55										
30-Apr-81	13	11	66	41	53										
30-May-81	14	13	110	41	53										
30-Jun-81	12	10	69	43	53										
31-Aug-81	14	7	67	32	52										
31-Dec-81	15	14	66	41	20										
31-Jan-82	13	8	64	42	51										
30-Apr-82	12	7	64	40	50										
31-Aug-82	12	6	67	43	43										
31-Dec-82	10.9	5.5	53	36	47.1	24.4	57.4	40.5	4.6						
25-Jan-83	16	11	71	46	57	32	70	53	6.4						
30-Jun-83	16.5	25	66.5	37.3	48.1	26.8	80.5	43.8	2.8						
31-Dec-83	13	8	63	36	54	32	65								
31-Mar-84	14.3	9.4	67.2	43.1	57.8	31.4	64.1	50.4	2.4						
30-Jun-84	12.0	7.0	63.0	43.0	54.0	32.0	65.0	49.0	3.0						
30-Sep-84	15.4	10.9	57.4	44.6	56.6	33.9	64.6	50.9	1.9						
31-Dec-84	14.2	7.1	67.4	42.5	53.2	31.9	67.4	49.6	3.5						
31-Mar-85	14.0	13.0	68.0	46.0	59.0	34.0	67.0	50.0	10.0						
30-Jun-85	17.0	7.8	73.0	42.0	53.0	31.0	62.0	46.0	1.0						
30-Sep-85	18.0	17.0	78.0	47.0	62.0	38.0	71.0	47.0	47.0						
31-Dec-85	53.2	70.9	35.0	53.0	71.0	71.0	53.0	71.0	62.0						
19-Jun-86	25.0	15.0	140.0	98.0	130.0	77.0	170.0	120.0	7.7						
30-Jun-86	25.0	17.0	140.0	95.0	130.0	70.0	150.0	100.0	9.1						
04-Sep-86	2.0	9.5	64.0	42.0	53.0	32.0	58.0	48.0	8.1						
10-Dec-86	8.8	2.7	68.0	45.0	54.0	33.0	64.0	50.0	3.3						
20-Feb-87	11.0	6.6	66.0	44.0	54.0	32.0	63.0	48.0	32.0						
29-Apr-87	12.1	7.7	65.3	42.4	54.3	43.2	62.7	48.7	1.7						
19-Aug-87	11.0	6.0	65.0	46.0	54.0	33.0	61.0	51.0	0.4						
20-Nov-87	9.3	4.6	62.6	45.3	53.2	31.9	61.2	49.2	0.1						
27-Jan-88	10.0	3.7	64.0	45.0	54.0	31.0	61.0	48.0	0.9						
01-Jun-88	9.9	4.8	66.0	45.0	53.0	32.0	64.0	50.0	0.1						
23-Aug-88	13.2	6.4	66.1	48.5	53.9	33.5	64.8	51.2	0.9						
03-Nov-88	11.8	6.6	67.7	48.2	54.7	35.2	65.1	52.1	2.7						
09-Mar-89	12.0	7.6	64.0	45.0	52.6	32.3	61.5	48.8	5.7						
21-Jun-89	11.3	6.4	66.9	45.9	54.6	32.4	60.8		5.2						
01-Sep-89	10.0	6.0	65.0	46.0	54.0	34.0	59.0		8.0						1
15-Nov-89	11.0	5.0	66.0	45.0	54.0	34.0	63.0		7.0	25.0	49.0				1
20-Feb-90	11.0	5.0	65.0	47.0	55.0	33.0	63.0		4.0	20.0	44.0				1
08-May-90	12.0	7.0	67.0	48.0	56.0	33.0	62.0		6.0	23.0	44.0				1
07-Aug-90	11.0	6.0	65.0	48.0	53.0	33.0	63.0		7.0	21.0	44.0				1
13-Nov-90	12.0	6.0	68.0	50.0	54.0	34.0	63.0		4.0	23.0	44.0				1

[redacted]

27-Feb-91	12.0	10.0	68.0	50.0	50.0	31.0	61.0		1.0	23.0	41.0				1	
21-May-91	12.0	6.0	56.0	44.0	48.0	30.0	55.0		1.0	21.0	38.0				1	
24-Sep-91	11.0	9.0	60.0	45.0	54.0	30.0	59.0		2.0	15.0	38.0				1	
03-Dec-91	13.0	7.0	64.0	46.0	50.0	31.0	60.0		2.0	19.0	38.0				1	
17-Mar-92	13.0	7.0	64.0	48.0	51.0	32.0	60.0		2.0	22.0	40.0				1	
11-Jun-92	10.0	6.0	76.0	43.0	46.0	29.0	56.0		1.0	18.0	35.0				1	
03-Sep-92	11	6	58	43	46	31	56		1	20	37				1	
19-Nov-92	13.0	6.0	63.0	45.0	50.0	41.0	62.0		1.0	18.0	39.0				1	
24-Mar-93	14.0	8.0	64.0	47.0	50.0	35.0	60.0		1.0	19.0	38.0	28	34	81	1	
08-Jun-93	12.0	6.0	61.0	46.0	48.0	39.0	54.0		4.0	17.0	38.0	27	34	92	4	
22-Sep-93	18	6	64	47	52	33	61		5	18	38	28	34	84		5
14-Dec-93	12.0	6.0	61.0	45.0	48.0	36.0	54.0		5.0	18.0	38.0	25	34	93		5
24-Mar-94	15.0	6.0	64.0	47.0	50.0	32.0	59.0		1.0	20.0	38.0	29	[illegible]	71		5
15-Jun-94	13.0	6.0	65.0	4.0	47.0	44.0	57.0		5.0	20.0	36.0	31	[illegible]	63		5
Chloride		10.1	65.8	44.8	54.9	35.3	66.1	54.8	6.5	20.0	39.9	28.0	34.2	82.3		3.5
mg/l	6.4	8.7	17.2	11.4	14.6	10.4	20.7	17.6	11.6	2.4	3.4	1.8	0.4	11.9		19.5
	2.0	2.7	12.6	4.0	20.0	24.4	53.0	40.5	0.1	15.0	35.0	25.0	34.0	63.0		0.0
	53.2	70.9	140.0	98.0	130.0	77.0	170.0	120.0	62.0	25.0	49.0	31.0	35.0	94.0		55.0

Sodium	mg/l														
	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19	QC (13A)
31-Oct-79	106	154	282	342											
31-Jan-80	140	213	334	274											
30-May-80	165	346	575	346	478										
30-Jun-80	166	361	642	322	462										
31-Jul-80	160	418	442	335	435										
31-Aug-80	158	410	653	336	465										
30-Sep-80	156	468	586	371	500										
31-Oct-80	162	415	677	341	443										
30-Nov-80	166	419	567	309	428										
31-Dec-80	168	442	699	338	460										
31-Jan-81	170	467	756	335	467										
28-Feb-81	148	462	704	384	487										
31-Mar-81	175	470	745	338	473										
30-Apr-81	161	476	703	314	467										
30-May-81	160	472	718	350	459										
30-Jun-81	162	458	685	351	437										
31-Aug-81	161	460	688	323	426										
31-Dec-81	170	469	730	330	460										
31-Jan-82	170	483	757	340	490										
30-Apr-82	190	460	790	330	510										
31-Aug-82	160	470	750	340	470										
31-Dec-82	170	480	810	334	431	550	310	630	67						
30-Jun-83	170	470	770	330	458	480	310	640	27						
31-Dec-83	170	500	800	320	480	540	290	640							
30-Jun-84	170	500	780	310	470	530	320	650	5.6						
31-Dec-84	182	443	489	340	428	446	328	459	7.2						
30-Jun-85	20	540	790	370	540	610	330	660	7.3						
31-Dec-85	320	490	780	340	530	550	380	600	5.5						
9-Jun-86	262	543	937	326	514	580	430	659	23.6						
04-Sep-86	175	456	746	289	436	477	296	541	29.5						
10-Dec-86	210	529	784	335	501	250	324	562	68.0						
20-Feb-87	116	333	513	209	307	366	197	360	54.3						
29-Apr-87	134	362	518	232	360	378	235	389	7.0						
20-Nov-87	212	618	958	395	564	768	334	677	11.6						
27-Jan-88	185	507	776												
23-Aug-88	187	495	768	266	432	535	244	446	15.2						
03-Nov-88	172	460	659	289	410	486	260	510	17.4						
09-Mar-89	169	464	713	276	321	375	186	564	22.0						
01-Sep-89	163	468	713	287	411	489	269								
15-Nov-89	194	515	637	270	508	567	321		70.1	70.7	72.6				
09-May-90	188	504	756	291	456	517	284		70.8	388.0	566.0				0.45
13-Nov-90	165	470	698	285	410	475	277		48.9	348.0	540.0				0.15
27-Feb-91	171	477	708	284	430	522	213		19.0	265.0	466.0				0.01
21-May-91	177	503	796	274	440	549	271		15.0	353.0	590.0				<0.01
03-Dec-91	179	492	797	324	466	646	336		17.0	366.0	490.0				0.04
11-Jun-92	180	490	760	300	410	540	290		15.2	350.0	510.0				0.03
03-Sep-92	162	475	742	291	428	538	291		9.5	345	504				0.91
19-Nov-92	182	467	736	318	453	520	318		8.5	358.0	478.0				
24-Mar-93	167	504	729	312	460	551	305		7.5	352.0	508.0	615	185	432	0.27
08-Jun-93	170	491	649	312	445	517	302		6.0	349.0	488.0	641	192	436	0.15
22-Sep-93	164	472	755	291	462	557	277		10	355	496	724	198	476	13
14-Dec-93	170	478	734	302	433	556	298		5.0	353.0	467.0	688	193	475	0.2
24-Mar-94	164	470	736	298	436	567	287		0.1	344.7	477.7	653	192.7	448.7	0.103

15-Jun-94	170	480	740	300	440	560	280		10.0	350.0	480.0	680	190	430	0 1
Sodium mg/l	169.1	458.1	699.3	316.4	452.7	518.5	294.2	561.6	22.7	329.8	475.6	590.1	234.5	484.0	1.2
	36.0	71.7	121.4	34.0	45.8	89.0	47.2	98.9	21.6	73.5	113.1	181.1	95.9	77.9	4.8
	19.9	154.0	282.0	209.0	307.0	250.0	186.0	360.0	0.1	70.7	72.6	192.7	185.0	430.0	0.0
	320.0	618.0	958.0	395.0	584.0	768.0	430.0	677.0	70.8	388.0	590.0	724.0	448.7	653.0	13.0

TDS	mg/l MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#1¯	MW#18	MW#19	QC (13A)
31-Oct-79	625	790	2100	2950											
31-Jan-80	870	1060	2450	2800											
30-May-80	1250	1950	4400	3600	2300										
30-Jun-80	1250	2300	4750	2500	2280										
31-Jul-80	1162	2449	4024	3198	2060										
31-Aug-80	1220	2278	4908	3480	2218										
30-Sep-80	1285	2769	4593	3525	2182										
31-Oct-80	1220	2652	4828	3402	2096										
30-Nov-80	1166	2492	4522	2990	1960										
31-Dec-80	1194	2648	4982	2998	2105										
31-Jan-81	1273	2768	5053	3330	2072										
28-Feb-81	1254	2835	4804	3322	2192										
31-Mar-81	1317		5122	3320	2256										
30-Apr-81	1330	3028	5130	3318	2309										
30-May-81	1306	2998	5198	3296	2297										
30-Jun-81	1188	2983	5387	3608	2114										
31-Aug-81	1197	2932	5124	3337	2119										
31-Dec-81	1199	2901	5167	3377	2190										
31-Jan-82	1200	2800	4950	3200	2250										
30-Apr-82	1200	2800	5125	3200	2500										
31-Aug-82	1200	2950	5300	3500	2250										
31-Dec-82	1326	3056	5366	3470	2180	1812	4116	3780	334						
30-Jun-83	1150	3500	4900	3500	2200	1650	4050	3850							
31-Dec-83	1200	2950	5150	3250	2100	1550	3950	3750							
30-Jun-84	1400	3200	5300	3500	2200	1700	4100	3700	280						
31-Dec-84	693	1479	2733	1581	1300		2000	2033	139						
30-Jun-85	1560	3130		3610	2200	1700	4300	3900	221						
31-Dec-85	4000	3700	5000	4600	6600	5100	5100	6800							
19-Jun-86	1280	3200	5500	3450	2130	1700	4140	3870	277						
30-Jun-86	1330	3250	5500	3610	3210	1700	4210	3850	292						
04-Sep-86	1250	3240	5320	3450	2040	1710	4040	3770	263						
10-Dec-86	1270	3140	5290	3530	2100	1710	4110	3820	403						
20-Feb-87	1270	3230	5330	3480	2050	1710	4120	3780	311						
29-Apr-87	1270	3180	5400	3340	2380	1880	4120	3810	249						
19-Aug-87	1280	3190	5320	3530	1990	1690	3990	3750	234						
20-Nov-87	1330	3260	5520	3570	1970	1720	4130	3840	236						
27-Jan-88	1310	3270	5100	3460	2030	1640	3960	3740	22						
01-Jun-88	1250	3140	5240	3430	1890	1660	4080	3720	25						
23-Aug-88	1220	3080	5230	3320	1930	1620	3010	3720	207						
03-Nov-88	1250	3150	5430	3450	1890	1710	4060	3670	170						
09-Mar-89	1280	3140	5270	3530	2010	1730	3960	3780							
21-Jun-89	1280	3210	5450	3580	2020	1750	4030		316						
01-Sep-89	1210	3040	5290	3430	1940	1760	3630		296						
15-Nov-89	1200	3060	5250	3370	2090	1860	3900		544	3430	3990				<4
20-Feb-90	1280	3190	5300	3540	2110	1780	4030		202	3710	3970				<4
08-May-90	1160	3050	5060	3240	1950	1660	3700		338	3000	3740				154
07-Aug-90	1210	3080	5220	3320	1970	1700	3750		344	3500	3770				<4
13-Nov-90	1170	3150	5290	3280	1880	1720	3760		308	3440	3780				<4
27-Feb-91	1272	3154	5268	3424	1850	1686	3260		252	2684	3356				15
21-May-91	1275	3037	5326	3348	1871	1740	3943		250	3613	3950				15
24-Sep-91	1352	3149	5309	3471	2139	1819	3810		266	3818	3817				27
03-Dec-91	1286	3179	5188	3462	1943	1810	3930		238	3661	3843				<10
17-Mar-92	1285	3206	5317	3523	1922	1797	4024		237	3704	3910				3

11-Jun-92	990	2910	4930	3190	1810	1740	3900		219	3580	3800				<10
03-Sep-92	1417	3294	5404	3520	2130	1923	4208		347	3958	4040				<10
19-Nov-92	1567	3357	5727	3773	2213	2850	4323		380	3833	4233				
24-Mar-93	1295	3122	5385	3515	1947	2090	3920		287	3630	3835	4607	2655	2625	107
08-Jun-93	1300	3288	5616	3760	2048	2396	4156		260	3728	4084	4636	2720	3144	40
22-Sep-93	1300	3176	5496	3564	2008	2352	3908		304	3708	4052	4592	2700	3172	28
14-Dec-93	1692	3800	6186	3892	2500	2528	4306		470	4062	4530	5296	2940	3694	28
24-Mar-94	1210	2770	5000	3140	1760	1790	3640		200	3380	3120	4190	2460	2340	6
15-Jun-94	1271	3043	5334	3303	2126	1916	3744		224	3512	3860	4534	2557	2067	<10
TDS	1290	2941	5052	3383	2173	1907	3937	3847	270	3570	3911	4349	2645	3255	23
mg/l	380	518	678	353	622	574	433	779	97	314	229	898	193	868	35
	625	790	2100	1581	1300	1550	2000	2033	22	2684	3356	2426	2299	2067	0
	4000	3800	6186	4600	6600	5100	5100	6800	544	4062	4530	5296	2940	4829	154

Sulfates	mg/l														
	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19	QC (13A)
31-Oct-79	220	240	930	1220											
31-Jan-80	520	630	2100	1700											
30-May-80	635	1075	2430	1860	1290										
30-Jun-80	632	1290	2625	1850	1200										
31-Jul-80	610	1400	2450	1980	1100										
31-Aug-80	612	1345	2975	1960	1150										
30-Sep-80	640	1550	2800	2075	960										
31-Oct-80	570	1535	3050	2020	1060										
30-Nov-80	613	1425	2750	1780	1050										
31-Dec-80	620	1520	3060	1780	1150										
31-Jan-81	638	1530	3012	1900	1140										
28-Feb-81	600	1550	2780	1980	1260										
31-Mar-81	658		3150	1890	1210										
30-Apr-81	620	1660	3030	1880	1220										
30-May-81	650	1730	3100	1910	1190										
30-Jun-81	626	1690	3040	2070	1105										
31-Aug-81	630	1750	3050	1910	1115										
31-Jan-82	613	1590	3100	1920	1260										
30-Apr-82	697	1766	3239	2056	1518										
31-Aug-82	662	1788	3185	2047	1295										
31-Dec-82	653	1749	3259	1979	1182	926	2395	2288	39						
30-Jun-83	658	1801	3226	2109	1228	943	2420	2324	41						
31-Dec-83	660	1820	3200	2075	1200	900	2338	2265	64						
29-Feb-84	637	1835	3235	2056	1175	937	2400	2250	77						
30-Jun-84	680	1900	3300	2075	1200	920	2400	2200	32						
31-Dec-84	637	1835	3235	2056	1175	937	2400	2250							
30-Jun-85	816	1890		2040	1210	909	2440	2300	18						
31-Dec-85	1080	1270	2870	2020	7820	79	7820	2120	79						
19-Jun-86	703	2010	3450	2120	1240	943	2500	2420	45						
30-Jun-86	691	2040	3400	2150	1890	949	2520	2420	43						
04-Sep-86	707	2020	3410	2160	1230	956	2470	2400	49						
10-Dec-86	680	1860	2620	2000	1140	911	2370	2240	77						
20-Feb-87	657	1910	2640	2030	1120	895	2100	1990	62						
29-Apr-87	664	1920	3200	1930	1310	1020	2300	2[illegible]70	22						
19-Aug-87	691	2000	3400	2130	1140	951	2430	2380	26						
20-Nov-87	697	2040	3520	2170	1120	961	2560	2450	25						
27-Jan-88	690	1930	3020	2080	1130	919	2380	2300	22						
01-Jun-88	681	1900	3360	2120	1030	947	2450	2370	25						
23-Aug-88	648	1970	3330	2100	1050	915	2290	2330	7						
03-Nov-88	688	1980	3410	2120	1090	974	2500	2240	34						
09-Mar-89	694	1990	3410	2070	1180	975	2530	2400	41						
21-Jun-89	718	2040	3500	2180	1180	1020	2500		65						
01-Sep-89	352	2000	3500	2140	1140	1020	2250		60						
15-Nov-89	697	1990	2670	2150	1180	993	2250		105	2230	2560				<5
20-Feb-90	692	2020	3330	2140	1210	1010	2460		98	2250	2448				<4
08-May-90	684	2020	3480	2080	1180	1000	2070		51	1160	1260				5
07-Aug-90	685	1970	3400	2080	1140	973	2450		88	2240	2445				<4
13-Nov-90	687	1980	3460	2130	1100	975	2460		89	2230	2470				4
27-Feb-91	662	1849	2712	1946	1028	967	1850		45	1512	1876				11
21-May-91	652	1885	2947	1988	1010	936	2255		51	2112	2299				9
24-Sep-91	692	1848	2532	1939	860	956	2240		49	1971	2215				25
03-Dec-91	677	1883	2214	1958	1035	968	2326		27	1919	2253				4
17-Mar-92	667	1899	3220	2035	1022	976	2330		21	2162	2314				2.9

11-Jun-92	642	1862	2894	1993	998	976	2304		26	2138	2293				<4
03-Sep-92	670	1933	3312	2029	1033	1005	2352		30	2208	2366				<4
19-Nov-92	654	1864	3200	1951	1055	1507	2343		21	2098	2362				
24-Mar-93	614	1733	2200	1920	1007	1162	2096		20	1872	2124	2004	1371	1500	5
08-Jun-93	676	1499	1890	1974	1064	1309	2154		27	2051	2203	2079	1431	1736	5
22-Sep-93	658	1841	2572	1962	1057	1307	2234		19	2106	2298	2678	1446	1811	4
14-Dec-93	752	1840	2528	1971	1065	1054	2261		21	2067	2292	2460	1446	1783	4
24-Mar-94	722	1840	3350	1960	1040	1020	2280		26	2110	2440	2770	1420	1400	0
15-Jun-94	670	1834	2199	1966	997	1118	2187		17	2110	2361	2553	1416	1204	<4
Sulfates	656	1744	2956	1998	1259	980	2468	2296	43	2028	2248	2370	1426	1583	5
mg/l	96	326	483	142	866	184	848	106	25	265	273	245	27	216	6
	220	240	930	1220	860	79	1850	1990	7	1160	1260	2004	1371	1204	0
	1080	2040	3520	2180	7820	1507	7820	2450	105	2250	2560	2678	1447	1811	25

ARSENIC

	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19	QC (13A)
31-Jul-80	0.0009	0.016	0.012	0.008	0.006										
31-Aug-80	0.004	0.004	0.0009	0.002	0.0009										
30-Sep-80	0.002	0.002	0.002	0.0009	0.0009										
31-Oct-80	0.0009	0.0009	0.0009	0.0009	0.0009										
30-Nov-80	0.002	0.004	0.004	0.002	0.002										
31-Dec-80	0.0009	0.0009	0.0009	0.0009	0.0009										
31-Jan-81	0.0009	0.0009	0.0009	0.0009	0.0009										
28-Feb-81	0.0009	0.0009	0.0009	0.0009	0.0009										
31-Mar-81	0.0009	0.0009	0.0009	0.0009	0.0009										
30-Apr-81	0.0009	0.0009	0.0009	0.0009	0.0009										
30-May-81	0.0009	0.0009	0.0009	0.0009	0.0009										
30-Jun-81	0.0009	0.0009	0.0009	0.0009	0.0009										
31-Aug-81	0.0009	0.0009	0.0009	0.0009	0.0009										
31-Jan-82	0.0009	0.0009	0.0009	0.0009	0.0009										
05-May-85	0.0009	0.0009	0.0009												
28-Jun-85	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.008						
23-Jul-85	0.0009	0.021	0.0009												
08-Aug-85	0.001	0.001	0.0009												
30-Sep-85	0.0009	0.0009	0.0009												
30-Oct-85	0.0009	0.0009	0.0009												
27-Nov-85	0.0009	0.0009	0.0009												
15-Dec-85	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009						
24-Jan-86	0.0009	0.0009	0.0009												
28-Feb-86	0.0009	0.0009	0.0009												
27-Mar-86	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.002	0.0009						
08-Apr-86	0.0009	0.0009	0.0009												
02-May-86	0.0009	0.0009	0.0009												
04-Sep-86	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009						
10-Dec-86	0.001	0.003	0.005												
20-Feb-87	0.0009	0.002	0.002	0.002	0.002	0.001	0.002	0.002	0.0009						
29-Apr-87	0.002	0.002	0.001	0.0009	0.0009	0.002	0.003	0.002	0.011						
20-Nov-87	0.003	0.005	0.006	0.002	0.001	0.001	0.009	0.008	0.013						
27-Jan-88	0.0030	0.0009	0.0030												
23-Aug-88	0.0020	0.0030	0.0070	0.0030	0.0030	0.0120	0.0040	0.0050	0.0040						
03-Nov-88	0.0009	0.0040	0.0110	0.0009	0.0009	0.0009	0.0009	0.0030	0.0009						
09-Mar-89	0.0150	0.0320	0.0460	0.0330	0.0190	0.0150	0.0360	0.0300	0.0070						
22-Jun-89	0.0040	0.0140	0.0330	0.0170	0.0100	0.0050	0.0210		0.0150						
01-Sep-89	0.0010	0.0050	0.0060	0.0030	0.0010	0.0000	0.0030		0.0060						
15-Nov-89	0.0010	0.0080	0.0100	0.0020	0.0070	0.0020	0.0030		0.0130	0.0030	0.0060				0.001
08-May-90	0.0020	C 0010	0.0050	0.0010	0.0009	0.0010	0.0010		0.0120	0.0010	0.0020				0.008
13-Nov-90	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	3.0009		0.0110	0.0009	0.0009				0.001
27-Feb-91	0.0010	0.0009	0.0009	0.0020	0.0009	0.0020	0.0010		0.0140	0.0009	0.0009				0.002
24-Sep-91	0.0009	0.0010	0.0009	0.0020	0.0080	0.0009	0.0010		0.0130	0.0009	0.0010				0.001
17-Mar-92	0.0009	0.0009	0.0009	0.0020	0.0100	0.0020	0.0009		0.0130	0.0009	0.0020				0.001
03-Sep-92	0.0009	0.0009	0.0009	0.0009	0.0060	0.0060	0.0009		0.0210	0.0009	0.0009				0.001
24-Mar-93	0.0009	0.0009	0.0090	0.0009	0.0060	0.0009	0.0030		0.0130	0.0009	0.0020	0.009	0.0009	0.0009	0.001
22-Sep-93	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009		0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
24-Mar-94	0.0009	0.0009	0.0009	0.0009	0.0020	0.0009	0.0010		0.0180	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
ARSENIC	0.0018	0.0036	0.0044	0.0033	0.0032	0.0029	0.0052	0.0069	0.0098	0.0011	0.0018	0.0036	0.0009	0.0009	0.0018
	0.0028	0.0063	0.0086	0.0066	0.0045	0.0045	0.0090	0.0094	0.0076	0.0006	0.0015	0.0038	0.0000	0.0000	0.0021
	0.0009	0.0009	0.0009	0.0009	0.0009	0.0000	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
	0.0150	0.0320	0.0460	0.0330	0.0190	0.0180	0.0360	0.0300	0.0330	0.0030	0.0060	0.0090	0.0009	0.0009	0.0080

SELENIUM

	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19	QC (13A)
31-Jul-80	0.0009	0.025	0.0009	0.0009	0.0009										
31-Aug-80	0.002	0.026	0.005	0.002	0.003										
30-Sep-80	0.0009	0.012	0.0009	0.0009	0.0009										
31-Oct-80	0.0009	0.017	0.0009	0.0009	0.0009										
30-Nov-80	0.001	0.011	0.003	0.001	0.001										
31-Dec-80	0.0009	0.0009	0.0009	0.0009	0.0009										
31-Jan-81	0.0009	0.016	0.0009	0.0009	0.0009										
28-Feb-81	0.0009	0.0009	0.0009	0.0009	0.0009										
31-Mar-81	0.0009		0.0009	0.0009	0.0009										
30-Apr-81	0.0009	0.0009	0.0009	0.0009	0.0009										
30-May-81	0.0009	0.002	0.0009	0.0009	0.0009										
30-Jun-81	0.0009	0.01	0.0009	0.0009	0.0009										
31-Aug-81	0.0009	0.004	0.0009	0.0009	0.0009										
31-Jan-82	0.0009	0.009	0.003	0.003	0.0009										
30-Jun-84	0.0049	0.015	0.031	0.009	0.0049	0.0049	0.0049	0.005	0.0049						
05-May-85	0.0009	0.0009	0.0009												
28-Jun-85	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009						
23-Jul-85	0.037	0.0009	0.0009												
06-Aug-85	0.0009	0.0009	0.0009												
30-Sep-85	0.0009	0.0009	0.0009												
30-Oct-85	0.0009	0.0009	0.0009												
27-Nov-85	0.0009	0.0009	0.0009												
15-Dec-85	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009						
24-Jan-86	0.0009	0.0009	0.0009												
28-Feb-86	0.0009	0.0009	0.0009												
27-Mar-86	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009						
08-Apr-86	0.0009	0.003	0.0009												
02-May-86	0.0009	0.0009	0.0009												
04-Sep-86	0.0009	0.0009	0.001	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009						
10-Dec-86	0.0019	0.0019	0.0019												
20-Feb-87	0.0009	0.0009	0.002	0.0009	0.001	0.003	0.001	0.007	0.0009						
28-Apr-87	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009							
20-Nov-87	0.005	0.023	0.036	0.01	0.015	0.02	0.004	0.027	0.0009						
27-Jan-88	0.009	0.01	0.016												
23-Aug-88	0.005	0.011	0.011	0.012	0.004	0.001	0.007	0.02	0.0009						
03-Nov-88	0.005	0.024	0.037	0.005	0.026	0.029	0.003	0.03	0.0009						
08-Mar-89	0.004	0.017	0.027	0.019	0.005	0.002	0.021	0.027	0.001						
22-Jun-89	0.001	0.002	0.003	0.003	0.004	0.004	0.001		0.001						
01-Sep-89	0.001	0.001	0.004	0.003	0	0	0		0.001						
15-Nov-89	0.005	0.015	0.019	0.015	0.006	0.02	0.02		0.001	0.014	0.019				0.001
08-May-90	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009		0.0009	0.0009	0.0009				0.001
13-Nov-90	0.0009	0.004	0.003	0.0009	0.0009	0.0009	0.0009		0.0009	0.0009					0.001
27-Feb-91	0.002	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019		0.0019	0.0019	0.0019				0.002
24-Sep-91	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019		0.0019	0.0019	0.0019				0.002
17-Mar-92	0.0019	0.002	0.0019	0.0019	0.0019	0.0019	0.0019		0.0019	0.0019	0.0019				0.002
03-Sep-92	0.0019	0.003	0.011	0.0019	0.0019	0.0019	0.0019		0.0019	0.0019	0.017				0.002
24-Mar-93	0.0019	0.003	0.003	0.0019	0.0019	0.0019	0.0019		0.0019	0.002	0.002	0.0019	0.0019	0.005	0.002
22-Sep-93	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019		0.0019	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019
24-Mar-94	0.0019	0.008	0.02	0.0019	0.0019	0.0019	0.004		0.0019	0.0019	0.078	0.0019	0.0019	0.011	0.0019
SELENIUM	0.003	0.007	0.007	0.003	0.004	0.008	0.004	0.014	0.001	0.003	0.009	0.002	0.002	0.003	0.002
	0.005	0.009	0.015	0.004	0.011	0.016	0.006	0.018	0.001	0.004	0.011	0.000	0.000	0.001	0.000
	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.001
	0.037	0.045	0.091	0.019	0.061	0.072	0.021	0.057	0.005	0.014	0.034	0.002	0.002	0.005	0.002

Ra-226 pCi/l	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19	QC (13A)
31-Jul-80	1	1.3	1	0.7	1										
31-Aug-80	0.7	1.7	0.6	0.7	0.6										
30-Sep-80	0.7	0.3	0.5	0.4	0.2										
31-Oct-80	0.8	1.9	1.1	0.9	1.1										
30-Nov-80	0.7	1.1	0.6	0.8	0.8										
31-Dec-80	0.5	0.4	0.3	0.7	0.4										
31-Jan-81	0.5	1.3	1.3	0.5	0.6										
28-Feb-81	0.6	1.7	0.6	0.9	0.6										
31-Mar-81	2	1.6	0.8	0.9	0.7										
30-Apr-81	2.2	1.3	1.8	0.5	0.3										
30-May-81	3.5	2.3	1.5	1.3	0.8										
30-Jun-81	1.5	2	2.3	1.2	1.8										
31-Aug-81	0.8	7.5	15.5	1.1	1.6										
30-Sep-81	0.4	1.1	0.5	0.8	0.2										
31-Jan-82	0.8	1.6	1.1	1	0.9										
30-Apr-82	0.3	0.6	0.5	1	0.3										
30-Jun-83	0.4	0.17	1.4	1	1.2	0.4	0.6	0.6	0.4						
30-Jun-84	0.3	0.8	0.8	0.7	0.2	0.2	0.2	0.2	0.7						
30-Jun-85	1	1.3	1	1.4	0.3	0.1	1.1	0.9	2						
31-Dec-85	0.5	0.9	5.3	0.9	0.8	0.1	0.7	0.4	0.55						
21-Mar-86	0.5	1	0.8	0.6	0.2	0.1	0.6	0.1	0.4						
19-Jun-86	0.5	0.9	5.3	0.9	0.8	0.1	0.7	0.4	0.055						
04-Sep-86	1.5	0.8	0.9	0.6	0.2	0.2	0.9	0.1	1.3						
10-Dec-86	0.4	0.5	1.1	0.7	0.3	0.3	0.7	0.3	0.3						
20-Feb-87	0.2	0.5	1.1	0.5	0.4	0.4	0.7	0.2	0.3						
29-Apr-87	0.6	0	0.3	0.4	0.3	0.2	0.6	0.3	0.5						
20-Nov-87	0.3	0.2	0.3	0.1	0	0.2	0.3	0	0.6						
27-Jan-88	0.6	0.2	0.8												
23-Aug-88	0.5	0.2	0.7	0.3	0.1	0.1	0.5	0.1	0.5						
03-Nov-88	0.1	0.2	0.3	0.1	0	0.2	0.7	0	0.5						
09-Mar-89	0.1	0.2	0.3	0.1	0.1	0.1	0.2	0.2	0.9						
01-Sep-89	0	0.5	0.2	0.2	0	0.1	0.5		0.2						
15-Nov-89	0.2	0.2	0.4	0.2	0.1	0.2	0.1		0.1	0.1	0.1				0
08-May-90	0.2	0.3	0.6	0.4	0.2	0.1	0.4		0.3	0.1	0.1				0
13-Nov-90	0.2	0.4	0.2	0.1	0.2	0.4	0.1		0.4	0.2	0.3				0.4
27-Feb-91	0.1	0.3	0.2	0.3	0	0.1	0.3		0.3	0.3	0				0
24-Sep-91	0.4	0.1	0.2	0	0	0	0.3		0.2	0.2	0				0
17-Mar-92	0.4	0.2	0.7	0.9	0.4	0.3	0.2		0.3	0.4	0.3				0.2
03-Sep-92	0.2	0.8	0.8	0.4	0.1	0.1	0.4		0.7	0.2	0				0.2
24-Mar-93	0	1.8	0.2	1.2	1.1	0	0.2		0.5	0.5	0	0.9	0.7	0.4	0
22-Sep-93	0.7	0.5	0.8	0.4	0.2	0.9	0.2		0.4	0.5	0.5	0.7	0.8	0.8	0.1
24-Apr-94	0.3	0.1	0.4	0.6	0	0	0.1		0.3	0.3	0	0.3	0.2	0.3	0
RA-226	0.712	1.142	1.488	0.798	0.510	0.268	0.684	0.471	0.760	0.280	0.130	0.600	0.600	0.500	0.090
	0.741	1.603	2.660	1.044	0.499	0.399	1.116	0.740	1.334	0.140	0.168	0.294	0.216	0.500	0.090
	0.000	0.000	0.200	0.000	0.000	0.000	0.100	0.000	0.055	0.100	0.000	0.200	0.300	0.500	0.090
	3.500	8.000	15.500	7.000	2.000	2.000	6.000	3.000	7.000	0.500	0.500	0.900	0.800	0.500	0.090

Ra-228

pCi/l	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19	QC (13A)
27-Feb-91	1.7	2.5	1.1	2.1	1.2	0.9	2.8		1.4	0.5	1.2				0.6
24-Sep-91	1.8	2.2	1.9	1.9	0.8	0.7	2.1		0	0	0.3				0.2
17-Mar-92	1.6	1.6	0	2.1	0.4	0	1.6		0.6	0.9	0.3				0.9
03-Sep-92	1.8	0	2.5	1.4	0	0	0		0	0.6	0.4				0
24-Mar-93	1	1.8	0	1.4	0	0	0		0	0	0	0	0	0	0
22-Sep-93	2.3	3.4	1.9	2.6	1.8	2.1	1.4		0	1.5	1.1	1.8	1.3	1.2	0.4
24-Apr-94	1.5	2.8	1.4	1.5	1.2	0.9	0.7		0.7	0.7	0.4	1.5	1.1	2	0
RA-228	1.671	2.04[illegible]	1.257	1.857	0.771	0.657	1.226	ERR	0.386	0.600	0.529	1.267	0.933	0.733	0.300
	0.361	1.005	0.893	0.417	0.627	0.707	0.978	ERR	0.503	0.484	0.413	0.898	0.685	0.525	0.325
	1.000	0.000	0.000	1.400	0.000	0.000	0.000	ERR	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2.300	3.400	2.500	2.600	1.800	2.100	2.800	ERR	1.400	1.500	1.200	2.000	1.500	1.200	0.900

Th-230 pCi/l	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19	QC (13A)
31-Jul-80	0.4	0.3	0.3	0.4	0.5										
31-Aug-80	0.4	0.4	0.5	0.3	0.3										
30-Sep-80	0.8	0.5	0.4	0.7	0.9										
31-Oct-80	0.5	0.9	0.4	0.9	1.1										
30-Nov-80	0.8	0.6	0.5	0.6	0.9										
31-Dec-80	0.5	0.4	0.8	0.9	0.6										
31-Jan-81	0.5	1.3	1.3	0.5	0.6										
28-Feb-81	0.5	0.8	0.6	0.7	0.6										
31-Mar-81	0.8	0.4	0.8	0.8	0.5										
30-Apr-81	0.5	0.6	0.6	0.5	0.9										
30-May-81	1.1	0.7	0.5	1.2	0.8										
30-Jun-81	1.7	1.1	0.8	1.3	0.7										
31-Aug-81	0.7	1.2	1.1	1.4	0.9										
31-Jan-82	1.1	0	0	1	2.9										
30-Apr-82	0.8	0.9	1.5	0.8	1.7										
31-Aug-82	0.2	0	0	0	0										
30-Jun-83	0	0.4	0.5	0.1	0.2	0	0.1	0.1	0						
30-Jun-84	0.2	0.4	0.1	0	0.1	0.2	0	0.5	0.2						
30-Jun-85	1.2	0.5	0.5	0.9	0.1	1.2	0.6	0.5	0.3						
31-Dec-85	0.1	0	0.7	0.1	0.1	0.1	0.5	0.1	0.05						
21-Mar-86	0.1	0	0.7	0.1	0.1	0.1	0.5	0.1	0.05						
19-Jun-86	0.1	0	0.7	0.1	0.1	0.1	0.5	0.1	0.05						
04-Sep-86	0.4	0.7	0.9	2.4	1.8	1.2	0	0.5	0.5						
10-Dec-86	0	0	0	0.5	0.1	0	0	0	0						
20-Feb-87	0.2	1.5	0	0	0.9	0	0	0	0.1						
29-Apr-87	0.1	0.1	0.2	0.6	0.3	1.9	5.4	4.3	1.2						
20-Nov-87	0	0	0	0.1	0	0.1	0	0.1	0						
27-Jan-88	0.1	0.1	0.3												
23-Aug-88	0.9	0	0.7	0	0.4	0	0	0	0.4						
03-Nov-88	0.7	0.2	0.3	0.4	0	0	0.5	0.5	0.2						
09-Mar-89	0	0	0	0.1	0	0.2	0.2	0.2	0						
01-Sep-89	0	0	0	0	0.1	0	0.4		0						
20-Nov-89	0	0	10	0.1	0	0	0		3.2	0	4.7				0
08-May-90	0.1	0	0.1	0	0	0	0		0	0	0				0.1
13-Nov-90	0.2	0.1	0	0.1	0	0.2	0.2		0	0	0.2				0.8
27-Feb-91	0	0	0.1	0	0	0	0		0.1	0	0.1				0
24-Sep-91	0	0	0	0	0	0	0.1		0	0	0.1				0
17-Mar-92	0	0	0	0	0	0	0		0	0	0				0
03-Sep-92	0	0	0	0	0	0	0		0	0	0.2				0
24-Mar-93	0	0	0	0	0	0.3	0		0.5	0	0.1	0	0.2	0	0.7
22-Sep-93	0.4	0	0	0	0	0	0		0.2	0	0	0	0.3	0	0
24-Apr-94	0	0.2	1	1.4	0.6	0	0		0.4	0.2	0	0.4	0	1.1	0.3
	0.426	0.426	0.662	0.463	0.459	0.296	0.360	0.821	0.370	0.020	0.540	0.233	0.167	0.367	0.190
	0.477	0.695	1.512	0.533	0.599	0.583	1.050	1.579	0.729	0.060	1.389	0.330	0.125	0.519	0.295
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2.000	4.000	10.000	2.400	2.900	2.000	5.400	5.000	3.200	0.200	4.700	0.700	0.300	1.100	0.800

Pb-210 pCi/l	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#13	CULINARY	WM#14	WM#15	WM#17	WM#18	WM#19	QC (13A)
31-Jul-80	3	3	3	3	5										
31-Aug-80	3	3	5	2	3										
30-Sep-80	3	3	2	3	5										
31-Oct-80	3	3	3	2	3										
30-Nov-80	3	2	4	5	4										
31-Dec-80	5	3	3	4	2										
31-Jan-81	3	3	4	2	4										
28-Feb-81	4	5	4	3	5										
31-Mar-81	4		5	3	5										
30-Apr-81	4	5	5	3	5										
30-May-81	4	3	5	3	4										
30-Jun-81	3	5	6	3	5										
31-Aug-81	2	3	6	5	3										
31-Jan-82	0	5	0	0	8										
30-Apr-82	1.3	1.2	1.8	0.9	1.1										
31-Aug-82	9	0.5	1.03	0.9	0										
30-Jun-83	0	0	0.5	0	0	0	0	0	0						
30-Jun-84	1.2	0.9	0.7	1	0.3	0.1	0.8	1.2	8.8						
30-Jun-85	2.7	8.3	1.2	0	0.3	0.8	0	0.2	1.6						
31-Dec-85	0	1	0.4	0.2	0.3	0.9	0.1	0.2	0.2						
21-Mar-86	0	1	0.4	0.2	0.3	0.9	0.1	0.2	0.2						
19-Jun-86	0	1	0.4	0.2	0.3	0.9	0.1	0.2	0.2						
04-Sep-86	0.3	0	0	0	3.6	0.1	0.3	0	0						
10-Dec-86	2.2	3	0	0	0	0.8	0	0	0						
20-Feb-87	2.2	2.3	1.8	1.5	2.7	1.5	2.1	1.1	1.3						
29-Apr-87	3.1	0.2	0.5	6.6	2.4	4	0	1.8	0.9						
20-Nov-87	0.7	0.0	0.0	1.7	0.6	6.7	2.3	1.2	0.9						
27-Jan-88	0.0	0.0	0.0												
23-Aug-88	0.0	0.4	0.0	0.0	0.0	0.4	0.0	0.0	0.0						
03-Nov-88	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0						
09-Mar-89	0.2	0.8	0.1	0.8	0.1	0.7	0.3	0.8	0.9						
01-Sep-89	0.0	0.1	0.0	0.5	0.0	0.1	0.0		0.3						
20-Nov-89	0.4	1.3	1.3	0.1	1.0	0.1	0.2		1.2	1.0	0.0				0.9
08-May-90	0.4	0.0	1.0	0.4	1.1	0.7	0.8		0.0	0.7	1.3				0.6
13-Nov-90	0.7	1.3	0.4	0.9	0.0	1.1	0.3		0.0	0.6	0.1				0.5
27-Feb-91	0.0	0.4	0.1	2.6	0.9	0.6	0.3		0.8	0.6	0.7				0
24-Sep-91	0.5	0.7	1.1	0.0	0.0	0.1	1.8		1.8	1.7	0.0				0
17-Mar-92	1.4	2.6	1.3	1.5	1.8	1.5	2.2		2.0	2.3	2.2				1
03-Sep-92	0.0	0.0	0.0	0.0	1.1	0.4	0.0		0.6	0.6	0.0				0
24-Mar-93	1.3	1.3	0.6	2.2	1.3	1.4	0.7		0.2	0.1	0.2	0.7	1	0.6	0.5
22-Sep-93	0.4	1.1	0.1	1.4	0.8	1.0	0.0		0.2	0.9	1.7	0	0.5	0	0.6
24-Apr-94	0.8	0.0	0.6	0.6	0.2	0.8	0.2		1.1	0.7	0.0	0.7	0.5	0.4	0.2
	1.519	2.037	1.825	1.590	2.046	1.076	0.792	0.493	0.928	0.920	0.620	0.467	0.667	0.333	0.430
	1.503	2.149	2.051	1.614	2.025	1.383	1.646	0.581	1.718	0.600	0.782	0.330	0.236	0.249	0.349
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.000	0.000	0.500	0.000	0.000
	5.000	9.000	7.000	6.600	8.000	6.700	8.000	1.600	8.800	2.300	2.200	0.700	1.000	0.600	1.000

Alkalinity (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	WM#17	WM#18	WM#19	QC (13A)	
01-Nov-89					326	316	346	428	374	0				4	
20-Nov-89	260	344	277	347	322	301	342	379	353	240				1	
15-Dec-89					314	304	324	392	355					1	
24-Jan-90					300	300	319	382	353					0.5	
27-Feb-91	271	349	204	384	303	301	296	361	356	201				0.14	meq/l
19-Nov-92	258	345	352	350	322	329	334	406	357	189					
24-Mar-93	260	349	324	348	318	312	344	392	363	188	384	324	194	7	
08-Jun-93	270	345	410	350	312	308	362	384	358	185	385	325	205	4	
22-Sep-93	252	284	402	340	309	310	343	378	357	192	383	323	208	1	
14-Dec-93	250	343	331	347	312	305	325	387	355	185	385	328	206	3	
24-Mar-94	256	347	358	352	317	311	349	390	371	190	336	213	398	2	
15-Jun-94	251	338	406	343	253	309	337	383	257	184	438	246	223	2.4	
	259	338	340	351	309	309	335	389	351	175	385	293	239	2	
	7	19	64	12	18	8	16	16	29	61	29	46	72	2	
	250	284	204	340	253	300	296	361	257	0	336	213	194	0	
	271	349	410	384	326	329	362	428	374	240	438	328	398	7	

Ammonia (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	QC (13A)
01-Nov-89					0.7	0.6	0.2	0.1	0.1		
20-Nov-89	0.5	0.009	0.009	0.7	0.7	0.6	0.1	0.009	0.2	0.2	0.1
15-Dec-89					0.7	0.6	0.1	0.1	0.1		
24-Jan-90					0.5	0.5	0.09	0.09	0.09		0.1
	0.500	0.009	0.009	0.700	0.650	0.575	0.123	0.075	0.123	0.200	
	0.000	0.000	0.000	0.000	0.087	0.043	0.045	0.038	0.045	0.000	
	0.500	0.009	0.009	0.700	0.500	0.500	0.090	0.009	0.090	0.200	
	0.500	0.009	0.009	0.700	0.700	0.600	0.200	0.100	0.200	0.200	

Vanadium (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	QC (13A)
01-Nov-89					0.009	0.009	0.009	0.009	0.009		
20-Nov-89	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.03	0.04	0.01
15-Dec-89					0.009	0.009	0.009	0.009	0.01		0.01
24-Jan-90					0.009	0.009	0.009	0.009	0.009		0.01
	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.015	0.040	0.010
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.009	0.000	0.000
	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.040	0.010
	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.030	0.040	0.010

Thallium (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	QC (13A)
01-Nov-89					0.009	0.009	0.009	0.009	0.009		
20-Nov-89	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
15-Dec-89					0.009	0.009	0.009	0.009	0.009		0.009
24-Jan-90					0.009	0.009	0.009	0.009	0.009		0.009
	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009

Gross Alpha Dissolved (pCi/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	WM#17	WM#18	WM#19	QC (13A)
01-Nov-89					7	42	47	53	89					
20-Nov-89	6.3	39	65	4	8	17	27	68	81	1.9				1
15-Dec-89					7	13	62	67	90					0.9
24-Jan-90					0	0	16	40	68					2
27-Feb-91	0	4	0	10	15	17	24	48	19	0.1				0.5
24-Sep-91	0	21	76	2	5	5	27	62	24	5.9				0.8
17-Mar-92	0	67	38	31	12	10	0	82	47	0.2				0
03-Sep-92	5	36	34	5	10	0	10	48	27	0				0
24-Mar-93	0	21	0	0	0	0	15	46	98	0	10	12	7	0
18-Oct-93	21	11	180	9	3.9	14	10	39	38	1.1	39	18	19	0.4
24-Mar-94	4.4	21	33	5	12	8	33	44	57	2.3	52	18	34	0.7
	4.588	27.500	53.250	8.250	7.264	11.455	24.636	54.273	58.000	1.438	22.333	21.333	26.000	0.630
	6.677	18.426	54.090	9.134	4.621	11.492	17.004	13.039	27.591	1.885	12.229	9.286	19.026	0.581
	0.000	4.000	0.000	0.000	0.000	0.000	0.000	39.000	19.000	0.000	10.000	12.000	7.000	0.000
	21.000	67.000	180.000	31.000	15.000	42.000	62.000	82.000	98.000	5.900	39.000	34.000	52.000	2.000

Gross Beta Dissolved (pCi/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	WM#17	WM#18	WM#19	QC (13A)
01-Nov-89					12	21	30	43	55					
20-Nov-89	11	31	50	15	18	7	34	40	29	6.7				2.6
15-Dec-89					19	16	44	37	51					0.9
24-Jan-90					13	10	29	37	41					1.1
27-Feb-91	7.1	21	31	13	6.3	8.3	26	25	18					1.1
24-Sep-91	15	21	63	40	17	18	25	33	42	5.6				2.8
17-Mar-92	20	28	42	22	13	16	25	56	29	4.2				0
03-Sep-92	12	58	60	10	10	14	38	67	39	4.2				1.3
24-Mar-93	0.3	9	51	0	7	5	36	47	40	3.6	40	13	21	0
16-Oct-93	11	30	49	24	14	14	22	29	19	3.3	38	18	18	3.3
24-Mar-94	9.5	32	62	22	15	15	19	34	24	4.8	35	19	22	0.7
	10.900	28.000	49.500	16.667	12.811	12.811	31.889	42.778	38.222	4.860	40.000	13.000	21.000	1.225
	6.160	15.100	10.751	12.324	4.315	5.151	6.208	11.858	10.799	1.131	0.000	0.000	0.000	0.989
	0.300	9.000	31.000	0.000	6.300	5.000	25.000	25.000	18.000	3.600	40.000	13.000	21.000	0.000
	20.000	58.000	63.000	40.000	19.000	21.000	44.000	67.000	55.000	6.700	40.000	13.000	21.000	2.800

Methylene Chloride (ug/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					4.9	4.9	4.9	4.9	4.9	
20-Nov-89	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	130
15-Dec-89					4.9	4.9	4.9	4.9	4.9	
24-Jan-90					4.9	4.9	4.9	4.9	4.9	
	5	5	5	5	5	5	5	5	5	130
	0	0	0	0	0	0	0	0	0	0
	5	5	5	5	5	5	5	5	5	130
	5	5	5	5	5	5	5	5	5	130

Acetone (ug/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					99	99	99	99	99	
20-Nov-89	99	99	99	99	99	99	99	99	99	99
15-Dec-89					9.9	9.9	9.9	9.9	9.9	
24-Jan-90					9.9	9.9	9.9	9.9	9.9	
	99	99	99	99	54	54	54	54	54	99
	0	0	0	0	45	45	45	45	45	0
	99	99	99	99	10	10	10	10	10	99
	99	99	99	99	99	99	99	99	99	99

Cadmium (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	WM#17	WM#18	WM#19	QC (13A)
01-Nov-89					0.0049	0.0049	0.0049	0.0049	0.0049					
20-Nov-89	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049				0.005
15-Dec-89					0.0049	0.007	0.006	0.0049	0.0049					
24-Jan-90					0.0049	0.007	0.007	0.0049	0.0049					0.005
24-Sep-91	0.001	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009				0.001
17-Mar-92	0.0009	0.0009	0.0009	0.0009	0.0009	0.001	0.001	0.0009	0.0009	0.0009				0.001
14-Sep-92	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009				0.001
24-Mar-93	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.002	0.0009	0.0009	0.0009	0.0009	0.0009	0.001
22-Sep-93	0.00009	0.00009	0.0003	0.00009	0.0003	0.0002	0.0004	0.0012	0.00009	0.00009	0.0002	0.0002	0.0004	0.00009
24-Mar-94	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049
	0.001	0.001	0.002	0.001	0.002	0.003	0.003	0.003	0.002	0.001	0.000	0.000	0.000	0.002
	0.002	0.002	0.001	0.002	0.002	0.003	0.003	0.002	0.002	0.002	0.000	0.000	0.000	0.002
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.005	0.005	0.005	0.005	0.005	0.007	0.007	0.005	0.005	0.005	0.001	0.001	0.001	0.005

Chromium (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	QC (13A)
01-Nov-89					0.009	0.009	0.009	0.009	0.009		
20-Nov-89	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.01
15-Dec-89					0.009	0.009	0.009	0.009	0.009		
24-Jan-90					0.009	0.009	0.009	0.009	0.009		0.01
	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.010
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.010
	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.010

Cyanide (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	QC (13A)
01-Nov-89					0.009	0.009	0.009	0.009	0.009		0.01
20-Nov-89	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	
15-Dec-89					0.009	0.009	0.009	0.009	0.009		
24-Jan-90					0.009	0.009	0.009	0.009	0.009		0.01
	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.010
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.010
	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.010

Mercury (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	QC (13A)
01-Nov-89					0.00019	0.00019	0.00019	0.00019	0.00019		
20-Nov-89	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.0002
15-Dec-89					0.00019	0.00019	0.00019	0.00019	0.00019		0.0002
24-Jan-90					0.00019	0.00019	0.00019	0.00019	0.00019		0.0002
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

Molybdenum (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	WM#17	WM#18	WM#19	QC (13A)
01-Nov-89					0.009	0.009	0.02	0.02	0.04					
20-Nov-89	0.01	0.02	0.009	0.02	0.009	0.009	0.02	0.02	0.009	0.009				0.01
15-Dec-89					0.009	0.009	0.02	0.02	0.03					0.01
24-Jan-90					0.009	0.009	0.009	0.009	0.01					0.01
24-Sep-91	0.001	0.003	0.01	0.014	0.0009	0.0009	0.006	0.025	0.001					0.001
17-Mar-92	0.001	0.001	0.0009	0.0009	0.0009	0.0009	0.002	0.003	0.003	0.001				0.001
14-Sep-92	0.0009	0.0009	0.0009	0.0009	0.001	0.001	0.001	0.002	0.0009	0 001				0.001
24-Mar-93	0.002	0.001	0.0009	0.001	0.001	0.001	0.002	0.003	0.001	0.0009	0.0009	0.0009	0.007	0.001
22-Sep-93	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.001	0.0009	0.0009	0.004	0.0009
24-Mar-94	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
	0.002	0.004	0.003	0.008	0.004	0.004	0.008	0.010	0.010	0.002	0.001	0.001	0.004	0.004
	0.003	0.007	0.004	0.007	0.004	0.004	0.008	0.009	0.013	0.003	0.000	0.001	0.002	0.004
	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	0.010	0.020	0.010	0.020	0.009	0.009	0.020	0.025	0.040	0.009	0.001	0.002	0.007	0.010

Nickel (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	WM#17	WM#18	WM#19	QC (13A)
01-Nov-89					0.009	0.009	0.03	0.03	0.02					
20-Nov-89	0.009	0.009	0.05	0.02	0.009	0.009	0.02	0.02	0.02	0.009				0.01
15-Dec-89					0.009	0.009	0.02	0.03	0.02					0.01
24-Jan-90					0.009	0.009	0.009	0.01	0.009					0.01
27-Feb-91	0.02	0.06	0.1	0.07	0.04	0.05	0.06	0.05	0.07	0.01				0.02
24-Sep-91	0.009	0.01	0.02	0.009	0.009	0.009	0.009	0.009	0.009	0.009				0.01
17-Mar-92	0.009	0.01	0.01	0.009	0.009	0.009	0.009	0.009	0.009	0.009				0.01
14-Sep-92	0.0009	0.0009	0.019	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009				0.001
24-Mar-93	0.0009	0.0009	0.014	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.005	0.0009	0.001
22-Sep-93	0.003	0.0009	0.012	0.003	0.0009	0.0009	0.005	0.003	0.0009	0.001	0.0009	0.0009	0.004	0.0009
24-Mar-94	0.009	0.009	0.01	0.009	0.009	0.009	0.009	0.009	0.03	0.009	0.009	0.009	0.009	0.009
	0.008	0.015	0.036	0.018	0.011	0.012	0.018	0.018	0.018	0.008	0.001	0.005	0.001	0.009
	0.006	0.020	0.032	0.024	0.011	0.014	0.017	0.015	0.020	0.004	0.000	0.000	0.000	0.006
	0.001	0.001	0.010	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.005	0.001	0.001
	0.020	0.060	0.100	0.070	0.040	0.050	0.060	0.050	0.070	0.010	0.001	0.005	0.001	0.020

Carbon Disulfide (ug/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					4.9	4.9	4.9	4.9	4.9	
20-Nov-89	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
15-Dec-89					4.9	4.9	4.9	4.9	4.9	
24-Jan-90					4.9	4.9	4.9	4.9	4.9	
	5	5	5	5	5	5	5	5	5	5
	0	0	0	0	0	0	0	0	0	0
	5	5	5	5	5	5	5	5	5	5
	5	5	5	5	5	5	5	5	5	5

Chloroform (ug/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					4.9	4.9	4.9	4.9	4.9	
20-Nov-89	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
15-Dec-89					4.9	4.9	4.9	4.9	4.9	
24-Jan-90					4.9	4.9	4.9	4.9	4.9	
	5	5	5	5	5	5	5	5	5	5
	0	0	0	0	0	0	0	0	0	0
	5	5	5	5	5	5	5	5	5	5
	5	5	5	5	5	5	5	5	5	5

2-Butanone (ug/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					99	99	99	99	99	
20-Nov-89	99	99	99	99	99	99	99	99	99	99
15-Dec-89					9.9	9.9	9.9	9.9	9.9	
24-Jan-90					9.9	9.9	9.9	9.9	9.9	
	99	99	99	99	54	54	54	54	54	99
	0	0	0	0	45	45	45	45	45	0
	99	99	99	99	10	10	10	10	10	99
	99	99	99	99	99	99	99	99	99	99

Beryllium (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	WM#17	WM#18	WM#19	QC (13A)
24-Sep-91	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009				0.0009
17-Mar-92	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009				0.0009
03-Sep-92	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009				0.0009
24-Mar-93	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
22-Sep-93	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019
24-Mar-94	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Calcium (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	WM#17	WM#18	WM#19	QC (13A)
03-Sep-92	126	306	377	377	110	34.5	488	467	359	47				3.5
14-Nov-92	152	334	437	424	132	198	504	474	431	49				
24-Mar-93	149	355	466	439	136	117	514	498	422	50	406	415	245	0.91
08-Jun-93	150	355	466	442	136	150	512	500	451	50	388	445	316	0.98
22-Sep-93	142	325	453	427	130	140	507	498	430	50	375	437	305	2
14-Dec-93	167	332	457	420	126	50	489	477	446	49	372	419	287	1
24-Mar-94	159	341	476	431	125	53.3	537	505	436	53.1	405	456	199	0.32
15-Jun-94	130	325	443	423	130	77	494	499	453	49	410	424	166	1.8
	144	338	437	421	129	125	505	485	416	49	397	430	281	2
	11	20	36	26	11	60	10	14	34	1	9	15	36	1
	126	306	377	377	110	35	488	467	359	47	388	415	245	1
	152	355	466	442	136	198	514	500	451	50	406	445	316	4

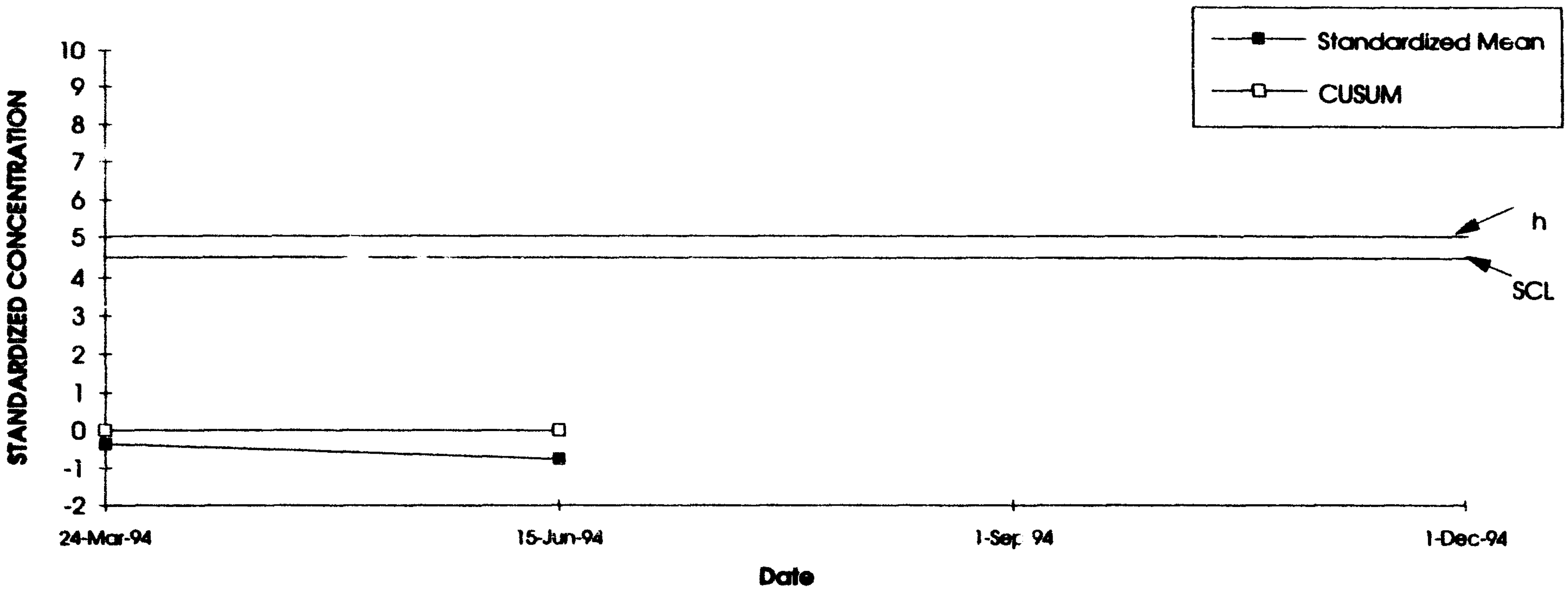
Potassium (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	WM#17	WM#18	WM#19	QC (13A)
03-Sep-92	6.77	11.4	23.9	10.17	7.7	6.3	13.8	12	10.2	3.27				0.7
14-Nov-92	6.65	12.25	24.3	10.6	7.85	10.55	13.25	11.5	10.1	3.15				
24-Mar-93	6.2	11.9	25.7	10.8	8.7	9.2	14.7	13.2	11.5	1.9	17.8	7.1	12.7	0.01
08-Jun-93	7.3	12.8	28.2	11.8	9	12.2	15.1	13.6	11.7	3.5	17.7	7.6	11.8	0.05
22-Sep-93	6.2	13.6	32	11.1	11.3	11.3	14.9	13.9	14.6	2.5	18.7	7.8	13	0.4
14-Dec-93	8	12.7	28.2	11.6	8.4	8	14.7	13.6	12.2	3.4	18.6	7.4	12.8	0.4
24-Mar-94	6.1	9.6	21.4	11.7	6.4	6.1	12	11.2	10.7	3.4	13.3	7	9.1	0.5
15-Jun-94	7	12	27	11	9	8	14	13	11	3	16	7	11	0.1
	6.7	12.1	25.5	10.8	8.3	9.6	14.2	12.6	10.9	3.0	17.8	7.4	12.3	0.3
Potassium	0.4	0.5	1.7	0.6	0.6	2.2	0.7	0.9	0.7	0.6	0.0	0.3	0.4	0.3
	6.2	11.4	23.9	10.2	7.7	6.3	13.3	11.5	10.1	1.9	17.7	7.1	11.8	0.0
	7.3	12.8	28.2	11.8	9.0	12.2	15.1	13.6	11.7	3.5	17.8	7.6	12.7	0.7

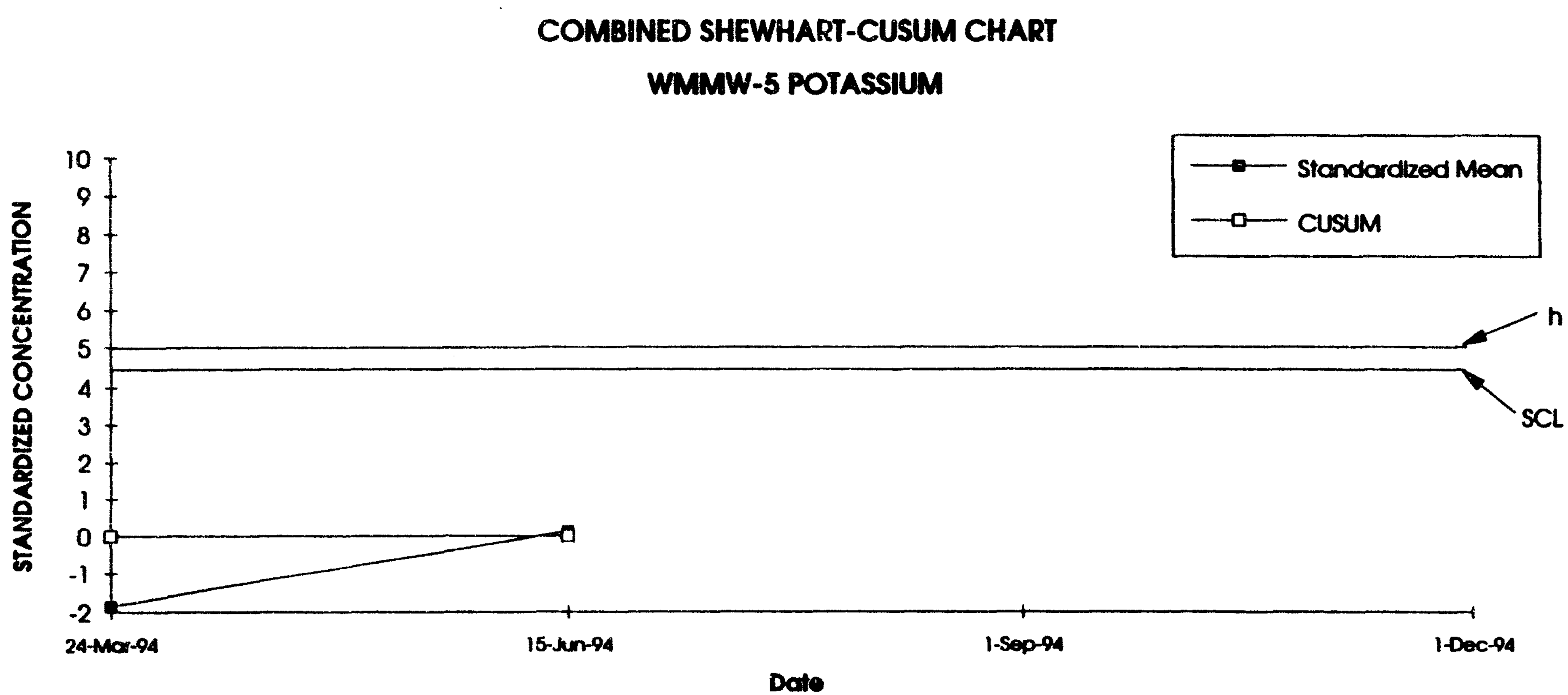
Magnesium (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	WM#17	WM#18	WM#19	QC (13A)
03-Sep-92	60.5	105	252	192	42	12	231	161	166	23				89
14-Nov-92	63	104	244	185	43	73	224	157	172	21				0.06
24-Mar-93	54	99	239	176	38	36	215	150	158	20	200	92	88	0.09
08-Jun-93	55	98	238	176	39	48	214	155	165	19	188	96	111	
22-Sep-93	53	95	241	176	39	47	210	151	163	20	180	97	115	0.1
14-Dec-93	63	94	244	173	37	15	210	148	169	19	177	95	102	0.1
24-Mar-94	61.2	97.1	249	177	37.7	16.1	220	153	165	19.8	205	97.1	76.9	0.05
15-Jun-94	55	92	237	173	37	23	207	152	161	19	200	95	61	0.07
Magnesium	63.0	105.0	252.0	192.0	43.0	73.0	231.0	161.0	172.0	23.0	200.0	96.0	111.0	89.0
	3.7	3.0	5.5	6.7	2.1	22.0	7.0	4.0	5.0	1.5	6.0	2.0	11.5	41.9
	54.0	98.0	238.0	176.0	38.0	12.0	214.0	150.0	158.0	19.0	188.0	92.0	88.0	0.1
	63.0	105.0	252.0	192.0	43.0	73.0	231.0	161.0	172.0	23.0	200.0	96.0	111.0	89.0

APPENDIX F

COMBINED SHEWHART/CUSUM CONTROL CHARTS FOR WHITE MESA POC's

COMBINED SHEWHART-CUSUM CHART
WMMW-5 CHLORIDE

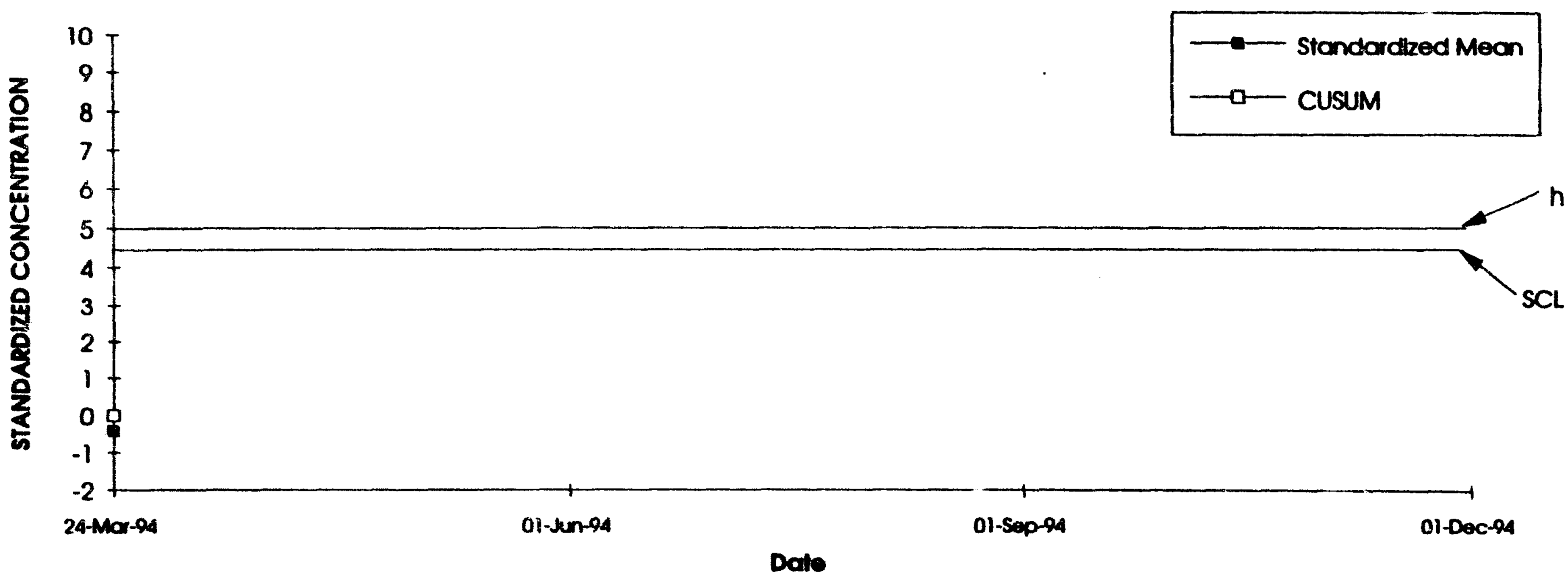


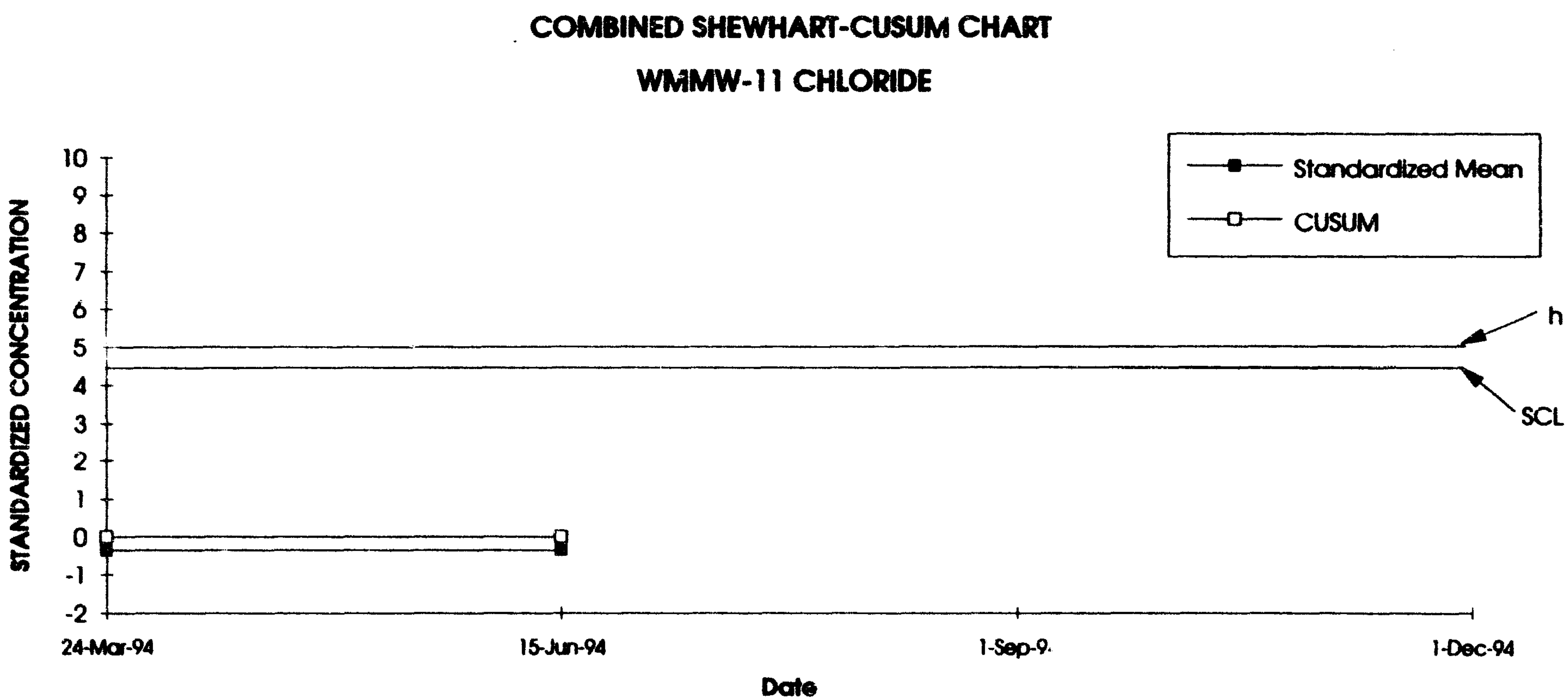


COMBINED SHEWHART-CUSUM CHART
WMMW-5 POTASSIUM
Standardized Mean
CUSUM
h
SCL
STANDARDIZED CONCENTRATION
10
9
8
7
6
5
4
3
2
1
0
-1
-2
24-Mar-94
15-Jun-94
1-Sep-94
1-Dec-94
Date

COMBINED SHEWHART-CUSUM CHART

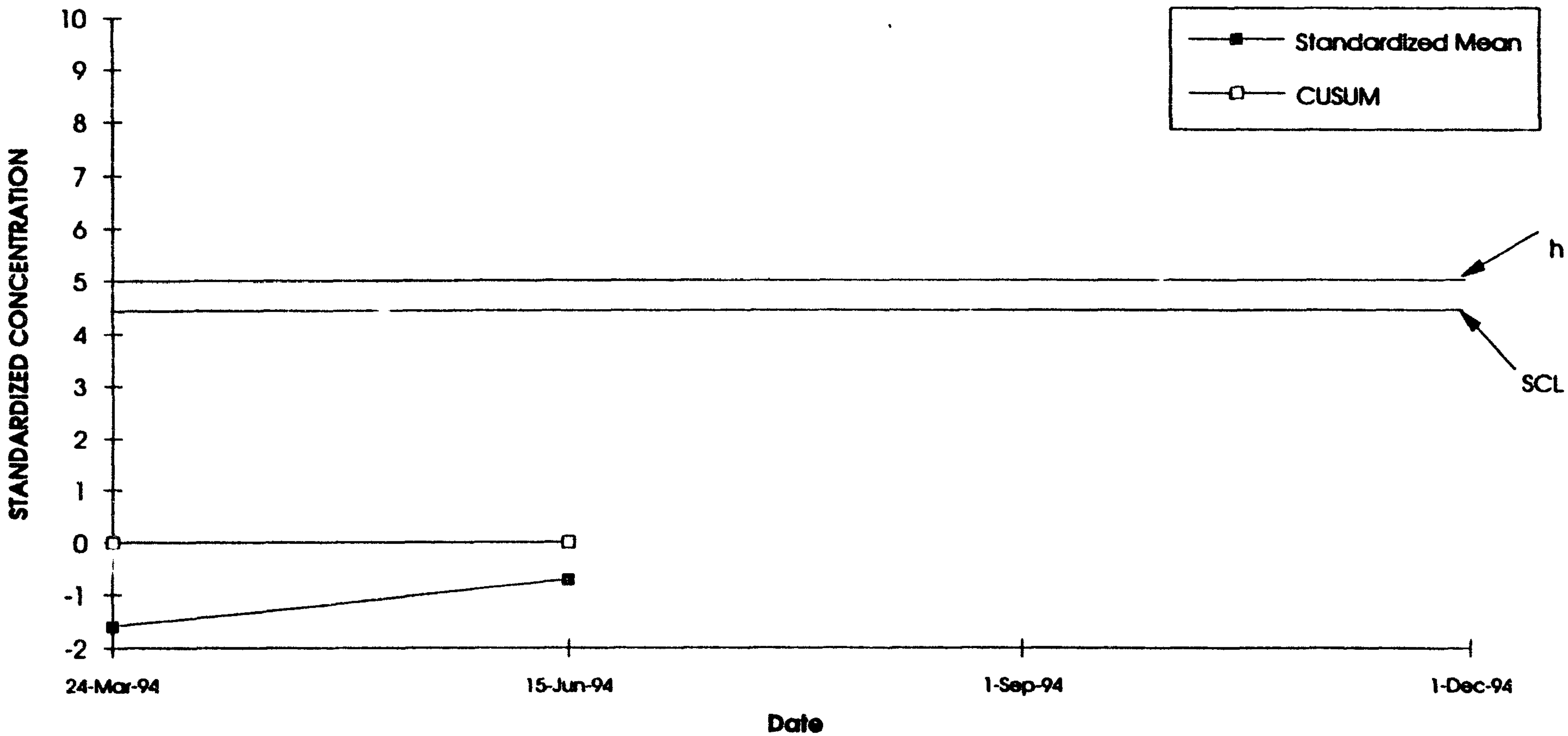
WMMW-5 NICKEL




COMBINED SHEWHART-CUSUM CHART
WMMW-11 CHLORIDE
Standardized Mean
CUSUM
h
SCL
STANDARDIZED CONCENTRATION
10
9
8
7
6
5
4
3
2
1
0
-1
-2
24-Mar-94
15-Jun-94
1-Sep-9
1-Dec-94
Date

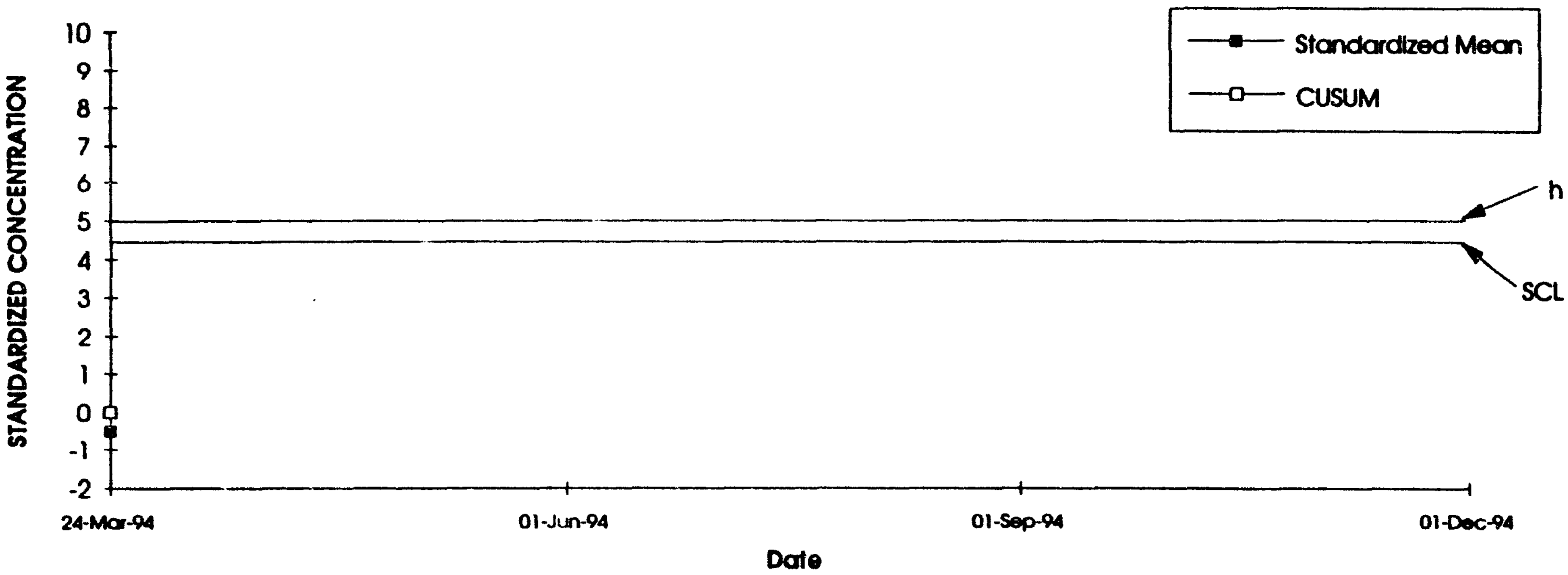
COMBINED SHEWHART-CUSUM CHART

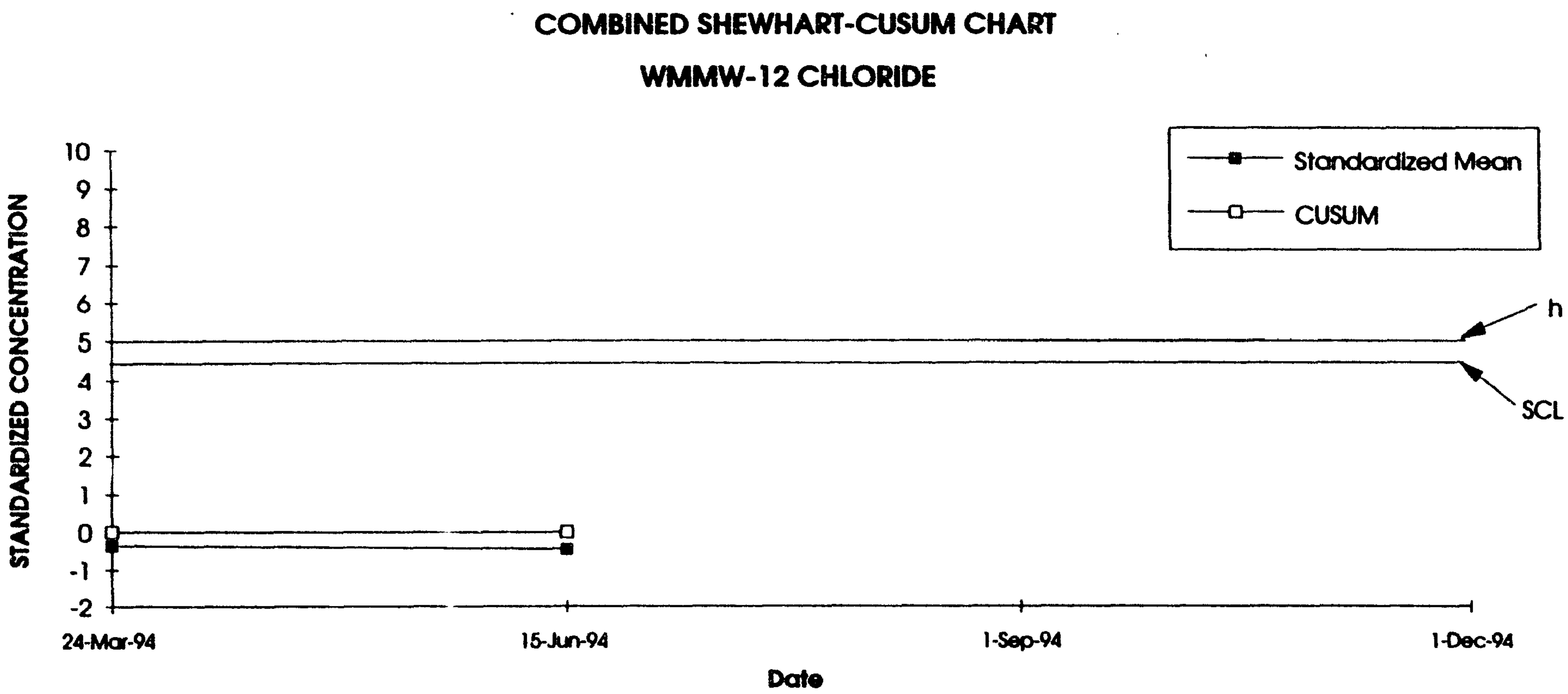
WMMW-11 POTASSIUM



COMBINED SHEWHART-CUSUM CHART

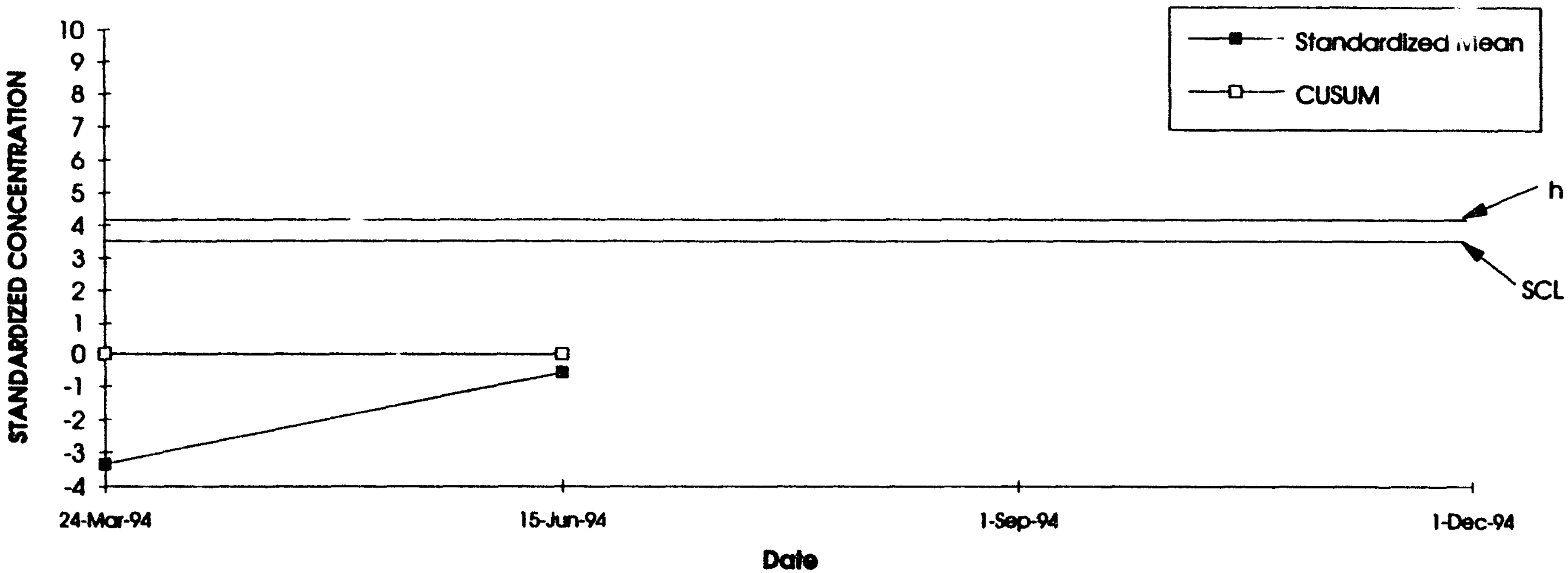
WMMW-11 NICKEL



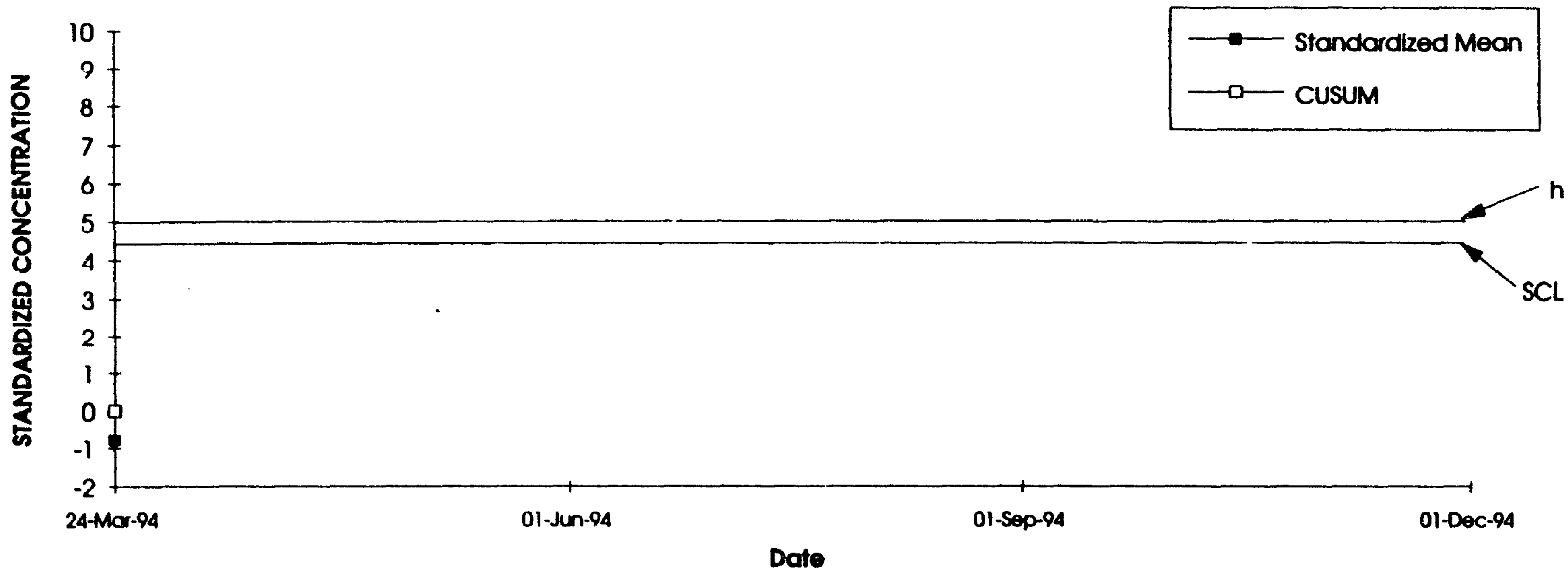


COMBINED SHEWHART-CUSUM CHART
WMMW-12 CHLORIDE
Standardized Mean
CUSUM
h
SCL
STANDARDIZED CONCENTRATION
10
9
8
7
6
5
4
3
2
1
0
-1
-2
24-Mar-94
15-Jun-94
1-Sep-94
1-Dec-94
Date

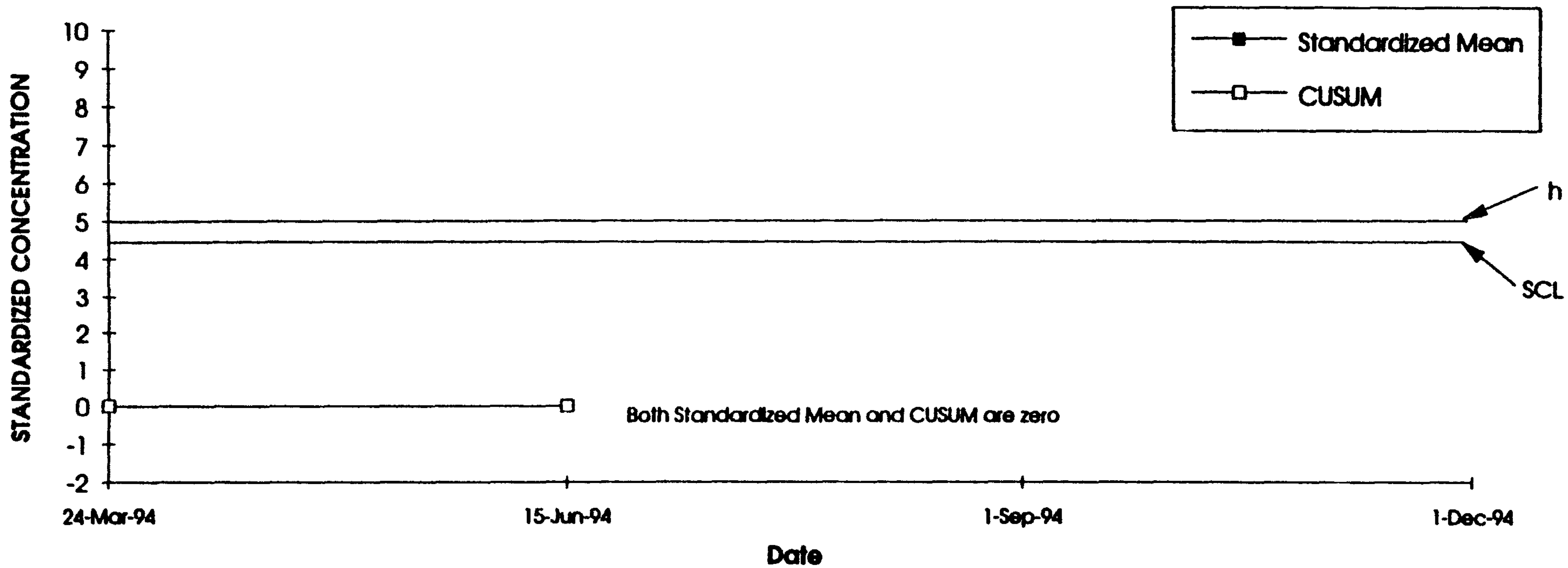
COMBINED SHEWHART-CUSUM CHART
WMMW-12 POTASSIUM



COMBINED SHEWHART-CUSUM CHART
WMMW-12 NICKEL

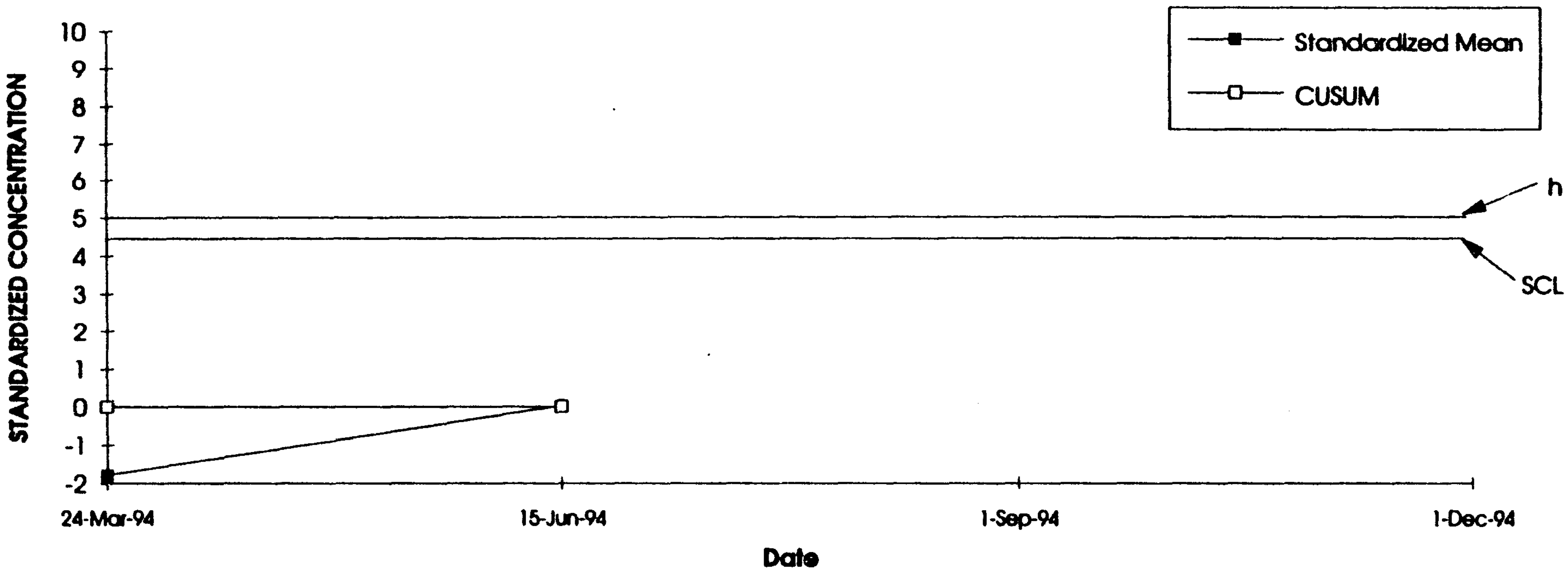


COMBINED SHEWHART-CUSUM CHART
WMMW-14 CHLORIDE



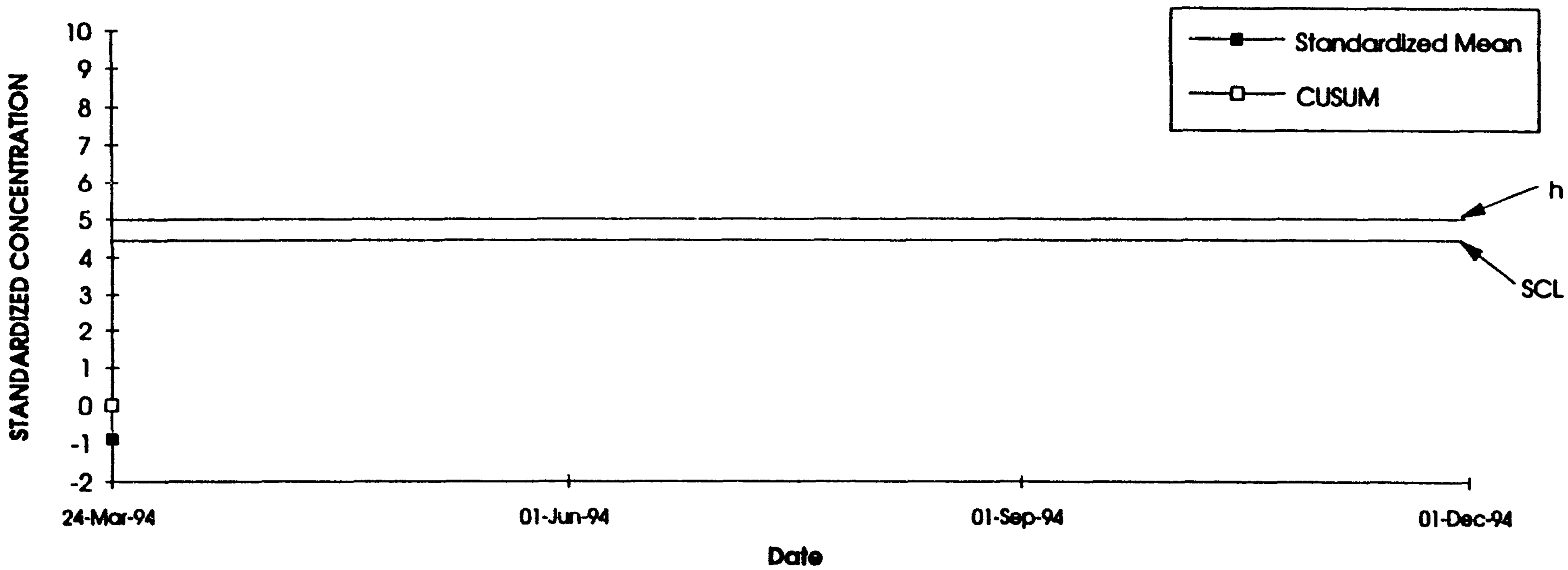
COMBINED SHEWHART-CUSUM CHART

WMMW-14 POTASSIUM



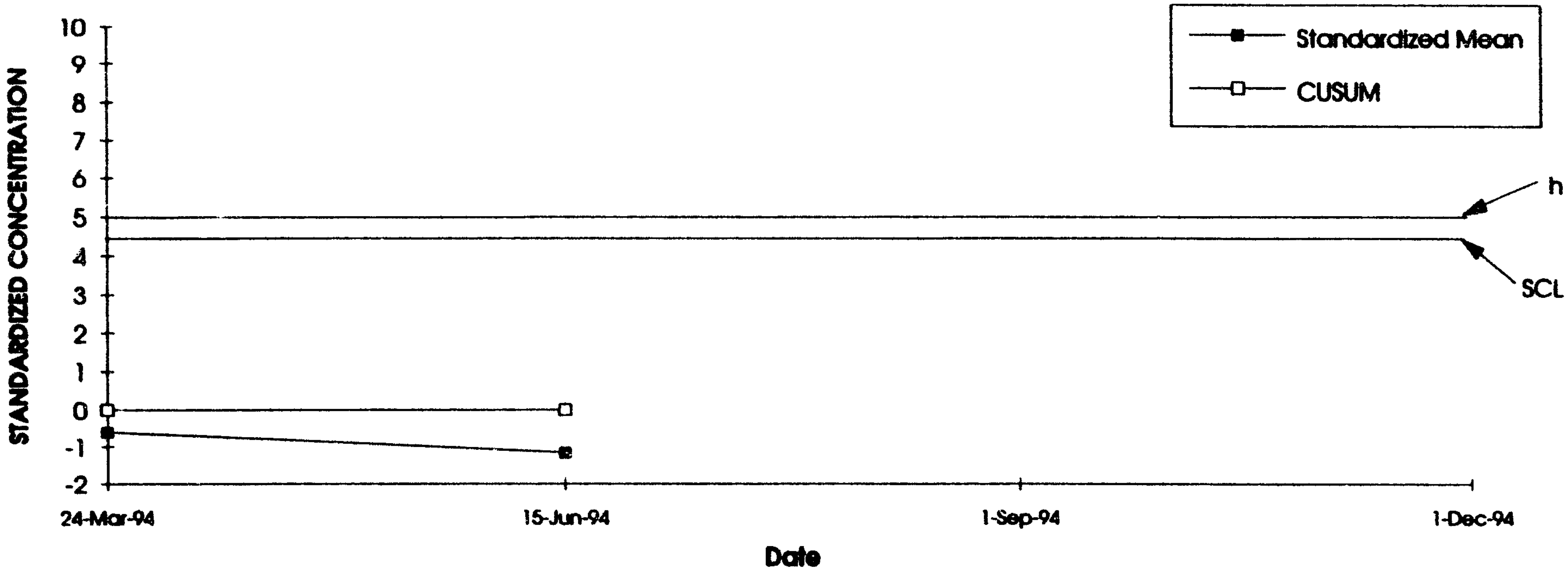
COMBINED SHEWHART-CUSUM CHART

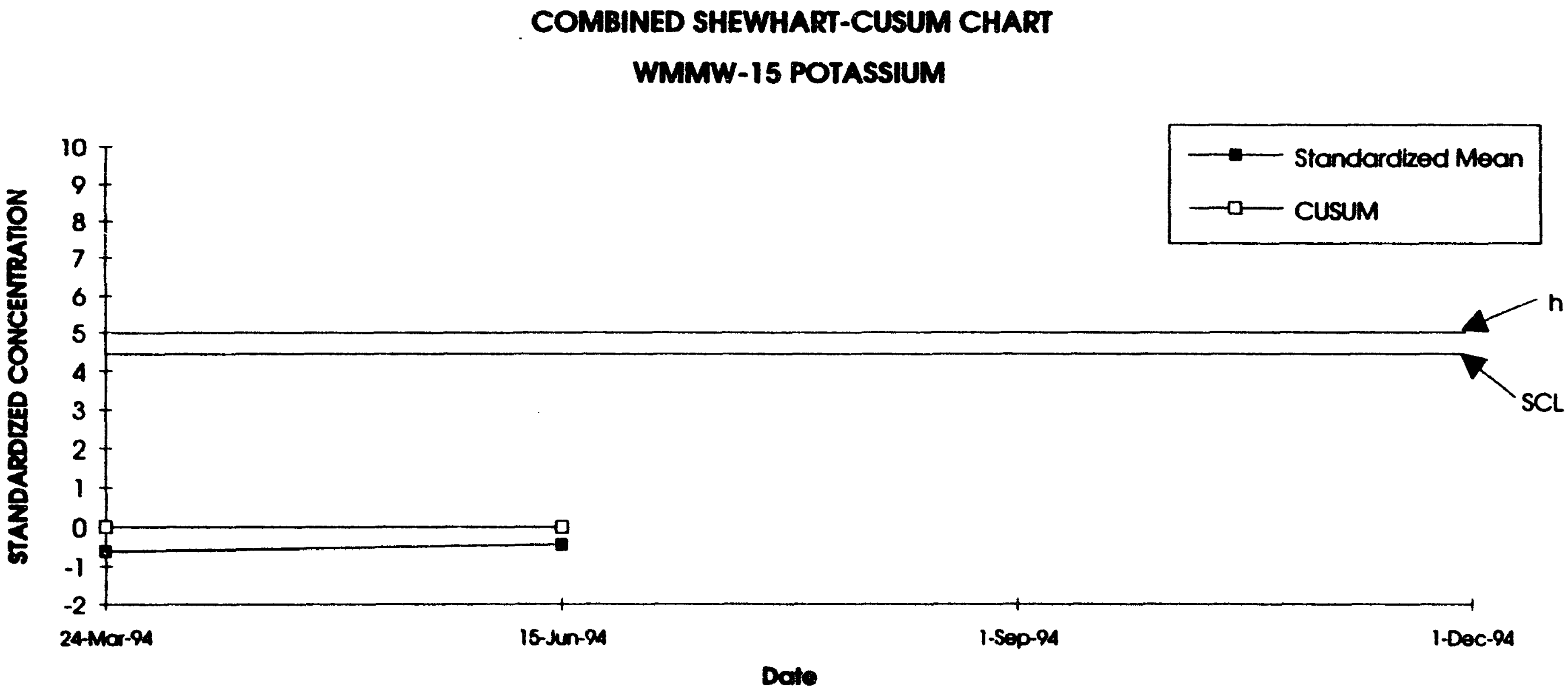
WMMW-14 NICKEL



COMBINED SHEWHART-CUSUM CHART

WMMW-15 CHLORIDE

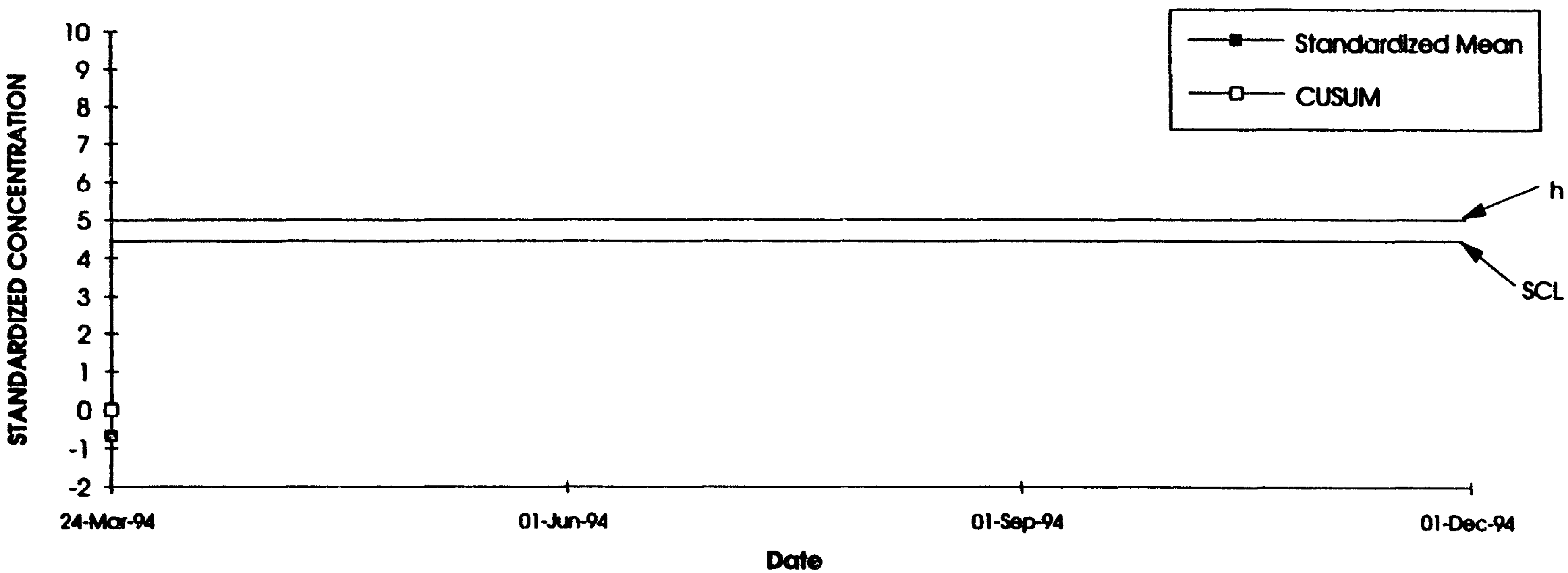




COMBINED SHEWHART-CUSUM CHART
WMMW-15 POTASSIUM
Standardized Mean
CUSUM
h
SCL
STANDARDIZED CONCENTRATION
10
9
8
7
6
5
4
3
2
1
0
-1
-2
24-Mar-94
15-Jun-94
1-Sep-94
1-Dec-94
Date

COMBINED SHEWHART-CUSUM CHART

WMMW-15 NICKEL



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

STATISTICAL ANALYSIS OF GROUND-WATER MONITORING DATA AT RCRA FACILITIES

INTERIM FINAL GUIDANCE

OFFICE OF SOLID WASTE
WASTE MANAGEMENT DIVISION
U.S. ENVIRONMENTAL PROTECTION AGENCY
401 M STREET, S.W.
WASHINGTON, D.C. 20460

APRIL 1989

Step 3. Within each month and year, subtract the average monthly concentration for that month and add the grand mean. For example, for January 1983, the adjusted concentration becomes

$$1.99 - 2.05 + 2.17 = 2.11$$

The adjusted concentrations are shown in the last three columns of Table 7-1.

The reader can check that the average of all 36 adjusted concentrations equals 2.17, the average unadjusted concentration. Figure 7-1 shows the plot of the unadjusted and adjusted data. The raw data clearly exhibit seasonality as well as an upwards trend which is less evident by simply looking at the data table.

INTERPRETATION

As can be seen in Figure 7-1, seasonal effects were present in the data. After adjusting for monthly effects, the seasonality was removed as can be seen in the adjusted data plotted in the same figure.

7.3 COMBINED SHEWHART-CUSUM CONTROL CHARTS FOR EACH WELL AND CONSTITUENT

Control charts are widely used as a statistical tool in industry as well as research and development laboratories. The concept of control charts is relatively simple, which makes them attractive to use. From the population distribution of a given variable, such as concentrations of a given constituent, repeated random samples are taken at intervals over time. Statistics, for example the mean of replicate values at a point in time, are computed and plotted together with upper and/or lower predetermined limits on a chart where the x-axis represents time. If a result falls outside these boundaries, then the process is declared to be "out of control"; otherwise, the process is declared to be "in control." The widespread use of control charts is due to their ease of construction and the fact that they can provide a quick visual evaluation of a situation, and remedial action can be taken, if necessary.

In the context of ground water monitoring, control charts can be used to monitor the inherent statistical variation of the data collected within a single well, and to flag anomalous results. Further investigation of data points lying outside the established boundaries will be necessary before any direct action is taken.

A control chart that can be used on a real time basis must be constructed from a data set large enough to characterize the behavior of a specific well. It is recommended that data from a minimum of eight samples within a year be collected for each constituent at each well to permit an evaluation of the consistency of monitoring results with the current concept of the hydrogeology of the site. Starks (1988) recommends a minimum of four sampling periods at a unit with eight or more wells and a minimum of eight sampling periods at a unit with less than four wells. Once the control chart for the specific constituent at a given well is acceptable, then subsequent data

points can be plotted on it to provide a quick evaluation as to whether the process is in control.

The standard assumptions in the use of control charts are that the data generated by the process, when it is in control, are independently (see Section 2.4.2) and normally distributed with a fixed mean μ and constant variance σ^2. The most important assumption is that of independence; control charts are not robust with respect to departure from independence (e.g., serial correlation, see glossary). In general, the sampling scheme will be such that the possibility of obtaining serially correlated results is minimized, as noted in Section 2. The assumption of normality is of somewhat less concern, but should be investigated before plotting the charts. A transformation (e.g., log-transform, square root transform) can be applied to the raw data so as to obtain errors normally distributed about the mean. An additional situation which may decrease the effectiveness of control charts is seasonality in the data. The problem of seasonality can be handled by removing the seasonality effect from the data, provided that sufficient data to cover at least two seasons of the same type are available (e.g., 2 years when monthly or quarterly seasonal effect). A procedure to correct a time series for seasonality was shown above in Section 7.2.

PURPOSE

Combined Shewhart-cumulative sum (CUSUM) control charts are constructed for each constituent at each well to provide a visual tool of detecting both trends and abrupt changes in concentration levels.

PROCEDURE

Assume that data from at least eight independent samples of monitoring are available to provide reliable estimates of the mean, μ, and standard deviation, σ, of the constituent's concentration levels in a given well.

Step 1. To construct a combined Shewhart-CUSUM chart, three parameters need to be selected prior to plotting:

h - a decision internal value
k - a reference value
SCL - Shewhart control limit (denoted by U in Starks (1988))

The parameter k of the CUSUM scheme is directly obtained from the value, D, of the displacement that should be quickly detected; k = D/2. It is recommended to select k = 1, which will allow a displacement of two standard deviations to be detected quickly.

When k is selected to be 1, the parameter h is usually set at values of 4 or 5. The parameter h is the value against which the cumulative sum in the CUSUM scheme will be compared. In the context of groundwater monitoring, a value of h = 5 is recommended (Starks, 1988; Lucas, 1982).

The upper Shewhart limit is set at SCL = 4.5 in units of standard deviation. This combination of k = 1, h = 5, and SCL = 4.5 was found most appropriate for the application of combined Shewhart-CUSUM charts for groundwater monitoring (Starks, 1988).

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Step 2. Assume that at time period T_i, n_i concentration measurements $X_1, \ldots, X_{ni}$, are available. Compute their average $\bar{X}_i$.

IF n_i = 1

Step 3. Calculate the standardized mean

$$Z_i = (\bar{X}_i - \mu)\sqrt{n_i}/\sigma$$

$4.5 = \frac{\bar{X} - \mu}{\sigma}$

$\sigma 4.5 + \mu = \bar{X}$ 4.5

where μ and σ are the mean and standard deviation obtained from prior monitoring at the same well (at least four sampling periods in a year).

Step 4. At each time period, T_i, compute the cumulative sum, S_i, as:

$$S_i = \max \{0, (Z_i - k) + S_{i-1}\}$$

where max {A, B} is the maximum of A and B, starting with $S_0 = 0$.

Step 5. Plot the values of S_i versus T_i on a time chart for this combined Shewhart-CUSUM scheme. Declare an "out-of-control" situation at sampling period T_i if for the first time, $S_i \geq h$ or $Z_i \geq$ SCL. This will indicate probable contamination at the well and further investigations will be necessary.

REFERENCES

Lucas, J. M. 1982. "Combined Shewhart-CUSUM Quality Control Schemes." *Journal of Quality Technology*. Vol. 14, pp. 51-59.

Starks, T. H. 1988 (Draft). "Evaluation of Control Chart Methodologies for RCRA Waste Sites."

Hockman, K. K., and J. M. Lucas. 1987. "Variability Reduction Through Subvessel CUSUM Control." *Journal of Quality Technology*. Vol. 19, pp. 113-121.

EXAMPLE

The procedure is demonstrated on a set of carbon tetrachloride measurements taken monthly at a compliance well over a 1-year period. The monthly means of two measurements each (n_i = 2 for all i's) are presented in the third column of Table 7-2 below. Estimates of μ and σ, the mean and standard deviation of carbon tetrachloride measurements at that particular well were obtained from a preceding monitoring period at that well; μ = 5.5 µg/L and σ = 0.4 µg/L.

TABLE 7-2. EXAMPLE DATA FOR COMBINED SHEWHART-CUSUM CHART--
CARBON TETRACHLORIDE CONCENTRATION (μg/L)

Date	Sampling period T_i	Mean concentration, $\bar{X}_i$	Standardized $\bar{X}_i$, Z_i	$Z_i - k$	CUSUM, S_i
Jan 6	1	5.52	0.07	-0.93	0
Feb 3	2	5.60	0.35	-0.65	0
Mar 3	3	5.45	-0.18	-1.18	0
Apr 7	4	5.15	-1.24	-2.24	0
May 5	5	5.95	1.59	0.59	0.59
Jun 2	6	5.54	0.14	-0.86	0.00
Jul 7	7	5.49	-0.04	-1.04	0.00
Aug 4	8	6.08	2.05	1.05	1.05
Sep 1	9	6.91	4.99[a]	3.99	5.04[b]
Oct 6	10	6.78	4.53[a]	3.53	8.56[b]
Nov 3	11	6.71	4.28	3.28	11.84[b]
Dec 1	12	6.65	4.07	3.07	14.91[b]

Parameters: Mean = 5.50; std = 0.4; k = 1; h = 5; SCL = 4.5.

[a] Indicates "out-of-control" process via Shewhart control limit ($Z_i > 4.5$).

[b] CUSUM "out-of-control" signal ($S_i > 5$).

Step 1. The three parameters necessary to construct a combined Shewhart-CUSUM chart were selected as h = 5; k = 1; SCL = 4.5 in units of standard deviation.

Step 2. The monthly means are presented in the third column of Table 7-2.

Step 3. Standardize the means within each sampling period. These computations are shown in the fourth column of Table 7-2. For example, $Z_1 = (5.52 - 5.50)*\sqrt{2}/0.4 = 0.07$.

Step 4. Compute the quantities S_i, i = 1, ..., 12. For example,

$S_1 = \max\{0, -0.93 + 0\} = 0$
$S_2 = \max\{0, -0.65 + 0\} = 0$

.
.
.

$S_5 = \max\{0, 0.59 + S_4\} = \max\{0, 0.59 + 0\} = 0.59$
$S_6 = \max\{0, -0.86 + S_5\} = \max\{0, -0.86 + 0.59) = \max\{0, -0.27\} = 0$

.
etc.

These quantities are shown in the last column of Table 7-2.

Step 5. Construct the control chart. The y-axis is in units of standard deviations. The x-axis represent time, or the sampling periods. For each sampling period, T_i, record the value of $\bar{X}_i$ and S_i. Draw horizontal lines at values h = 5 and SCL = 4.5. These two lines represent the upper control limits for the CUSUM scheme and the Shewhart control limit, respectively. The chart for this example data set is shown in Figure 7-2.

The combined chart indicates statistically significant evidence of contamination starting at sampling period T_9. Both the CUSUM scheme and the Shewhart control limit were exceeded by S_9 and Z_9, respectively. Investigation of the situation should begin to confirm contamination and action should be required to bring the variability of the data back to its previous level.

INTERPRETATION

The combined Shewhart-CUSUM control scheme was applied to an example data set of carbon tetrachloride measurements taken on a monthly basis at a well. The statistic used in the construction of the chart was the mean of two measurements per sampling period. (It should be noted that this method can be used on an individual measurement as well, in which case $n_i = 1$). Estimates of the mean and standard deviation of the measurements were available from previous data collected at that well over at least four sampling periods.

The parameters of the combined chart were selected to be k = 1 unit, the reference value or allowable slack for the process; h = 5 units, the decision interval for the CUSUM scheme; and SCL = 4.5 units, the upper Shewhart control limit. All parameters are in units of σ, the standard deviation obtained from the previous monitoring results. Various combinations of parameter values can be selected. The particular values recommended here appear to be the best for the initial use of the procedure from a review of the simulations and recommendations in the references. A discussion on this subject is given by Lucas (1982), Hockman and Lucas (1987), and Starks (1988). The choice of the parameters h and k of a CUSUM chart is based on the desired performance of the chart. The criterion used to evaluate a control scheme is the average number of samples or time periods before an out-of-control signal is obtained. This criterion is denoted by ARL or average run length. The ARL should be large when the mean concentration of a hazardous constituent is near its target value and small when the mean has shifted too far from the target. Tables have been developed by simulation methods to estimate ARLs for given combinations of the parameters (Lucas, Hockman and Lucas, and Starks). The user is referred to these articles for further reading.

7.4 UPDATE OF A CONTROL CHART

The control chart is based on preselected performance parameters as well as on estimates of μ and σ, the parameters of the distribution of the measurements in question. As monitoring continues and the process is found to be in control, these parameters need periodic updating so as to incorporate this new information into the control charts. Starks (1988) has suggested that in

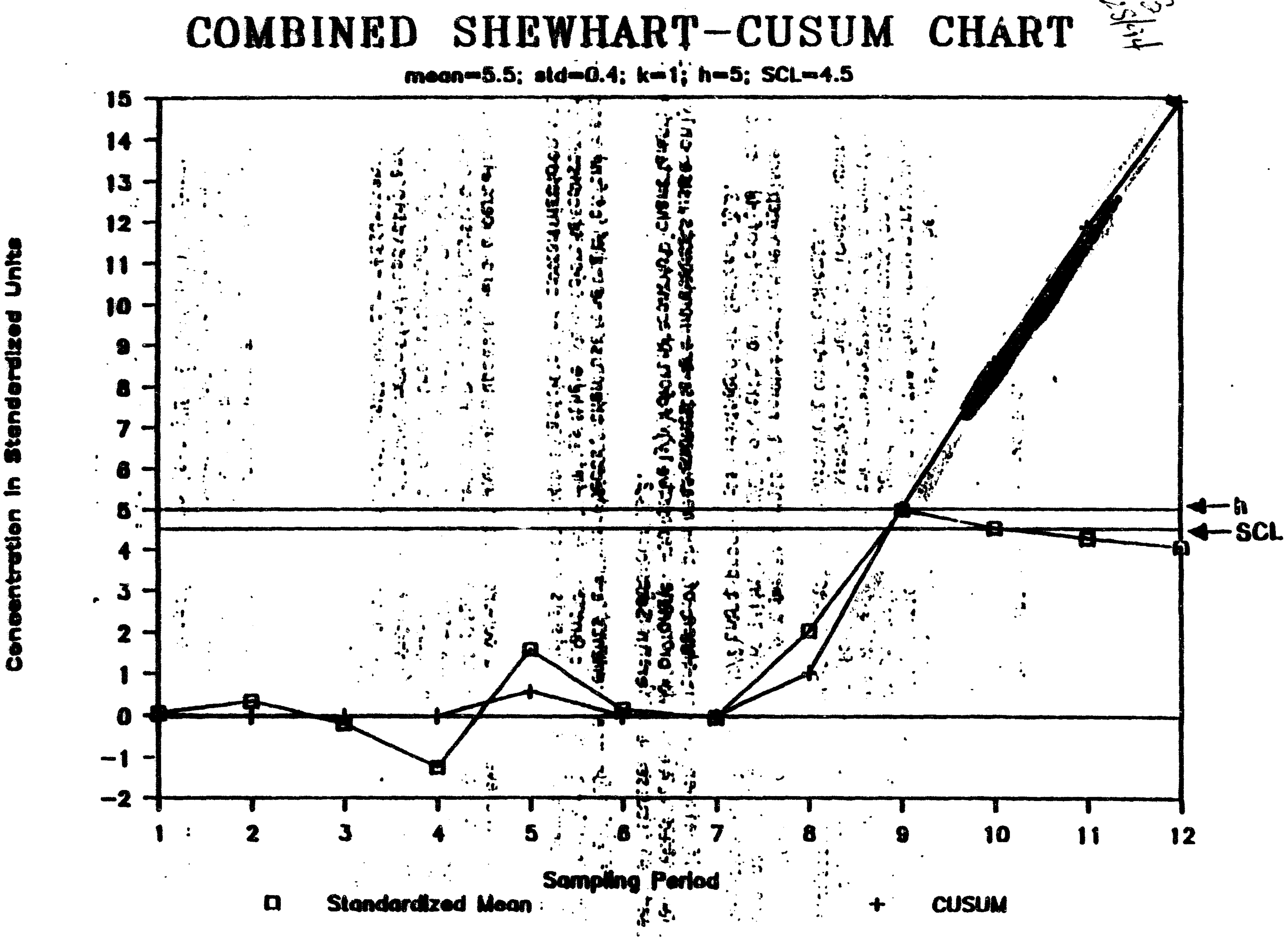

Figure 7-2. Combined Shewhart-CUSUM chart.

general, adjustments in sample means and standard deviations be made after sampling periods 4, 8, 12, 20, and 32, following the initial monitoring period recommended to be at least eight sampling periods. Also, the performance parameters h, k, and SCL would need to be updated. The author suggests that $h = 5$, $k = 1$, and SCL = 4.5 be kept at those values for the first 12 sampling periods following the initial monitoring plan, and that k be reduced to 0.75 and SCL to 4.0 for all subsequent sampling periods. These values and sampling period numbers are not mandatory. In the event of an out-of-control state or a trend, the control chart should not be updated.

7.5 NONDETECTS IN A CONTROL CHART

Regulations require that four independent water samples be taken at each well at a given sampling period. The mean of the four concentration measurements of a particular constituent is used in the construction of a control chart. Now situations will arise when the concentration of a constituent is below detection limit for one or more samples. The following approach is suggested for treating nondetects when plotting control charts.

If only one of the four measurements is a nondetect, then replace it with one half of the detection limit (MDL/2) or with one half of the practical quantitation limit (PQL/2) and proceed as described in Section 7.3.

If either two or three of the measurements are nondetects, use only the quantitated values (two or one, respectively) for the control chart and proceed as discussed earlier in Section 7.3.

If all four measurements are nondetects, then use one half of the detection limit or practical quantitation limit as the value for the construction of the control chart. This is an obvious situation of no contamination of the well.

In the event that a control chart requires updating and a certain proportion of the measurements is below detection limit, then adjust the mean and standard deviation necessary for the control chart by using Cohen's method described in Section 8.1.4. In that case, the proportion of nondetects applies to the pool of data available at the time of the updating and would include all nondetects up to that time, not just the four measurements taken at the last sampling period.

<u>CAUTIONARY NOTE</u>: Control charts are a useful supplement to other statistical techniques because they are graphical and simple to use. However, it is inappropriate to construct a control chart on wells that have shown evidence of contamination or an increasing trend (see §264.97(a)(1)(i)). Further, contamination may not be present in a well in the form of a steadily increasing concentration profile--it may be present intermittently or may increase in a step function. Therefore, the absence of an increasing trend does not necessarily prove that a release has not occurred.

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TABLE 1

Parameter	CELL 2 LDS C2 LDS	CELL 2 LDS Blind Duplicate	FLY ASH POND Upper Pool	FLY ASH POND Lower Pool	FLY ASH POND Previous Sample	Slimes Drain	Blank
Na, mg/l *	34	36	391	279	570	2345	ND
Ni, mg/l	0.02	0.02	0.05	0.04	3.8	7.2	ND
K, mg/l *	2.6	3.3	7.2	9.6	23	251	0.03
Se, mg/l	ND	ND	0.028	0.23	0.085	0.64	ND
Ag, mg/l	ND	ND	ND	ND	0.002	0.005	ND
Sr, mg/l	2.2	2.5	1.1	2.1	1.4	14	ND
Ti, mg/l	0.04	0.05	0.05	0.04	0.08	1.1	ND
U, uCi/ml	1.2E-08	1.0E-08	2.6E-07	2.7E-07	1.6E-07	1.0E-05	ND
V, mg/l	0.03	0.03	9.7	11	0.43	165	ND
Zn, mg/l	ND	ND	ND	ND	7.9	50	ND
Zr, mg/l	ND	ND	ND	ND	ND	ND	ND
Total Alkalinity, meq/l *	3.8	3.92	2.52	1.38	0.8	ND	0.2
NH3-N, mg/l	ND	ND	1.4	4.0	57	1761	ND
Cl, mg/l	179	180	134	74	526	3191	ND
CN (Total), mg/l	ND	ND	ND	ND	ND	ND	ND
P (total), mg/l	ND	ND	0.1	0.3	0.2	8.2	ND
SO4, mg/l *	150	159	654	688	1414	38404	ND
TDS, mg/l	765	770	1514	1363	2868	67710	ND
TSS, mg/l	ND	ND	ND	ND	ND	ND	ND
Report Date	Feb-91	Feb-91	Feb-91	Feb-91	Oct-90	Feb-91	Feb-91

mg/l = milligrams per liter
pCi/l = picoCuries per liter
mmg/l = micrograms per liter
ND = not detected
NS = not sampled

Note: The blank sample is obtained by flushing the sampling equipment with deionized water. After 10 to 20 minutes of flushing, fresh deionized water is pumped through the equipment and sampled.

Sept 1991

TABLE 1

Parameter	CELL 2 LDS		FLY ASH POND				
	C2 LDS	Blind Duplicate	Upper Pool	Lower Pool	Previous Sample	Slimes Drain	Blank
Gross Alpha, pCi/l	4.50	7.00	280	250	230	14000	0.0
Gross Beta, pCi/l	4.70	3.60	130	130	140	6200	1.0
Ra-226, pCi/l	1.70	1.40	0.7	3.4	58	40	0.0
Ra-228, pCi/l	1.50	1.80	1.6	0.7	1.8	1.9	1.4
Th-230, pCi/l	0.00	0.80	2.4	2.9	38	3860	0.5
acetone, mmg/l	ND	ND	ND	ND	NS	513.61	ND
2-butanone, mmg/l	ND	ND	ND	ND	NS	15.13	ND
chloroform, mmg/l	ND	ND	ND	ND	NS	16.64	ND
toluene, mmg/l	ND	ND	ND	ND	NS	6.25	ND
di-n-butyl phthalate, mmg/l	ND	ND	1.3	ND	NS	1.08	ND
fluoranthene, mmg/l	ND	ND	1.15	ND	NS	ND	ND
chrysene, mmg/l	ND	ND	1.73	ND	NS	ND	ND
bis(2-ethylhexyl)phthalate, mmg/l	ND	ND	1.79	1.2	NS	1.13	ND
benzo(a)pyrene, mmg/l	ND	ND	1.78	ND	NS	ND	ND
phenol, mmg/l	ND	ND	ND	ND	NS	38.4	ND
napthalene, mmg/l	ND	ND	ND	ND	NS	2.44	ND
dimethyl phthalate, mmg/l	ND	ND	ND	ND	NS	2.70	ND
diethyl phthalate, mmg/l	ND	ND	ND	ND	NS	18.10	ND
Al, mg/l	0.08	0.08	0.46	0.33	1.6	2450	0.01
As, mg/l	0.004	0.004	0.24	0.43	0.092	0.28	0.002
Ba, mg/l	0.10	0.10	0.03	0.04	0.16	ND	ND
B, mg/l	0.1	0.1	0.3	0.3	0.2	3.5	ND
Ca, mg/l	108	110	72	112	81	474	ND
Cd, mg/l	0.001	0.002	0.002	0.002	0.066	4.2	0.001
Cr, mg/l	0.008	0.005	0.002	0.003	0.006	1.0	ND
Co, mg/l	ND	ND	ND	ND	1.8	14	ND
Cu, mg/l	ND	ND	ND	ND	2.0	177	ND
Pb, mg/l	0.008	0.005	0.007	0.025	0.062	0.21	ND
Mg, mg/l	51	52	23	35	121	2450	ND
Mn [illegible]g/l	4.1	4.1	ND	ND	2.3	128	ND
Mo, mg/l	0.030	0.030	1.6	2.8	0.49	0.44	ND

APPENDIX C

SUPPORTING CALCULATIONS FOR CONTROL CHARTS

TITAN ENVIRONMENTAL

BY: JFL
DATE: 9/27/94

TITLE: CONSTRUCTION OF COMBINED SHEWHART-CUSUM CONTROL CHARTS

CHK'D BY: [signature]
DATE: 9/28/94

Objective: The objective of this calculation brief is to construct the Shewhart-CUSUM control charts for the POC monitoring wells at the White Mesa Uranium Mill. The POC monitoring wells are: WMMW-5, WMMW-11, WMMW-12, WMMW-14, and WMMW-15. Control charts need to be constructed for the following indicator constituents for each well: chloride, potassium, and nickel.

Method: The method of constructing the Shewhart-CUSUM control charts is presented in EPA (1989). A copy of the method is presented in Appendix A of this calculation brief.

Assumptions: The water quality data are independently and normally distributed with a fixed mean and constant variance. As per EPA (1989) the statistical parameters for the control charts are assumed to be k=1, h=5, and SCL=4.5

Control Chart Construction

To construct a combined Shewhart-CUSUM control chart, the constituent concentration data must first be standardized. The constituent concentration data is standardized using the following equation:

$$Z_i = (\overline{X_i} - \mu) \frac{\sqrt{n_i}}{\sigma}$$

where:

Z_i = standardized mean,
X_i = average concentration of sample event,
μ = mean concentration from previous sample events,
σ = standard deviation from previous sample events, and
n_i = number of measurements during sample event.

In addition to the standardized mean, the cumulative sum for the standardized data must also be calculated. The cumulative sum is equal to:

$$S_i = \max[0, (Z_i - k) + S_{i-1}]$$

where:

S_i = present cumulative sum,
S_{i-1} = previous cumulative sum,
Z_i = standardized mean, and
k = reference value = 1 (EPA, 1989)

Once the concentration data is standardized, the data is plotted versus time. Two upper bounds are also plotted with the data, **h** and **SCL**. The upper bound **h** is a statistical upper bound for the cumulative sum data, while **SCL** is an upper bound for the standardized mean data. EPA (1989) recommends setting **h** equal to 5 and **SCL** equal to 4.5.

Compliance is evaluated by comparing the cumulative sum data to the upper bound **h**, and the standardized mean data to the **SCL** upper bound. If the cumulative sum data exceeds or equals the **h** upper bound or the standardized mean data exceeds or equals the **SCL** upper bound, this would indicate a statistically significant increase in constituent concentration. For the White Mesa Uranium Mill, this would indicate probable cell leakage.

To construct the control charts for the indicator constituents, the water quality data base was used. A print out of the data base is presented in Appendix B of this calculation brief. Spreadsheets were constructed to streamline the process of construction. In order to construct the control chart, a mean and standard deviation for a portion of the data set needs to be calculated. A mean and standard deviation were calculated for all water quality data collected before March 24, 1994. Data collected on or after March 24, 1994 were used to construct the control charts. This way all control charts will cover the same time period.

In addition, the water quality data for nickel contained many non-detects. In the water quality database, the non-detects were replaced with 0.009 or 0.0009 ppm which represent the detection level during those sampling events. For control chart construction, EPA (1989) suggests replacing non-detects with 1/2

TITAN ENVIRONMENTAL

BY: JFL
DATE: 9/27/94

TITLE: CONSTRUCTION OF COMBINED SHEWHART-CUSUM CONTROL CHARTS

CHK'D BY: KRB
DATE 9-28-94

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the detection level. Therefore, population statistics and control charts for nickel were constructed by replacing all non-detects with 1/2 the detection level, either 0.0045 or 0.00045 depending on the detection limit.

The following spreadsheets present the calculations needed to construct the control charts. The control charts follow the spreadsheets.

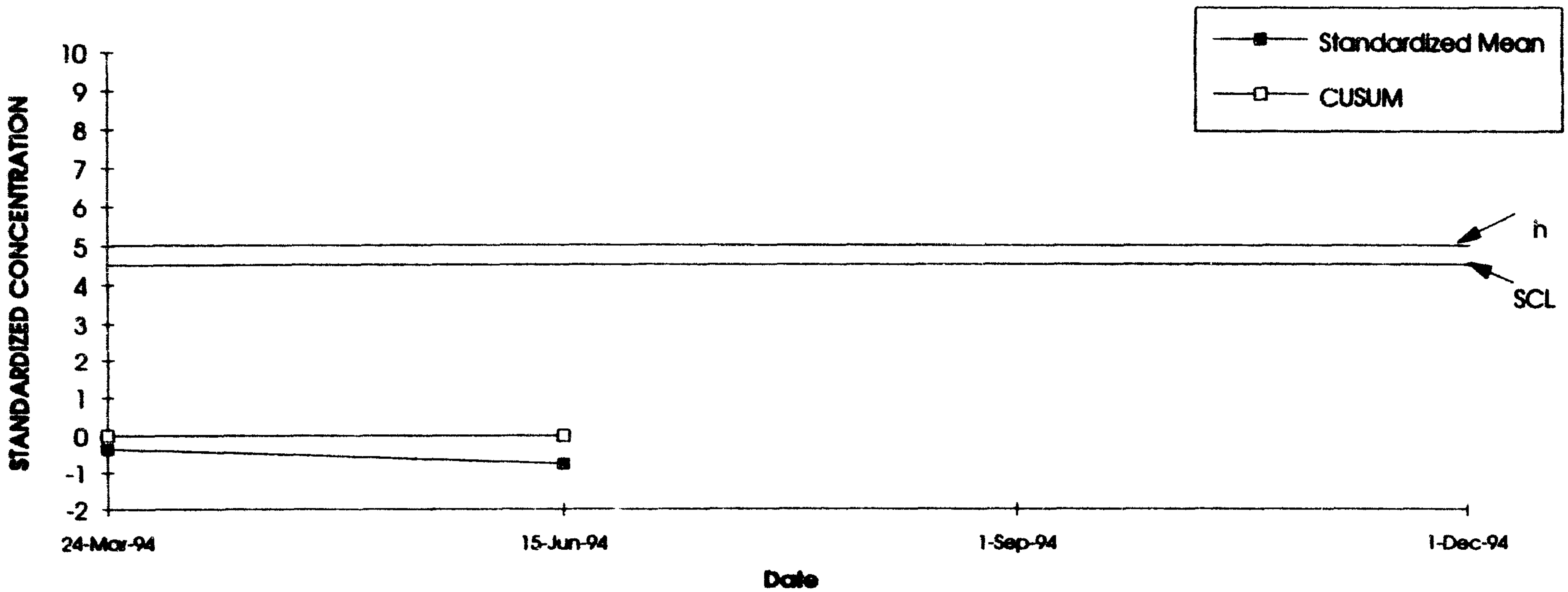
Ref: EPA, 1989. Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance. Office of Solid Waste, Waste Management Division, U.S. EPA, EPA/530-SW-89-026.

CHLORIDE WMMW-5

DATE	CONC			
30-May-80	60			
30-Jun-80	57			
31-Jul-80	60			
31-Aug-80	60			
30-Sep-80	51			
31-Oct-80	56			
30-Nov-80	49			
31-Dec-80	52			
31-Jan-81	53			
28-Feb-81	54			
31-Mar-81	55			
30-Apr-81	53			
30-May-81	53			
30-Jun-81	53			
31-Aug-81	52			
31-Dec-81	20			
31-Jan-82	51			
30-Apr-82	50			
31-Aug-82	43			
31-Dec-82	47.1			
25-Jan-83	57			
30-Jun-83	48.1			
31-Dec-83	54			
31-Mar-84	57.8			
30-Jun-84	54.0			
30-Sep-84	56.6			
31-Dec-84	53.2			
31-Mar-85	59.0			
30-Jun-85	53.0			
30-Sep-85	62.0			
31-Dec-85	71.0			
19-Jun-86	130.0			
30-Jun-86	130.0			
4-Sep-86	53.0			
10-Dec-86	54.0			
20-Feb-87	54.0			
29-Apr-87	54.3			
19-Aug-87	54.0			
20-Nov-87	53.2			
27-Jan-88	54.0			
1-Jun-88	53.0			
23-Aug-88	53.9			
3-Nov-88	54.7			
9-Mar-89	52.6			
21-Jun-89	54.6			
1-Sep-89	54.0			
15-Nov-89	54.0			
20-Feb-90	55.0			

8-May-90	56.0			
7-Aug-90	53.0			
13-Nov-90	54.0			
27-Feb-91	50.0			
21-May-91	48.0			
24-Sep-91	54.0			
3-Dec-91	50.0			
17-Mar-92	51.0			
11-Jun-92	46.0			
3-Sep-92	46			
19-Nov-92	50.0			
24-Mar-93	50.0			
8-Jun-93	48.0			
22-Sep-93	52			
14-Dec-93	48.0			
MEAN =	55.2			
STDEV =	14.9			
DATE	CONC	ZI	ZI-K	CUSUM
24-Mar-94	50.0	-0.3498	-1.3498	0
15-Jun-94	44.0	-0.75279	-1.75279	0
1-Sep-94				
1-Dec-94				

COMBINED SHEWHART-CUSUM CHART
WMMW-5 CHLORIDE



POTASSIUM WMMW-5

7/36

DATE	CONC.			
3-Sep-92	7.7			
14-Nov-92	7.85			
24-Mar-93	8.7			
8-Jun-93	9			
22-Sep-93	11.3			
14-Dec-93	8.4			
MEAN =	8.8			
STDEV =	1.309103			
DATE	CONC	ZI	ZI-k	CUSUM
24-Mar-94	6.4	-1.85241	-2.85241	0
15-Jun-94	9	0.133679	-0.86632	0
1-Sep-94				
1-Dec-94				

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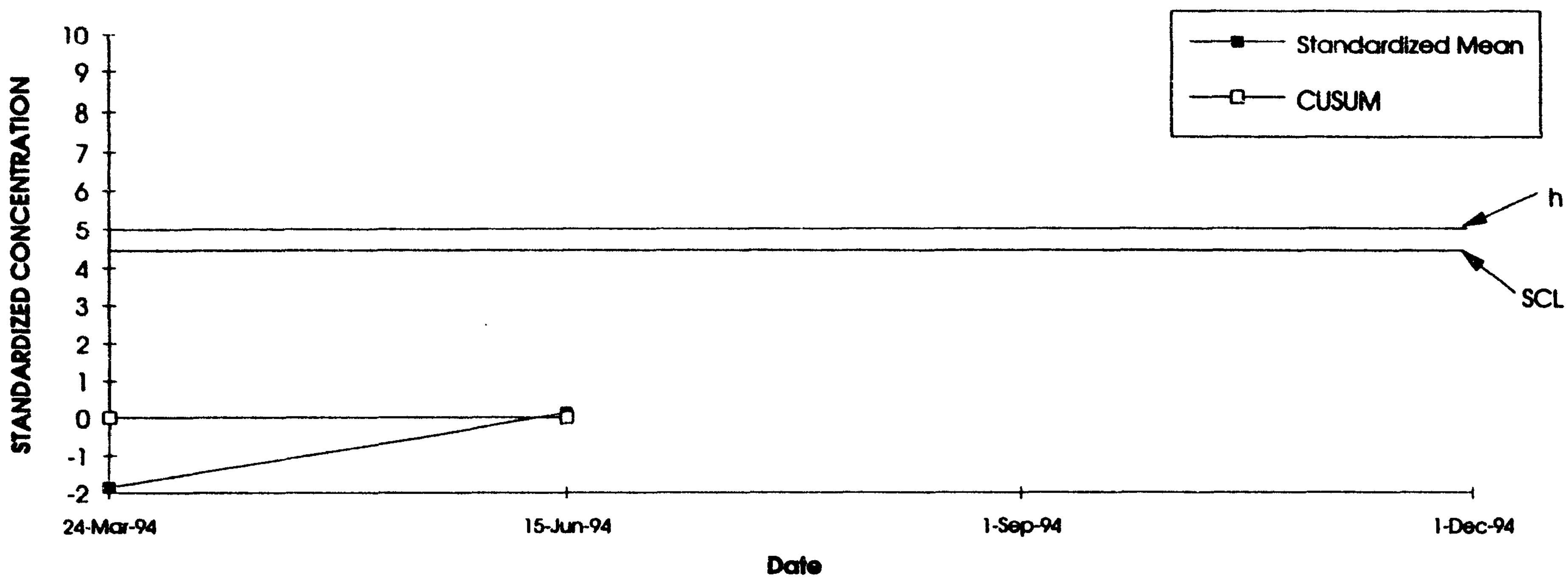
COMBINED SHEWHART-CUSUM CHART

WMMW-5 POTASSIUM



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NICKEL WMMW-5

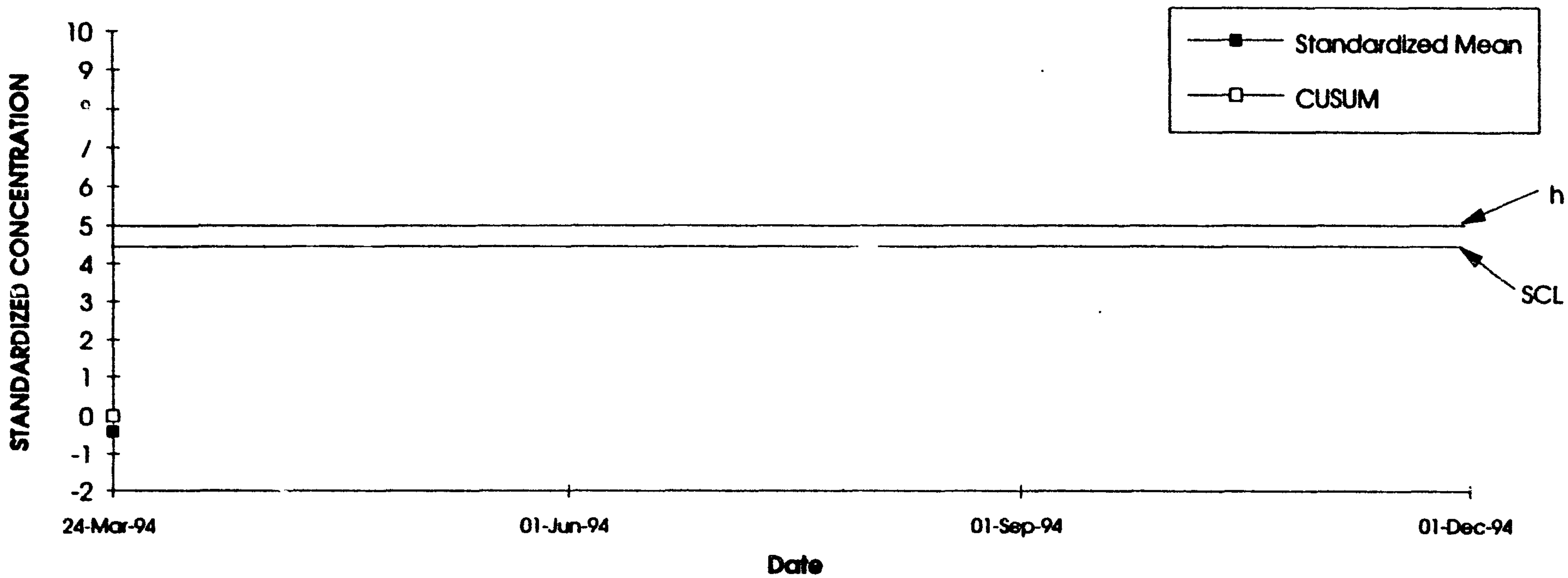
9/36

DATE	CONC.	ADJUSTED CONC.			
01-Nov-89	0.009	0.0045			
20-Nov-89	0.009	0.0045			
15-Dec-89	0.009	0.0045			
24-Jan-90	0.009	0.0045			
27-Feb-91	0.04	0.04			
24-Sep-91	0.009	0.0045			
17-Mar-92	0.009	0.0045			
14-Sep-92	0.0009	0.00045			
24-Mar-93	0.0009	0.00045			
22-Sep-93	0.0009	0.00045			
MEAN =		0.006835			
STDEV =		0.011808355			
DATE	CONC	ADJ. CONC.	ZI	ZI-k	CUSUM
24-Mar-94	0.002	0.002	-0.40946	-1.4094558	0
01-Jun-94					
01-Sep-94					
01-Dec-94					
NOTE:					
1. ADJUSTED VALUES ARE 1/2 THE DETECTION LIMIT					
2. DETECTION LIMIT VARIED FROM 0.009 TO 0.0009					

9/28/94

COMBINED SHEWHART-CUSUM CHART

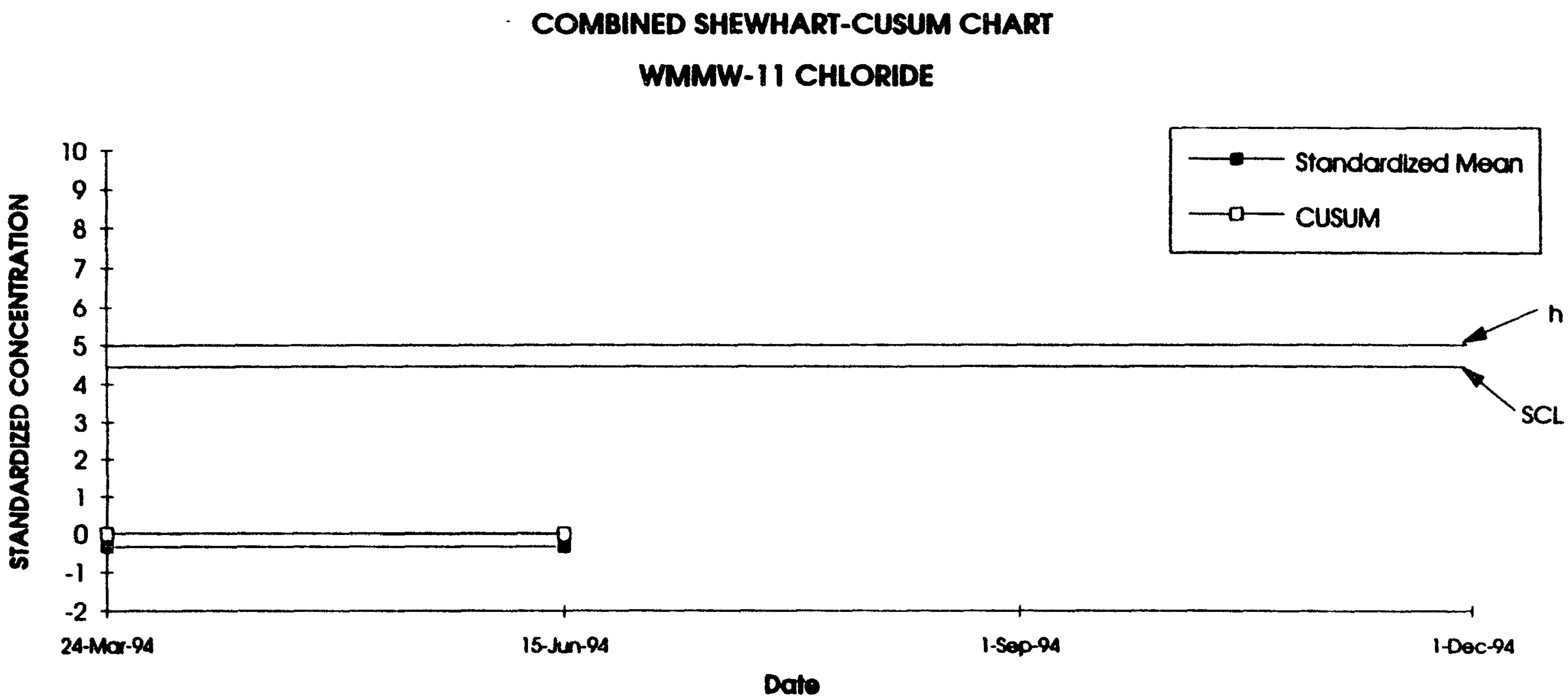
WMMW-5 NICKEL



KRB 9/28/94

CHLORIDE WMMW-11

DATE	CONC.					
31-Dec-82	24.4					
25-Jan-83	32					
30-Jun-83	26.8					
31-Dec-83	32					
31-Mar-84	31.4					
30-Jun-84	32.0					
30-Sep-84	33.9					
31-Dec-84	31.9					
31-Mar-85	34.0					
30-Jun-85	31.0					
30-Sep-85	38.0					
31-Dec-85	71.0					
19-Jun-86	77.0					
30-Jun-86	70.0					
4-Sep-86	32.0					
10-Dec-86	33.0					
20-Feb-87	32.0					
29-Apr-87	43.2					
19-Aug-87	33.0					
20-Nov-87	31.9					
27-Jan-88	31.0					
1-Jun-88	32.0					
23-Aug-88	33.5					
3-Nov-88	35.2					
9-Mar-89	32.3					
21-Jun-89	32.4					
1-Sep-89	34.0					
15-Nov-89	34.0					
20-Feb-90	33.0					
8-May-90	33.0					
7-Aug-90	33.0					
13-Nov-90	34.0					
27-Feb-91	31.0					
21-May-91	30.0					
24-Sep-91	30.0					
3-Dec-91	31.0					
17-Mar-92	32.0					
11-Jun-92	29.0					
3-Sep-92	31					
19-Nov-92	41.0					
24-Mar-93	35.0					
8-Jun-93	39.0					
22-Sep-93	33					
14-Dec-93	36.0					
Mean =	35.6					
Stdev =	10.65905					
DATE	CONC	Zi	Zi-k	CUSUM		
24-Mar-94	32.0	-0.33659	-1.33659	0		
15-Jun-94	32.0	-0.33659	-1.33659	0		
1-Sep-94						
1-Dec-94						


COMBINED SHEWHART-CUSUM CHART
WMMW-11 CHLORIDE
Standardized Mean
CUSUM
STANDARDIZED CONCENTRATION
10
9
8
7
6
5
4
3
2
1
0
-1
-2
h
SCL
24-Mar-94
15-Jun-94
1-Sep-94
1-Dec-94
Date

POTASSIUM WMMW-11

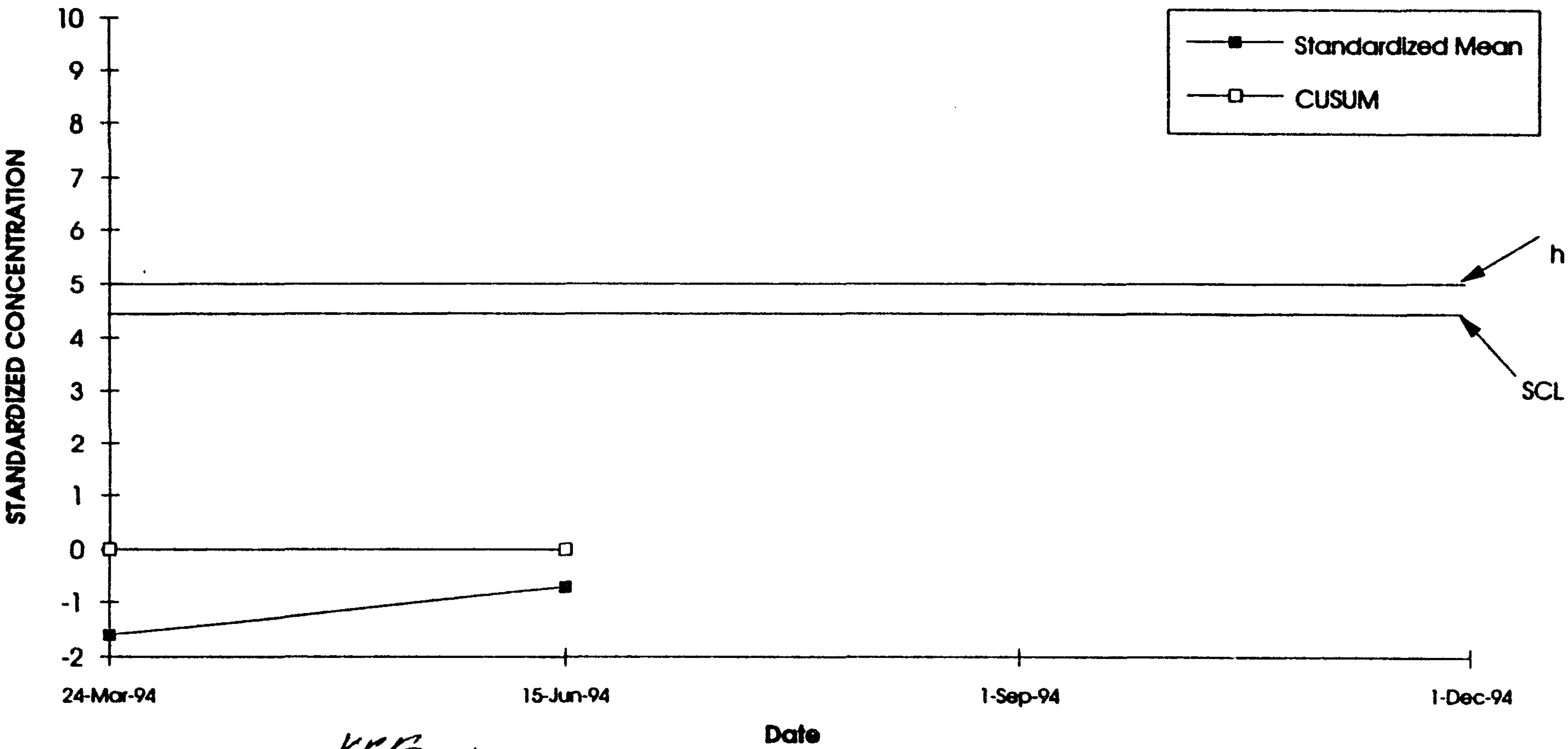
DATE	CONC.			
3-Sep-92	6.3			
14-Nov-92	10.55			
24-Mar-93	9.2			
8-Jun-93	12.2			
22-Sep-93	11.3			
14-Dec-93	8			
MEAN =	9.6			
STDEV =	2.198276			
DATE	CONC	Zi	Zi-k	CUSUM
24-Mar-94	6.1	-1.58837	-2.58837	0
15-Jun-94	8	-0.72405	-1.72405	0
1-Sep-94				
1-Dec-94				

13/36

KRB 9/28/94

COMBINED SHEWHART-CUSUM CHART

WMMW-11 POTASSIUM



KKB 9/28/94

14/36

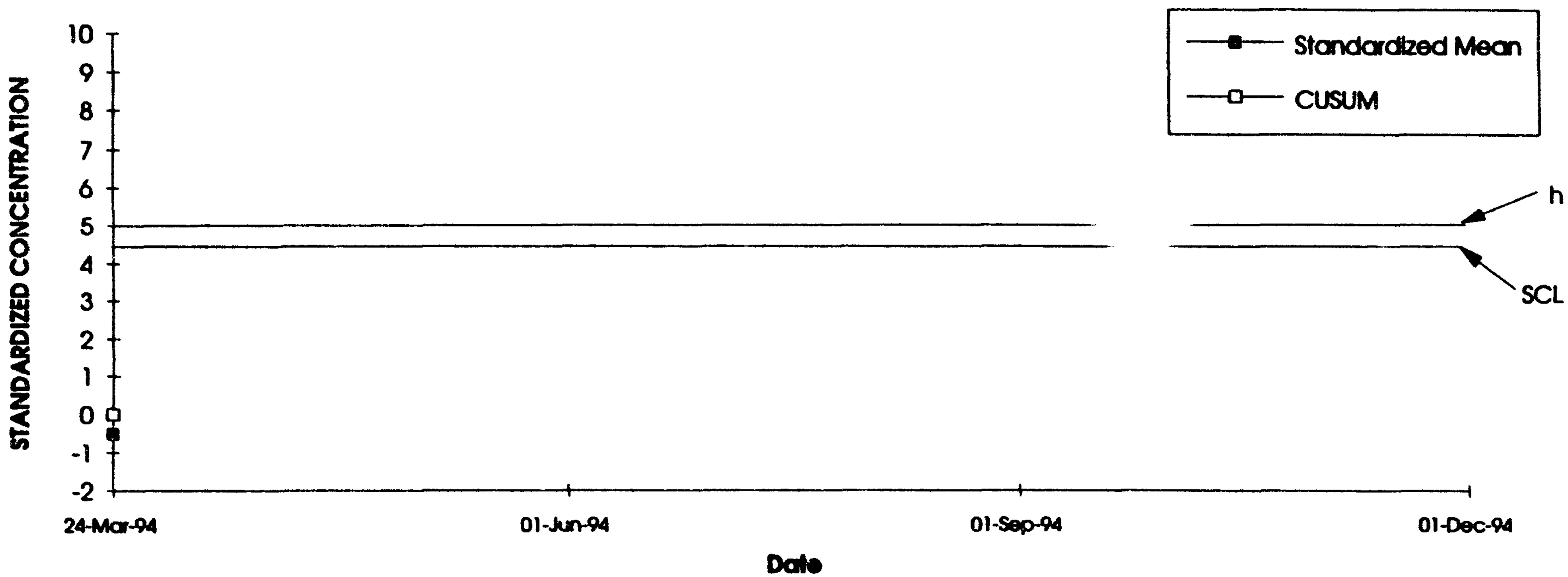
NICKEL WMMW-11

15/36

DATE	CONC.	ADJUSTED CONC.			
01-Nov-89	0.009	0.0045			
20-Nov-89	0.009	0.0045			
15-Dec-89	0.009	0.0045			
24-Jan-90	0.009	0.0045			
27-Feb-91	0.05	0.05			
24-Sep-91	0.009	0.0045			
17-Mar-92	0.009	0.0045			
14-Sep-92	0.0009	0.00045			
24-Mar-93	0.0009	0.00045			
22-Sep-93	0.0009	0.00045			
MEAN =		0.007835			
STDEV =		0.014937779			
DATE	CONC	ADJ. CONC.	Zi	Zi-k	CUSUM
24-Mar-94	0.0009	0.00045	-0.49438	-1.4943841	0
01-Jun-94					
01-Sep-94					
01-Dec-94					
NOTE:					
1. ADJUSTED VALUES ARE 1/2 THE DETECTION LIMIT					
2. DETECTION LIMIT VARIED FROM 0.009 TO 0.0009					

KRB 9/28/94

COMBINED SHEWHART-CUSUM CHART
WMMW-11 NICKEL



KCG
9/28/94

16/32

CHLORIDE WMMW-12

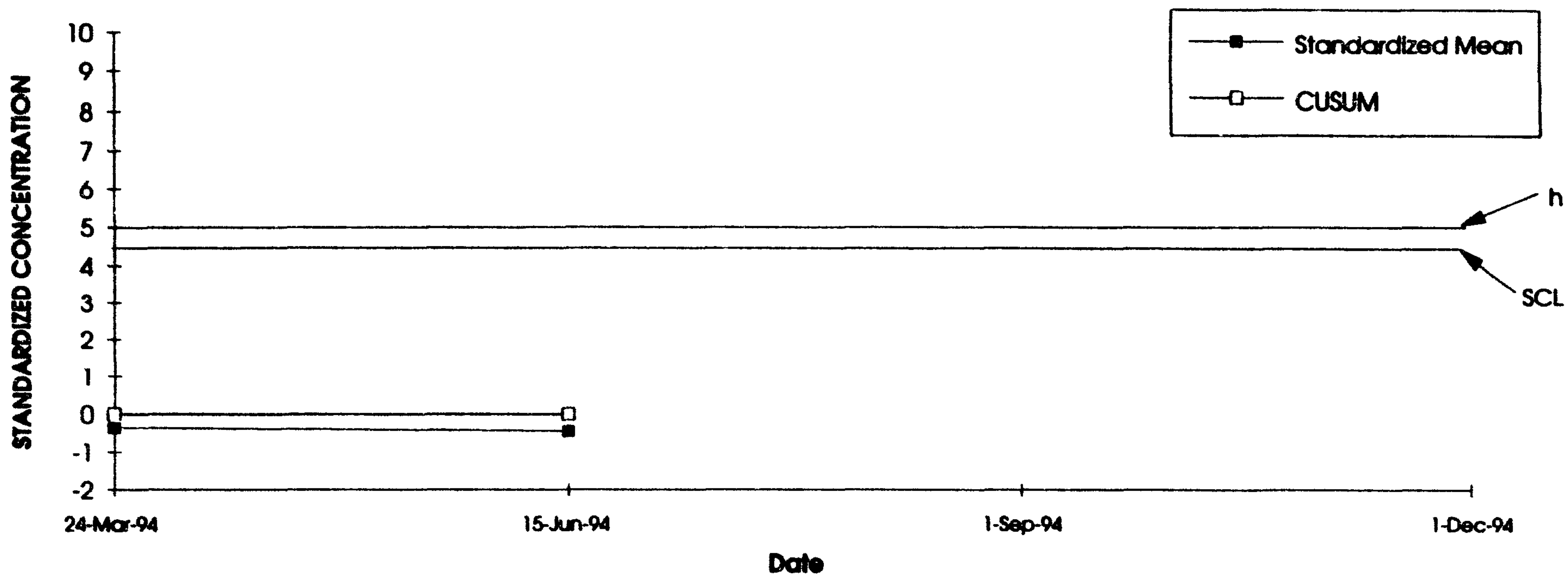
17/36

DATE	CONC.					
31-Dec-82	57.4					
25-Jan-83	70					
30-Jun-83	80.5					
31-Dec-83	65					
31-Mar-84	64.1					
30-Jun-84	65.0					
30-Sep-84	64.6					
31-Dec-84	67.4					
31-Mar-85	67.0					
30-Jun-85	62.0					
30-Sep-85	71.0					
31-Dec-85	53.0					
19-Jun-86	170.0					
30-Jun-86	150.0					
04-Sep-86	58.0					
10-Dec-86	64.0					
20-Feb-87	63.0					
29-Apr-87	62.7					
19-Aug-87	61.0					
20-Nov-87	61.2					
27-Jan-88	61.0					
01-Jun-88	64.0					
23-Aug-88	64.8					
03-Nov-88	65.1					
09-Mar-89	61.5					
21-Jun-89	60.8					
01-Sep-89	59.0					
15-Nov-89	63.0					
20-Feb-90	63.0					
08-May-90	62.0					
07-Aug-90	63.0					
13-Nov-90	63.0					
27-Feb-91	61.0					
21-May-91	55.0					
24-Sep-91	59.0					
03-Dec-91	60.0					
17-Mar-92	60.0					
11-Jun-92	56.0					
03-Sep-92	56					
19-Nov-92	62.0					
24-Mar-93	60.0					
08-Jun-93	54.0					
22-Sep-93	61					
14-Dec-93	54.0					
MEAN =	66.5					
STDEV =	21.31167					
DATE	CONC	Zi	Zi-k	CUSUM		
24-Mar-94	59.0	-0.35097	-1.35097	0		
15-Jun-94	57.0	-0.44482	-1.44482	0		
1-Sep-94						
1-Dec-94						

KRB 9/25/94

COMBINED SHEWHART-CUSUM CHART

WMMW-12 CHLORIDE



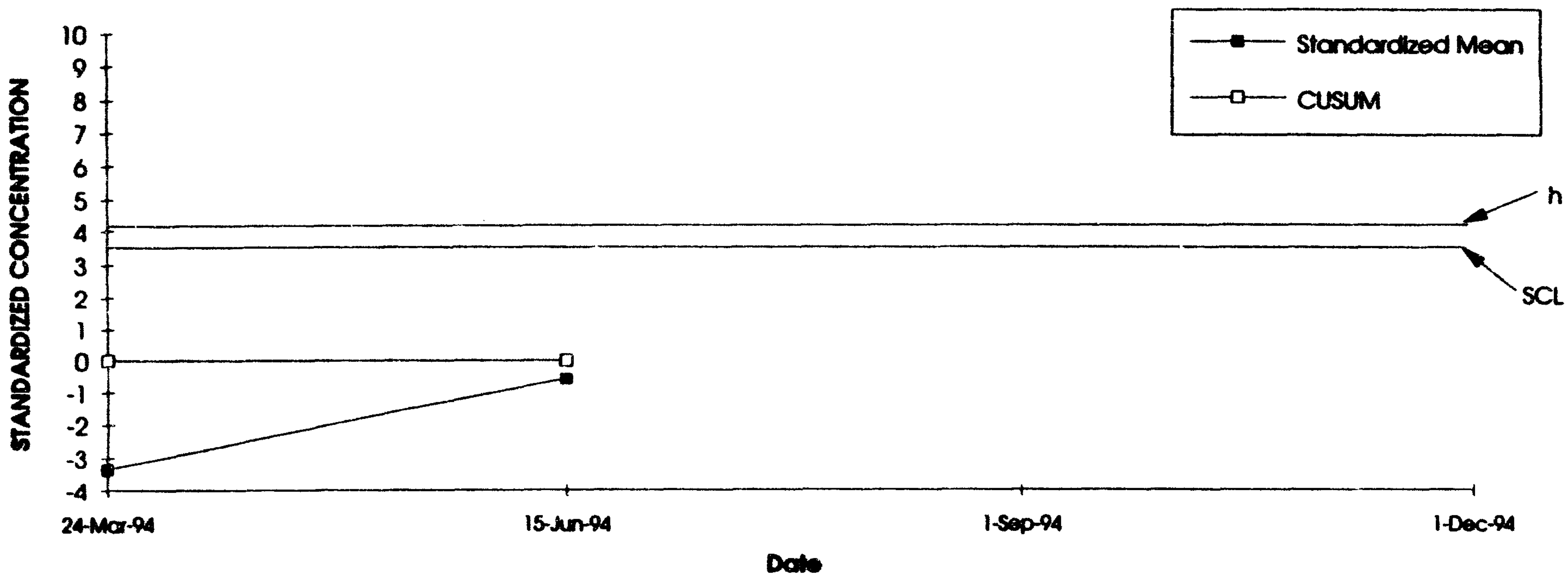
KRB
9/28/94

15/36

POTASSIUM WMMW-12

DATE	CONC.			
3-Sep-92	13.8			
14-Nov-92	13.25			
24-Mar-93	14.7			
8-Jun-93	15.1			
22-Sep-93	14.9			
14-Dec-93	14.7			
MEAN =	14.4			
STDEV =	0.721399			
DATE	CONC	ZI	ZI-k	CUSUM
24-Mar-94	12	-3.33842	-4.33842	0
15-Jun-94	14	-0.56603	-1.56603	0
1-Sep-94				
1-Dec-94				

COMBINED SHEWHART-CUSUM CHART
WMMW-12 POTASSIUM



NICKEL WMMW-12

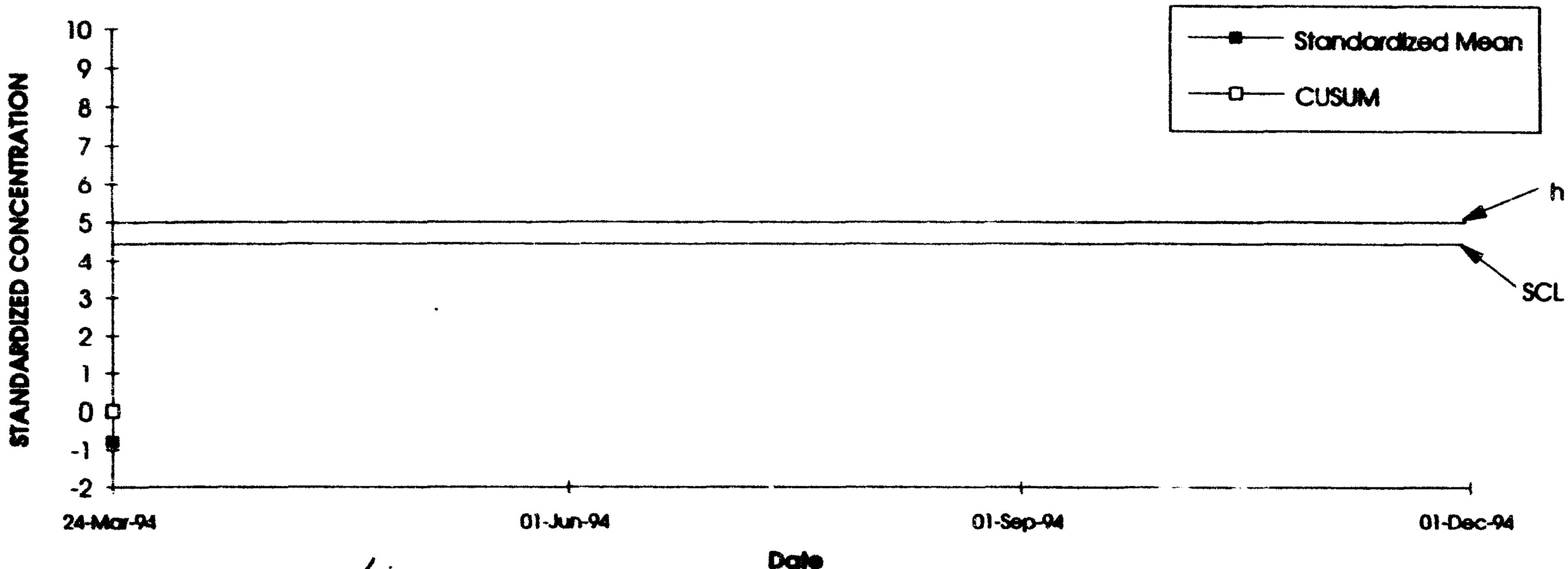
21/36

DATE	CONC.	ADJUSTED CONC.			
01-Nov-89	0.03	0.03			
20-Nov-89	0.02	0.02			
15-Dec-89	0.02	0.02			
24-Jan-90	0.009	0.0045			
27-Feb-91	0.06	0.06			
24-Sep-91	0.009	0.0045			
17-Mar-92	0.009	0.0045			
14-Sep-92	0.0009	0.00045			
24-Mar-93	0.0009	0.00045			
22-Sep-93	0.005	0.005			
MEAN =		0.01494			
STDEV =		0.018720515			
DATE	CONC	ADJ. CONC.	ZI	ZI-k	CUSUM
24-Mar-94	0.0009	0.00045	-0.77402	-1.7740172	0
01-Jun-94					
01-Sep-94					
01-Dec-94					
NOTE:					
1. ADJUSTED VALUES ARE 1/2 THE DETECTION LIMIT					
2. DETECTION LIMIT VARIED FROM 0.009 TO 0.0009					

KRB 9/28/94

COMBINED SHEWHART-CUSUM CHART

WMMW-12 NICKEL



KRB 9/28/94

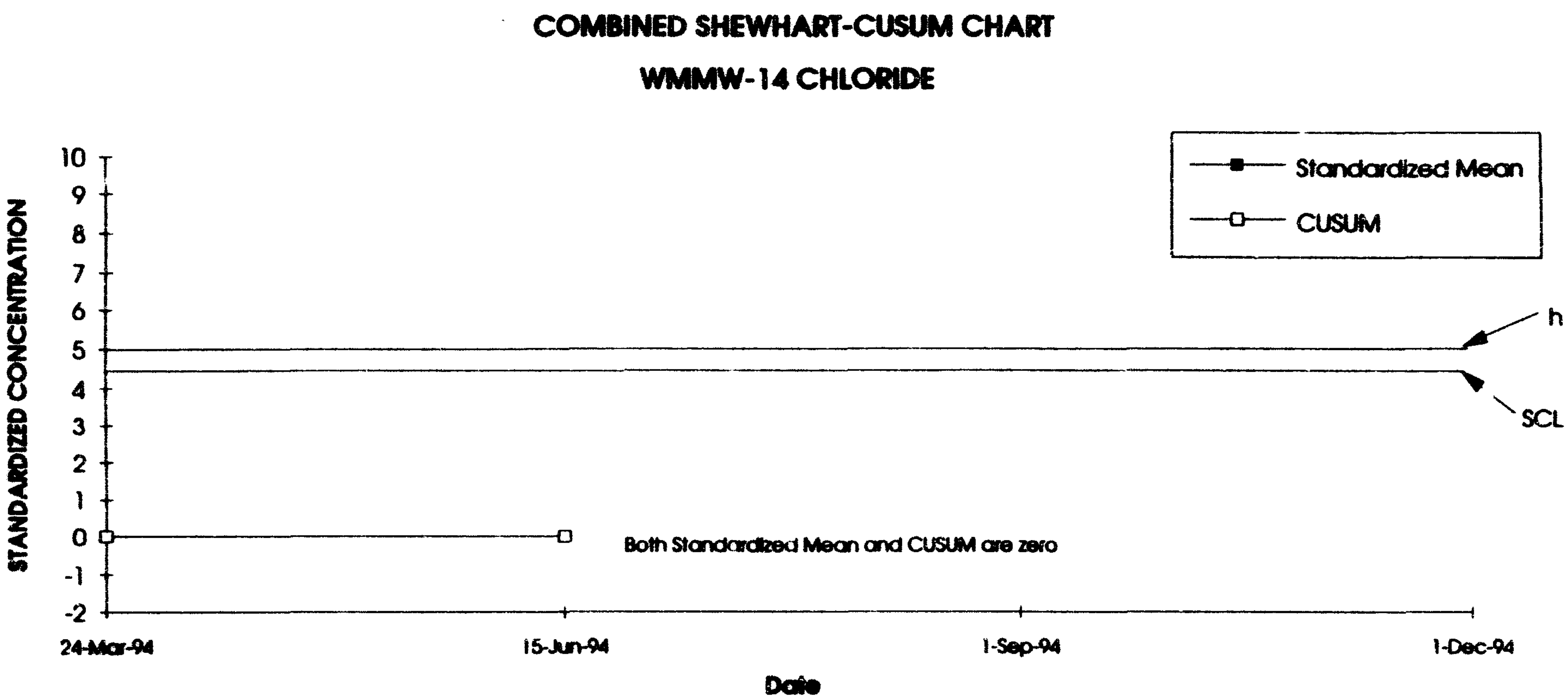
22/32

CHLORIDE WMMW-14

23/36

DATE	CONC.			
15-Nov-89	25.0			
20-Feb-90	20.0			
8-May-90	23.0			
7-Aug-90	21.0			
13-Nov-90	23.0			
27-Feb-91	23.0			
21-May-91	21.0			
24-Sep-91	15.0			
3-Dec-91	19.0			
17-Mar-92	22.0			
11-Jun-92	18.0			
3-Sep-92	20			
19-Nov-92	18.0			
24-Mar-93	19.0			
8-Jun-93	17.0			
22-Sep-93	18			
14-Dec-93	18.0			
MEAN =	20.0			
STDEV =	2.622022			
DATE	CONC	ZI	ZI-k	CUSUM
24-Mar-94	20.0	0	-1	0
15-Jun-94	20.0	0	-1	0
1-Sep-94				
1-Dec-94				

KRB 9/28/94



KRB 9/28/94

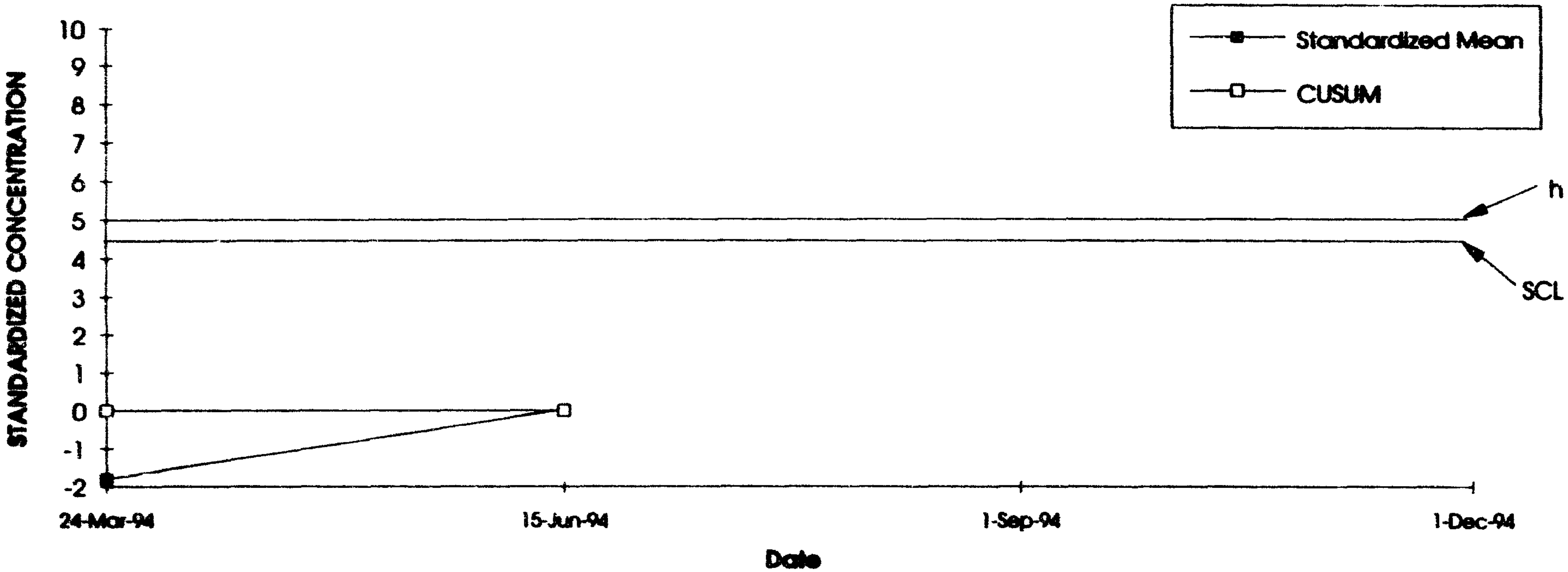
24/36

POTASSIUM WMMW-14

DATE	CONC.			
3-Sep-92	12			
14-Nov-92	11.5			
24-Mar-93	13.2			
8-Jun-93	13.6			
22-Sep-93	13.9			
14-Dec-93	13.6			
MEAN =	13.0			
STDEV =	0.981156			
DATE	CONC	ZI	ZI-k	CUSUM
24-Mar-94	11.2	-1.8006	-2.8006	0
15-Jun-94	13	0.033974	-0.96603	0
1-Sep-94				
1-Dec-94				

COMBINED SHEWHART-CUSUM CHART

WMMW-14 POTASSIUM



NICKEL WMMW-14

21/34

DATE	CONC.	ADJUSTED CONC.			
01-Nov-89	0.03	0.03			
20-Nov-89	0.02	0.02			
15-Dec-89	0.03	0.03			
24-Jan-90	0.01	0.01			
27-Feb-91	0.05	0.05			
24-Sep-91	0.009	0.0045			
17-Mar-92	0.009	0.0045			
14-Sep-92	0.0009	0.00045			
24-Mar-93	0.0009	0.00045			
22-Sep-93	0.003	0.003			
MEAN =		0.01529			
STDEV =		0.016706832			
DATE	CONC	ADJ. CONC.	ZI	ZI-k	CUSUM
24-Mar-94	0.0009	0.00045	-0.88826	-1.8882594	0
01-Jun-94					
01-Sep-94					
01-Dec-94					
NOTE:					
1. ADJUSTED VALUES ARE 1/2 THE DETECTION LIMIT					
2. DETECTION LIMIT VARIED FROM 0.009 TO 0.0009					

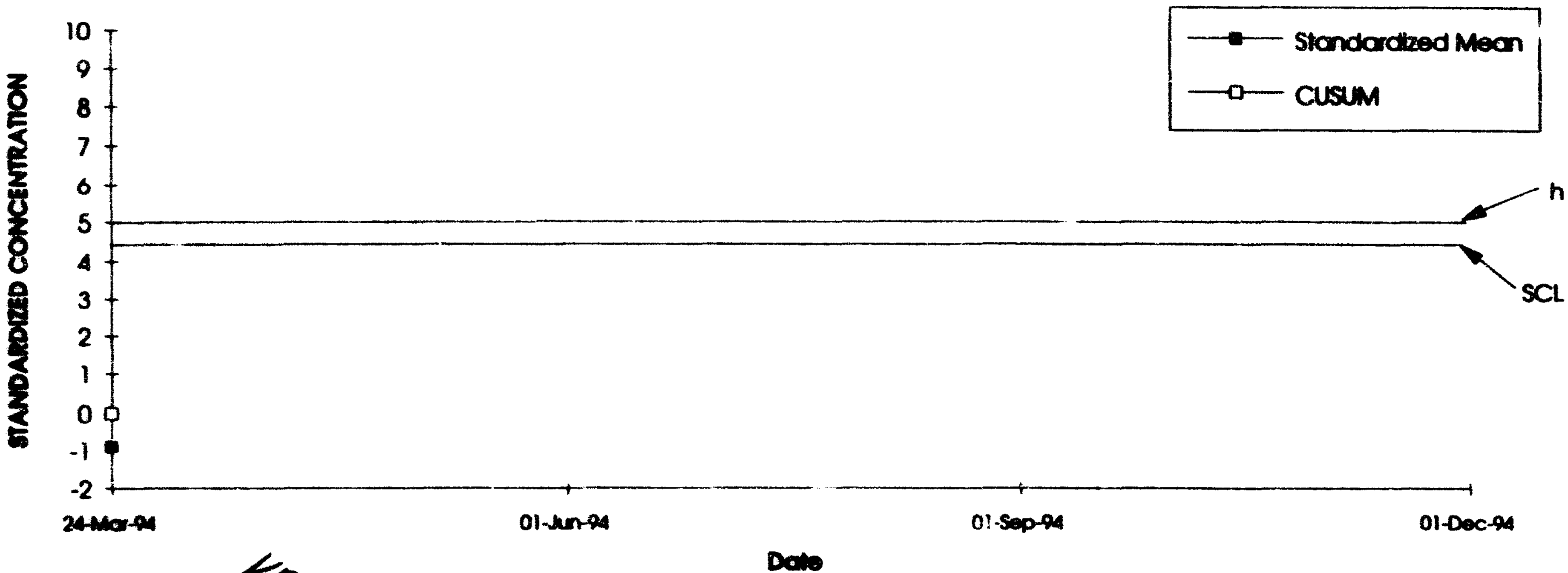
mean dates = .02833...

SD/mean = .016207/.02833 = .57208...

KRB 9/28/94

COMBINED SHEWHART-CUSUM CHART

WMMW-14 NICKEL

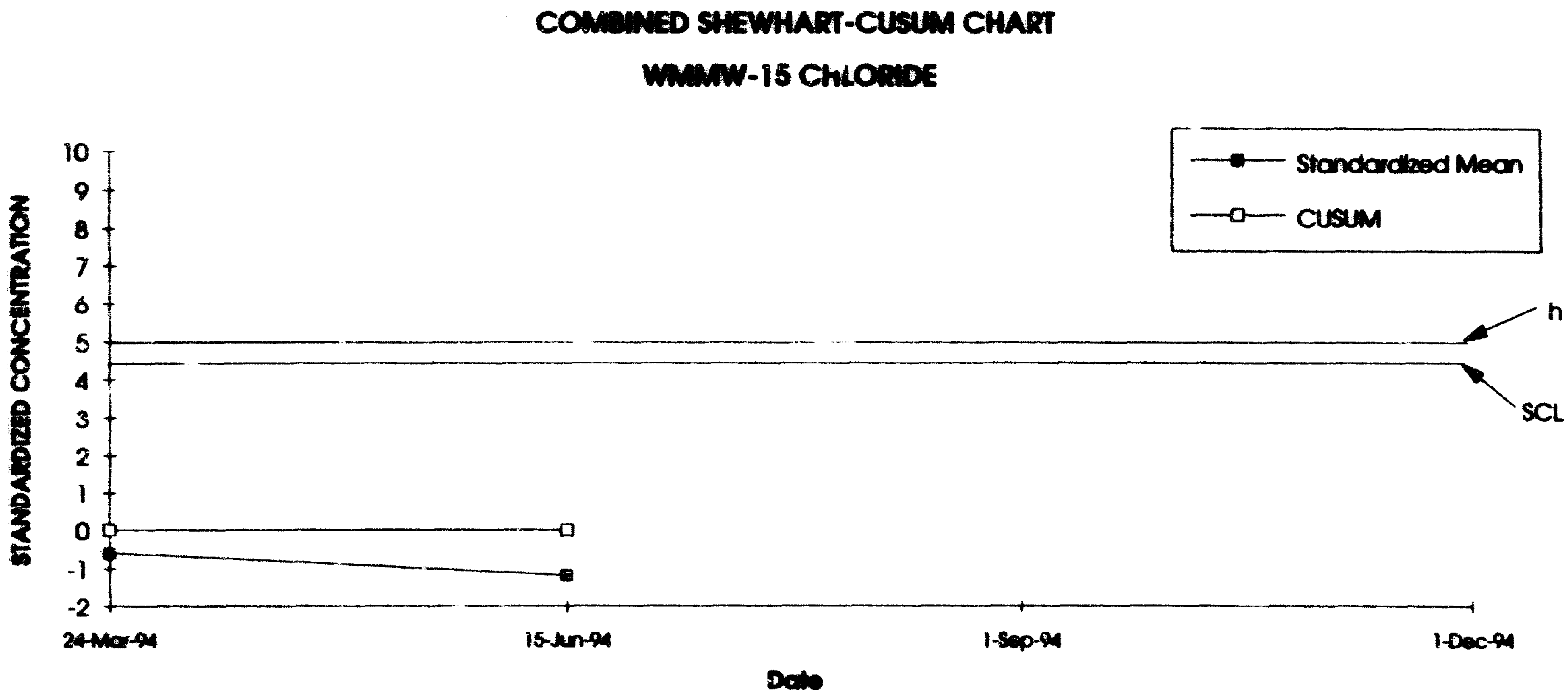


KRB 9/28/94

28/34

CHLORIDE WMMW-15

DATE	CONC.			
15-Nov-89	49.0			
20-Feb-90	44.0			
8-May-90	44.0			
7-Aug-90	44.0			
13-Nov-90	44.0			
27-Feb-91	41.0			
21-May-91	38.0			
24-Sep-91	38.0			
3-Dec-91	38.0			
17-Mar-92	40.0			
11-Jun-92	35.0			
3-Sep-92	37			
19-Nov-92	39.0			
24-Mar-93	38.0			
8-Jun-93	38.0			
22-Sep-93	38			
14-Dec-93	38.0			
MEAN =	40.2			
STDEV =	3.609628			
DATE	CONC	ZI	ZI-k	CUSUM
24-Mar-94	38.0	-0.60296	-1.60296	0
15-Jun-94	36.0	-1.15704	-2.15704	0
1-Sep-94				
1-Dec-94				



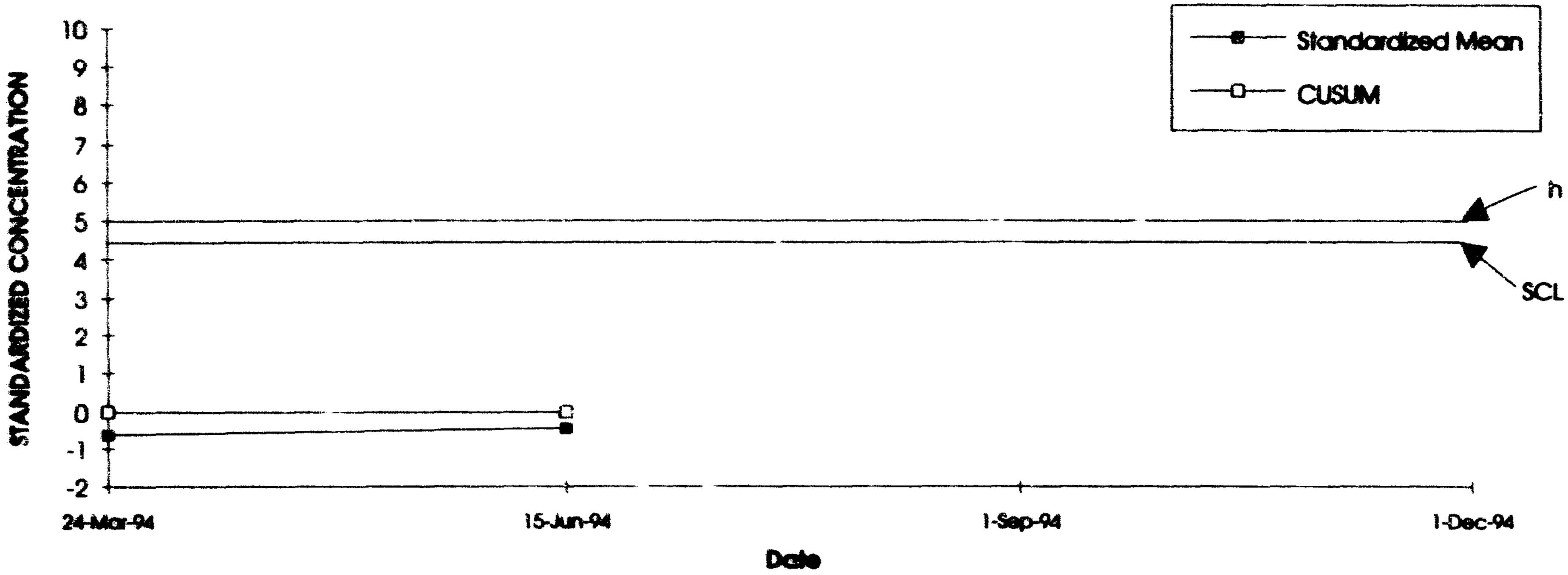
COMBINED SHEWHART-CUSUM CHART
WMMW-15 CHLORIDE
Standardized Mean
CUSUM
h
SCL
STANDARDIZED CONCENTRATION
10
9
8
7
6
5
4
3
2
1
0
-1
-2
24-Mar-94
15-Jun-94
1-Sep-94
1-Dec-94
Date

POTASSIUM WMMW-15

DATE	CONC.			
3-Sep-92	10.2			
14-Nov-92	10.1			
24-Mar-93	11.5			
8-Jun-93	11.7			
22-Sep-93	14.6			
14-Dec-93	12.2			
MEAN =	11.7			
STDEV =	1.643675			
DATE	CONC	Zi	Zi-k	CUSUM
24-Mar-94	10.7	-0.61853	-1.61853	0
15-Jun-94	11	-0.43601	-1.43601	0
1-Sep-94				
1-Dec-94				

COMBINED SHEWHART-CUSUM CHART

WMMW-15 POTASSIUM



NICKEL WMMW-15

33/36

DATE	CONC.	ADJUSTED CONC.			
01-Nov-89	0.02	0.02			
20-Nov-89	0.02	0.02			
15-Dec-89	0.02	0.02			
24-Jan-90	0.009	0.0045			
27-Feb-91	0.07	0.07			
24-Sep-91	0.009	0.0045			
17-Mar-92	0.009	0.0045			
14-Sep-92	0.0009	0.00045			
24-Mar-93	0.0009	0.00045			
22-Sep-93	0.0009	0.00045			
MEAN =		0.014485			
STDEV =		0.021247759			
DATE	CONC	ADJ. CONC.	ZI	ZI-k	CUSUM
24-Mar-94	0.0009	0.00045	-0.66054	-1.6605403	0
01-Jun-94					
01-Sep-94					
01-Dec-94					
NOTE:					
1. ADJUSTED VALUES ARE 1/2 THE DETECTION LIMIT					
2. DETECTION LIMIT VARIED FROM 0.009 TO 0.0009					

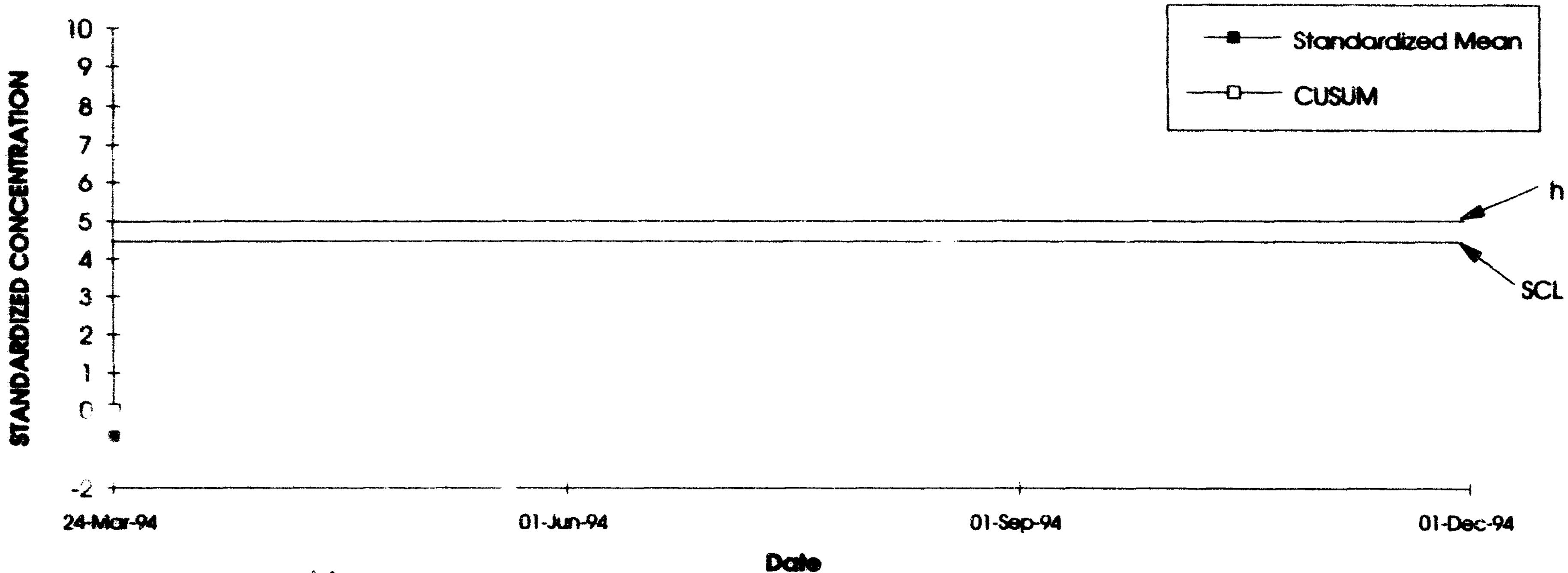
mean for detects = .03

sd/mean = .02/.03 = .6666 → normal dist assumption ok

KRB 9/20/94

COMBINED SHEWHART-CUSUM CHART

WMMW-15 NICKEL



KRB 9/28/94

TITAN ENVIRONMENTAL

BY: JFL

DATE: 9/27/94

TITLE: CONSTRUCTION OF COMBINED SHEWHART-CUSUM CONTROL CHARTS

CHK'D BY: [illegible]

DATE: 9/28/94

Appendix A
Control Chart Construction Method

Appendix B
Water Quality Data

KKB 9/28/94

W_QUAL

	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15				
U-Nat	uCi/ml														
	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19	QC (13A)
30-Sep-81	2.7E-09	3.2E-08	2.4E-08	1.5E-08	1.4E-08				6.8E-10						
31-Dec-81	6.5E-10	3.0E-09	1.4E-08	2.0E-09	3.0E-09				6.9E-10						
31-Mar-82	6.5E-10	2.0E-09	2.7E-09	6.9E-10	6.8E-10				6.9E-10						
30-Jun-82	1.4E-09	4.7E-09	2.4E-08	1.3E-09	2.7E-09				7.0E-10						
30-Sep-82	6.8E-10	2.7E-09	8.9E-09	6.8E-10	6.7E-10				4.5E-09						
31-Dec-82	6.8E-10	6.6E-10	2.5E-08	6.7E-10	6.7E-10				6.6E-10						
31-Mar-83	7.4E-09	2.0E-08	1.0E-08	5.5E-09	8.0E-10	3.4E-10	5.0E-09	4.1E-09							
30-Jun-83	6.7E-10	3.4E-09	2.0E-08	6.8E-10	6.7E-10	6.8E-10	2.0E-09	4.0E-09							
30-Sep-83	2.3E-09	2.3E-09	1.4E-08	2.3E-09	5.6E-09	8.5E-09	1.1E-08	6.8E-09							
31-Dec-83	2.3E-09	6.0E-09	2.8E-08	6.7E-10	6.8E-10	6.9E-10	1.0E-08	1.4E-08							
31-Mar-84	2.71E-09	1.35E-09	1.49E-08	1.35E-09	1.35E-09	7.45E-09	2.91E-08	5.24E-09	3.25E-08						
30-Jun-84	2.71E-09	2.71E-09	1.29E-08	2.71E-09	2.71E-09	2.71E-09	1.83E-08	1.83E-08	2.71E-09						
30-Sep-84	8.12E-10	4.06E-10	1.22E-09	4.06E-10	4.06E-10	4.06E-10	4.06E-10	4.06E-10	4.06E-10						
31-Dec-84	4.06E-10	0.00E+00	1.49E-09	8.12E-10	0.00E+00	1.76E-09	1.62E-09	1.49E-09	1.35E-09						
31-Mar-85	1.76E-09	1.90E-09	1.56E-09	4.20E-09	6.09E-10	2.71E-10	4.74E-10	2.30E-09	2.0E-10						
30-Jun-85	7.99E-10	6.20E-09	1.08E-09	9.00E-10	6.03E-10	2.98E-10	6.80E-09	2.50E-09	1.50E-09						
30-Sep-85	1.35E-09	1.69E-08	3.05E-08	1.35E-09	3.39E-09	8.80E-09	3.39E-09	2.03E-09	1.66E-09						
31-Dec-85	1.70E-09	9.40E-09	2.06E-08	1.60E-09	5.00E-10	5.00E-10	6.60E-09	1.35E-08	2.15E-09						
31-Mar-86	1.90E-09	8.80E-09	1.90E-08	2.20E-09	1.10E-09	1.70E-09	9.60E-09	1.48E-08							
30-Jun-86	1.90E-09	6.40E-09	1.50E-08	1.80E-09	5.00E-09	1.50E-09	9.60E-09	1.10E-08	1.00E-09						
04-Sep-86	2.30E-09	5.80E-09	1.67E-08	1.00E-09	7.00E-10	4.00E-10	9.00E-09	1.17E-08	2.00E-09						
10-Dec-86	2.90E-09	8.20E-09	1.21E-08	1.90E-10	1.60E-09	1.90E-10	1.29E-08	1.17E-08	2.20E-09						
20-Feb-87	1.90E-10	3.50E-09	1.10E-08	1.90E-10	1.90E-10	1.90E-10	9.10E-09	7.00E-09	1.90E-10						
29-Apr-87	1.50E-09	3.10E-09	1.26E-08	1.30E-09	9.00E-10	3.00E-10	1.05E-08	9.50E-09	7.00E-10						
19-Aug-87	2.40E-09	6.20E-09	2.30E-08	1.50E-09	2.10E-09	7.00E-10	9.00E-09	1.20E-08	5.00E-10						
20-Nov-87	1.30E-09	4.10E-09	1.60E-08	9.00E-10	3.00E-10	5.00E-10	9.40E-09	1.20E-08	3.00E-10						
26-Jan-88	1.80E-09	4.10E-09	2.00E-08	1.60E-09	1.00E-09	1.90E-10	8.90E-09	1.20E-08	3.00E-10						
01-Jun-88	7.00E-10	4.70E-09	1.84E-08	1.40E-09	9.00E-10	5.00E-10	1.23E-08	1.43E-08	8.00E-10						
23-Aug-88	7.20E-09	1.10E-09	1.50E-09	5.40E-10	1.20E-10	5.00E-11	1.00E-09	1.20E-09	2.20E-10						
03-Nov-88	1.22E-09	4.94E-09	1.48E-07	3.60E-12	1.08E-09	2.71E-10	1.20E-07	1.23E-07	1.62E-09						
09-Mar-89	1.02E-09	6.00E-09	2.20E-08	1.40E-09	1.50E-09	9.00E-10	1.00E-08	0.00E+00	1.90E-09						
21-Jun-89	2.00E-09	6.80E-09	2.30E-08	1.20E-09	6.00E-10	8.00E-10	1.10E-08	0.00E+00	6.00E-10						
01-Sep-89	9.00E-10	8.80E-09	2.20E-08	2.60E-09	1.10E-09	1.60E-09	1.10E-08	0.00E+00	9.00E-10						
20-Nov-89	2.00E-10	9.50E-09	1.90E-08	9.00E-10	4.00E-10	6.00E-10	5.60E-09		0.00E+00	2.7E-08	4.4E-08				5.0E-10
16-Feb-90	2.40E-09	7.40E-09	1.40E-08	1.60E-09	7.00E-10	7.00E-10	8.80E-09		3.00E-10	3.2E-08	3.0E-08				5.0E-10
08-May-90	7.00E-10	8.00E-09	2.30E-08	1.60E-09	7.00E-10	8.00E-10	1.00E-08		3.00E-10	3.3E-08	3.0E-08				6.0E-10
16-Aug-90	4.67E-10	5.87E-09	1.67E-08	1.27E-09	6.00E-10	4.67E-10	1.07E-08		4.00E-10	3.3E-08	2.5E-08				3.3E-10
13-Nov-90	5.00E-10	7.20E-09	1.60E-08	1.20E-09	3.00E-10	6.00E-10	1.00E-08		5.00E-10	3.3E-08	2.4E-08				4.1E-10
27-Feb-91	2.20E-10	3.50E-09	8.00E-09	1.30E-09	2.70E-10	2.00E-10	8.80E-09		2.00E-10	2.4E-08	2.0E-08				1.6E-09
21-May-91	9.10E-10	4.30E-09	1.30E-08	7.70E-10	1.10E-09	2.30E-10	1.00E-08		8.60E-10	2.2E-08	1.8E-08				3.9E-10
24-Sep-91	8.20E-10	7.60E-09	2.20E-08	9.00E-10	8.00E-10	7.40E-10	1.10E-08		9.90E-10	3.1E-08	3.3E-08				2.0E-10
03-Dec-91	4.30E-10	9.50E-09	8.10E-09	7.40E-10	5.30E-10	2.40E-10	6.80E-09		2.40E-10	3.0E-08	2.3E-08				2.0E-10
17-Mar-92	4.54E-10	7.07E-09	4.53E-09	1.02E-09	1.60E-09	2.70E-09	1.01E-08		1.46E-09	3.03E-08	2.37E-08				7.2E-10
11-Jun-92	2.76E-09	4.66E-09	9.13E-09	2.00E-10	2.00E-10	2.00E-10	5.53E-09		2.00E-10	2.6E-08	1.9E-08				2.0E-10
03-Sep-92	2.0E-09	1.2E-08	1.9E-08	4.1E-09	4.1E-09	3.4E-09	1.3E-08		2.0E-09	4.3E-08	2.8E-08				
19-Nov-92	5.42E-10	1.02E-08	1.12E-08	1.42E-07	6.77E-10	3.18E-09	1.39E-08		1.83E-09	4.3E-08	2.7E-08				2.0E-09
24-Mar-93	2.00E-10	1.15E-09	1.42E-08	1.35E-09	1.35E-09	2.03E-09	1.02E-08		1.35E-09	2.5E-09	1.2E-08	2.0E-08	1.2E-08	1.0E-08	6.1E-09
08-Jun-93	2.03E-09	8.80E-09	1.42E-08	2.71E-09	2.03E-09	2.71E-09	8.80E-09		3.39E-09	2.9E-08	2.3E-08	1.3E-08	9.5E-09	9.5E-09	2.0E-09
22-Sep-93	1.4E-09	6.8E-09	1.2E-08	1.2E-08	1.4E-09	1.4E-09	6.1E-09		2.0E-10	2.8E-08	1.7E-08	9.5E-09	8.1E-09	8.8E-09	2.0E-10
14-Dec-93	2.00E-10	7.45E-09	8.80E-08	1.35E-09	2.00E-10	2.00E-10	9.48E-09		6.77E-10	3.0E-08	2.3E-08	9.5E-09	1.1E-08	8.1E-09	2.0E-10
24-Mar-94	2.10E-09	7.80E-09	1.50E-08	1.30E-09	2.00E-10	2.00E-10	8.90E-09		3.30E-08	2.6E-08	1.7E-08	9.6E-09	7.7E-09	6.7E-09	5.4E-10

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15-Jun-94	2.00E-10	2.50E-09	2.80E-09	2.00E-10	2.00E-10	8.10E-10	2.20E-09		8.80E-10	6.0E-09	4.9E-09	3 1E-09	1.8E-09	5.9E-09	2.0E-10
U-Nat	1.49E-09	6.33E-09	1.86E-08	4.54E-09	1.43E-09	1.39E-09	1.13E-08	1.17E-08	1.69E-09	2.81E-08	2.38E-08	1.07E-08	8.34E-09	7.32E-09	9.38E-10
uCi/ml	1.42E-09	5.22E-09	2.20E-08	1.94E-08	2.06E-09	2.01E-09	1.69E-08	2.25E-08	4.63E-09	9.61E-09	8.02E-09	5.18E-09	3.31E-09	2.96E-09	1.38E-09
	1.90E-10	0.00E+00	1.08E-09	3.60E-12	0.00E+00	5.00E-11	4.06E-10	0.00E+00	0.00E+00	2.51E-09	4.90E-09	3.10E-09	1.80E-09	1.43E-09	2.00E-10
	7.40E-09	3.20E-08	1.48E-07	1.42E-07	1.35E-08	8.80E-09	1.20E-07	1.23E-07	3.25E-08	4.27E-08	4.40E-08	2.03E-08	1.22E-08	1.02E-08	6.09E-09

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Conductance

	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19
31-Oct-79	948	1270	3260	3360										
30-May-80	1500	2413	3915	3205	2660									
30-Jun-80	1367	3031	4276	3196	2372									
31-Jul-80	1469	2500	4386	3264	2371									
31-Aug-80	1565	2712	4537	3233	2440									
30-Sep-80	1547	2791	4768	2791	2559									
31-Oct-80	1578	2930	4846	3268	2479									
30-Nov-80	1509	2668	4782	3289	2568									
31-Dec-80	1568	2730	4828	3254	2412									
31-Jan-81	1682	3190	5398	3435	2282									
28-Feb-81	1723	3089	5054	3370	2268									
31-Mar-81	1472		5153	3391	2638									
30-Apr-81	1425	3097	4893	3363	2589									
30-May-81	1543	2985	4918	3084	2422									
30-Jun-81	1303	2806	4433	3108	2699									
14-Aug-81	1716	3702	5832	3963	3077									
27-Jan-82	1450	3450	5100	3370	3050									
07-Apr-82	1635	3402	5489	3630	3275				459					
07-Jul-82	1570	3340	5170	3380	2790				573					
10-Dec-82	1320	2720	4390	3030	2220	2102	3280	3360	530					
25-Jan-83	1310	2680	4260	2910	2150	1630	3130	3290	439					
30-Apr-83	1320	2800	4820	3420	2490	2330	3400	3970	450					
07-Sep-83	1390	2810	4490	2970	2130	2260	3250	3160	412					
26-Oct-83	1680	3560	5550	3700	2840	2600	4000	4380	470					
20-Mar-84	1200	2380	4200	2340	2150	1500	3050	3200	312					
14-Jun-84	1200	2400	4500	2500	2300	1800	3200	3200	370					
05-Dec-84	1100	2275	3975	2325	2000	1900	3000	3050	238					
21-Feb-85	1300	2800	4000	2700	2100	1900	4000	3200	380					
25-Jun-85	1100	2600	4200	2800	2200	1850	3300	3150	300					
30-Sep-85	1500	2500	5000	3300	2800	2350	3800	3800	470					
15-Dec-85	3000	3200	4700	3000	2200	3100	2600	3600						
27-Mar-86	1350	2650	4000	2800	2300	1900	3100	3000	500					
26-Jun-86	1900	3800	5600	3600	3800	3400	5400	4400	700					
04-Sep-86	1800	3700	6000	4100	3250	2700	5500	5000	550					
10-Dec-86	2200	3200	4600	3400	2400	1500	3300	3600	800					
20-Feb-87	1800	3800	5600	3200	2800	3400	5500	4400	460					
29-Apr-87	1800	5000	5600	2600	3700	3250	4400	3900	500					
19-Aug-87	1500	3300	5400	3800	2700	2800	3300	4200	500					
20-Nov-87	1600	3400	5000	3700	2600	2300	3900	4000	600					
27-Jan-88	1300	2600	4500		1900	1800	3000	3050	265					
01-Jun-88	1350	2800	4500	2850	2100	2000	3250	3400	340					
23-Aug-88	1550	3400	4500	3100	2200	1900	3400	3350	310					
03-Nov-88	1250	2850	4400		2000	1950	3000	3300						
09-Mar-89	1300	2800	4200	2700	2100	2000	3200	3150						
21-Jun-89	1694	3680	5660	3690	2710	2520	4000		550					
01-Sep-89	1670	3670	5550	3670	2740	[illegible]560	4010		575	3860	4560			
15-Nov-89	1680	3620	5590	3640	2780	2510	4020		693	3880	4450			
20-Feb-90	1695	3630	5550	3630	2780	2750	3980		684	3830	4300			
08-May-90	1694	3630	5850	3650	2750	2550	4000		700	3880	4360			
07-Aug-90	1667	3560	5480	3550	2660	2530	3880		686	3710	4240			
13-Nov-90	1040	2060	4010	2070	2000	1090	3000		550	2080	3030			
27-Feb-91	1700	3720	5530	3730	2640	2680	4120		449	3960	4360			
21-May-91	1705	3680	5660	3670	2650	2620	4040		448	3880	4400			

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24-Sep-91	1726	3660	5570	3660	2650	2690	4030		447	3840	4310			
03-Dec-91	1705	3650	5560	3610	2630	2610	4100		442	3900	4220			
17-Mar-92	1702	3600	5490	3670	2620	2630	4070		440	3890	4320			
11-Jun-92	1669	3640	5480	3620	2600	2600	4000		447	3850	4380			
03-Sep-92	1694	3620	5590	3610	2600	2630	4000		411	3810	4200			
19-Nov-92	1690	3660	5710	3650	2680	2630	4070		407	3850	4270			
24-Mar-93	1683	3570	5450	3620	2630	2900	3990		409	3780	4210	4490	2800	3210
08-Jun-93	1364	3580	5530	3630	2680	3060	3850		408	3770	4180	4880	2860	3490
22-Sep-93	1678	3570	5460	3630	2650	3070	3860		409	3760	4180	4830	2830	3580
14-Dec-93	2020	3820	6280	4200	2730	2830	4240		420	4180	4540	6450	3340	4170
24-Mar-94	1370	3650	5680	3670	2630	2640	4030		350	3650	4240	2770	3150	4960
15-Jun-94	1720	3640	5650	3660	2750	2830	3980		404	3830	4240	4950	2870	2760
Conductance	1558	3172	4999	3322	2561	2414	3772	3604	473	3760	4250	4728	2975	3695
umhos/cm	292	575	632	432	364	520	625	530	122	399	300	1075	200	708
	948	1270	3260	2070	1900	1090	2600	3000	238	2080	3030	2770	2800	2760
	3000	5000	6280	4200	3800	3400	5500	5000	800	4180	4560	6450	3340	4960

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pH

	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19
31-Oct-79	8.6	7.2	7.3	7.1										
31-Jan-80	7.4	7.2	6.8	7.1										
30-May-80	7.3	7.4	7.2	7.2	7.6									
30-Jun-80	7.5	7.4	7.2	7.3	7.6									
31-Jul-80	7.4	7.5	7.2	7.3	7.7									
31-Aug-80	7.2	7.2	6.9	7.1	7.4									
30-Sep-80	7.6	7.6	7.6	7.7	7.7									
31-Oct-80	7.4	7.3	7.2	7.8	7.6									
30-Nov-80	7.5	7.4	7.1	7.3	7.7									
31-Dec-80	7.4	7.4	7.1	7.2	7.2									
31-Jan-81	7.2	7.2	7	7.1	7.4									
28-Feb-81	7.2	7.1	6.8	7	7.3									
31-Mar-81	7.5	7.15	7	7.7	7.7									
30-Apr-81	7.5	7.2	7.1	7.5	7.5									
30-May-81	7	7	6.5	6.8	7.2									
30-Jun-81	7.3	7.2	6.8	7.3	7.3									
31-Aug-81	7.4	7.4	6.9	7.2	7.8									
31-Dec-81	7.5	7.7	7.3	7.7	7.7									
31-Jan-82	7.3	7.2	6.7	7.1	7.35									
30-Apr-82	7.7	7.5	7.2	7.3	7.8									
31-Aug-82	7.8	7.7	7.5	7.8	8									
31-Dec-82	7.8	7.7	7.5	7.6	8	8.2	7.8	7.85						
31-Mar-83	7.6	7.5	7.2	7.3	8.05	7.4	6.7	7.4						
30-Jun-83	7.8	7.7	7.5	7.7	8.12	8	7.4	8						
31-Dec-83	7.6	7.55	7.4	7.55	7.7	7.2	7.2	7.6						
31-Mar-84	7.7	7.0	6.8	7.8	7.9	7.8	7.2	7.0	7.6					
30-Jun-84	7.6	7.2	7.4	7.8	7.8	7.2	7.8	7.5	8.2					
30-Sep-84	7.5	7.1	6.6	7.0	7.5	7.9	6.8	7.0	7.8					
31-Dec-84	7.7	7.1	6.8	6.8	7.8	7.9	6.7	7.1	8.3					
31-Mar-85	7.8	7.6	6.9	7.1	7.8	7.9	7.1	7.4	8.0					
30-Jun-85	7.6	7.0	6.8	6.7	7.9	8.0	6.8	7.2	7.8					
30-Sep-85	6.8	7.1	6.4	6.3	7.0	7.9	6.9	6.5	7.4					
31-Dec-85	7.3	7.3	6.8	6.9	8.1	7.1	7.7	7.1						
31-Mar-86	7.0	7.0	6.6	6.9	7.0	7.0	6.7	6.9	7.0					
30-Jun-86	7.5	7.0	6.7	7.0	7.5	7.9	6.7	6.9						
04-Sep-86	7.3	6.9	6.7	6.8	7.6	7.9	6.8	7.0	7.0					
10-Dec-86	7.7	6.9	6.5	7.0	7.1	7.9	7.1	7.1	7.6					
20-Feb-87	7.4	7.1	6.5	7.0	7.6	7.9	6.9	7.0	8.5					
29-Apr-87	7.6	6.7	6.5	6.9	7.6	7.8	6.9	7.0	7.6					
19-Aug-87	7.6	6.7	6.6	7.9	7.4	7.5	7.0	7.1	7.4					
20-Nov-87	7.8	7.4	7.2	7.2	8.0	7.8	7.3	7.4	7.4					
27-Jan-88	8.0	7.4	6.8		7.7	7.0	7.1	7.1	7.7					
01-Jun-88	8.1	7.2	7.0	7.1	7.6	7.9	7.1	7.3	8.2					
23-Aug-88	7.6	7.1	6.7	6.8	7.8	7.7	6.7	6.9	7.8					
03-Nov-88	7.5	7.2	6.7		7.5	8.0	6.6	7.0	7.8					
09-Mar-89	7.4	7.1	6.7	7.3	7.6	7.9	6.9	6.8						
21-Jun-89	8.0	7.1	6.7	6.9	7.4	7.8	6.8		7.7					
01-Sep-89	7.3	7.4	6.9	7.0	7.7	7.6	6.8		7.7					
15-Nov-89	7.5	7.0	6.5	6.8	7.8	7.8	7.1		7.6	6.9	6.9			
20-Feb-90	7.8	7.5	6.8	7.0	8.0	8.1	7.2		8.0	6.87	7.46			
08-May-90	7.5	7.1	6.6	7.0	7.6	7.8	6.8		7.9	6.8	7.07			
07-Aug-90	7.5	7.0	6.8	7.7	7.7	7.4	7.0		7.8	6.87	7.18			
13-Nov-90	7.9	7.5	6.6	7.7	8.0	8.0	7.5		8.2	6.47	7.06			

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27-Feb-91	7.9	7.5	6.6	7.7	8.0	8.0	7.5		8.2	6.47	7.06			
21-May-91	7.4	7.1	6.3	6.8	7.4	7.9	7.0		7.1	6.82	7.06			
24-Sep-91	7.7	7.0	6.7	7.0	7.4	8.0	6.8		7.3	6.69	6.94			
03-Dec-91	7.6	7.3	6.8	6.9	7.7	7.9	6.9		7.8	6.8	7			
17-Mar-92	6.7	7.2	5.8	6.9	7.6	7.9	7.0		7.1	7	7.21			
11-Jun-92	7.1	6.9	6.1	6.7	7.2	7.4	6.6		7.7	6.6	7.33			
03-Sep-92	8.1	7.9	6.7	7.0	7.6	7.9	7.4		7.6	6.89	7.03			
19-Nov-92	7.5	7.8	7.1	6.9	7.8	6.2	8.1		7.7	6.83	7.16			
23-Mar-93	7.6	7.2	6.6	6.9	7.4	7.3	7.0		7.7	6.85	7.08	7.23	6.82	7.39
08-Jun-93	7.5	7.3	6.7	7.1	7.7	7.5	6.9		7.8	6.83	7.03	7.04	6.63	7.48
22-Sep-93	7.6	7.6	6.9	7.3	7.6	7.6	7.1		7.9	6.95	7.19	7.2	6.94	7.52
14-Dec-93	7.7	7.2	6.7	7.2	7.9	7.9	7.1		7.1	6.92	7.26	7.29	6.89	7.57
24-Mar-94	6.7	7.2	6.6	6.9	7.4	7.2	6.8		7.4	6.82	6.89	6.15	7.38	6.17
15-Jun-94	7.2	7.2	6.7	7.0	7.7	7.7	7.0		7.8	6.88	7.02	7.08	6.99	7.61
pH	7.5	7.3	6.8	7.2	7.6	7.7	7.0	7.2	7.7	6.8	7.1	7.0	6.9	7.3
	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.4	0.1	0.1	0.4	0.2	0.5
	6.7	6.7	5.8	6.3	7.0	6.2	6.6	6.5	7.0	6.5	6.9	6.2	6.6	6.2
	8.6	7.9	7.6	7.9	8.1	8.2	8.1	8.0	8.5	7.0	7.5	7.3	7.4	7.6

Cl mg/l

	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19	QC (13A)
31-Oct-79	2.5	5	12.6	20.1											
31-Jan-80	14	18	25	35											
30-May-80	20	18	50	44	60										
30-Jun-80	16	15	51	43	57										
31-Jul-80	20	20	62	48	60										
31-Aug-80	18	16	65	56	60										
30-Sep-80	13	15	62	43	51										
31-Oct-80	30	20	65	50	55										
30-Nov-80	12	8	64	38	49										
31-Dec-80	13	10	65	41	52										
31-Jan-81	15	11	71	48	53										
28-Feb-81	14	9	65	41	54										
31-Mar-81	14	10	66	40	55										
30-Apr-81	13	11	66	41	53										
30-May-81	14	13	110	41	53										
30-Jun-81	12	10	69	43	53										
31-Aug-81	14	7	67	32	52										
31-Dec-81	15	14	66	41	20										
31-Jan-82	13	8	64	42	51										
30-Apr-82	12	7	64	40	50										
31-Aug-82	12	6	67	43	43										
31-Dec-82	10.9	5.5	53	38	47.1	24.4	57.4	40.5	4.6						
25-Jan-83	16	11	71	48	57	32	70	53	6.4						
30-Jun-83	16.5	25	66.5	37.3	48.1	28.8	80.5	43.8	2.8						
31-Dec-83	13	8	63	38	54	32	65								
31-Mar-84	14.3	9.4	67.2	43.1	57.8	31.4	64.1	50.4	2.4						
30-Jun-84	12.0	7.0	63.0	43.0	54.0	32.0	65.0	49.0	3.0						
30-Sep-84	15.4	10.9	57.4	44.6	56.6	33.9	64.6	50.9	1.9						
31-Dec-84	14.2	7.1	67.4	42.5	53.2	31.9	67.4	49.6	3.5						
31-Mar-85	14.0	13.0	68.0	46.0	59.0	34.0	67.0	50.0	10.0						
30-Jun-85	17.0	7.8	73.0	42.0	53.0	31.0	62.0	46.0	1.0						
30-Sep-85	18.0	17.0	78.0	47.0	62.0	38.0	71.0	47.0	47.0						
31-Dec-85	53.2	70.9	35.0	53.0	71.0	71.0	53.0	71.0	62.0						
19-Jun-86	25.0	15.0	140.0	98.0	130.0	77.0	170.0	120.0	7.7						
30-Jun-86	25.0	17.0	140.0	95.0	130.0	70.0	150.0	100.0	9.1						
04-Sep-86	2.0	9.5	64.0	42.0	53.0	32.0	58.0	48.0	8.1						
10-Dec-86	8.8	2.7	68.0	45.0	54.0	33.0	64.0	50.0	3.3						
20-Feb-87	11.0	6.6	68.0	44.0	54.0	32.0	63.0	48.0	32.0						
29-Apr-87	12.1	7.7	65.3	42.4	54.3	43.2	62.7	48.7	1.7						
19-Aug-87	11.0	6.0	65.0	46.0	54.0	33.0	61.0	51.0	0.4						
20-Nov-87	9.3	4.6	62.8	45.3	53.2	31.9	61.2	49.2	0.1						
27-Jan-88	10.0	3.7	64.0	45.0	54.0	31.0	61.0	48.[illegible]	0.9						
01-Jun-88	9.9	4.8	66.0	45.0	53.0	32.0	64.0	50.0	0.1						
23-Aug-88	13.2	6.4	66.1	48.5	53.9	33.5	64.8	51.2	0.9						
03-Nov-88	11.8	6.6	67.7	48.2	54.7	35.2	65.1	52.1	2.7						
09-Mar-89	12.0	7.6	64.0	45.0	52.6	32.3	61.5	48.8	5.7						
21-Jun-89	11.3	6.4	66.9	45.9	54.6	32.4	60.8		5.2						
01-Sep-89	10.0	6.0	65.0	46.0	54.0	34.0	59.0		8.0						1
15-Nov-89	11.0	5.0	68.0	45.0	54.0	34.0	63.0		7.0	25.0	49.0				1
20-Feb-90	11.0	5.0	65.0	47.0	55.0	33.0	63.0		4.0	20.0	44.0				1
08-May-90	12.0	7.0	67.0	48.0	56.0	33.0	62.0		6.0	23.0	44.0				1
07-Aug-90	11.0	6.0	65.0	48.0	53.0	33.0	63.0		7.0	21.0	44.0				1
13-Nov-90	12.0	6.0	68.0	50.0	54.0	34.0	63.0		4.0	23.0	44.0				1

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27-Feb-91	12.0	10.0	68.0	50.0	50.0	31.0	61.0		1.0	23.0	41.0				1
21-May-91	12.0	6.0	56.0	44.0	48.0	30.0	55.0		1.0	21.0	38.0				1
24-Sep-91	11.0	9.0	60.0	45.0	54.0	30.0	59.0		2.0	15.0	38.0				1
03-Dec-91	13.0	7.0	64.0	46.0	50.0	31.0	60.0		2.0	19.0	38.0				1
17-Mar-92	13.0	7.0	64.0	48.0	51.0	32.0	60.0		2.0	22.0	40.0				1
11-Jun-92	10.0	6.0	76.0	43.0	46.0	29.0	56.0		1.0	18.0	35.0				1
03-Sep-92	11	6	58	43	46	31	56		1	20	37				1
19-Nov-92	13.0	6.0	63.0	45.0	50.0	41.0	62.0		1.0	18.0	39.0				1
24-Mar-93	14.0	8.0	64.0	47.0	50.0	35.0	60.0		1.0	19.0	38.0	28	34	81	1
08-Jun-93	12.0	6.0	61.0	46.0	48.0	39.0	54.0		4.0	17.0	38.0	27	34	92	4
22-Sep-93	18	6	64	47	52	33	61		5	18	38	28	34	94	5
14-Dec-93	12.0	6.0	61.0	45.0	48.0	36.0	54.0		5.0	18.0	38.0	25	34	93	5
24-Mar-94	15.0	6.0	64.0	47.0	50.0	32.0	59.0		1.0	20.0	38.0	29	34	71	5
15-Jun-94	13.0	6.0	65.0	4.0	47.0	44.0	57.0		5.0	20.0	36.0	31	35	63	5
Chloride		10.1	65.8	44.8	54.9	35.3	66.1	54.8	6.5	20.0	39.9	28.0	34.2	82.3	3.5
mg/l	6.4	8.7	17.2	11.4	14.6	10.4	20.7	17.6	11.6	2.4	3.4	1.8	0.4	11.9	19.5
	2.0	2.7	12.6	4.0	20.0	24.4	53.0	40.5	0.1	15.0	35.0	25.0	34.0	63.0	0.0
	53.2	70.8	140.0	98.0	130.0	77.0	170.0	120.0	62.0	25.0	49.0	31.0	35.0	94.0	55.0

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Sodium	mg/l MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19	QC (13A)
31-Oct-79	106	154	282	342											
31-Jan-80	140	213	334	274											
30-May-80	165	346	575	346	478										
30-Jun-80	166	361	642	322	462										
31-Jul-80	160	418	442	335	435										
31-Aug-80	158	410	653	336	465										
30-Sep-80	156	468	586	371	500										
31-Oct-80	162	415	677	341	443										
30-Nov-80	166	419	567	309	428										
31-Dec-80	168	442	690	336	460										
31-Jan-81	170	467	756	335	467										
28-Feb-81	148	462	704	384	487										
31-Mar-81	175	470	745	338	473										
30-Apr-81	161	476	703	314	467										
30-May-81	160	472	718	350	459										
30-Jun-81	162	458	685	351	437										
31-Aug-81	161	460	688	323	426										
31-Dec-81	170	469	730	330	460										
31-Jan-82	170	483	757	340	490										
30-Apr-82	190	460	790	336	510										
31-Aug-82	160	470	750	340	470										
31-Dec-82	170	460	810	334	431	550	310	630	67						
30-Jun-83	170	470	770	330	458	480	310	640	27						
31-Dec-83	170	500	800	320	480	540	290	640							
30-Jun-84	170	500	780	310	470	530	320	650	5.6						
31-Dec-84	182	443	489	340	428	446	328	459	7.2						
30-Jun-85	20	540	790	370	540	610	330	660	7.3						
31-Dec-85	320	490	780	340	530	550	380	600	5.5						
19-Jun-86	262	543	937	326	514	580	430	659	23.6						
04-Sep-86	175	456	746	289	436	477	296	541	29.5						
10-Dec-86	210	529	784	335	501	250	324	562	68.0						
20-Feb-87	118	333	513	209	307	366	197	360	54.3						
29-Apr-87	134	362	518	232	360	378	236	389	7.0						
20-Nov-87	212	618	958	366	584	768	334	677	11.6						
27-Jan-88	185	507	776												
23-Aug-88	167	496	768	266	432	636	244	446	15.2						
03-Nov-88	172	480	659	289	410	486	280	510	17.4						
09-Mar-89	169	464	713	275	321	375	186	584	22.0						
01-Sep-89	163	466	713	287	411	469	269								
15-Nov-89	194	515	637	270	508	567	321		70.1	70.7	72.6				
09-May-90	188	504	756	291	456	517	284		70.8	388.0	566.0				0.45
13-Nov-90	165	470	698	285	410	475	277		48.9	348.0	540.0				0.15
27-Feb-91	171	477	708	284	430	522	213		19.0	265.0	466.0				0.01
21-May-91	177	503	796	274	440	549	271		15.0	353.0	590.0				<0.01
03-Dec-91	179	492	797	324	466	646	336		17.0	366.0	490.0				0.04
11-Jun-92	180	490	760	300	410	540	290		15.2	350.0	510.0				0.03
03-Sep-92	162	475	742	291	428	538	291		9.5	345	504				0.91
19-Nov-92	182	467	736	316	453	520	318		8.5	358.0	478.0				
24-Mar-93	167	504	729	312	460	551	305		7.5	352.0	508.0	615	185	432	0.27
08-Jun-93	170	491	649	312	445	517	302		6.0	349.0	488.0	641	192	438	0.15
22-Sep-93	164	472	755	291	462	557	277		10	355	493	724	196	476	13
14-Dec-93	170	478	734	302	433	556	298		5.0	353.0	467.0	688	193	475	0.2
24-Mar-94	164	470	736	298	436	567	287		0.1	344.7	477.7	653	192.7	448.7	0.103

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15-Jun-94	170	480	740	300	440	560	280		10.0	350.0	480.0	680	190	430	0 1
Sodium	169.1	458.1	699.3	316.4	452.7	518.5	294.2	561.6	22.7	329.8	475.6	590.1	234.5	484.0	1.2
mg/l	36.0	71.7	121.4	34.0	45.8	89.0	47.2	98.9	21.6	73.5	113.1	181.1	95.9	77.9	4.8
	19.9	154.0	282.0	209.0	307.0	250.0	186.0	360.0	0.1	70.7	72.6	192.7	185.0	430.0	0.0
	320.0	618.0	958.0	395.0	564.0	768.0	430.0	677.0	70.8	388.0	590.0	724.0	448.7	653.0	13.0

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TDS	mg/l MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19	QC (13A)
31-Oct-79	625	790	2100	2850											
31-Jan-80	870	1000	2450	2800											
30-May-80	1250	1850	4400	3000	2300										
30-Jun-80	1250	2300	4750	2500	2200										
31-Jul-80	1182	2440	4024	3100	2080										
31-Aug-80	1220	2270	4000	3400	2218										
30-Sep-80	1285	2700	4583	3525	2182										
31-Oct-80	1220	2852	4828	3402	2086										
30-Nov-80	1186	2482	4522	2800	1980										
31-Dec-80	1194	2848	4882	2808	2105										
31-Jan-81	1273	2700	5053	3330	2072										
28-Feb-81	1254	2835	4884	3322	2192										
31-Mar-81	1317		5122	3320	2256										
30-Apr-81	1330	3028	5130	3318	2300										
30-May-81	1308	2900	5100	3298	2287										
30-Jun-81	1188	2883	5387	3008	2114										
31-Aug-81	1197	2832	5124	3337	2119										
31-Dec-81	1180	2801	5167	3377	2190										
31-Jan-82	1280	2809	4850	3200	2250										
30-Apr-82	1200	2800	5125	3200	2500										
31-Aug-82	1200	2850	5300	3500	2250										
31-Dec-82	1326	3058	5308	3470	2180	1812	4116	3780	334						
30-Jun-83	1150	3500	4900	3500	2200	1850	4050	3850							
31-Dec-83	1200	2850	5150	3250	2100	1550	3850	3750							
30-Jun-84	1400	3200	5300	3500	2200	1700	4100	3700	280						
31-Dec-84	[illegible]	1479	2733	[illegible]	[illegible]		[illegible]	2033	139						
30-Jun-85	1900	3130		3610	2200	1700	4300	3900	221						
31-Dec-85	[illegible]	3700	5000	[illegible]	[illegible]	5100	5100	[illegible]							
10-Jun-86	1260	3200	5500	3450	2130	1700	4140	3870	277						
30-Jun-86	1330	3250	5500	3610	3210	1700	4210	3850	292						
04-Sep-86	1250	3240	5320	3450	2040	1710	4040	3770	263						
10-Dec-86	1270	3140	5280	3530	2100	1710	4110	3620	403						
20-Feb-87	1270	3230	5330	3480	2050	1710	4120	3780	311						
20-Apr-87	1270	3180	5400	3340	2380	1880	4120	3810	249						
10-Aug-87	1280	3180	5320	3530	1880	1880	3980	3750	234						
20-Nov-87	1330	3280	5520	3570	1970	1720	4130	3840	236						
27-Jan-88	1310	3270	5100	3480	2030	1640	3880	3740	22						
01-Jun-88	1250	3140	5240	3430	1880	1680	4080	3720	25						
23-Aug-88	1220	3080	5230	3320	1930	1620	3010	3720	207						
03-Nov-88	1250	3150	5430	3450	1880	1710	4080	3670	170						
08-Mar-89	1280	3140	5270	3630	2010	1730	3880	3780							
21-Jun-89	1280	3210	5450	3580	2020	1750	4030		316						
01-Sep-89	1210	3040	5290	3430	1840	1780	3630		296						
15-Nov-89	1280	3080	5250	3370	2080	1860	3900		544	3430	3880				<4
20-Feb-90	1280	3180	5300	3540	2110	1780	4030		282	3710	3970				<4
08-May-90	1180	3050	5060	3240	1950	1880	3700		336	3080	3740				154
07-Aug-90	1210	3080	5220	3320	1970	1700	3750		344	3500	3770				<4
13-Nov-90	1170	3150	5280	3280	1880	1720	3780		308	3440	3780				<4
27-Feb-91	1272	3154	5288	3424	1850	1686	3280		252	2884	3356				15
21-May-91	1275	3037	5326	3348	1871	1740	3943		250	3813	3850				15
24-Sep-91	1352	3148	5309	3471	2130	1819	3810		286	3818	3817				27
03-Dec-91	1286	3179	5188	3462	1943	1810	3930		238	3861	3643				<10
17-Mar-92	1285	3206	5317	3523	1922	1797	4024		237	3704	3910				3

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11-Jun-92	980	2910	4830	3190	1810	1740	3900		219	3580	3800				<10
03-Sep-92	1417	3294	5404	3520	2130	1923	4208		347	3958	4040				<10
18-Nov-92	1567	3357	5727	3773	2213	2850	4323		380	3833	4233				
24-Mar-93	1285	3122	5385	3515	1947	2080	3920		287	3830	3835	4807	2855	2825	107
08-Jun-93	1308	3288	5616	3780	2048	2396	4156		260	3728	4084	4636	2720	3144	40
22-Sep-93	1380	3176	5406	3584	2008	2352	3908		304	3708	4052	4592	2700	3172	26
14-Dec-93	1692	3800	6186	3882	2500	2528	4306		470	4062	4530	5296	2940	3894	28
24-Mar-94	1210	2770	5000	3140	1760	1790	3640		200	3380	3120	4190	2460	2340	6
15-Jun-94	1271	3043	5334	3383	2126	1916	3744		224	3512	3860	4534	2557	2067	<10
TDS	1290	2841	5052	3383	2173	1907	3937	3847	270	3570	3911	4349	2645	3255	23
mg/l	380	518	678	353	622	574	433	779	97	314	229	888	193	886	35
	825	780	2100	1581	1300	1550	2060	2033	22	2684	3356	2426	2289	2067	0
	4000	3800	6186	4000	6800	5100	5100	6800	544	4062	4530	5286	2940	4829	154

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Sulfates	mg/l MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19	QC (13A)
31-Oct-79	220	240	930	1220											
31-Jan-80	520	630	2150	1700											
30-May-80	635	1075	2430	1880	1290										
30-Jun-80	632	1290	2625	1850	1200										
31-Jul-80	610	1400	2450	1980	1100										
31-Aug-80	612	1345	2575	1980	1150										
30-Sep-80	640	1550	2800	2075	980										
31-Oct-80	570	1535	3050	2020	1060										
30-Nov-80	613	1425	2750	1780	1050										
31-Dec-80	620	1520	3080	1780	1150										
31-Jan-81	636	1530	3012	1800	1140										
28-Feb-81	600	1550	2780	1980	1260										
31-Mar-81	656		3150	1880	1210										
30-Apr-81	620	1880	3030	1980	1220										
30-May-81	660	1730	3100	1910	1190										
30-Jun-81	626	1680	3040	2070	1165										
31-Aug-81	630	1750	3060	1910	1115										
31-Jan-82	613	1590	3100	1920	1280										
30-Apr-82	697	1766	3230	2058	1518										
31-Aug-82	662	1768	3185	2047	1295										
31-Dec-82	653	1749	3259	1979	1182	926	2385	2288	39						
30-Jun-83	658	1601	3226	2108	1228	943	2420	2324	41						
31-Dec-83	680	1620	3200	2075	1200	900	2338	2265	64						
29-Feb-84	637	1635	3235	2056	1175	937	2400	2250	77						
30-Jun-84	680	1900	3300	2075	1200	920	2400	2200	32						
31-Dec-84	637	1635	3235	2056	1175	937	2400	2250							
30-Jun-85	616	1880		2040	1210	939	2440	2380	18						
31-Dec-85	1080	1270	2870	2020	7820	79	7620	2120	79						
10-Jun-86	703	2010	3450	2120	1240	943	2500	2420	45						
30-Jun-86	691	2040	3490	2150	1890	949	2520	2420	43						
04-Sep-86	707	2020	3410	2180	1230	956	2470	2400	49						
10-Dec-86	680	1880	2620	2000	1140	911	2370	2240	77						
20-Feb-87	657	1910	2840	2030	1120	885	2100	1990	62						
29-Apr-87	684	1920	3200	1930	1310	1020	2300	2270	22						
19-Aug-87	691	2000	3400	2130	1140	951	2430	2380	28						
20-Nov-87	697	2040	3520	2170	1120	961	2560	2450	25						
27-Jan-88	690	1930	3020	2080	1130	919	2380	2300	22						
01-Jun-88	681	1880	3380	2120	1030	947	2450	2370	25						
23-Aug-88	648	1970	3330	2100	1050	915	2290	2330	7						
03-Nov-88	666	1980	3410	2120	1080	974	2600	2240	34						
09-Mar-89	684	1980	3410	2070	1180	975	2530	2400	41						
21-Jun-89	716	2040	3500	2180	1180	1020	2500		65						
01-Sep-89	352	2000	3500	2140	1140	1020	2250		60						
15-Nov-89	697	1980	2870	2150	1180	993	2250		105	2230	2560				<5
20-Feb-90	692	2020	3330	2140	1210	1010	2460		98	2250	2448				<4
09-May-90	684	2020	3480	2080	1180	1080	2070		51	1160	1260				5
07-Aug-90	685	1970	3480	2080	1140	973	2450		88	2240	2445				<4
13-Nov-90	687	1980	3460	2130	1100	975	2480		89	2230	2470				4
27-Feb-91	682	1849	2712	1946	1028	967	1850		45	1512	1876				11
21-May-91	652	1885	2947	1988	1010	938	2255		51	2112	2298				9
24-Sep-91	692	1848	2532	1930	880	956	2240		49	1971	2215				25
03-Dec-91	677	1883	2214	1958	1035	988	2326		27	1919	2253				4
17-Mar-92	667	1899	3220	2035	1022	976	2330		21	2162	2314				2.9

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11-Jun-92	642	1882	2894	1983	988	976	2304		26	2138	2293				<4
03-Sep-92	670	1933	3312	2029	1033	1005	2352		30	2208	2366				<4
18-Nov-92	654	1864	3290	1951	1055	1507	2343		21	2098	2362				
24-Mar-93	614	1733	2200	1826	1007	1162	2086		20	1872	2124	2004	1371	1590	5
08-Jun-93	678	1480	1880	1974	1084	1380	2154		27	2051	2203	2079	1431	1738	5
22-Sep-93	658	1841	2572	1982	1057	1307	2234		19	2106	2298	2678	1446	1811	4
14-Dec-93	752	1840	2528	1971	1085	1054	2261		21	2067	2292	2480	1446	1783	4
24-Mar-94	722	1840	3350	1980	1040	1020	2280		26	2110	2440	2770	1420	1400	0
15-Jun-94	670	1834	2189	1988	897	1118	2187		17	2118	2361	2553	1416	1204	<4
Sulfates	656	1744	2956	1968	1250	980	2468	2296	43	2028	2248	2370	1426	1583	5
mg/l	96	326	483	142	886	184	848	106	25	265	273	245	27	216	6
	220	240	930	1220	860	79	1850	1990	7	1160	1260	2004	1371	1204	0
	1880	2040	3620	2180	7820	1507	7820	2450	105	2250	2580	2678	1447	1811	25

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ARSENIC

	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19	QC (13A)
31-Jul-80	0.0000	0.016	0.012	0.008	0.006										
31-Aug-80	0.004	0.004	0.0000	0.002	0.0000										
30-Sep-80	0.002	0.002	0.002	0.0000	0.0000										
31-Oct-80	0.0000	0.0000	0.0000	0.0000	0.0000										
30-Nov-80	0.002	0.004	0.004	0.002	0.002										
31-Dec-80	0.0000	0.0000	0.0000	0.0000	0.0000										
31-Jan-81	0.0000	0.0000	0.0000	0.0000	0.0000										
28-Feb-81	0.0000	0.0000	0.0000	0.0000	0.0000										
31-Mar-81	0.0000	0.0000	0.0000	0.0000	0.0000										
30-Apr-81	0.0000	0.0000	0.0000	0.0000	0.0000										
30-May-81	0.0000	0.0000	0.0000	0.0000	0.0000										
30-Jun-81	0.0000	0.0000	0.0000	0.0000	0.0000										
31-Aug-81	0.0000	0.0000	0.0000	0.0000	0.0000										
31-Jan-82	0.0000	0.0000	0.0000	0.0000	0.0000										
05-May-85	0.0000	0.0000	0.0000												
28-Jun-85	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.008						
31-Jul-85	0.0000	0.021	0.0000												
08-Aug-85	0.001	0.001	0.0000												
30-Sep-85	0.0000	0.0000	0.0000												
30-Oct-85	0.0000	0.0000	0.0000												
27-Nov-85	0.0000	0.0000	0.0000												
16-Dec-85	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000						
24-Jan-86	0.0000	0.0000	0.0000												
28-Feb-86	0.0000	0.0000	0.0000												
27-Mar-86	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.002	0.0000						
08-Apr-86	0.0000	0.0000	0.0000												
02-May-86	0.0000	0.0000	0.0000												
04-Sep-86	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000						
19-Dec-86	0.001	0.003	0.005												
20-Feb-87	0.0000	0.002	0.002	0.002	0.002	0.001	0.002	0.002	0.0000						
28-Apr-87	0.002	0.002	0.001	0.0000	0.0000	0.002	0.003	0.002	0.011						
20-Nov-87	0.003	0.005	0.006	0.002	0.001	0.001	0.000	0.008	0.013						
27-Jan-88	0.0030	0.0000	0.0030												
2?-Aug-88	0.0020	0.0030	0.0070	0.0030	0.0030	0.0120	0.0040	0.0050	0.0040						
03-Nov-88	0.0000	0.0040	0.0110	0.0000	0.0000	0.0000	0.0000	0.0030	0.0000						
[illegible]-Mar-89	0.0150	0.0320	0.0460	0.0330	0.0180	0.0150	0.0300	0.0300	0.0070						
22-Jun-89	0.0040	0.0140	0.0330	0.0170	0.0100	0.0050	0.0210		0.0150						
01-Sep-89	0.0010	0.0050	0.0000	0.0030	0.0010	0.0000	0.0030		0.0000						
15-Nov-89	0.0010	0.0000	0.0100	0.0020	0.0070	0.0020	0.0030		0.0130	0.0030	0.0060				0.001
08-May-90	0.0020	0.0010	0.0050	0.0010	0.0000	0.0010	0.0010		0.0120	0.0010	0.0020				0.008
13-Nov-90	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0110	0.0000	0.0000				0.001
27-Feb-91	0.0010	0.0000	0.0000	0.0020	0.0000	0.0020	0.0010		0.0140	0.0000	0.0000				0.002
24-Sep-91	0.0000	0.0010	0.0000	0.0020	0.0000	0.0000	0.0010		0.0130	0.0000	0.0010				0.001
17-Mar-92	0.0000	0.0000	0.0000	0.0020	0.0100	0.0020	0.0000		0.0130	0.0000	0.0020				0.001
03-Sep-92	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0210	0.0000	0.0000				0.001
24-Mar-93	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0030		0.0130	0.0000	0.0020	0.000	0.0000	0.0000	0.001
22-Sep-93	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
24-Mar-94	0.0000	0.0000	0.0000	0.0000	0.0020	0.0000	0.0010		0.0180	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ARSENIC	0.0016	0.0036	0.0044	0.0033	0.0032	0.0029	0.0052	0.0000	0.0008	0.0011	0.0016	0.0036	0.0000	0.0000	0.0018
	0.0028	0.0063	0.0066	0.0066	0.0045	0.0045	0.0090	0.0094	0.0076	0.0006	0.0015	0.0036	0.0000	0.0000	0.0021
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0150	0.0320	0.0460	0.0330	0.0180	0.0180	0.0300	0.0300	0.0330	0.0030	0.0060	0.0000	0.0000	0.0000	0.0000

KW 9/28/94

SELENIUM

	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19	QC (13A)
31-Jul-80	0.0000	0.025	0.0000	0.0000	0.0000										
31-Aug-80	0.002	0.026	0.005	0.002	0.003										
30-Sep-80	0.0000	0.012	0.0000	0.0000	0.0000										
31-Oct-80	0.0000	0.017	0.0000	0.0000	0.0000										
30-Nov-80	0.001	0.011	0.003	0.001	0.001										
31-Dec-80	0.0000	0.0000	0.0000	0.0000	0.0000										
31-Jan-81	0.0000	0.016	0.0000	0.0000	0.0000										
28-Feb-81	0.0000	0.0000	0.0000	0.0000	0.0000										
31-Mar-81	0.0000		0.0000	0.0000	0.0000										
30-Apr-81	0.0000	0.0000	0.0000	0.0000	0.0000										
30-May-81	0.0000	0.002	0.0000	0.0000	0.0000										
30-Jun-81	0.0000	0.01	0.0000	0.0000	0.0000										
31-Aug-81	0.0000	0.004	0.0009	0.0000	0.0000										
31-Jan-82	0.0000	0.000	0.003	0.003	0.0000										
[illegible]	0.0040	0.015	0.031?	0.000	0.0040	0.0040	0.0040	0.005	0.0040						
05-May-85	0.0000	0.0000	0.0000												
28-Jun-85	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000						
[illegible]	0.027?	0.0000	0.0000												
0?-Aug-85	0.0000	0.0000	0.0000												
30-Sep-85	0.0000	0.0000	0.0000												
30-Oct-85	0.0000	0.0000	0.0000												
27-Nov-85	0.0000	0.0000	0.0000												
15-Dec-85	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000						
24-Jan-86	0.0000	0.0000	0.0000												
28-Feb-86	0.0000	0.0000	0.0000												
27-Mar-86	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000						
08-Apr-86	0.0000	0.003	0.0000												
02-May-86	0.0000	0.0000	0.0000												
04-Sep-86	0.0000	0.0000	0.001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000						
10-Dec-86	0.0019	0.0019	0.0019												
23-Feb-87	0.0000	0.0000	0.002	0.0000	0.001	0.003	0.001	0.007	0.0000						
2?-Apr-87	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000							
[illegible]	0.005	0.023	[illegible]	0.01	[illegible]	0.021	0.004	0.027	0.0000						
27-Jan-88	0.000	0.01	0.016												
23-Aug-88	0.005	0.011	0.011	0.012	0.004	0.001	0.007	0.02	0.0000						
[illegible]	0.005	0.024	0.032?	0.005	0.026?	0.029	0.003	0.03	0.0000						
[illegible]	0.004	0.017	0.027	[illegible]	0.005	0.002	0.021	0.027	0.001						
22-Jun-89	0.001	0.002	0.003	0.003	0.004	0.004	0.001		0.001						
01-Sep-89	0.001	0.001	0.004	0.003	0	0	0		0.001						
[illegible]	0.005	0.015	0.019	0.015	0.006	0.02	0.02		0.001	0.014	0.019?				0.001
08-May-90	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000				0.001
13-Nov-90	0.0000	0.004	0.003	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000					0.001
27-Feb-91	0.002	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019		0.0019	0.0019	0.0019				0.002
24-Sep-91	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019		0.0019	0.0019	0.0019				0.002
17-Mar-92	0.0019	0.002	0.0019	0.0019	0.0019	0.0019	0.0019		0.0019	0.0019	0.0019				0.002
[illegible]	0.0019	0.003	0.011	0.0019	0.0019	0.0019	0.0019		0.0019	0.0019	0.017				0.002
24-Mar-93	0.0019	0.003	0.003	0.0019	0.0019	0.0019	0.0019		0.0019	0.002	0.002	0.0019	0.0019	0.005	0.002
22-Sep-93	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019		0.0019	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019
[illegible]	0.0019	0.006	0.02	0.0019	0.0019	0.0019	0.004		0.0019	0.0019	0.078	0.0019	0.0019	0.011	0.0019
SELENIUM	0.003	0.007	0.007	0.003	0.004	0.008	0.004	0.014	0.001	0.003	0.000	0.002	0.002	0.003	0.002
	0.005	0.000	0.015	0.004	0.011	0.016	0.006	0.018	0.001	0.004	0.011	0.000	0.000	0.001	0.000
	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.001
	0.037	0.045	0.001	0.019	0.061	0.072	0.021	0.057	0.005	0.014	0.034	0.002	0.002	0.005	0.002

KIY 4/25/94

Ra-226

pCi/l	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19	QC (13A)
31-Jul-80	1	1.3	1	0.7	1										
31-Aug-80	0.7	1.7	0.6	0.7	0.6										
30-Sep-80	0.7	0.3	0.5	0.4	0.2										
31-Oct-80	0.8	1.9	1.1	0.9	1.1										
30-Nov-80	0.7	1.1	0.8	0.8	0.8										
31-Dec-80	0.5	0.4	0.3	0.7	0.4										
31-Jan-81	0.5	1.3	1.3	0.5	0.6										
28-Feb-81	0.6	1.7	0.6	0.9	0.6										
31-Mar-81	2	1.8	0.8	0.9	0.7										
30-Apr-81	2.2	1.3	1.8	0.5	0.3										
30-May-81	3.5	2.3	1.5	1.3	0.8										
30-Jun-81	1.5	2	2.3	1.2	1.8										
31-Aug-81	0.8	7.5	15.5	1.1	1.6										
30-Sep-81	0.4	1.1	0.5	0.8	0.2										
31-Jan-82	0.8	1.6	1.1	1	0.9										
30-Apr-82	0.3	0.6	0.5	1	0.3										
30-Jun-83	0.4	0.17	1.4	1	1.2	0.4	0.6	0.6	0.4						
30-Jun-84	0.3	0.6	0.8	0.7	0.2	0.2	0.2	0.2	0.7						
30-Jun-85	1	1.3	1	1.4	0.3	0.1	1.1	0.9	2						
31-Dec-85	0.5	0.9	5.3	0.9	0.8	0.1	0.7	0.4	0.55						
21-Mar-86	0.5	1	0.8	0.6	0.2	0.1	0.6	0.1	0.4						
10-Jun-86	0.5	0.9	5.3	0.9	0.8	0.1	0.7	0.4	0.055						
04-Sep-86	1.5	0.8	0.9	0.6	0.2	0.2	0.9	0.1	1.3						
10-Dec-86	0.4	0.5	1.1	0.7	0.3	0.3	0.7	0.3	0.3						
20-Feb-87	0.2	0.5	1.1	0.5	0.4	0.4	0.7	0.2	0.3						
20-Apr-87	0.6	0	0.3	0.4	0.3	0.2	0.6	0.3	0.5						
20-Nov-87	0.3	0.2	0.3	0.1	0	0.2	0.3	0	0.6						
27-Jan-88	0.6	0.2	0.8												
23-Aug-88	0.5	0.2	0.7	0.3	0.1	0.1	0.5	0.1	0.5						
03-Nov-88	0.1	0.2	0.3	0.1	0	0.2	0.7	0	0.5						
08-Mar-89	0.1	0.2	0.3	0.1	0.1	0.1	0.2	0.2	0.9						
01-Sep-89	0	0.5	0.2	0.2	0	0.1	0.5		0.2						
15-Nov-89	0.2	0.2	0.4	0.2	0.1	0.2	0.1		0.1	0.1	0.1				0
08-May-90	0.2	0.3	0.6	0.4	0.2	0.1	0.4		0.3	0.1	0.1				0
13-Nov-90	0.2	0.4	0.2	0.1	0.2	0.4	0.1		0.4	0.2	0.3				0.4
27-Feb-91	0.1	0.3	0.2	0.3	0	0.1	0.3		0.3	0.3	0				0
24-Sep-91	0.4	0.1	0.2	0	0	0	0.3		0.2	0.2	0				0
17-Mar-92	0.4	0.2	0.7	0.9	0.4	0.3	0.2		0.3	0.4	0.3				0.[illegible]
03-Sep-92	0.2	0.8	0.8	0.4	0.1	0.1	0.4		0.7	0.2	0				0.2
24-Mar-93	0	1.8	0.2	1.2	1.1	0	0.2		0.5	0.5	0	0.9	0.7	0.4	0
22-Sep-93	0.7	0.5	0.6	0.4	0.2	0.9	0.2		0.4	0.5	0.5	0.7	0.8	0.8	0.1
24-Apr-94	0.3	0.1	0.4	0.6	0	0	0.1		0.3	0.3	0	0.3	0.2	0.3	0
RA-226	0.712	1.142	1.408	0.798	0.510	0.288	0.884	0.471	0.780	0.280	0.130	0.600	0.600	0.500	0.000
	0.741	1.603	2.800	1.044	0.400	0.380	1.116	0.740	1.334	0.140	0.168	0.294	0.216	0.500	0.000
	0.000	0.000	0.200	0.000	0.000	0.000	0.100	0.000	0.055	0.100	0.000	0.200	0.300	0.500	0.000
	3.500	8.000	15.500	7.000	2.000	2.000	6.000	3.000	7.000	0.500	0.500	0.900	0.800	0.500	0.000

Ra-228

pCi/l	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19	QC (13A)
27-Feb-01	1.7	2.5	1.1	2.1	1.2	0.9	2.8		1.4	0.5	1.2				0.6
24-Sep-01	1.8	2.2	1.9	1.9	0.6	0.7	2.1		0	0	0.3				0.2
17-Mar-02	1.6	1.6	0	2.1	0.4	0	1.6		0.6	0.9	0.3				0.9
09-Sep-02	1.8	0	2.5	1.4	0	0	0		0	0.6	0.4				0
24-Mar-03	1	1.8	0	1.4	0	0	0		0	0	0	0	0	0	0
22-Sep-03	2.3	3.4	1.9	2.6	1.8	2.1	1.4		0	1.5	1.1	1.8	1.3	1.2	0.4
24-Apr-04	1.5	2.8	1.4	1.5	1.2	0.9	0.7		0.7	0.7	0.4	1.5	1.1	2	0
RA-228	1.671	2.043	1.257	1.857	0.771	0.657	1.229	ERR	0.386	0.600	0.529	1.267	0.933	0.733	0.300
	0.381	1.085	0.883	0.417	0.627	0.707	0.978	ERR	0.503	0.484	0.413	0.800	0.685	0.525	0.325
	1.000	0.000	0.000	1.400	0.000	0.000	0.000	ERR	0.000	0.000	0.600	0.000	0.000	0.000	0.000
	2.300	3.400	2.500	2.600	1.800	2.100	2.800	ERR	1.400	1.500	1.200	2.000	1.500	1.200	0.900

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Th-230

pCi/l	MW#1	MW#2	MW#3	MW#4	MW#5	MW#11	MW#12	MW#13	CULINARY	MW#14	MW#15	MW#17	MW#18	MW#19	QC (13A)
31-Jul-80	0.4	0.3	0.3	0.4	0.5										
31-Aug-80	0.4	0.4	0.5	0.3	0.3										
30-Sep-80	0.8	0.5	0.4	0.7	0.9										
31-Oct-80	0.5	0.9	0.4	0.9	1.1										
30-Nov-80	0.8	0.6	0.5	0.8	0.9										
31-Dec-80	0.5	0.4	0.8	0.9	0.6										
31-Jan-81	0.5	1.3	1.3	0.5	0.6										
28-Feb-81	0.5	0.8	0.6	0.7	0.6										
31-Mar-81	0.8	0.4	0.8	0.8	0.5										
30-Apr-81	0.6	0.6	0.6	0.5	0.9										
30-May-81	1.1	0.7	0.5	1.2	0.8										
30-Jun-81	1.7	1.1	0.8	1.3	0.7										
31-Aug-81	0.7	1.2	1.1	1.4	0.9										
[illegible]	1.1	0	0	1	2.9										
30-Apr-82	0.8	0.9	1.5	0.8	1.7										
31-Aug-82	[illegible]	0	0	0	0										
30-Jun-83	0	0.4	0.5	0.1	0.2	0	0.1	0.1	0						
30-Jun-84	0.2	0.4	0.1	0	0.1	0.2	0	0.5	0.2						
30-Jun-85	1.2	0.5	0.5	0.9	0.1	1.2	0.6	0.5	0.3						
31-Dec-85	0.1	0	0.7	0.1	0.1	0.1	0.5	0.1	0.05						
21-Mar-86	0.1	0	0.7	0.1	0.1	0.1	0.5	0.1	0.05						
18-Jun-86	0.1	0	0.7	0.1	0.1	0.1	0.5	0.1	0.05						
[illegible]	0.4	0.7	0.9	2.4	1.8	1.2	0	0.5	0.5						
10-Dec-86	0	0	0	0.5	0.1	0	0	0	0						
20-Feb-87	0.2	1.5	0	0	0.9	0	0	0	0.1						
[illegible]-Apr-87	0.1	0.1	0.2	0.6	0.3	[illegible]	5.4	4.3	1.2						
20-Nov-87	0	0	0	0.1	0	0.1	0	0.1	0						
27-Jan-88	0.1	0.1	0.3												
23-Aug-88	0.9	0	0.7	0	0.4	0	0	0	0.4						
08-Nov-88	0.7	0.2	0.3	0.4	0	0	0.5	0.5	0.2						
08-Mar-89	0	0	0	0.1	0	0.2	0.2	0.2	0						
01-Sep-89	0	0	0	0	0.1	0	0.4		0						
[illegible]	0	0	[illegible]	0.1	0	0	0		3.2	0	4.7				0
08-May-90	0.1	0	0.1	0	0	0	0		0	0	0				0.1
13-Nov-90	0.2	0.1	0	0.1	0	0.2	0.2		0	0	0.2				0.8
27-Feb-91	0	0	0.1	0	0	0	0		0.1	0	0.1				0
24-Sep-91	0	0	0	0	0	0	0.1		0	0	0.1				0
17-Mar-92	0	0	0	0	0	0	0		0	0	0				0
08-Sep-92	0	0	0	0	0	0	0		0	0	0.2				0
24-Mar-93	0	0	0	0	0	0.3	0		0.5	0	0.1	0	0.2	0	0.7
22-Sep-93	0.4	0	0	0	0	0	0		0.2	0	0	0	0.3	0	0
24-Apr-94	0	0.2	1	1.4	0.8	0	0		0.4	0.2	0	0.4	0	1.1	0.3
	0.426	0.426	0.862	0.463	0.450	0.298	0.380	0.821	0.370	0.020	0.540	0.233	0.167	0.367	0.180
	0.477	0.885	1.512	0.533	0.580	0.583	1.050	1.579	0.729	0.080	1.380	0.330	0.125	0.519	0.285
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2.000	4.000	10.030	2.400	2.900	2.000	5.400	5.000	3.200	0.200	4.700	0.700	0.300	1.100	0.800

[illegible] 9/28/[illegible]

Pb-210 pCi/l	WMMF1	WMMF2	WMMF3	WMMF4	WMMF5	WMMF11	WMMF12	WMMF13	CULINARY	WMMF14	WMMF15	WMMF17	WMMF18	WMMF19	QC (13A)
31-Jul-80	3	3	3	3	5										
31-Aug-80	3	3	5	2	3										
30-Sep-80	3	3	2	3	5										
31-Oct-80	3	3	3	2	3										
30-Nov-80	3	2	4	5	4										
31-Dec-80	5	3	3	4	2										
31-Jan-81	3	3	4	2	4										
28-Feb-81	4	5	4	3	5										
31-Mar-81	4		5	3	5										
30-Apr-81	4	5	5	3	5										
30-May-81	4	3	5	3	4										
30-Jun-81	3	5	6	3	5										
31-Aug-81	2	3	6	5	3										
31-Jan-82	0	5	0	0	8										
30-Apr-82	1.3	1.2	1.8	0.9	1.1										
31-Aug-82	0	0.5	1.03	0.9	0										
30-Jun-83	0	0	0.5	0	0	0	0	0	0						
[illegible]	1.2	0.9	0.7	1	0.3	0.1	0.8	1.2	[illegible]						
[illegible]	2.7	[illegible]	1.2	0	0.3	0.8	0	0.2	1.6						
31-Dec-85	0	1	0.4	0.2	0.3	0.9	0.1	0.2	0.2						
21-Mar-86	0	1	0.4	0.2	0.3	0.9	0.1	0.2	0.2						
10-Jun-86	0	1	0.4	0.2	0.3	0.9	0.1	0.2	0.2						
[illegible]	0.3	0	0	0	[illegible]	0.1	0.3	0	0						
10-Dec-86	2.2	3	0	0	0	0.8	0	0	0						
28-Feb-87	2.2	2.3	1.8	1.5	2.7	1.5	2.1	1.1	1.3						
[illegible]	3.1	0.2	0.5	[illegible]	2.4	4	0	1.8	0.9						
[illegible]	0.7	0.0	0.0	1.7	0.6	[illegible]	2.3	1.2	0.9						
27-Jun-88	0.0	0.0	0.0												
23-Aug-88	0.0	0.4	0.0	0.0	0.0	0.4	0.0	0.0	0.0						
03-Nov-88	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0						
08-Mar-89	0.2	0.8	0.1	0.8	0.1	0.7	0.3	0.8	0.9						
01-Sep-89	0.0	0.1	0.0	0.5	0.0	0.1	0.0		0.3						
20-Nov-89	0.4	1.3	1.3	0.1	1.0	0.1	0.2		1.2	1.0	0.0				0.0
08-May-90	0.4	0.0	1.0	0.4	1.1	0.7	0.8		0.0	0.7	1.3				0.6
13-Nov-90	0.7	1.3	0.4	0.9	0.0	1.1	0.3		0.0	0.6	0.1				0.5
27-Feb-01	0.0	0.4	0.1	2.8	0.9	0.6	0.3		0.8	0.6	0.7				0
24-Sep-01	0.5	0.7	1.1	0.0	0.0	0.1	1.8		1.8	1.7	0.0				0
17-Mar-02	1.4	2.8	1.3	1.5	1.8	1.6	2.2		2.0	2.3	2.2				1
08-Sep-02	0.0	0.0	0.0	0.0	1.1	0.4	0.0		0.6	0.6	0.0				0
24-Mar-03	1.3	1.3	0.6	2.2	1.3	1.4	0.7		0.2	[illegible]	0.2	0.7	1	0.6	0.5
22-Sep-03	0.4	1.1	0.1	1.4	0.8	1.0	0.0		0.2	0.9	1.7	0	0.5	0	0.6
24-Apr-04	0.8	0.0	0.6	0.6	0.2	0.8	0.2		1.1	0.7	0.0	0.7	0.5	0.4	0.2
	1.519	2.037	1.825	1.580	2.046	1.076	0.782	0.493	0.928	0.920	0.620	0.467	0.667	0.333	0.430
	1.583	2.140	2.051	1.614	2.025	1.383	1.046	0.581	1.718	0.800	0.782	0.330	0.236	0.240	0.349
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.000	0.000	0.500	0.000	0.000
	5.000	6.000	7.000	6.000	8.000	6.700	8.000	1.800	8.800	2.300	2.200	0.700	1.000	0.800	1.000

VRU? 9/28/94

Alkalinity (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	WM#17	WM#18	WM#19	QC (13A)	
01-Nov-89					326	316	346	428	374	0				4	
28-Nov-89	280	344	277	347	322	301	342	379	353	240				1	
15-Dec-89					314	304	324	382	355					1	
24-Jan-90					300	300	319	382	353					0.5	
27-Feb-91	271	349	204	384	303	301	286	361	356	201				0.14	meq/l
10-Nov-92	258	345	352	350	322	329	334	406	357	180					
24-Mar-93	280	349	324	348	318	312	344	382	363	188	384	324	184	7	
08-Jun-93	270	346	410	350	312	308	382	384	358	185	385	325	205	4	
22-Sep-93	252	284	402	340	300	310	343	378	357	182	383	323	288	1	
14-Dec-93	250	343	331	347	312	306	325	387	356	185	385	328	206	3	
24-Mar-94	286	347	350	362	317	311	340	390	371	190	336	213	300	2	
15-Jun-94	251	338	406	343	253	309	337	383	257	184	438	246	223	2.4	
	259	338	340	351	300	309	335	380	351	175	385	283	230	2	
	7	19	64	12	18	8	16	16	29	81	29	46	72	2	
	250	284	204	340	253	300	286	361	257	0	336	213	184	0	
	271	349	410	384	326	329	382	428	374	240	438	328	300	7	

Ammonia (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	QC (13A)
01-Nov-89					0.7	0.6	0.2	0.1	0.1		
28-Nov-89	0.5	0.000	0.000	0.7	0.7	0.6	0.1	0.000	0.2	0.2	0.1
15-Dec-89					0.7	0.6	0.1	0.1	0.1		
24-Jan-90					0.5	0.5	0.09	0.09	0.09		0.1
	0.500	0.000	0.000	0.700	0.650	0.575	0.123	0.075	0.123	0.200	
	0.000	0.000	0.000	0.000	0.087	0.043	0.045	0.038	0.045	0.000	
	0.500	0.000	0.000	0.700	0.500	0.500	0.090	0.000	0.090	0.200	
	0.500	0.000	0.000	0.700	0.700	0.600	0.200	0.100	0.200	0.200	

[illegible] (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	QC (13A)
01-Nov-89					0.000	0.000	0.000	0.000	0.000		
20-Nov-89	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.03	0.04	0.01
15-Dec-89					0.000	0.000	0.000	0.000	0.01		0.01
24-Jan-90					0.000	0.000	0.000	0.000	0.000		0.01
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.015	0.040	0.010
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.040	0.010
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.030	0.040	0.010

[illegible] (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	QC (13A)
01-Nov-89					0.000	0.000	0.000	0.000	0.000		
20-Nov-89	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15-Dec-89					0.000	0.000	0.000	0.000	0.000		0.000
24-Jan-90					0.000	0.000	0.000	0.000	0.000		0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Gross Alpha Dissolved (pCi/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	WM#17	WM#18	WM#19	QC (13A)
[illegible]					7	42	47	53	[illegible]					
[illegible]	8.3	38	65	4	8	17	27	68	81	1.9				1
[illegible]					7	13	62	67	98					0.9
[illegible]					0	0	18	40	[illegible]					2
27-Feb-91	0	4	0	10	15	17	24	48	19	0.1				0.5
[illegible]	0	21	76	2	5	5	27	62	24	5.9				0.8
17-[illegible]	0	67	38	31	12	10	0	82	47	0.2				0
[illegible]	5	36	34	5	10	0	10	48	27	0				0
[illegible]	0	21	0	0	0	0	15	46	98	0	10	12	7	0
[illegible]	21	11	100	0	3.9	14	10	30	38	1.1	30	16	19	0.4
[illegible]	4.4	21	33	5	12	8	33	44	57	2.3	52	18	34	0.7
	4.088	27.500	53.250	8.250	7.284	11.455	24.636	54.273	58.000	1.438	22.333	21.333	26.000	0.630
	6.677	16.426	54.000	9.134	4.821	11.492	17.004	13.039	27.591	1.885	12.220	9.286	10.026	0.581
	0.000	4.000	0.000	0.000	0.000	0.000	0.000	30.000	19.000	0.000	10.000	12.000	7.000	0.000
	21.000	67.000	100.000	31.000	15.000	42.000	62.000	82.000	98.000	5.000	30.000	34.000	52.000	2.000

Gross Beta Dissolved (pCi/l)

Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	WM#17	WM#18	WM#19	QC (13A)
[illegible]					12	21	30	43	55					
29-Nov-—	11	31	50	15	18	7	34	40	29	6.7				2.6
15-Dec-—					10	16	44	37	51					0.9
24-Jan-—					13	10	20	37	41					1.1
27-Feb-91	7.1	21	31	13	6.3	8.3	28	25	18					1.1
[illegible]	15	21	63	[illegible]	17	18	25	33	42	5.6				2.8
[illegible]	[illegible]	28	42	22	13	18	25	[illegible]	29	4.2				0
20-—-92	12	[illegible]	60	10	10	14	30	67	30	4.2				1.3
2—-—-93	0.3	9	51	0	7	5	36	47	40	3.6	40	13	21	0
16-Oct-93	11	30	40	24	14	14	22	29	19	3.3	38	18	18	3.3
24-Mar-94	9.5	32	62	22	15	15	19	34	24	4.8	35	19	22	0.7
	10.900	28.000	40.500	16.667	12.811	12.811	31.000	42.778	38.222	4.860	40.000	13.000	21.000	1.225
	6.100	15.100	10.751	12.324	4.315	5.151	6.200	11.856	10.700	1.131	0.000	0.000	0.000	0.900
	0.300	9.000	31.000	0.000	6.300	5.000	25.000	25.000	18.000	3.600	40.000	13.000	21.000	0.000
	20.000	58.000	63.000	40.000	18.000	21.000	44.000	67.000	55.000	6.700	40.000	13.000	21.000	2.800

Methylene Chloride (ug/l)

Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					4.9	4.9	4.9	4.9	4.9	
29-Nov-89	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	130
15-Dec-89					4.9	4.9	4.9	4.9	4.9	
24-Jan-90					4.9	4.9	4.9	4.9	4.9	
	5	5	5	5	5	5	5	5	5	130
	0	0	0	0	0	0	0	0	0	0
	5	5	5	5	5	5	5	5	5	130
	5	5	5	5	5	5	5	5	5	130

Acetone (ug/l)

Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					90	90	90	90	90	
29-Nov-89	90	90	90	90	90	90	90	90	30	90
15-Dec-89					9.9	9.9	9.9	9.9	9.9	
24-Jan-90					9.9	9.9	9.9	9.9	9.9	
	90	90	90	90	54	54	54	54	54	90
	0	0	0	0	45	45	45	45	45	0
	90	90	90	90	10	10	10	10	10	90
	90	90	90	90	90	90	90	90	90	90

Cadmium

(mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	WM#17	WM#18	WM#19	QC (13A)
01-Nov-89					0.0049	0.0049	0.0049	0.0049	0.0049					
29-Nov-89	0.0043	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049				0.005
15-Dec-89					0.0049	0.007	0.006	0.0049	0.0049					
24-Jan-90					0.0049	0.007	0.007	0.0049	0.0049					0.005
24-Sep-91	0.001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000				0.001
17-Mar-92	0.0000	0.0000	0.0000	0.0000	0.0000	0.001	0.001	0.0000	0.0000	0.0000				0.001
14-Sep-92	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0009	0.0000	0.0000	0.0000				0.001
24-Mar-93	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.002	0.0000	0.0000	0.0000	0.0000	0.0000	0.001
22-Sep-93	0.00000	0.00000	0.0003	0.00000	0.0003	0.0002	0.0004	0.0012	0.00000	0.00000	0.0002	0.0002	0.0004	0.00000
24-Mar-94	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049
	0.001	0.001	0.002	0.001	0.002	0.003	0.003	0.003	0.002	0.001	0.000	0.000	0.000	0.002
	0.002	0.002	0.001	0.002	0.002	0.003	0.003	0.002	0.002	0.002	0.000	0.000	0.000	0.002
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.005	0.005	0.005	0.005	0.005	0.007	0.007	0.005	0.005	0.005	0.001	0.001	0.001	0.005

Chromium

(mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	QC (13A)
01-Nov-89					0.000	0.000	0.000	0.000	0.000		
29-Nov-89	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.01
15-Dec-89					0.000	0.000	0.000	0.000	0.000		
24-Jan-90					0.000	0.000	0.000	0.000	0.000		0.01
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010

Cyanide

(mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	QC (13A)
01-Nov-89					0.000	0.000	0.000	0.000	0.000		0.01
29-Nov-89	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
15-Dec-89					0.000	0.000	0.000	0.000	0.000		
24-Jan-90					0.000	0.000	0.000	0.000	0.000		0.01
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010

Mercury (mg/l) Date	MW#1	MW#2	WMW#3	WMW#4	WMW#5	WMW#11	WMW#12	WMW#14	WMW#15	Culinary	QC (13A)
01-Nov-00					0.00019	0.00019	0.00019	0.00019	0.00019		
29-Nov-00	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.0002
15-Dec-00					0.00019	0.00019	0.00019	0.00019	0.00019		0.0002
24-Jan-01					0.00019	0.00019	0.00019	0.00019	0.00019		0.0002
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

Molybdenum (mg/l) Date	MW#1	MW#2	WMW#3	WMW#4	WMW#5	WMW#11	WMW#12	WMW#14	WMW#15	Culinary	WMW#17	WMW#18	WMW#19	QC (13A)
01-Nov-00					0.000	0.000	0.02	0.02	0.04					
29-Nov-00	0.01	0.02	0.000	0.02	0.000	0.000	0.02	0.02	0.000	0.000				0.01
15-Dec-00					0.000	0.000	0.02	0.02	0.03					0.01
24-Jan-01					0.000	0.000	0.000	0.000	0.01					0.01
24-Sep-01	0.001	0.003	0.01	0.014	0.0000	0.0000	0.000	0.025	0.001					0.001
17-Mar-02	0.001	0.001	0.0000	0.0000	0.0000	0.0000	0.002	0.003	0.003	0.001				0.001
14-Sep-02	0.0000	0.0000	0.0000	0.0000	0.001	0.001	0.001	0.002	0.0000	0.001				0.001
24-Mar-03	0.002	0.001	0.0000	0.001	0.001	0.001	0.002	0.003	0.001	0.0000	0.0000	0.0000	0.007	0.001
22-Sep-03	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.001	0.0000	0.0000	0.004	0.0000
24-Mar-04	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.002	0.004	0.003	0.003	0.004	0.004	0.000	0.010	0.010	0.002	0.001	0.001	0.004	0.004
	0.003	0.007	0.004	0.007	0.004	0.004	0.000	0.000	0.013	0.003	0.000	0.001	0.002	0.004
	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	0.010	0.020	0.010	0.020	0.000	0.000	0.020	0.025	0.040	0.000	0.001	0.002	0.007	0.010

Nickel (mg/l) Date	MW#1	MW#2	WMW#3	WMW#4	WMW#5	WMW#11	WMW#12	WMW#14	WMW#15	Culinary	WMW#17	WMW#18	WMW#19	QC (13A)
01-Nov-00					0.000	0.000	0.03	0.03	0.02					
29-Nov-00	0.000	0.000	0.05	0.02	0.000	0.000	0.02	0.02	0.02	0.000				0.01
15-Dec-00					0.000	0.000	0.02	0.03	0.02					0.01
24-Jan-01					0.000	0.000	0.000	0.01	0.000					0.01
27-Feb-01	0.02	0.06	0.1	0.07	0.04	0.05	0.06	0.05	0.07	0.01				0.02
24-Sep-01	0.000	0.01	0.02	0.000	0.000	0.000	0.000	0.000	0.000	0.000				0.01
17-Mar-02	0.000	0.01	0.01	0.000	0.000	0.000	0.000	0.000	0.000	0.000				0.01
14-Sep-02	0.0000	0.0000	0.019	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000				0.001
24-Mar-03	0.0000	0.0000	0.014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.005	0.0000	0.001
22-Sep-03	0.003	0.0000	0.012	0.003	0.0000	0.0000	0.005	0.003	0.0000	0.001	0.0000	0.0000	0.004	0.0000
24-Mar-04	0.000	0.000	0.01	0.000	0.000	0.000	0.000	0.000	0.03	0.000	0.000	0.000	0.000	0.000
	0.000	0.015	0.036	0.016	0.011	0.012	0.018	0.016	0.018	0.006	0.001	0.005	0.001	0.000
	0.006	0.020	0.032	0.024	0.011	0.014	0.017	0.015	0.020	0.004	0.000	0.000	0.000	0.006
	0.001	0.001	0.010	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.005	0.001	0.001
	0.020	0.060	0.100	0.070	0.040	0.050	0.060	0.050	0.070	0.010	0.001	0.005	0.001	0.020

MW3 4/28/94

Carbon Disulfide

(ug/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					4.9	4.9	4.9	4.9	4.9	
29-Nov-89	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
15-Dec-89					4.9	4.9	4.9	4.9	4.9	
24-Jan-90					4.9	4.9	4.9	4.9	4.9	
	5	5	5	5	5	5	5	5	5	5
	0	0	0	0	0	0	0	0	0	0
	5	5	5	5	5	5	5	5	5	5
	5	5	5	5	5	5	5	5	5	5

Chloroform

(ug/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					4.9	4.9	4.9	4.9	4.9	
29-Nov-89	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
15-Dec-89					4.9	4.9	4.9	4.9	4.9	
24-Jan-90					4.9	4.9	4.9	4.9	4.9	
	5	5	5	5	5	5	5	5	5	5
	0	0	0	0	0	0	0	0	0	0
	5	5	5	5	5	5	5	5	5	5
	5	5	5	5	5	5	5	5	5	5

2-Butanone

(ug/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary
01-Nov-89					90	90	90	90	90	
29-Nov-89	90	90	90	90	90	90	90	90	90	90
15-Dec-89					9.9	9.9	9.9	9.9	9.9	
24-Jan-90					9.9	9.9	9.9	9.9	9.9	
	90	90	90	90	54	54	54	54	54	90
	0	0	0	0	45	45	45	45	45	0
	90	90	90	90	10	10	10	10	10	90
	90	90	90	90	90	90	90	90	90	90

UU3 4/20/94

Beryllium (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	WM#17	WM#18	WM#19	QC (13A)
24-Sep-91	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009				0.0009
17-Mar-92	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009				0.0009
03-Sep-92	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009				0.0009
24-Mar-93	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
22-Sep-93	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019	0.00019
24-Mar-94	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Calcium (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	WM#17	WM#18	WM#19	QC (13A)
03-Sep-92	126	306	377	377	110	34.5	488	467	359	47				3.5
14-Nov-92	152	334	437	424	132	198	504	474	431	49				
24-Mar-93	149	355	486	439	136	117	514	498	422	50	406	415	245	0.91
08-Jun-93	150	355	486	442	136	150	512	500	451	50	388	445	316	0.98
22-Sep-93	142	325	453	427	130	140	507	498	430	50	375	437	305	2
14-Dec-93	167	332	457	420	128	50	489	477	446	49	372	419	287	1
24-Mar-94	159	341	478	431	125	53.3	537	505	436	53.1	405	456	199	0.32
15-Jun-94	130	325	443	423	130	77	494	499	453	49	410	424	166	1.8
	144	338	437	421	129	125	505	485	416	49	397	430	281	2
	11	20	36	26	11	60	10	14	34	1	9	15	36	1
	126	306	377	377	110	35	488	467	359	47	388	415	245	1
	152	355	486	442	136	198	514	500	451	50	406	445	316	4

Potassium (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	WM#17	WM#18	WM#19	QC (13A)
03-Sep-92	6.77	11.4	23.9	10.17	7.7	6.3	13.8	12	10.2	3.27				0.7
14-Nov-92	6.65	12.25	24.3	10.6	7.85	10.55	13.25	11.5	10.1	3.15				
24-Mar-93	6.2	11.9	25.7	10.8	8.7	9.2	14.7	13.2	11.5	1.9	17.8	7.1	12.7	0.01
08-Jun-93	7.3	12.8	28.2	11.8	9	12.2	15.1	13.6	11.7	3.5	17.7	7.6	11.8	0.05
22-Sep-93	6.2	13.6	32	11.1	11.3	11.3	14.9	13.9	14.6	2.5	18.7	7.8	13	0.4
14-Dec-93	8	12.7	28.2	11.6	8.4	8	14.7	13.6	12.2	3.4	18.6	7.4	12.8	0.4
24-Mar-94	6.1	9.8	21.4	11.7	6.4	6.1	12	11.2	10.7	3.4	13.3	7	9.1	0.5
15-Jun-94	7	12	27	11	9	8	14	13	11	3	16	7	11	0.1
	6.7	12.1	25.5	10.8	8.3	9.6	14.2	12.6	10.9	3.0	17.8	7.4	12.3	0.3
Potassium	0.4	0.5	1.7	0.6	0.6	2.2	0.7	0.9	0.7	0.6	0.0	0.3	0.4	0.3
	6.2	11.4	23.9	10.2	7.7	6.3	13.3	11.5	10.1	1.9	17.7	7.1	11.8	0.0
	7.3	12.8	28.2	11.8	9.0	12.2	15.1	13.6	11.7	3.5	17.8	7.6	12.7	0.7

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Magnesium (mg/l) Date	MW#1	MW#2	WM#3	WM#4	WM#5	WM#11	WM#12	WM#14	WM#15	Culinary	WM#17	WM#18	WM#19	QC (13A)
03-Sep-92	60.5	105	252	192	42	12	231	161	166	23				89
14-Nov-92	63	104	244	185	43	73	224	157	172	21				0.08
24-Mar-93	54	99	239	176	38	36	215	150	158	20	200	92	88	0.09
08-Jun-93	55	98	238	176	39	48	214	155	165	19	188	96	111	
22-Sep-93	53	95	241	176	39	47	210	151	163	20	180	97	115	0.1
14-Dec-93	63	94	244	173	37	15	210	148	169	19	177	95	102	0.1
24-Mar-94	61.2	97.1	249	177	37.7	16.1	220	153	165	19.8	205	97.1	76.9	0.05
15-Jun-94	55	92	237	173	37	23	207	152	161	19	200	95	61	0.07
Magnesium	63.0	105.0	252.0	192.0	43.0	73.0	231.0	161.0	172.0	23.0	200.0	96.0	111.0	89.0
	3.7	3.0	5.5	6.7	2.1	22.0	7.0	4.0	5.0	1.5	6.0	2.0	11.5	41.9
	54.0	98.0	238.0	176.0	38.0	12.0	214.0	150.0	158.0	19.0	188.0	92.0	88.0	0.1
	63.0	105.0	252.0	192.0	43.0	73.0	231.0	161.0	172.0	23.0	200.0	96.0	111.0	89.0

Reclamation Plan
White Mesa Mill
Blanding, Utah

Source Material License No. SUA-1358

Docket No. 40-8681

Revision 1.0

February 1997

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INTRODUCTION

This document prepared by Energy Fuels Nuclear, Inc. (EFN), presents EFN's plans and estimated costs for the reclamation of Cells 1-I, 2, 3, and 4, and for decommissioning of the White Mesa Mill.

The uranium processing sections of the mill will be decommissioned as follows:

The uranium and vanadium processing areas of the mill, including all equipment, structures and support facilities will be decommissioned and disposed of in tailings or buried on site as appropriate. All equipment, including tankage and piping; agitation; process control instrumentation and switchgears; and contaminated structures; will be cut up, removed, and buried in tailings prior to final cover placement. Concrete structures and foundations will be demolished and removed or covered with soil as appropriate. These decommissioned areas would include, but not be limited to, the following:

- Coarse ore bin and associated equipment, conveyors and structures.
- Grind circuit including semi-autogenous grind (SAG) mill, screens, pumps and cyclones.
- Three pre-leach tanks to the east of the mill building, including all associated tankage, agitation equipment, pumps, and piping.
- Seven leach tanks inside the main mill building, including all associated agitation equipment, pumps and piping.
- Counter-current decantation (CCD) circuit including all thickeners and equipment, pumps and piping.
- Uranium precipitation circuit, including all thickeners, pumps and piping.
- Two yellowcake dryers and all mechanical and electrical support equipment, including uranium packaging equipment.
- Clarifiers to the west of the mill building including the preleach thickener and claricone.
- Boiler and all ancillary equipment and buildings.
- Entire vanadium precipitation, drying, and fusion circuit.

- All external tankage not included in the above list including: reagent tanks for the storage of acid, ammonia, kerosene, water, or dry chemicals; and the vanadium oxidation circuit.
- Uranium and vanadium solvent extraction (SX) circuit including all SX and reagent tankage, mixers and settlers, pumps, and piping.
- SX building.
- Mill building.
- Office building.
- Shop and warehouse building.
- Sample plant building.

The sequence of demolition would proceed so as to allow the maximum use of support areas of the facility, such as the office and shop areas. It is anticipated that all major structures and large equipment will be demolished with the use of hydraulic shears. These will speed the process, provide proper sizing of the materials to be placed in tailings, and reduce exposure to radiation and other safety hazards during the demolition. Any uncontaminated or decontaminated equipment to be considered for salvage will be released in accordance with the NRC document, Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct or Source Materials, dated September, 1984, and in compliance with the conditions of Source Material License SUA-1358. As with the equipment for disposal, any contaminated soils from the mill area will be disposed of in the tailings facilities in accordance with Section 4.0 of Attachment A, Plans and Specifications.

The estimated reclamation costs for surety are summarized as follows:

White Mesa Reclamation
Cost Summary

Direct Costs		M$
Mill Decommissioning		1,485
Cell 1 Reclamation		738
Cell 2 Reclamation		1,736
Cell 3 Reclamation		2,216
Cell 4A Reclamation		115
Misc. Items (Project General)		2,045
	Subtotal Direct:	8,335
Profit Allowance	10%	833
Contingency	15%	1,250
Licensing and Bonding	2%	167
Long Term Care Fund		585
	Total Surety Requirement:	11,170

REPORT ORGANIZATION

General site characteristics pertinent to the reclamation plan are contained in Section 1.0. Descriptions of the facility construction, operations and monitoring are given in Section 2.0. The current environmental monitoring program is described in Section 2.3. Seismic risk was assessed in Section 2.6.3.

The Reclamation Plan including descriptions of facilities to be reclaimed and design criteria, is presented in Section 3.0. Section 3.0 Attachments A, B, and C are the Plans and Specifications, Quality Plan for Construction Activities, and Cost Estimates, respectively.

Supporting documents, which have been reproduced as appendices for ease of review, include:

- Semi-Annual Effluent Report, White Mesa Mill, SUA-1358, Docket No. 40-8681, (July through December 1995) and Semi-Annual Effluent Report, White Mesa Mill, SUA-1358, Docket No. 40-8681, (January through June 1996) Energy Fuels Nuclear, Inc.

- Hydrogeologic Evaluation of White Mesa Uranium Mill, July 1994. Titan Environmental Corporation (Titan).

- Points of Compliance, White Mesa Uranium Mill, September 1994. Titan.

- Tailings Cover Design, White Mesa Mill, October 1996. Titan.

- Neshaps Radon Flux Measurement Program, White Mesa Mill, 1995, October 1995. Tellco Environmental.

1.0 SITE CHARACTERISTICS

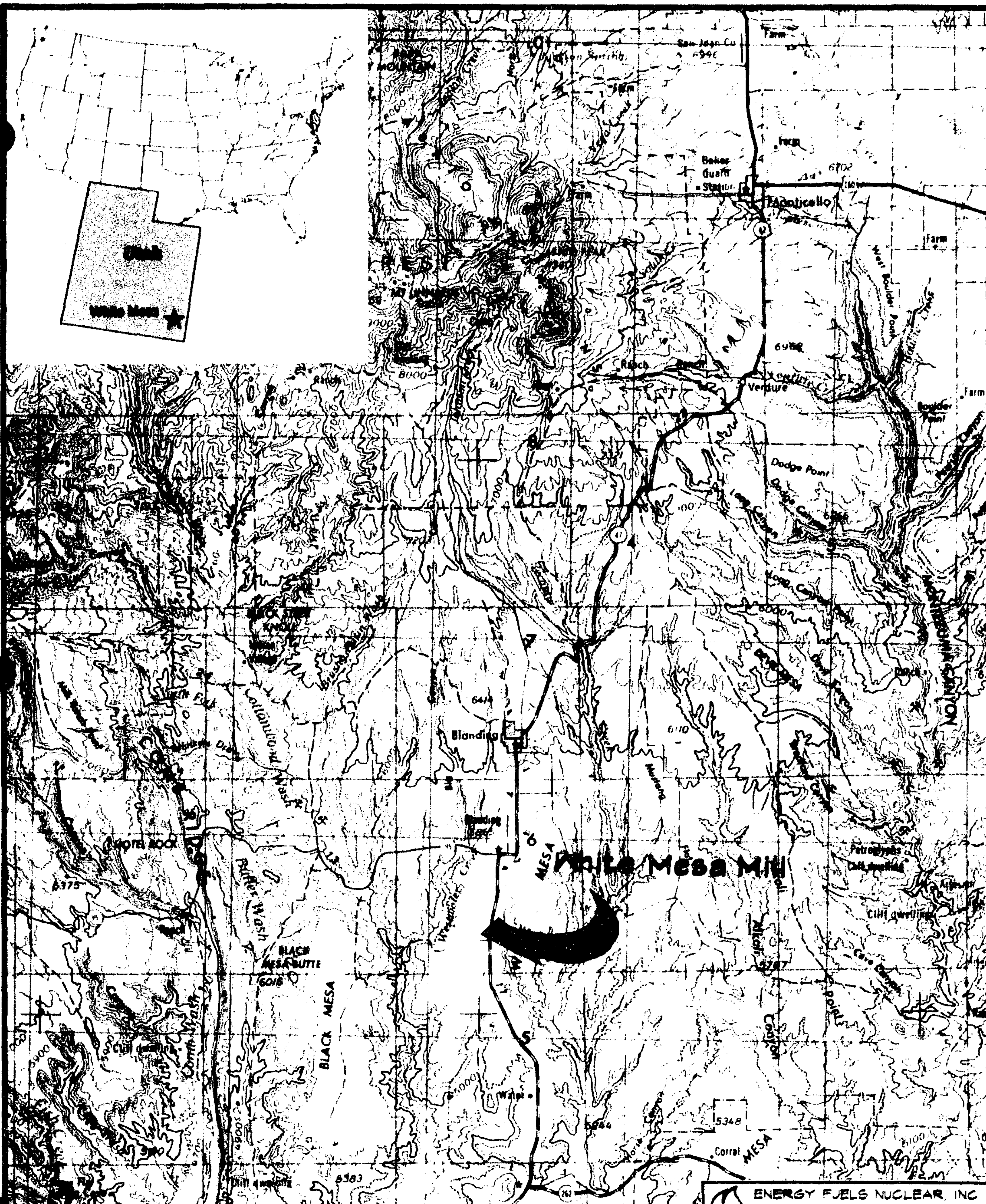
The White Mesa Mill is located in southeastern Utah (see Figure 1-1), approximately six miles south of Blanding, Utah (see Figure 1-2).

The Environmental Report ("ER") (Dames and Moore 1978b) has been reproduced, with minor revisions, to describe site characteristics. The Final Environmental Statement ("Final ES") (U.S. NRC 1979) has also been used, where noted below, for descriptions of the preoperational environment. Section 2.0, Site Characteristics, contains certain pertinent sections reproduced from the Final ES with minor changes in syntax. Where these sections were reproduced, the ER or Final ES section numbers are referenced in parentheses after the section title.

Section 1.6.1, Regional Geology, and Section 1.6.2, Blanding Site Geology, were reproduced from the ER with minor changes in syntax. Section 1.6.3, Seismic Risk Assessment, summarizes the results of static and pseudostatic analyses performed in September of 1996. These analyses were based on the most recent data available as well as previously collected data, and were used to establish the stability of the side slopes of the tailings soil cover. Complete details of the tailings cover design are provided in Appendix D, Tailings Cover Design, White Mesa Mill (Titan Environmental Corporation, 1996).

The Semi-Annual Effluent Report for July through December, 1996 (EFN, 1996) is reproduced in Appendix A. Many of the graphs in the Semi-Annual Effluent Report show data from late 1979 or early 1980 to the present. The word "current" is used to describe these data and/or updates. The Hydrogeologic Evaluation of White Mesa Uranium Mill (Titan, 1994) is reproduced in Appendix B. Points of Compliance, White Mesa Mill (Titan, 1994) is reproduced in Appendix C. Tailings

Cover Design, White Mesa Mill (Titan, 1996) is reproduced in Appendix D. Appendix E is the most recently completed radon monitoring report.


Utah
White Mesa
Monticello
Verdure
Dodge Point
Blanding
White Mesa Mill
BLACK MESA
BLACK MESA BUTTE
Cliff dwelling
Corral
MESA
ENERGY FUELS NUCLEAR, INC
Colorado Plateau Operations
FIGURE 1-1
Regional Location Map
DESIGN.
DRAWN. R. Van Horn
CHKD BY.
DATE. Feb 1997
APP.
SCALE. 250,000
SHEET
A Portion of USGS Map No. NJ12-9 Cortez Colo-Utah

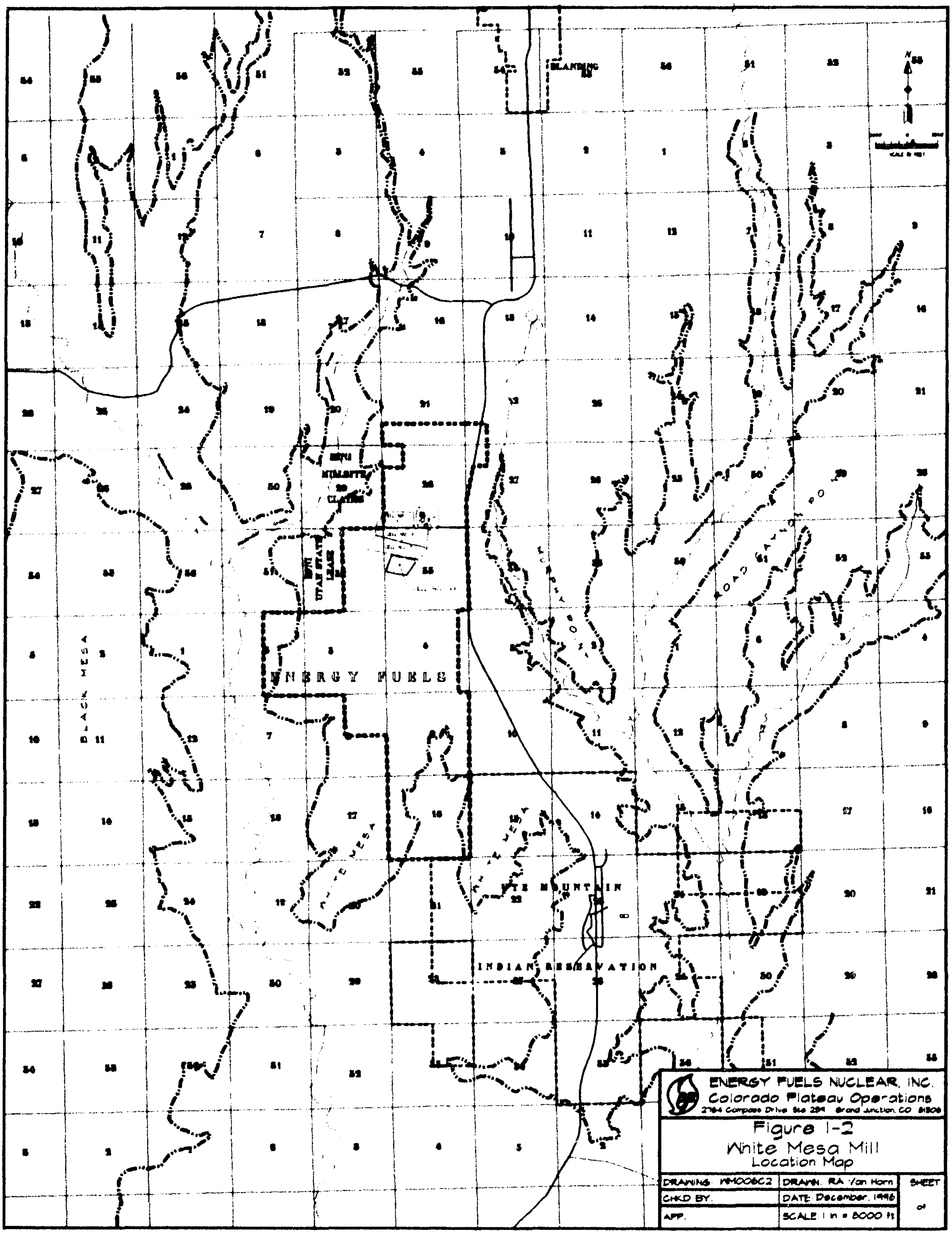


Figure 1-2
White Mesa Mill
Location Map

1.1 CLIMATE

Text on climate and associated tables are adapted, with minor revisions, from the Final ES. New table numbers are added to the text below to correspond to sections in this Reclamation Plan, but the original table numbers from the Final ES are cited on the modified tables, for ease of reference.

1.1.1 General Influences (Final ES Section 2.1.1)

Although varying somewhat with elevation and terrain in the vicinity of the site, the climate can generally be described as semiarid. Skies are usually clear with abundant sunshine, precipitation is light, humidity is low, and evaporation is high. Daily ranges in temperature are relatively large, and winds are normally light to moderate. Influences that would result in synoptic meteorological conditions are relatively weak; as a result, topography and local micrometerological effects play an important role in determining climate in the region.

Seasons are well defined in the region. Winters are cold but usually not severe, and summers are warm. The normal mean annual temperature reported for Blanding, Utah, is about 50° F (10° C), as shown in Table 1.1-1 (Table 2.1 in the Final ES). January is usually the coldest month in the region, with a normal mean monthly temperature of about 27° F (-3° C). Temperatures of 0° F (-18° C) or below may occur in about two of every three years, but temperatures below -15° F (-26° C) are rare. July is generally the warmest month, having a normal mean monthly temperature of about 73° F (23° C). Temperatures above 90° F (32° C) are not uncommon in the summer and are reported to occur about 34 days a year; however, temperatures above 100° F (38° C) occur rarely.

1.1.2 Precipitation (Final ES Section 2.1.2)

Precipitation in the vicinity of the White Mesa Uranium Project is light (Table 1.1-2) (Final ES Table 2.2). Normal annual precipitation is about 12 inches (30 cm). Most precipitation in the area is rainfall, with about 25 percent of the annual total in the form of snowfall.

There are two separate rainfall seasons in the region. The first occurs in late summer and early autumn when moisture-laden air masses occasionally move in from the Gulf of Mexico, resulting in showers and thunderstorms. The second rainfall period occurs during the winter when Pacific storms frequent the region.

1.1.3 Winds (Final ES Section 2.1.3)

Wind speeds are generally light to moderate at the site during all seasons, with occasional strong winds during late winter and spring frontal activity and during thunderstorms in the summer. Southerly wind directions are reported to prevail throughout the year.

1.1.4 Storms (Final ES Section 2.1.4)

Thunderstorms are frequent during the summer and early fall when moist air moves into the area from the Gulf of Mexico. Related precipitation is usually light, but a heavy local storm can produce over an inch of rain in one day. The maximum 24-hour precipitation reported to have fallen during a 30-year period at Blanding was 1.98 inches (5.02 cm). Hailstorms are uncommon in this area. Although winter storms may occasionally deposit comparable amounts of moisture, maximum short-term precipitation is usually associated with summer thunderstorms.

Tornadoes have been observed in the general region, but they occur infrequently. Strong winds can occur in the area along with thunderstorm activity in the spring and summer. The White Mesa site is susceptible to occasional dust storms, which vary greatly in intensity, duration, and time of occurrence. The basic conditions for blowing dust in the region are created by wide areas of exposed dry topsoil and strong, turbulent winds. Dust storms usually occur following frontal passages during the warmer months and are occasionally associated with thunderstorm activities.

TABLE 1.1-1

Temperature means and extremes at Blanding, Utah[a]

Month	Means						Extremes					
	Daily maximum		Daily minimum		Monthly		Record highest		Year	Record lowest		Year
	°C	°F	°C	°F	°C	°F	°C	°F		°C	°F	
January	3.9	39.1	-9.1	15.6	-2.6	27.4	16	60	1956	-27	-17	1937
February	6.5	43.7	-6.4	20.4	0.1	32.1	19	67	1932	-31	-23	1933
March	11.1	51.9	-3.3	26.1	3.9	39.0	22	72	1934	17	2	1948
April	17.0	62.6	0.9	33.7	8.9	48.1	28	82	1943	12	11	1936
May	22.2	71.9	5.2	41.3	13.7	56.6	33	92	1951	-5	23	1933
June	28.2	82.8	9.6	49.2	18.9	66.0	38	100	1954	-2	28	1947
July	31.7	89.1	13.8	56.9	27.8	73.0	39	103	1931	2	36	1934
August	30.3	86.5	13.1	55.5	21.7	71.0	37	98	1954	6	42	1950
September	26.2	79.3	8.7	47.7	17.6	63.6	35	95	1948	-2	29	1934
October	19.0	66.2	2.7	36.9	10.9	51.6	32	90	1937	-10	14	1935
November	10.4	50.8	-4.4	24.1	3.1	37.5	21	69	1934	-22	-7	1931
December	5.3	41.6	-7.4	18.6	1.1	30.1	16	61	1949	-24	-11	1935
Annual	17.7	63.8	1.9	35.5	9.8	49.7	39	103	July 1931	-31	-23	February 1933

[a]Period of record: 1931-1960 (30 years).

Source: Adapted from U. S. NRC (1979) Final Environmental Statement, Page 2-2, Table 2.1.
Original Source: Plateau Resources, Limited, *Application for Source Material License*, Table 2.2-1, p. 2-6, Apr. 3, 1978.

TABLE 1.1-2

Precipitation means and extremes at Blanding, Utah[a]

Month	Total						
	Mean monthly		Maximum monthly		Greatest daily		Year
	cm	in.	cm	in.	cm	in.	
January	3.04	1.20	10.31	4.06	2.64	1.04	1952
February	2.95	1.16	4.39	1.73	2.62	1.03	1937
March	2.38	0.94	5.00	1.97	2.54	1.00	1937
April	2.18	0.86	5.41	2.13	2.69	1.06	1957
May	1.63	0.64	5.11	2.01	2.39	0.94	1947
June	1.39	0.55	5.51	2.17	3.56	1.40	1938
July	2.13	0.84	7.79	3.07	3.35	1.32	1930
August	3.02	1.19	12.59	4.96	5.03	1.98	1951
September	3.02	1.19	9.60	3.78	3.07	1.21	1933
October	3.51	1.38	16.79	6.61	3.94	1.55	1940
November	1.88	0.74	5.21	2.05	2.41	0.95	1946
December	3.20	1.26	9.29	3.66	3.56	1.40	1931

[a]Period of record: 1931-1960 (30 years).

Source: Adapted from U. S. NRC (1979) Final Environmental Statement, Page 2-2, Table 2.2.
Original Source: Plateau Resources, Limited, *Application for Source Material License*, Table 2.2-2, p. 2-8, Apr. 3, 1978.

1.2 TOPOGRAPHY

The following text is reproduced from Section 2.3 of the Final ES.

The site is located on a "peninsula" platform tilted slightly to the south-southeast and surrounded on almost all sides by deep canyons, washes, or river valleys. Only a narrow neck of land connects this platform with high country to the north, forming the foothills of the Abajo Mountains. Even along this neck, relatively deep stream courses intercept overland flow from the higher country. Consequently, this platform (White Mesa) is well protected from runoff flooding, except for that caused by incidental rainfall directly on the mesa itself. The land on the mesa immediately surrounding the White Mesa site is relatively flat.

1.3 ARCHEOLOGICAL RESOURCES

The following discussion of archeological sites is adapted from Section 2.5.2.3 of the Final ES.

1.3.1 Archeological Sites

Archeological surveys of portions of the entire project site were conducted between the fall of 1977 and the spring of 1979. The total area surveyed contained parts of Section 21, 22, 27, 28, 32, and 33 of T37S, R22E, and encompassed 2,000 acres (809 ha), of which 200 acres (81 ha) are administered by the U. S. Bureau of Land Management and 320 acres (130 ha) are owned by the State of Utah. The remaining acreage is privately owned. During the surveys, 121 sites were recorded and all were determined to have an affiliation with the San Juan Anasazi who occupied this area of Utah from 0 A.D. to 1300 A.D. All but 22 of the sites were within the project boundaries.

Table 1.3-1, adapted from Final ES Table 2.18, summarizes the recorded sites according to their probable temporal positions. The dates of occupation are the best estimates available, based on professional experience and expertise in the interpretation of archeological evidence. Available evidence suggests that settlement on White Mesa reached a peak in perhaps 800 A.D. Occupation remained at approximately that level until some time near the end of Pueblo II or in the Pueblo II/Pueblo III transition period. After this period, the population density declined sharply, and it may be assumed that the White Mesa was, for the most part, abandoned by about 1250 A.D.

Archeological test excavations were conducted by the Antiquities Section, Division of State History, in the spring of 1978, on 20 sites located in the area later to be occupied by tailings cells 2, 3 and 4. Of these sites, 12 were deemed by the State Archeologist to have significant National Register potential and four possible significance. The primary determinant of significance in this study was the presence of structures, though storage features and pottery artifacts were also common.

In the fall of 1978, a surface survey was conducted on much of the previously unsurveyed portions of the proposed mill site. Approximately 45 archeological sites were located during this survey, some of which are believed to be of equal or greater significance than the more significant sites form the earlier study. Determination of the actual significance of all untested sites would require additional field investigation.

TABLE 1.3-1

Distribution of Recorded Sites According to Temporal Position

Temporal position	Approximate dates (A.D.)*a*	Number of sites
Basket Maker III	575-750	2
Basket Maker III/Pueblo I	575-850	27
Pueblo I	750-850	12
Pueblo I/Pueblo II	850-950	13
Pueblo II	950-1100	14
Pueblo II/Pueblo III	1100-1150	12
Pueblo III	1150-1250	8
Pueblo II+	*b*	5
Multicomponent	*c*	3
Unidentified	*d*	14

a Includes transitional periods.

b Although collections at these locations were lacking in diagnostic material, available evidence indicates that the site would have been used or occupied no earlier than 900 A.D. and possibly later.

c Ceramic collections from each of these sites indicate an occupation extending from Pueblo I through Pueblo II and into Pueblo III.

d These sites did not produce evidence strong enough to justify any identification.

Source: Adapted from Dames & Moore (1978b) (ER), Table 2.3-2, U. S. NRC (1979) Final Environmental Statement, Page 2-20, Table 2.18, and from supplementary reports on project archeology.

Pursuant to 10 CFR Part 63.3, the NRC submitted on March 28, 1979, a request to the Keeper of the National Register for a determination of eligibility for the area which had been surveyed and tested. The area contained 112 archeological sites and six historical sites. The determination by the Keeper of the National Register on April 6, 1979, was that the White Mesa Archeological District is eligible for inclusion in the National Register.

1.3.2 Current Status of Excavation

Archeological investigations for the entire mill site and for Cells 1-I through Cell 4 were completed with the issuance of four separate reports covering 30 sites, excluding re-investigations. (Lindsay 1978, Nielson 1979, Casjens et al 1980, and Agenbroad et al 1981).

The sites reported as excavated are as follows:

6380	6394	6437
6381	6395	6684
6384	6396	6685
6385	6397	6686
6386	6403	6697
6387	6404	6698
6388	6420	6699
6391	6429	6754
6392	6435	6757
6393	6436	7754

Sites for which excavation has not been required are:

6379	6441	7658	7690
6382	6443	7659	7691
6405	6444	7660	7693

6379	6441	7658	7690
6382	6443	7659	7691
6405	6444	7660	7693

The sites remaining to be excavated are (continued):

6408	6445	7661	7696
6421	6739	7665	7700
6427	6740	7668	7752
6430	7653	7675	7876
6431	7655	7684	8014
6432	7656	7687	
6439	7657	7689	

1.4 SURFACE WATER

The following description of undisturbed surface water conditions is adapted from Section 2.6.1 of the Final ES. Since construction, the mill has been designed to prevent runon or runoff of storm water. No perennial surface water drainages exist on the site. The description of surface water quality in subsection 1.4.2 reflects baseline sampling performed in July 1977 - March 1978. Continuous monitoring of surface water is not possible due to lack of streamflow.

1.4.1 Surface Water Description (Final ES Section 2.6.1.1)

The mill site is located on White Mesa, a gently sloping (1% SSW) plateau that is physically defined by the adjacent drainages which have cut deeply into regional sandstone formations. There is a small drainage area of approximately 62 acres (25 ha) above the site that could yield surface runoff to the site. Runoff from the project area is conducted by the general surface topography to either

snowmelt and local rainstorms (particularly thunderstorms). Surface runoff from approximately 384 acres (155 ha) of the project site drains westward and is collected by Westwater Creek, and runoff from another 384 acres (155 ha) drains east into Corral Creek. The remaining 713 acres (289 ha) of the southern and southwestern portions of the site drain indirectly into Cottonwood Wash (Dames & Moore, 1978b, p. 2-143). The site and vicinity drainages carry water only on an intermittent basis. The major drainages in the project vicinity are depicted in Figure 1.4-1 and their drainages tabulated in Table 1.4-1. Total runoff from the site (total yield per watershed area) is estimated to be less than 0.5 inch (1.3cm) annually (Dames & Moore, 1978b, p. 2-143).

There are no perennial surface waters on or in the vicinity of the project site. This is due to the gentle slope of the mesa on which the site is located, the low average annual rainfall of 11.8 inches (29.7 cm) per year at Blanding (Dames & Moore, 1978b, p. 2-168), local soil characteristics and the porous nature of local stream channels. Prior to construction, three small ephemeral catch basins were present on the site to the northwest and northeast of the scale house.

Corral Creek is an intermittent tributary to Recapture Creek. The drainage area of that portion of Corral Creek above and including drainage from the eastern portion of the site is about 5 square miles (13 km^2). Westwater Creek is also an intermittent tributary of Cottonwood Wash. The Westwater Creek drainage basin covers nearly 27 square miles (70 km^2) at its confluence with Cottonwood Wash 1.5 miles (2.5 km) west of the project site. Both Recapture Creek and Cottonwood Wash are similarly intermittently active, although they carry water more often and for longer periods of time due to their larger watershed areas. They both drain to the south and are tributaries of the San Juan River. The confluences of Recapture Creek and Cottonwood Wash with the San Juan River are approximately 18 miles (29 km) south of the project site. The San Juan River, a major tributary for the upper Colorado River, has a drainage of 23,000 square miles

(60,000 km^2) measured at the USGS gauge to the west of Bluff, Utah (Dames & Moore, 1978b, p. 2-130).

● 1 USGS GAUGE NO. 09376900
● 2 USGS GAUGE NO. 09378630
● 3 USGS GAUGE NO. 09378700

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Colorado Plateau Operations
2764 Compass Drive Ste 201 Grand Junction CO 81506

FIGURE 4-1
Drainage Map of the Vicinity of the White Mesa Mill

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CHKD BY	DATE	of
APP	SCALE As Shown	

TABLE 1.4-1

Drainage Areas of Project Vicinity and Region

Basin description	Drainage area km²	Drainage area sq. miles
Corra[illegible] at confluence with Recapture Creek	15.0	5.8
Westwater Creek at confluence with Cottonwood Wash	68.8	26.6
Cottonwood Wash at USGS gage west of project site	<531	<205
Cottonwood Wash at confluence with San Juan River	<860	<332
Recapture Creek at USGS gage	9.8	3.8
Recapture Creek at confluence with San Juan River	<518	<200
San Juan River at USGS gage downstream at Bluff, Utah	<60,000	<23,000

Source: Adapted from Dames & Moore (1978b), Table 2.6-3

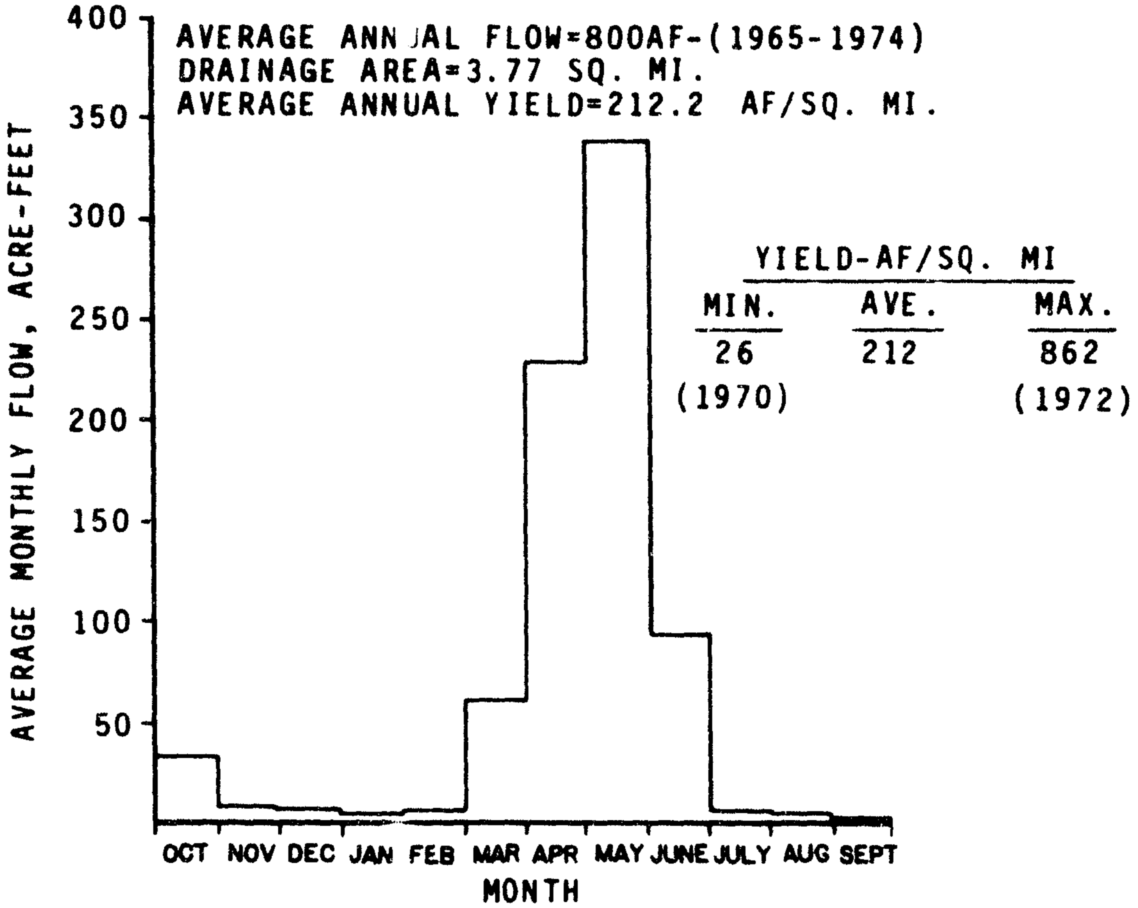
Storm runoff in these streams is characterized by a rapid rise in the flow rates, followed by rapid recession primarily due to the small storage capacity of the surface soils in the area. For example, on August 1, 1968, a flow of 20,500 cfs (581 m^3/sec) was recorded in Cottonwood Wash near Blanding. The average flow for that day, however, was only 4,340 cfs (123 m^3/sec). By August 4, the flow had returned to 16 cfs (0.5 m^3/sec) (Dames & Moore, 1978b, p. 2-135). Monthly streamflow summaries are presented in Figure 1.4-2 for Cottonwood Wash and Recapture Creek. Flow data are not available for the two smaller water courses closest to the project site, Corral Creek and Westwater Creek, because these streams carry water infrequently and only in response to local heavy rainfall and snowmelt, which occurs primarily in the months of April, August, and October. Flow typically ceases in Corral and Westwater Creeks within 6 to 48 hours after precipitation or snowmelt ends.

1.4.2 Surface Water Quality (Final ES Section 2.6.1.2)

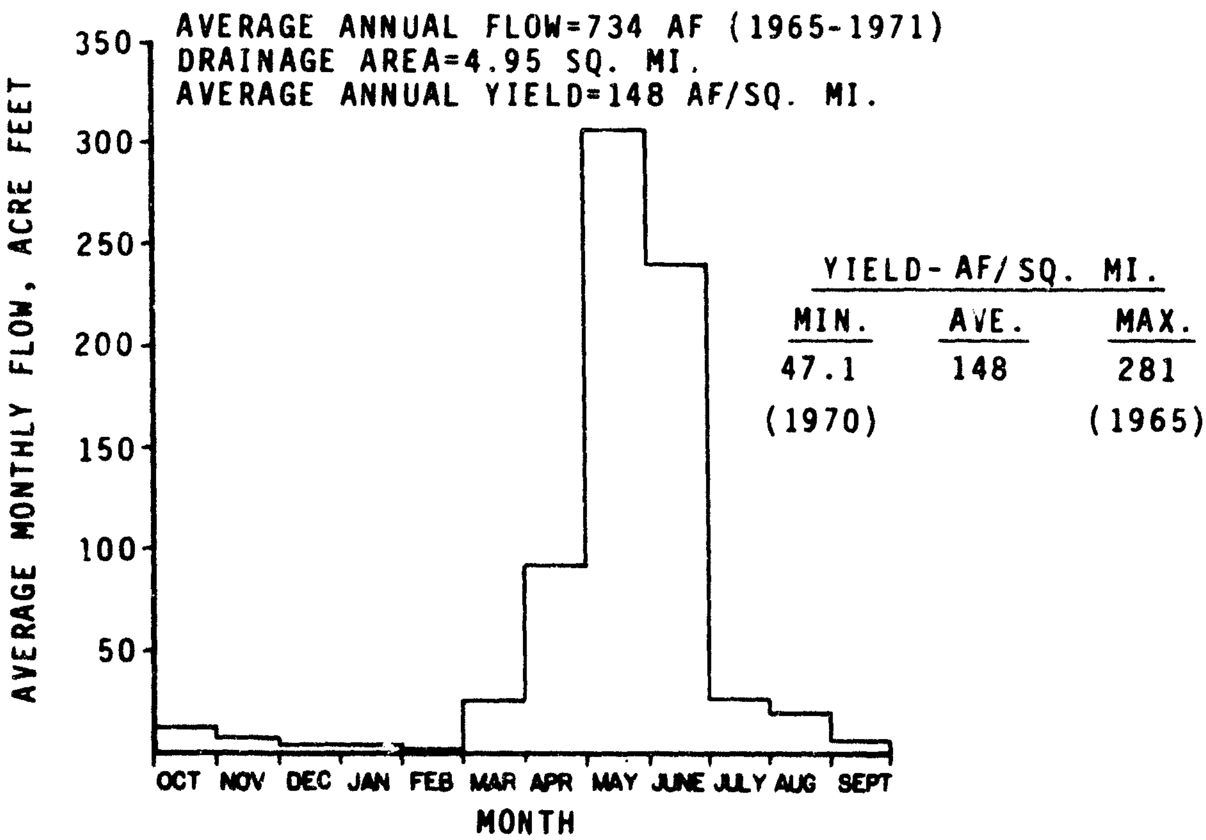
Sampling of surface water quality in the project vicinity began in July 1977 and continued through March 1978. Baseline data describe and evaluate existing conditions at the project site and vicinity. Sampling of the temporary on-site surface waters (two catch basins) has been attempted but without success because of the lack of naturally occurring water in these basins. The basin to the northeast of the mill site has been filled with well water to serve as a nonpotable water source during construction of office and laboratory buildings in conjunction with the mill (approximately six months). This water has not been sampled but presumably reflects the poor quality associated with local groundwater. Sampling of ephemeral surface waters in the vicinity was possible only during major precipitation events, as these streams are normally dry at other times.

The locations of the surface water sample sites are presented in Figure 1.4-3. The water quality values obtained for these sample sites are given in Dames & Moore (1978b) Table 2.6-7, and U.S. NRC (1979) Table 2.22. Water quality samples were collected during the spring at several intermittently active streams that drain the project area. These streams include Westwater Creek (S1R, S9) Corral Creek below the small irrigation pond (S3R), the junction of Corral Creek and Recapture Creek (S4R), and Cottonwood Creek (S8R). Samples were also taken from a surface pond southeast of the mill (S5R). No samples were taken at S2R on Corral Creek or at the small wash (S6R) located south of the site.

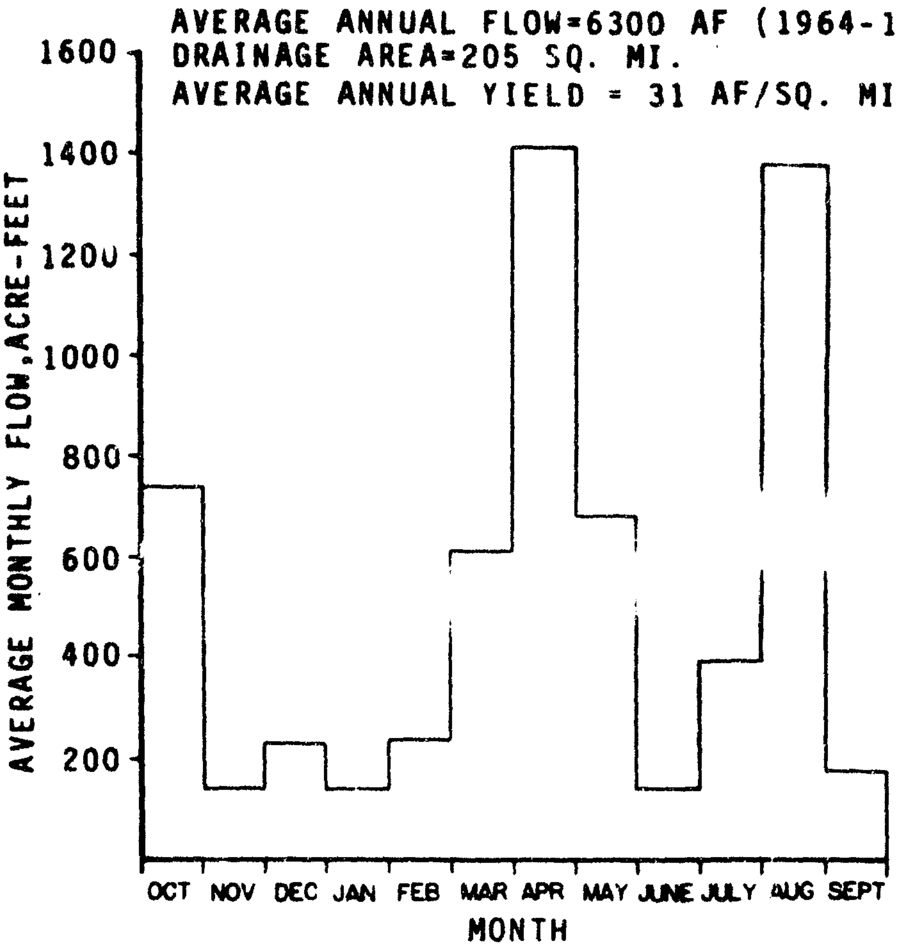
Surface water quality in the vicinity of the mill is generally poor. Waters in Westwater Creek (S1R and S9) were characterized by high total dissolved solids (TDS; mean of 674 mg/liter) and sulfate levels (mean 117 mg of SO_4 per liter). The waters were typically hard (total hardness measured as $CaCO_3$; mean 223 mg/liter) and had an average pH of 8.25. Estimated water velocities for Westwater Creek averaged 0.3 fps (0.08 m/sec) at the time of sampling.



RECAPTURE CREEK NEAR BLANDING
USGS GAUGE 09378630



SPRING CREEK ABOVE DIVERSIONS,
NEAR MONTICELLO
USGS GAUGE 09376900



COTTONWOOD WASH NEAR BLANDING
USGS GAUGE 09378700

YIELD-AF/SQ. MI.		
MIN.	AVE.	MAX.
6.7	31	100
(1969)		([illegible])

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NOTES

1. FOR THE LOCATION OF WATERCOURCES SUMMARIZED, SEE PLATE
2. SOURCE OF DATA. WATER RESOURCES DATA RECORDS. COMPILED AND PUBLISHED BY USGS

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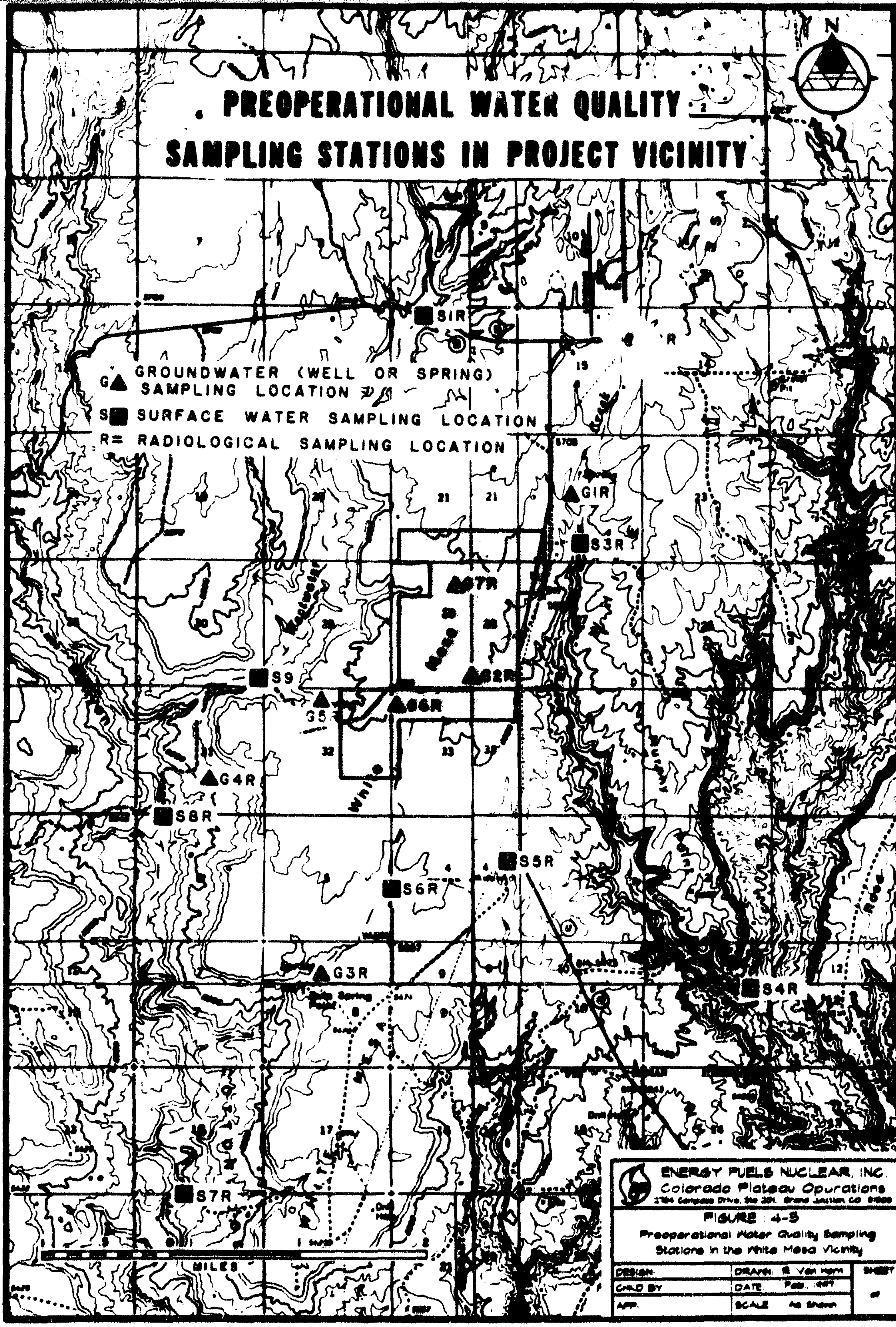
FIGURE 1.4-2
Stream Flow Summary
in the Blanding, Utah Vicinity

DESIGN.	DRAWN. R. Van Horn	SHEET
CHKD BY:	DATE Feb., 1997	of
APPD	SCALE As Shown	


PREOPERATIONAL WATER QUALITY
SAMPLING STATIONS IN PROJECT VICINITY
G▲ GROUNDWATER (WELL OR SPRING) SAMPLING LOCATION
S■ SURFACE WATER SAMPLING LOCATION
R= RADIOLOGICAL SAMPLING LOCATION
S1R
G1R
S3R
G7R
G2R
S9
G5
G6R
G4R
S8R
S5R
S6R
G3R
S4R
S7R
MILES
N
ENERGY FUELS NUCLEAR, INC.
Colorado Plateau Operations
FIGURE 4-3
Preoperational Water Quality Sampling Stations in the White Mesa Vicinity
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SHEET
CHKD BY
DATE Feb. 1987
APP.
SCALE As Shown

Samples from Cottonwood Creek (S8R) were similar in quality to Westwater Creek water samples, although the TDS and sulfate levels were lower (TDS averaged 264 mg/liter; SO_4 averaged 40 mg/liter) during heavy spring flow conditions [80 fps (24 m/sec) water velocity].

The concentrations of TDS increased downstream in Corral Creek, averaging 3,180 mg/liter at S3R and 6,660 mg/liter (one sample) at S4R. Total hardness averaged in excess of 2,000 mg/liter, and pH values were slightly alkaline. Estimated water velocities in Corral Creek were typically less than 0.1 fps (0.03 [illegible]) during sampling.

The spring sample collected a the surface pond south of the project site (S5R) indicated a TDS concentration of less than 300 mg/liter. The water was slightly alkaline with moderate dissolved sulfate levels averaging 42 mg/liter.

During heavy runoff, the concentration of total suspended solids in these streams increased sharply to values in excess of 1,500 mg/liter (U.S. NRC 1979, Table 2.22). High concentrations of certain trace elements were measured in some sampling areas. Levels of mercury (total) were reported as high as 0.002 mg/liter (S3R, 7/25/77; S8R, 7/25/77). Total iron measured in the pond (S5R, 11/10/77) was 9.4 mg/liter. These values appear to reflect groundwater quality in the vicinity and are probably due to evaporative concentration and not due to human perturbation of the environment.

1.5 GROUNDWATER

The following descriptions of groundwater occurrence and characteristics in and around the White Mesa Mill is a summary and compilation of information contained in documents previously submitted to and reviewed by the U.S. NRC. These include the Final ES, the <u>Hydrogeologic</u>

Evaluation of White Mesa Uranium Mill ("Hydrogeologic Evaluation") (Titan, 1994a), Points of Compliance, White Mesa Uranium Mill ("POC") (Titan, 1994b), the Semi-Annual Effluent Report for July through December 1995 and the Semi-Annual Effluent Report for January through June 1996 ("Semi-annual Effluent Reports") (Energy Fuels Nuclear, Inc.).

The Hydrogeologic Evaluation referenced numerous technical studies: Regional geologic and geohydrologic data were obtained primarily from U.S. Geologic Survey (U.S.G.S.) and State of Utah publications; Site-specific information was obtained from the 1978 Environmental Report (Dames & Moore); a 1992 groundwater study report submitted to the NRC by Umetco; a 1991 groundwater hydrology report on White Mesa prepared by Hydro-Engineering; and reports by D'Appolonia (1981, 1982, and 1984). See the Hydrogeologic Evaluation, transmitted herewith in its entirety as Appendix B, for complete data tables, lists of references, and technical details described in this section.

This section is primarily an adaptation of the Hydrogeologic Evaluation. For ease of reference, a copy of the Hydrogeologic Evaluation is included as Appendix B. The POC is included as Appendix C. The Hydrogeologic Evaluation focused on description and definition of the site hydrostratigraphy, and occurrence of groundwater as it relates to the natural and manmade safeguards which protect groundwater resources from potential leakage of tailings cells at the site. The POC summarized and statistically analyzed the available groundwater database, and proposed a revised groundwater monitoring and data review program.

The findings of the Hydrogeologic Evaluation indicated that the tailings located in the existing disposal cells are not impacting groundwater at the site. In addition, it does not appear that future impacts to groundwater would be expected as a result of continuing operations.

These conclusions are based on chemical and hydrogeologic data which show that:

1. The chemistry of perched groundwater encountered below the site does not show concentrations or increasing trends in concentrations of constituents that would indicate seepage from the existing disposal cells;

2. The useable aquifer at the site is separated from the facility by about 1,200 feet of unsaturated, low-permeability rock;

3. The useable aquifer is under artesian pressure and, therefore, has an upward pressure gradient which would preclude downward migration of constituents into the aquifer; and

4. The facility has operated for a period of 16 years and has caused no discernible impacts to groundwater during this period.

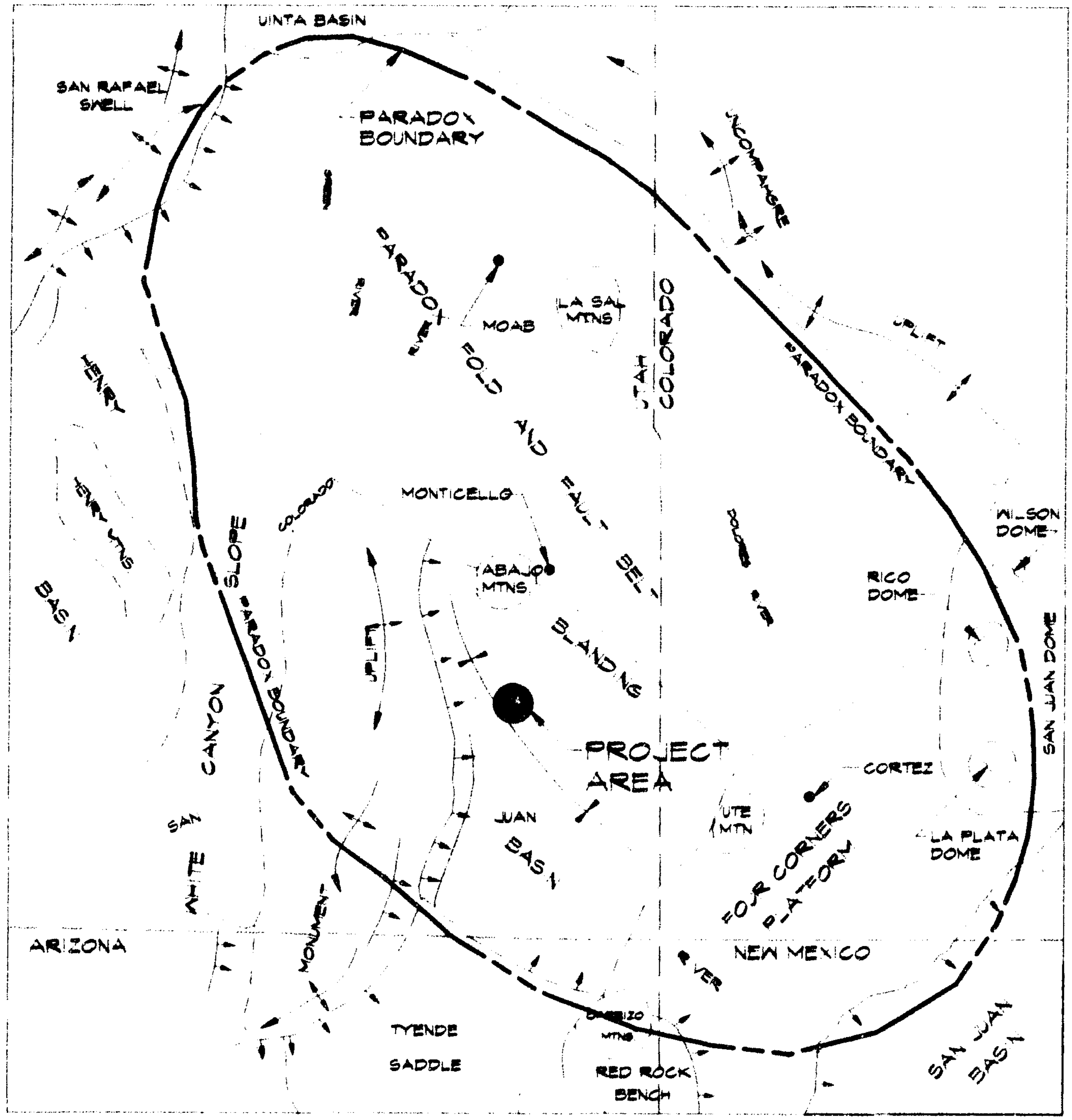
Continued monitoring of groundwater at the site are performed to verify that past, current, and future operations will not impact groundwater. The existing monitoring program and results are presented in the Semi-annual Effluent reports (Appendix A).

1.5.1 Site Description

As shown on Figure 1.1-2, White Mesa Uranium Mill is located in southeastern Utah, approximately six miles south of the town of Blanding. It is situated on White Mesa, a flat area bounded on the east by Corral Canyon, to the west by Westwater Creek, and to the south by Cottonwood Canyon. The site consists of the uranium processing mill, and four engineered lined tailings disposal cells.

1.5.2 Geologic Setting

The White Mesa Uranium Mill site is located near the western edge of the Blanding Basin within the Canyon Lands section of the Colorado Plateau physiographic province (Figure 1.5-1, Hydrogeologic Evaluation Figure 1.1). The Canyon Lands have undergone broad, fairly horizontal uplift and subsequent erosion which have produced the region's characteristic topography represented by high plateaus, mesas, buttes and deep canyons incised into relatively flat lying sedimentary rocks of pre-Tertiary age. Elevations range from approximately 3,000 feet in the bottoms of the deep canyons along the southwestern margins of the region to more than 11,000 feet in the Henry, Abajo and La Sal mountains located to the northwest and northeast of the facility. With the exception of the deep canyons and isolated mountain peaks, an average elevation slightly in excess of 5,000 feet persists over most of the Canyon Lands. The average elevation at the White Mesa Uranium Mill is 5,600 feet mean sea level (MSL).



BOUNDARY OF TECTONIC DIVISION

MONOCLINE SHOWING TRACE OF AXIS AND DIRECTION OF DIP

ANTICLINE SHOWING TRACE OF AXIS AND DIRECTION OF PLUNGE

SYNCLINE SHOWING TRACE OF AXIS AND DIRECTION OF PLUNGE

FIGURE 1.5.1

Colorado Plateau Geologic Map

1.5.2.1 Stratigraphy

Rocks of Upper Jurassic and Cretaceous age are exposed in the canyon walls in the vicinity of the White Mesa Uranium Mill site. These rock units (Figure 1.5-2, Hydrogeologic Evaluation Figure 1.2) include, in descending order, the following. Eolian sand of Quaternary Age and varying thickness overlies the Dakota sandstone and Mancos shale on the mesa. A thin deposit of talus derived from rock falls of Dakota sandstone and Burro Canyon formation mantles the lower valley flanks. Underlying these units are the Cretaceous Age erosional remnants of Mancos shale, Dakota Sandstone, and Burro Canyon formation. Erosional remnants of Mancos shale are only found north of the Mill site. The Brushy Basin, Westwater Canyon, Recapture and Salt Wash Members of the per Jurassic Age Morrison formation are encountered below the Burro Canyon formation. The Summerville formation, Entrada Sandstone and Navajo Sandstone are the deepest units of concern encountered at the site.

1.5.2.2 Local Geologic Structure

In general, the rock formations of the region are flat-lying with dips of 1 to 3 degrees. The rock formations are incised by streams that have formed canyons between intervening areas of broad mesas and buttes. An intricate system of deep canyons along and across hog-backs and cuestas has resulted from faulting, upwarping and dislocation of rocks around the intrusive rock masses, such as the Abajo Mountains. Thus the region is divided up into numerous hydrological areas controlled by structural features.

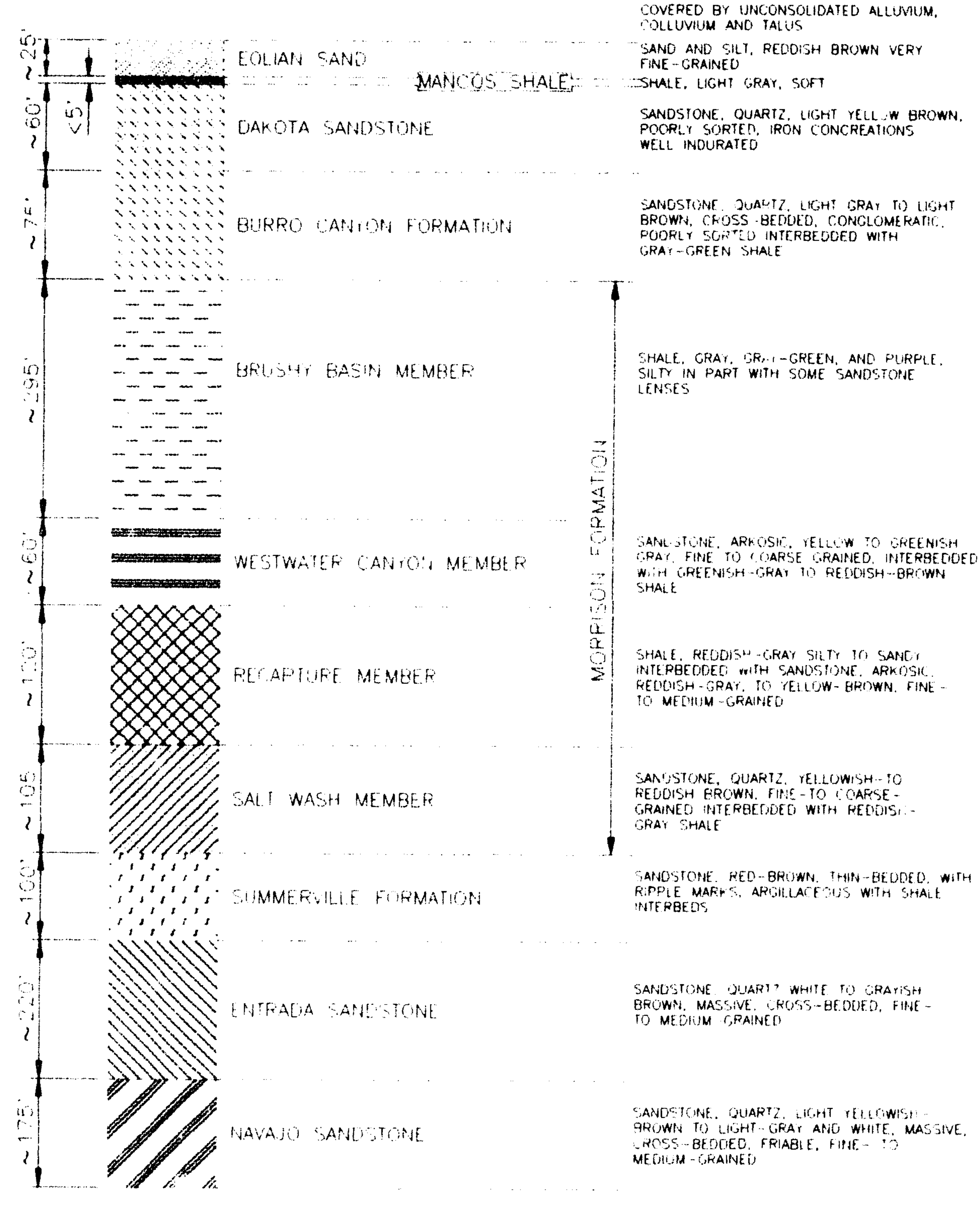


FIGURE 1.5-2

Generalized Stratigraphy of White Mesa

The strata underlying White Mesa have a regional dip of 1/2 to 1 degrees to the south; however, local dips of 5 degrees have been measured. Haynes, et al (1972) includes a map showing the structure at the base of the Dakota formation. Approximately 25 miles to the north, the Abajo Mountains, formed by igneous intrusions, have caused local faulting, upwarping, and displacement of the sedimentary section. However, no faults have been mapped in the immediate vicinity of White Mesa.

1.5.3 Hydrogeologic Setting

On a regional basis, the formations that are recognized as aquifers are: Cretaceous-age Dakota Sandstone and the upper part of the Morrison formation of late Jurassic age; the Entrada Sandstone, and the Navajo Sandstone of Jurassic age; the Wingate Sandstone and the Shinarump Member of the Chinle formation of Triassic age; and the DeChelle Member of the Cutler formation of Permian age.

Recharge to aquifers in the region occurs by infiltration of precipitation into the aquifers along the flanks of the Abajo, Henry and La Sal Mountains and along the flanks of folds, such as Comb Ridge Monocline and the San Rafael Swell, where the permeable formations are exposed at the surface (Figure 1.5-1, Hydrogeologic Evaluation Figure 1.1).

Seventy-six groundwater appropriation applications, within a five-mile radius of the Mill site, are on file with the Utah State Engineer's office. A summary of the applications is presented in Table 1.5-1 and shown on Figure 1.5-3. The majority of the applications is by private individuals and for wells drawing small, intermittent quantities of water, less than eight gpm, from the Burro Canyon formation. For the most part, these wells are located upgradient (north) of the White Mesa Uranium Mill site. Stockwatering and irrigation are listed as primary uses of the majority

of the wells. It is important to note that no wells completed in the perched groundwater of the Burro Canyon formation exist directly downgradient of the site within the five-mile radius. Two water wells which available data indicate are completed in the Entrada/Navajo sandstone (Clow, 1997), exist approximately 4.5 miles southeast of the site on the Ute Mountain Ute Reservation. These wells supply domestic water for the Ute Mountain Ute White Mesa Community, situated on the mesa along Highway 191 (see Figure 1 5-3). Data supplied by the Tribal Environmental Programs Office indicate that both wells are completed in the Entrada/Navajo sandstone, which is approximately 1,200 feet below the ground surface. Insufficient data are available to define the groundwater flow direction in the Entrada/Navajo sandstone in the vicinity of the mill.

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Table 1.5-1
Wells Located Within A 5-Mile Radius of The White Mesa Uranium Mill

Map No.	Water Right	SEC	TWP	RNG	CFS	USE	Depth (ft.)
1	Nielson, Norman and Richard C.	11	37S	22E	0.015	IDS	150-200
2	Guymon, Willard M.	10	37S	22E	0.015	S	82
3	Nielson, J. Rex	10	37S	22E	0.015	IDS	160
4	Nielson, J. Rex	10	37S	22E	0.013	S	165
5	Lyman, Fred S.	10	37S	22E	0.022	IDS	120
6	Plateau Resources	15	37S	22E	0.015	O	740
7	Plateau Resources	15	37S	22E	0.015	O	135
8	Nielson, Norman and Richard C.	14	37S	22E	0.015	IS	150-200
9	Lyman, George F.	15	37S	22E	0.015	S	135
10	Holt, N.E., McLaws, W.	15	37S	22E	0.007	S	195
11	Perkins, Dorothy	21	37S	22E	0.015	S	150
12	Energy Fuels Nuclear, Inc.	21	37S	22E	0.6	O	1600
13	Energy Fuels Nuclear, Inc.	22	37S	22E	1.11	O	1820
14	Utah Launch Complex	27	37S	22E	0.015	D	650
15	Energy Fuels Nuclear, Inc.	28	37S	22E	1.11	O	1885
16	Energy Fuels Nuclear, Inc.	28	37S	22E	1.11	O	1850
17	Energy Fuels Nuclear, Inc.	28	37S	22E	0.015	DSO	1800
18	Energy Fuels Nuclear, Inc.	28	37S	22E	0.6	O	1600
19	Jones, Alma U.	33	37S	22E	0.015	S	200
20	Energy Fuels Nuclear, Inc.	33	37S	22E	0.6	O	1600
21	BLM	8	37S	22E	0.01	S	170
22	Halliday, Fred L.	11	37S	22E	0.015	IS	180
23	Perking, Paul	2	37S	22E	0.015	ID	180
24	Redd, James D.	2	37S	22E	0.1	ID	200
25	Brown, Aroe G.	1	37S	22E	0.015	IS	210
26	Brown, George	1	37S	22E	0.015	IDS	140

Table 1.5-1
Wells Located Within A 5-Mile Radius of
The White Mesa Uranium Mill
(continued)

Map No.	Water Right	SEC	TWP	RNG	CFS	USE	Depth (ft.)
27	Brown, Llo M.	1	37S	22E	0.004	IDS	141
28	Rentz, Alyce M.	1	37S	22E	0.015	ID	180
29	Rogers, Clarence	2	37S	22E	0.015	S	142
30	Perkins, Dorothy	2	37S	22E	0.015	S	100-200
31	Brandt J.R. & C.J.	1	37S	22E	0.015	IDS	160
32	Montella, Frank A.	3	37S	22E	0.015	IDO	190
33	Snyder, Bertha	1	37S	22E	0.1	IDS	196
34	Martineau, Stanley D.	1	37S	22E	0.015	ID	160
35	Kirk, Ronald D. & Catherine A.	1	37S	22E	0.015	IDS	160
36	Palmer, Ned J. and Marilyn	1	37S	22E	0.015	IDS	0
37	Grover, Jess M.	1	37S	22E	0.015	S	160
38	Monson, Larry	1	37S	22E	0.015	IDS	140
39	Neilson, Norman and Richard	1	37S	22E	0.015	IS	132
40	Watkins, Henry Clyde	1	37S	22E	0.015	IS	150
41	Shumway, Glen & Eve	15	37S	22E	0.015	IS	60
42	Energy Fuels Nuclear, Inc. (not drilled)	21	37S	22E	0.600	O	1600
43	Energy Fuels Nuclear, Inc. (#1)	28	37S	22E	1.100	O	1860
44	Watkins, Ivan R	1	37S	22E	0.200	S	185
45	Waukesha of Utah	3	37S	22E	0.015	D	226
46	Simpson, William	3	37S	22E	0.030	ID	180
47	Guyman, Willard M.	2	37S	22E	0.030	S	164
48	Harrieson, Lynda	2	37S	22E	0.012	IDS	---
49	Hurst, Reed	2	37S	22E	0.015	D	100-300
50	Kaer, Alvin	2	37S	22E	0.015	IDS	100-300
51	Heiner, Gerald B.	2	37S	22E	0.015	ID	75
52	Laws, James A.	2	37S	22E	0.015	IDS	100-300

Table 1.5-1
Wells Located Within A 5-Mile Radius of
The White Mesa Uranium Mill
(continued)

Map No.	Water Right	SEC	TWP	RNG	CFS	USE	Depth (ft.)
53	Laws, J. Parley	2	37S	22E	0.015	IDS	
54	Anderson, Dennis & Edith	2	37S	22E	0.015	IDS	160
55	Guymon, Eugene	2	37S	22E	0.100	IDS	130
56	Guymon, Eugene	2	37S	22E	0.015	S	130
57	Guymon, Dennis & Doris	2	37S	22E	0.030	IDS	210
58	Guymon, Eugene	2	37S	22E	0.115	IDS	100-200
59	Guymon, Eugene	2	37S	22E	0.115	IDS	100-200
60	Perkins, Dorothy	2	37S	22E	0.015	IDS	140
61	Watkins, Ivan R.	1	37S	22E	0.015	IDS	145
62	Roper, Lloyd	34	36S	22E	0.015	ID	180
63	Smith, Lee & Marylynn	34	36S	22E	0.060	IDS	170
64	McDonald, Kenneth P.	34	36S	22E	0.015	IDS	734
65	Brake, John	34	36S	22E	0.015	ID	250
66	Brake, John	34	36S	22E	0.015	IS	150
67	Redd, Parley V. & Reva V.	34	36S	22E	0.015	IS	200
68	C & C Construction	34	26S	22E	0.015	IS	190
69	Guymon, Dean W.	3	37S	22E	0.015	IDS	180
70	Phillips, Elizabeth Ann Hurst	34	36S	22E	0.015	I	165
71	Howe, Leonard R.	3	37S	22E	0.015	O	160
72	Shumway, Mark Eugene	3	37S	22E	0.015	ID	
73	Shumway, Mark Eugene	3	37S	22E	0.015	IDS	150
74	Lyman, Henry M.	3	37S	22E	0.100	IDS	200
75	Uta Mountain Ute	23	38S	22E	0.535	D	-
76	Ute Mountain Ute	23	38S	22E	0.1606	D	1515

Notes:
D - Domestic
I - Irrigation
S - Stockwatering
O - Industrial
SEC - Section
TWP - Township
RNG - Range
CFS - Cubic Feet Per Second

The well yield from wells completed in the Burro Canyon formation within the White Mesa site is generally lower than that obtained from wells in this formation upgradient of the site. For the most part, the documented pumping rates from on-site wells completed in the Burro Canyon formation are less than 0.5 gpm. Even at this low rate, the on-site wells completed in the Burro Canyon formation are typically pumped dry within a couple of hours.

This low productivity suggests that the White Mesa Uranium Mill is located over a peripheral fringe of perched water; with saturated thickness in the perched zone discontinuous and generally decreasing beneath the site, and with conductivity of the formation being very low. These observations have been verified by studies performed for the U.S. Department of Energy's disposal site at Slick Rock, which noted that the Dakota Sandstone, Burro Canyon formation, and upper claystone of the Brushy Basin Member are not considered aquifers due to the low permeability, discontinuous nature, and limited thickness of these units (U.S. DOE, 1993).

1.5.3.1 Hydrostratigraphy

The site stratigraphy is described above in Section 1.5.2.1. The detailed site stratigraphic column with descriptions of each geologic unit is provided on Figure 1.5-2. The following discussion, adapted from the Hydrogeologic Evaluation, focuses on those geologic units at or in the vicinity of the site which have or may have groundwater present.

The presence of groundwater within and in proximity to the site has been documented in three strata: the Dakota Sandstone, the Burro Canyon formation, and the Entrada/Navajo Sandstone. The Burro Canyon formation hosts perched groundwater over the Brushy Basin Member of the Morrison formation at the site.

The Entrada/Navajo Sandstones form one of the most permeable aquifers in the region. This aquifer is separated from the Burro Canyon formation by the Morrison formation and Summerville formation. Water in this aquifer is under artesian pressure and is used by the site's operator for industrial needs and consumption. The artesian conditions present in this aquifer are discussed in Section 1.5.6.4.

Geologic cross sections which illustrate the stratigraphic position of the Entrada/Navajo Sandstone aquifer and intervening strata are shown on Figures 1.5.3-1, 1.5.3-2, and 1.5.3-3 (from Hydrogeologic Evaluation Figures 2.1, 2.2, and 2.3, respectively). The summary of the borehole information supporting the site's stratigraphy, description of the drilling information and boring logs are presented in Appendix A of the Hydrogeologic Evaluation. With the exception of six deep water supply wells installed at various locations around the site and completed in Entrada/Navajo Sandstone, all of the boring data are from wells drilled through the Dakota/Burro Canyon Sandstones and terminated in the Brushy Basin Member. The drilling and logging data indicate that the physical characteristics of the bedrock vary considerably, both vertically and laterally. The following sections discuss the relevance of those strata and their physical characteristics to the site's hydrogeology.

Dakota Sandstone

The Dakota Sandstone is a low- to moderately-permeable formation that produces acceptable quality water at low production rates. Water from this formation is typically used for stock water and/or irrigation.

The Dakota Sandstone is the uppermost stratum in which the tailings disposal cells are sited. At the ground surface, the Dakota Sandstone is overlain by a veneer of reddish-brown clayey or sandy silts

with a thickness of up to 10 feet and extends to depths of 43 to 66 feet below the surface (D'Appolonia, 1982). The Dakota Sandstone at this site is typically composed of moderately hard to hard sandstones with random discontinuous shale (claystone) and siltstone layers. The sandstones are moderately cemented (upper part of formation) to well cemented with kaolinitic clays. The claystones and siltstones are typically 2 to 3 feet thick, although boring WMMW-19 encountered a siltstone layer having a thickness of 8 feet at 33 to 41 feet below the ground surface.

Porosity of the Dakota Sandstone is predominately intergranular. Laboratory tests performed (see Table 1.5.3.1-1, from Hydrogeologic Evaluation Table 2.1) show the total porosity of the sandstone varies from 13.4 to 26.0 percent with an average value of 19.9 percent. The formation is very dry to dry with volumetric water contents varying from 0.6 to 7.1 percent with an average value of 3.0 percent. Saturation values for the Dakota Sandstone vary from 3.7 to 27.2 percent. The hydraulic conductivity values as determined from packer tests range from 9.12E-04 centimeters per second (cm/sec) to 2.71E-06 cm/sec with a geometric mean of 3.89E-05 cm/sec (Dames & Moore, 1978; Umetco, 1992). A summary of hydraulic properties of the Dakota Sandstone is presented in Table 1.5.3.1-2 (Hydrogeologic Evaluation Table 2.2).

Table 1.5.3.1-1
Properties of the Dakota/Burro Canyon Formation
White Mesa Uranium Mill

Formation	Well No. and Sample Interval		Moisture Content (Percent)	Mosture Content Volumetric	Dry Unit Weight (lbs/cu ft)	Porosity (Percent)	Particle Sp. Gr.	Saturation (Percent)	Retained Moisture (Percent)	Liquid Limit (Percent)	Plastic Limit (Percent)	Plasticity Index (Percent)	Rock Type
Dakota	WMMW-16	26.4' - 38.4'	1.5	3.3	135.2	17.9	2.64	18.2	5.1				Sandstone
	WMMW-16	37.8' - 38.4'	0.4	0.8	127.4	22.4	2.63	3.7	6.3				Sandstone
	WMMW-17	27.0' - 27.5'	0.3	0.6	138.8	13.4	2.57	4.8	5.1				Sandstone
	WMMW-17	49.0' - 49.5'	3.6	7.1	121.9	26.0	2.64	27.2	9.6				Sandstone
Burro Canyon	WMMW-16	45.0' - 45.5'	5.6	12.6	140.9	16.4	2.70	77.2		29.6	15.4	14.2	Sandy Mudstone
	WMMW-16	47.5' - 48.0'	2.6	5.9	142.8	12.0	2.60	48.9	4.4				Sandstone
	WMMW-16	53.5' - 54.1'	0.7	1.4	129.0	19.9	2.58	7.1	6.4				Sandstone
	WMMW-16	60.5' - 61.0'	0.1	0.2	117.9	27.3	2.61	0.8	9.9				Sandstone
	WMMW-16	65.5' - 66.0'	2.6	5.5	131.5	19.3	2.62	28.2	7.1				Sandstone
	WMMW-16	73.0' - 73.5'	0.1	0.3	130.3	20.6	2.63	1.3	5.5				Sandstone
	WMMW-16	82.0' - 82.4'	0.1	0.1	134.3	18.5	2.64	0.6	4.8				Sandstone
	WMMW-16	90.0' - 90.7'	0.1	0.3	161.5	2.0	2.64	12.8	0.9				Sandstone
	WMMW-16	91.1' - 91.4'	5.2	9.8	118.1	29.1	2.67	33.8		33.7	16.2	17.5	Claystone
	WMMW-17	104.0' - 104.5'	0.2	0.4	161.4	1.7	2.67	26.6	0.8				Sandstone
Average:			**1.65**	**3.4**	**135**	**17.6**	**2.63**	**21**	**5.5**				

Adapted from: Table 2.1, Hydrogeologic Evaluation.

Table 1.5.3.1-2
Summary of Hydraulic Properties
White Mesa Mill

Boring/Well Location	Test Type	Interval (ft. - ft.)	Document Referenced	Hydraulic Conductivity (ft./yr.)	Hydraulic Conductivity (cm./sec.)
Soils					
6	Laboratory Test	9	D&M	1.2E+01	1.2E-05
7	Laboratory Test	4.5	D&M	1.0E+01	1.0E-05
10	Laboratory Test	4	D&M	1.2E+01	1.2E-05
12	Laboratory Test	9	D&M	1.4E+02	1.4E-04
16	Laboratory Test	4.5	D&M	2.2E+01	2.1E-05
17	Laboratory Test	4.5	D&M	9.3E+01	9.0E-05
19	Laboratory Test	4	D&M	7.0E+01	6.8E-05
22	Laboratory Test	4	D&M	3.9E+00	3.8E-06
			Geometric Mean	2.45E+01	2.37E-05
Dakota Sandstone					
No. 3	Injection Test	28-33	D&M (1)	5.68E+02	5.49E-04
No. 3	Injection Test	33-42.5	D&M	2.80E+00	2.71E-06
No. 12	Injection Test	16-22.5	D&M	5.10E+00	4.93E-06
No. 12	Injection Test	22.5-37.5	D&M	7.92E+01	7.66E-05
No. 19	Injection Test	26-37.5	D&M	7.00E+00	6.77E-06
No. 19	Injection Test	37.5-52.5	D&M	9.44E+02	9.12E-04
			Geometric Mean	4.03E+01	3.89E-05
Burro Canyon Formation					
No. 3	Injection Test	42.5-52.5	D&M	5.80E+00	5.61E-06
No. 3	Injection Test	52.5-63	D&M	1.62E+01	1.57E-05
No. 3	Injection Test	63-72.5	D&M	5.30E+00	5.13E-06
No. 3	Injection Test	72.5-92.5	D&M	3.20E+00	3.09E-06

Table 1.5.3.1-2
Summary of Hydraulic Properties
White Mesa Mill
(continued)

Boring/Well Location		Test Type	Interval (ft. - ft.)		Document Referenced		Hydraulic Conductivity (ft./yr.)	Hydraulic Conductivity (cm./sec.)
No. 3		Injection Test	92.5-107.5		D&M		4.90E+00	4.74E-06
No. 3		Injection Test	122.5-142		D&M		6.00E+01	5.80E-07
No. 9		Injection Test	27.5-42.5		D&M		2.70E+00	2.61E-06
No. 9		Injection Test	42.5-59		D&M		2.00E+00	1.93E-06
No. 9		Injection Test	59-82.5		D&M		7.00E+01	6.77E-07
No. 9		Injection Test	82.5-107.5		D&M		1.10E+00	1.06E-06
No. 9		Injection Test	107.5-132		D&M		3.00E+01	2.90E-07
No. 12		Injection Test	37.5-57.5		D&M		9.01E+01	8.70E-07
No. 12		Injection Test	57.5-82.5		D&M		1.40E+00	1.35E-06
No. 12		Injection Test	82.5-102.5		D&M		1.07E+01	1.03E-05
No. 28		Injection Test	76-87.5		D&M		4.30E+00	4.16E-06
No. 28		Injection Test	87.5-107.5		D&M		3.00E+01	2.90E-07
No. 28		Injection Test	107.5-132.5		D&M		2.00E+01	1.93E-07
WMMW1	(7)	Recovery	92-112		Peel	(2)	3.00E+00	2.90E-06
WMMW3	(7)	Recovery	67-87		Peel		2.97E+00	2.87E-06
WMMW5	(7)	Recovery	95.5-133.5		H-E		1.31E+01	1.27E-05
WMMW5	(7)	Recovery	95.5-133.5		Peel		2.10E+01	2.03E-05
WMMW11	(7)	Recovery	90.7-130.4		H-E	(3)	1.23E+03	1.19E-03
WMMW11	(7)	Single well drawdown	90.7-130.4		Peel		1.63E+03	1.58E-03
WMMW12	(7)	Recovery	84-124		H-E		6.84E+01	6.61E-05
WMMW12	(7)	Recovery	84-124		Peel		6.84E+01	6.61E-05
WMMW14		Single well drawdown	90-120	(5)	H-E		1.21E+03	1.16E-03
WMMW14		Single well drawdown	90-120	(6)	H-E		4.02E+02	3.88E-04
WMMW15		Single well drawdown	99-129		H-E		3.65E+01	3.53E-05
WMMW15	(7)	Recovery	99-129		Peel		2.58E+01	2.49E-05
WMMW16		Injection Test	28.5-31.5		Peel		9.42E+02	9.10E-04
WMMW16		Injection Test	45.5-51.5		Peel		5.28E+01	5.10E-05

Table 1.5.3.1-2
Summary of Hydraulic Properties
White Mesa Mill
(continued)

Boring/Well Location	Test Type	Interval (ft. - ft.)	Document Referenced		Hydraulic Conductivity (ft./yr.)	Hydraulic Conductivity (cm./sec.)
WMMW16	Injection Test	65.5-71.5	Peel		8.07E+01	7.80E-05
WMMW16	Injection Test	85.5-91.5	Peel		3.00E+01	2.90E-05
WMMW17	Injection Test	45-50	Peel		3.10E+00	3.00E-06
WMMW17	Injection Test	90-95	Peel		3.62E+00	3.50E-06
WMMW17	Injection Test	100-105	Peel		5.69E+00	5.50E.06
WMMW18	Injection Test	27-32	Peel		1.14E+02	1.10E-04
WMMW18	Injection Test	85-90	Peel		2.69E+01	2.60E-05
WMMW18	Injection Test	120-125	Peel		4.66E+00	4.50E-06
WMMW19	Injection Test	55-60	Peel		8.69E+00	8.40E-06
WMMW19	Injection Test	95-100	Peel		1.45E+00	1.40E-06
			Geometric Mean		1.05E+01	1.01E-05
Entrada Navajo Sandstones						
WW-1	Recovery		D'Appolonia	(4)	3.80E+02	3.67E-04
WW-1	Multi-well drawdown		D'Appolonia		4.66E+02	4.50E-04
WW-1,2,3	Multi-well drawdown		D'Appolonia		4.24E+02	4.10E-04
			Geometric Mean		4.22E+02	4.08E-04

Notes:
(1) D&M = Dames & Moore, Environmental Report, White Mesa Uranium Project, January, 1978.
(2) Peel = Peel Environmental Services, UMETCO Minerals Corp., Ground Water Study, White Mesa Facility, June 1994.
(3) H-E= Hydro-Engineering, Ground-Water Hydrology at the White Mesa Tailings Facility, July, 1991.
(4) D'Appolonia, Assessment of the Water Supply System, White Mesa Project, Feb. 1981.
(5) Early test data.
(6) Late test data.
(7) Test data reanalyzed by TEC.

Adapted from: Table 2.2. Hydrogeologic Evaluation.

Burro Canyon Sandstone

Directly below the Dakota Sandstone, the borings encountered sandstones and random discontinuous shale layers of the Burro Canyon formation to depths of 91 to 141 feet below the site. The importance of this stratum to the site's hydrogeology is that it hosts perched water beneath the site. Beneath the Burro Canyon formation, the Brushy Basin Member is composed of variegated bentonitic mudstone and siltstone; its permeability is lower than the overlying Burro Canyon formation and prevents downward percolation of groundwater (Haynes, et al, 1972). Observed plasticity of claystones (Umetco, 1992) forming the Brushy Basin Member indicates low potential for open fractures which could increase permeability. Section 1.5.3.2 contains a summary of a drilling program carried out in response to agency requests to obtain additional hydrogeologic data.

Previous investigators have seldom made a distinction between the Dakota and Burro Canyon Sandstones. However, examination of borehole cuttings, cores and geophysical logging methods has allowed separation of the two formations. Although similar to the Dakota, the Burro Canyon formation varies from a very fine- to coarse-grained sandstone. The sand grains are generally poorly sorted. The coarse-grained layers also tend to be conglomeratic. The grains are cemented with both silica and kaolin, but silica-cemented sandstones are dominant. The formation becomes argillaceous near the contact with the Brushy Basin Member.

The saturated thickness in the Burro Canyon formation varies across the project area from 55 feet in the northern section to less than 5 feet in the southern area. Some wells are dry, which suggests that the zone of saturation is not continuous. Saturation ceases or is marginal along the western and southern section of the project. The extent toward the east is not defined, but its maximum extent is certainly not beyond the walls of Westwater Creek and Corral Canyons where the Burro Canyon

formation crops out. Perched groundwater elevations and saturated thickness of this formation are shown on Figures 1.5.3.1-4 and 1.5.3.1-5, respectively (from Hydrogeologic Evaluation Figures 2.4 and 2.5).

Hydraulic properties of this stratum have been determined from 12 single, well-pumping/recovery tests and from 30 packer tests. A summary of the hydraulic properties is given in Table 1.5.3.1-2 (Hydrogeologic Evaluation Table 2.2). These tests indicate the hydraulic conductivity geometric mean to be 1.0E-05 cm/sec. The physical properties of the Burro Canyon Sandstone are summarized in Table 1.5.3.1-1. Based on the core samples tested, the sandstones of the Burro Canyon formation vary in total porosity from 1.7 to 27.6 percent, the average being 16.0 percent. Volumetric water content in these sandstones ranges from 0.1 to 7.1 percent, averaging 2.2 percent, with the fine-grained materials having the higher moisture content. Porosities in the claystone layers vary from 16.4 to 29.1 percent with saturation values ranging from 33.8 to 77.2 percent.

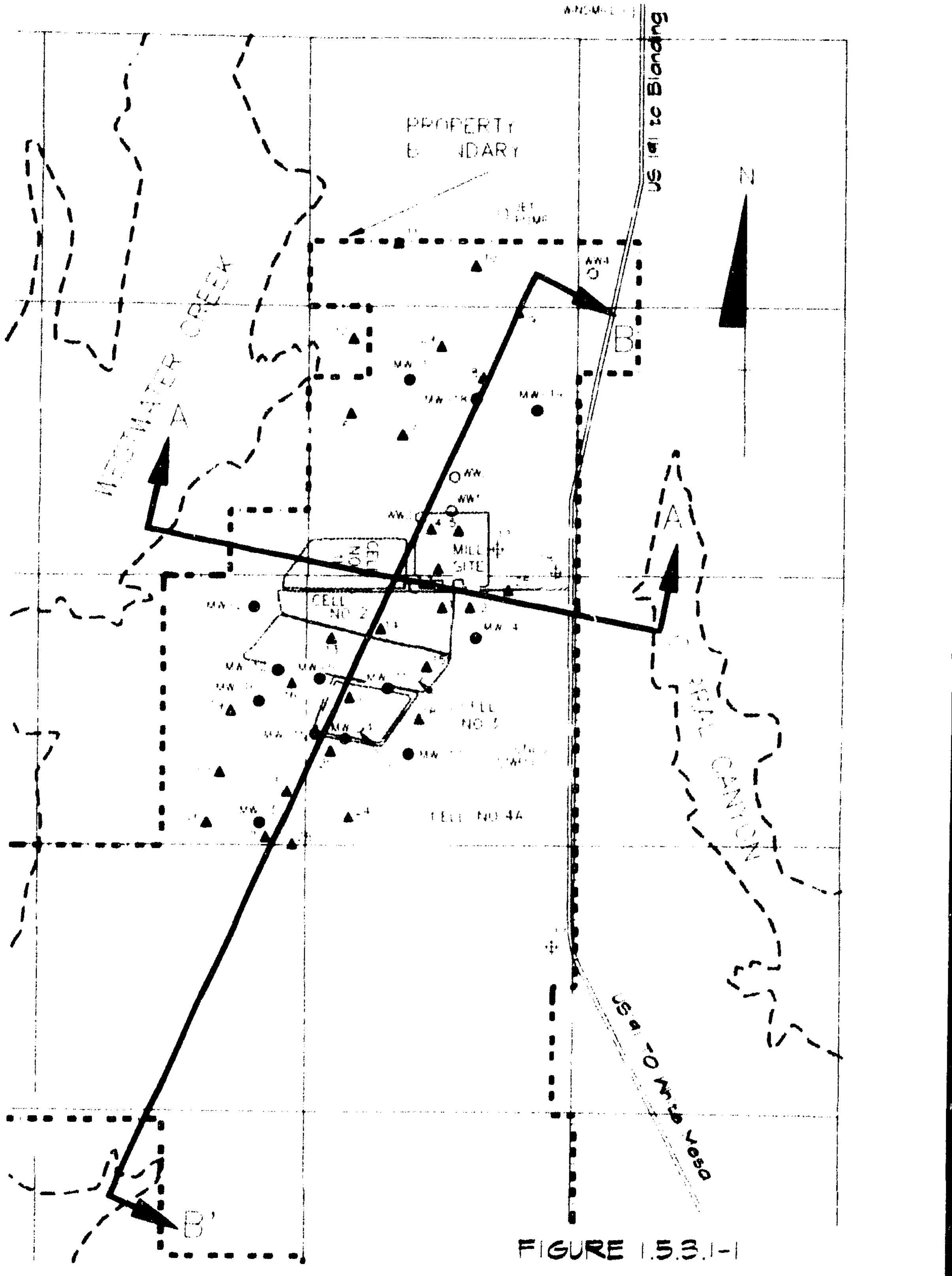


FIGURE 1.5.3.1-1

White Mesa Mill
Site Plan Map showing
Monitor Wells and Borings

SCALE

2000 0 2000 4000 feet

▲ DAMES AND MOORE 1978 BORINGS

○ WATER SUPPLY WELLS D'APPOLONIA (1981)

● EXISTING MONITORING WELLS

EXISTING WATER SUPPLY WELLS

STOCK WELLS

Brushy Basin Member

The Brushy Basin Member of the Morrison formation is the first aquitard isolating perched water in the Burro Canyon formation from the productive Entrada/Navajo Sandstones. The Brushy Basin Member, in contrast to the overlying Dakota Sandstone, is composed of bentonitic mudstone and claystone. Limited site-specific hydraulic property data are available for the Brushy Basin Member.

The thickness of the Brushy Basin Member in this region reportedly varies from 200-450 feet (Dames & Moore, 1978). This stratum was penetrated by six water supply wells [see Figure 1.5.3.1-1 (Hydrogeologic Evaluation Figure 2.1)]and Appendix A of the Hydrogeologic Evaluation) and its thickness was estimated at 275 feet. Borings which terminate in the Brushy Basin Member encounter moderately plastic dark green to dark reddish-brown mudstones. Plastic bentonitic mudstone is not prone to develop fracturing. Hence, competency of this strata, as an aquitard, is very likely.

Entrada/Navajo Aquifer

Within and in proximity to the site, the Entrada/Navajo Sandstones are both prolific aquifers. Since site water wells are screened in both aquifers, they are, from a hydrogeologic standpoint, treated as a single aquifer. The Entrada/Navajo Sandstone is the first useable aquifer of significance documented within the project area. This aquifer is present at depths between 1,200 and 1,800 feet below the surface and is capable of delivering from 150 to 225 gpm of water per well (D'Appolonia, 1981).

Water is present under artesian pressure and is documented to rise by about 800 to 900 feet above the top of Entrada/Navajo Sandstone contact with the overlying Summerville formation. The static water level is about 400 to 500 feet below the surface (Figures 1.5.3.1-2 and 1.5.3.1-3). Section 1.5.6.4. provides a more detailed discussion regarding the artesian conditions of this formation.

The thickness of the strata separating this aquifer from water present in the Burro Canyon formation is about 1,200 feet. This confining layer is competent enough to maintain pressure of 900 feet of water or 390 pounds per square inch (psi) within the Entrada/Navajo Aquifer.

The positioning of this aquifer and its hydraulic head versus other strata is shown on Figures 1.5.3.1-2 and 1.5.3.1-3. In-situ hydraulic pressure of groundwater in the Entrada/Navajo Aquifer is strong evidence of the confining (i.e. "aquitard") properties of the overlying sedimentary section. Due to the presence of significant artesian pressure in this aquifer, any future hydraulic communication between perched water in the Burro Canyon formation and the Entrada/Navajo Aquifer is unlikely.

1.5.3.2 Data Collected in 1994

This subsection contains a summary of a 1994 drilling program carried out in response to a request by the U. S. Nuclear Regulatory Commission (NRC) and the U. S. Environmental Protection Agency (EPA) to further investigate the competence of the Brushy Basin member of the Morrison formation and to provide additional hydrogeologic data. Three vertical and four angle core holes were drilled.

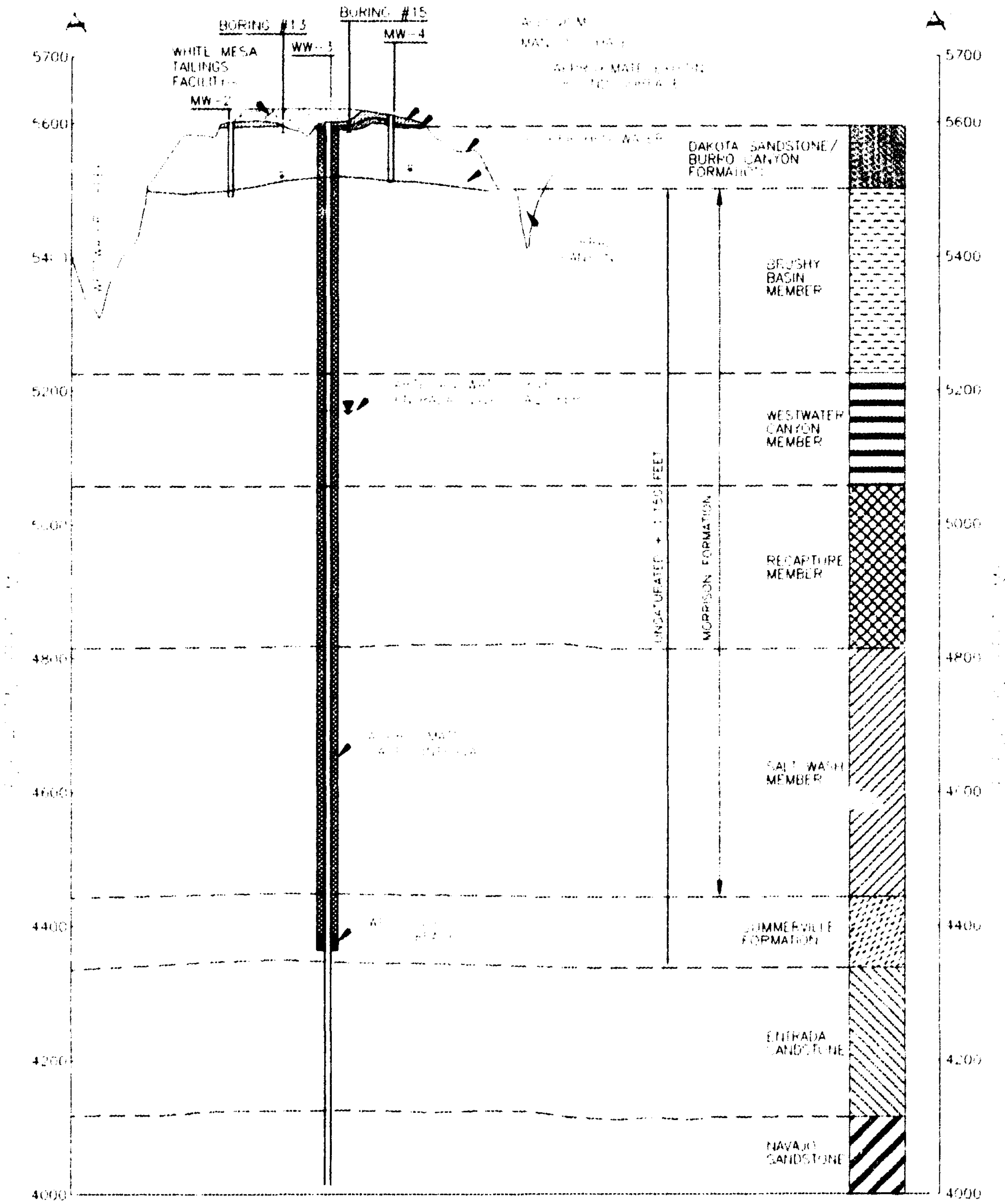


FIGURE 1.5.3.1-2

White Mesa Mill
Section A-A'

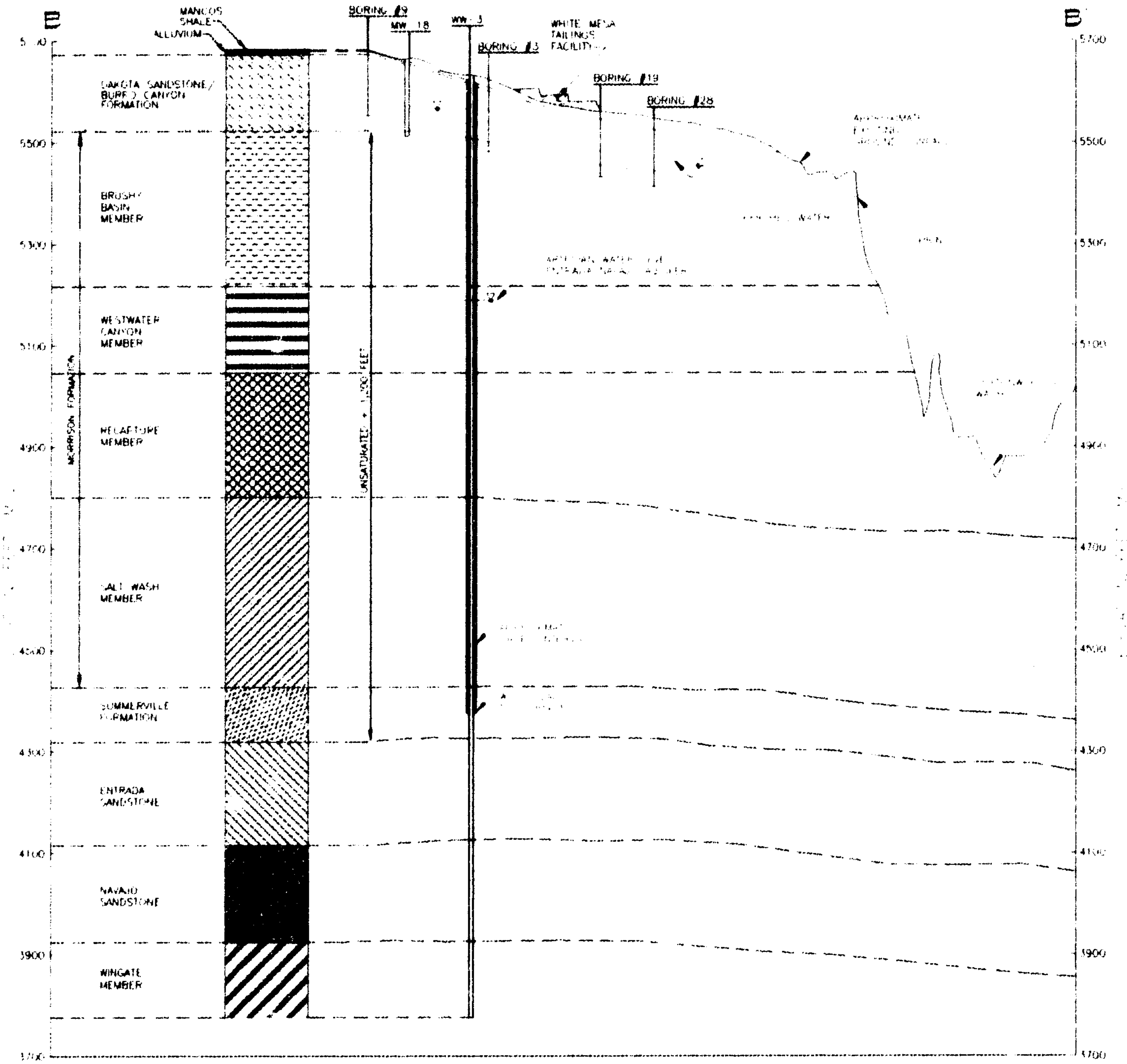


FIGURE 1.5.3.1-3
White Mesa Mill
Section B-B'

The three vertical holes (WMMW-20, WMMW-21, and WMMW-22) were drilled downgradient of the existing monitoring wells. Constant head packer tests were conducted over intervals within the Brushy Basin member to gain information about the horizontal hydraulic conductivity of this unit. Selected cores samples of the Brushy Basin member were analyzed for vertical hydraulic conductivities. The three vertical holes were drilled to sufficient depth to penetrate 20± feet of Brushy Basin Member. Four core holes were drilled along the edge of tailings ponds No. 3 and No. 4. The cores were examined to determine if open fractures were present. Few fractures were observed, and where noted, they were closed and infilled with gypsum. Packer tests were conducted during the drilling of the holes to gain further information about the hydraulic conductivity of the rocks.

Upon completion of drilling, all the geotechnical holes were logged using wireline geophysical methods. A video camera survey was performed in three of the four core holes. The holes were then plugged and abandoned.

Selected cores of the Brushy Basin from all the holes were sent for laboratory measurement of the vertical permeability. The results of these tests are presented in Table 1.5.3.2-1. The hydraulic conductivities calculated from these tests vary from 7.10E-06 cm/sec to 8.90E-04 cm/sec in the Dakota formation, from 9.88E-07 cm/sec to 7.70E-04 cm/sec in the Burro Canyon formation and from 2.30E-07 cm/sec to 1.91E-06 cm/sec in the Brushy Basin member. Three packer tests run within the Brushy Basin member yielded "No Take." Due to the low hydraulic conductivities, measurements could not be made with the equipment available. The hydraulic conductivities of these zones can be expected to be lower than the zones in which actual measurements were made. It can, therefore, be assumed that the hydraulic conductivities of these zones are less than 2.30E-07

cm/sec. Packer tests tend to reflect horizontal hydraulic conductivities which can be expected to be greater than vertical hydraulic conductivities of the same zone.

Slug tests were conducted in wells WMMW-20 and WMMW-22. The test results are shown in Table 1.5.3.2-1. A hydraulic conductivity of 3.14E-06 cm/sec was calculated for WMMW-20 and 9.88E-07 cm/sec (essentially 1.0E-06 cm/sec) for WMMW-22.

Cores from the Brushy Basin were sent to Western Engineers of Grand Junction, Colorado for horizontal and vertical permeability determination. The results of these tests are shown on Table 1.5.3.2-2. The vertical hydraulic conductivities of the cores vary from 5.95E-04 to 7.28E-11 cm/sec. The geometric mean of the vertical permeabilities is 1.23E-08 cm/sec.

For the few analyses conducted for horizontal permeabilities, the results ranged from 1.09E-07 to 6.14E-10 cm/sec and the geometric mean of these values was calculated to be 6.72E-09 cm/sec.

Packer tests were conducted over zones within the Dakota, Burro Canyon and Brushy Basin units. The cores and video surveys of the drill holes showed that the few closed hairline fractures present in the Burro Canyon and Dakota Formations do not substantially affect the hydraulic conductivity of the formations.

TABLE 1.5.3.2-1
Summary of Borehole Tests, 1994 Drilling Program
White Mesa Project, San Juan County, Utah

Well No	Interval	Type of Test	Formation	Hydraulic Conductivity gpd/ft^2	Hydraulic Conductivity cm/sec
WMMW-20	110.5-114.5	Constant Head	Brushy Basin	0.005	2.30E-07
	87.0-90.0	Slug	Burro Canyon	0.015	5.29E-06
WMMW-21	109.5-117.0	Constant Head	Brushy Basin	0.17	8.15E-06
WMMW-22	130.0-140.0	Constant Head	Brushy Basin	-No Take-	
	76-120	Slug	Burro Canyon	0.06	3.14E-06
GH-94-1	34.0-40.0	Constant Head	Dakota	0.16	7.10E-06
	40 -50.0	Constant Head	Dakota	1.18	5.60E-05
	70.0-80.0	Constant Head	Burro Canyon	0.01	9.88E-07
	92.0-100	Constant Head	Burro Canyon	13.1	6.20E-04
	103.0-110.0	Constant Head	Burro Canyon	15.84	7.70E-04
	130.0-140.0	Constant Head	Brushy Basin	3.6	1.70E-04
	163.0-165.0	Constant Head	Brushy Basin	-No Take-	
GH-94-2A	34.0-40.0	Constant Head	Dakota	0.66	3.10E-05
	32.5-40.0	Constant Head	Dakota	18.72	8.90E-04
	50.0-56.0	Constant Head	Dakota	2.30	1.10E-04
	60.0-70.0	Constant Head	Burro Canyon	1.04	4.90E-05
	70.0-80.0	Constant Head	Burro Canyon	4.18	2.00E-04
	80.0-90.0	Constant Head	Burro Canyon	3.02	1.50E-04
	138.0-144.0	Constant Head	Brushy Basin	-No Take-	
GH-94-3	155.0-161.0	Constant Head	Brushy Basin	0.07	3.26E-06
	138.0-144.0	Constant Head	Brushy Basin	0.06	2.70E-06

TABLE 1.5.3.2-2
Results of Laboratory Tests

Well No.	Interval Tested (ft)	Formation Tested	Vertical Permeabilities cm/sec
WMMW-20	92.0-92.5	Brushy Basin	7.96E-11
	95.4-96.0	Brushy Basin	2.96E-09
	104.0-104.4	Brushy Basin	2.43E-09
	105.0-105.5	Brushy Basin	7.28E-11
	109.5-110.0	Brushy Basin	1.02E-09
WMMW-21	94.8-95.3	Brushy Basin	5.78E-06
	106.5-107.0	Brushy Basin	6.38E-10
	114.5-115.0	Brushy Basin	1.46E-07
WMMW-22	122.2-122.7	Brushy Basin	1.08E-06
	126.3-127.2	Brushy Basin	6.94E-10
	133.3-133.7	Brushy Basin	2.11E-09
	137.3-137.8	Brushy Basin	5.95E-04
GH-1	163.0-163.5	Brushy Basin	1.68E-08
	165.0-165.5	Brushy Basin	6.76E-07
GH-2A	161.0-161.5	Brushy Basin	6.73E-09
GH-3	157.0-157.5	Brushy Basin	9.42E-10
GH-4	158.0-158.5	Brushy Basin	2.17E-09

Well No.	Interval Tested (ft)	Formation Tested	Horizonal Permeabilities cm/sec
WMMW-20	95.4-96.0	Brushy Basin	1.09E-07
	105.0-105.5	Brushy Basin	6.14E-10
WMMW-21	94.8-95.3	Brushy Basin	8.31E-10
WMMW-22	137.3-137.8	Brushy Basin	3.67E-08

1.5.4 Climatological Setting

The climate of southeastern Utah is classified as dry to arid continental. The region is generally typified by warm summer and cold winter temperatures, with precipitation averaging less than 11.8 inches annually and evapotranspiration in the range of 61.5 inches annually (Dames and Moore, 1978).

Precipitation in southeastern Utah is characterized by wide variations in seasonal and annual rainfall and by long periods of no rainfall. Short duration summer storms furnish rain in small areas of a few square miles and this is frequently the total rainfall for an entire month within a given area. The average annual precipitation in the region ranges from less than 8 inches at Bluff to more than 16 inches on the eastern flank of the Abajo Mountains, as recorded at Monticello. The mountain peaks in the Henry, La Sal and Abajo Mountains may receive more than 30 inches of precipitation, but these areas are very small in comparison to the vast area of much lower precipitation in the region

1.5.5 Perched Groundwater Characteristics

The perched water in the Burro Canyon formation originates in the areas north of the site as shown by the direction of groundwater flow from north to south (see Figure 1.5.5-1). The thickness of saturation is greatest in the northern and central sections of the site and reduces toward the south. The configuration of the perched water table and map of saturated thicknesses are provided on Figures 1.5.5-1 and 1.5.5-2, respectively. The topography of the Brushy Basin Member which defines the bottom of the perched water is shown on Figure 1.5.5-3 (Hydrogeologic Evaluation Figure 2.6).

The groundwater from the Burro Canyon formation discharges into the adjacent canyons (Westwater Creek and Corral Canyon) as evidenced by springs and productive vegetation patterns. Some part of the groundwater flow may enter the Brushy Basin Member via relief fractures which occur in close proximity to the canyons. The location of the canyons which bound the White Mesa on the west, east and south are shown on Figure 1.5.3-1.

The geometric mean of the hydraulic conductivity of the saturated part of Burro Canyon formation is 1.0E-05 cm/sec. The water yield per well is very low, as documented by nine pumping tests, and is typically below 0.5 gpm. In contrast to the very low pumping rates observed in eight wells, Well WMMW-11 produced a higher yield on the order of 2 gpm. This higher yield may be attributable to the presence of localized high-permeability material, such as a lense of coarser material acting as a drainage gallery. Localized fracturing could also cause a similar effect, but few fractures have been documented during drilling of this or other wells (Umetco, 1992; Dames & Moore, 1978).

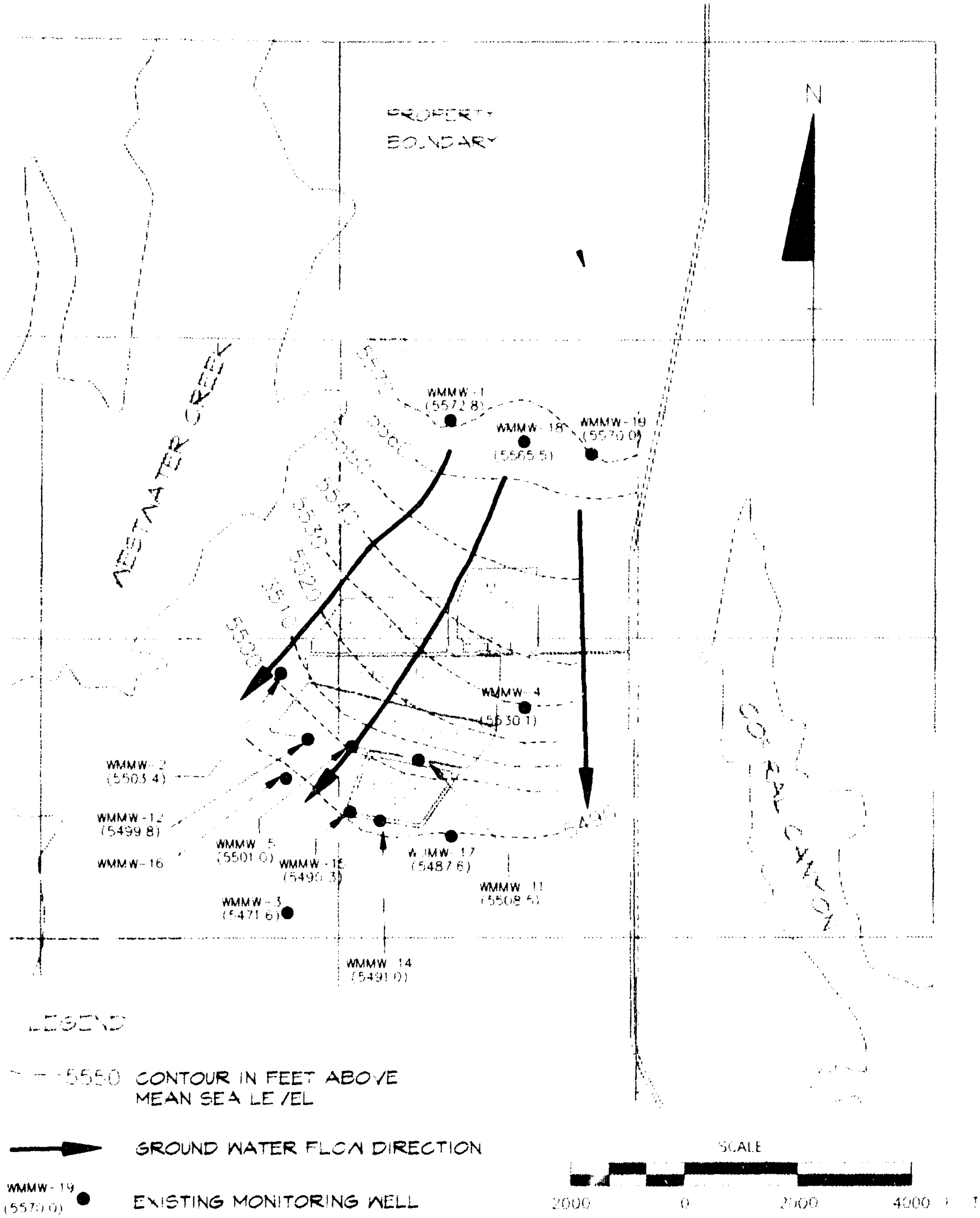


FIGURE 1.5.5-1 : Perched Ground Water Levels

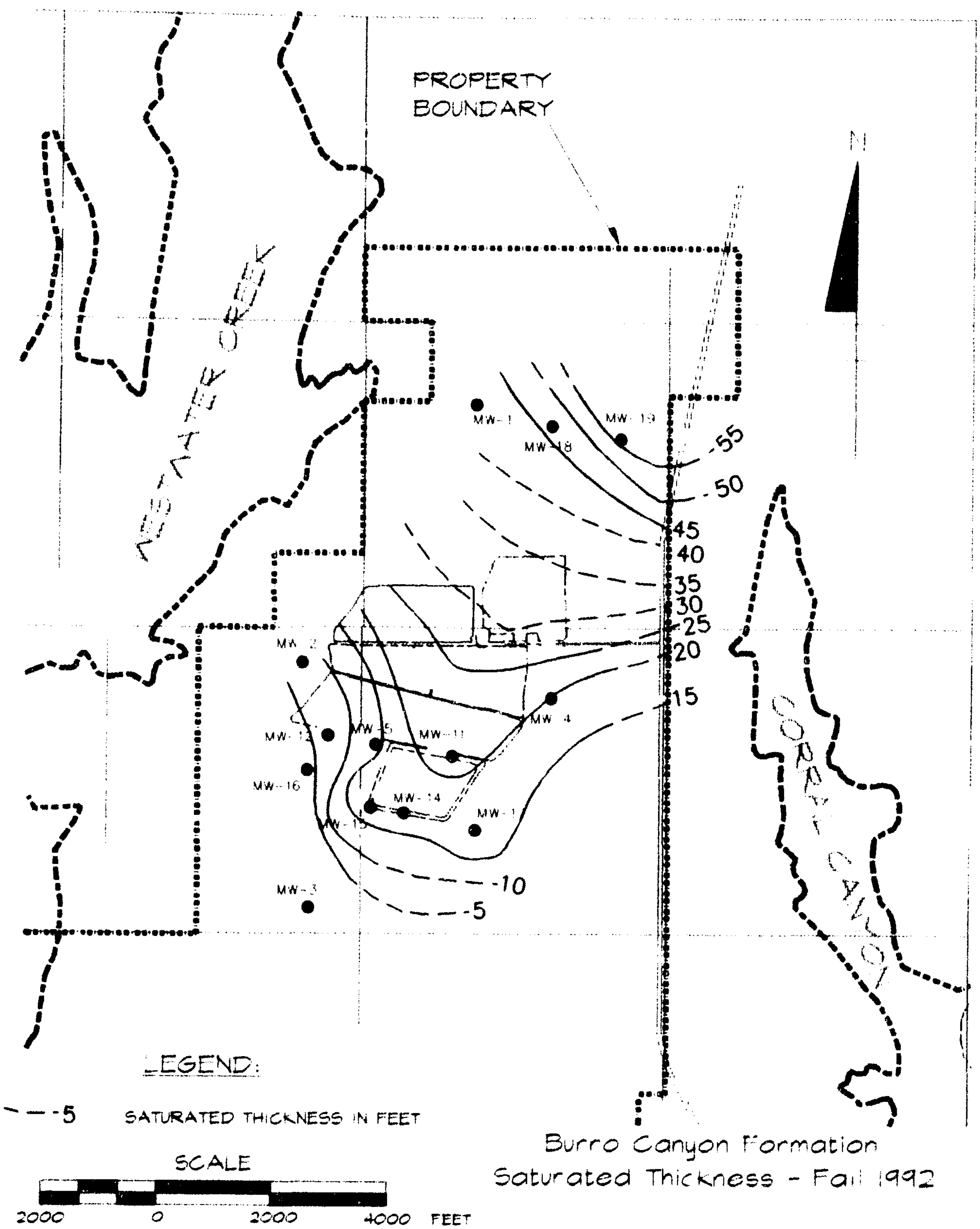


FIGURE 1.5.5-2: Saturated Thickness of Perched Water

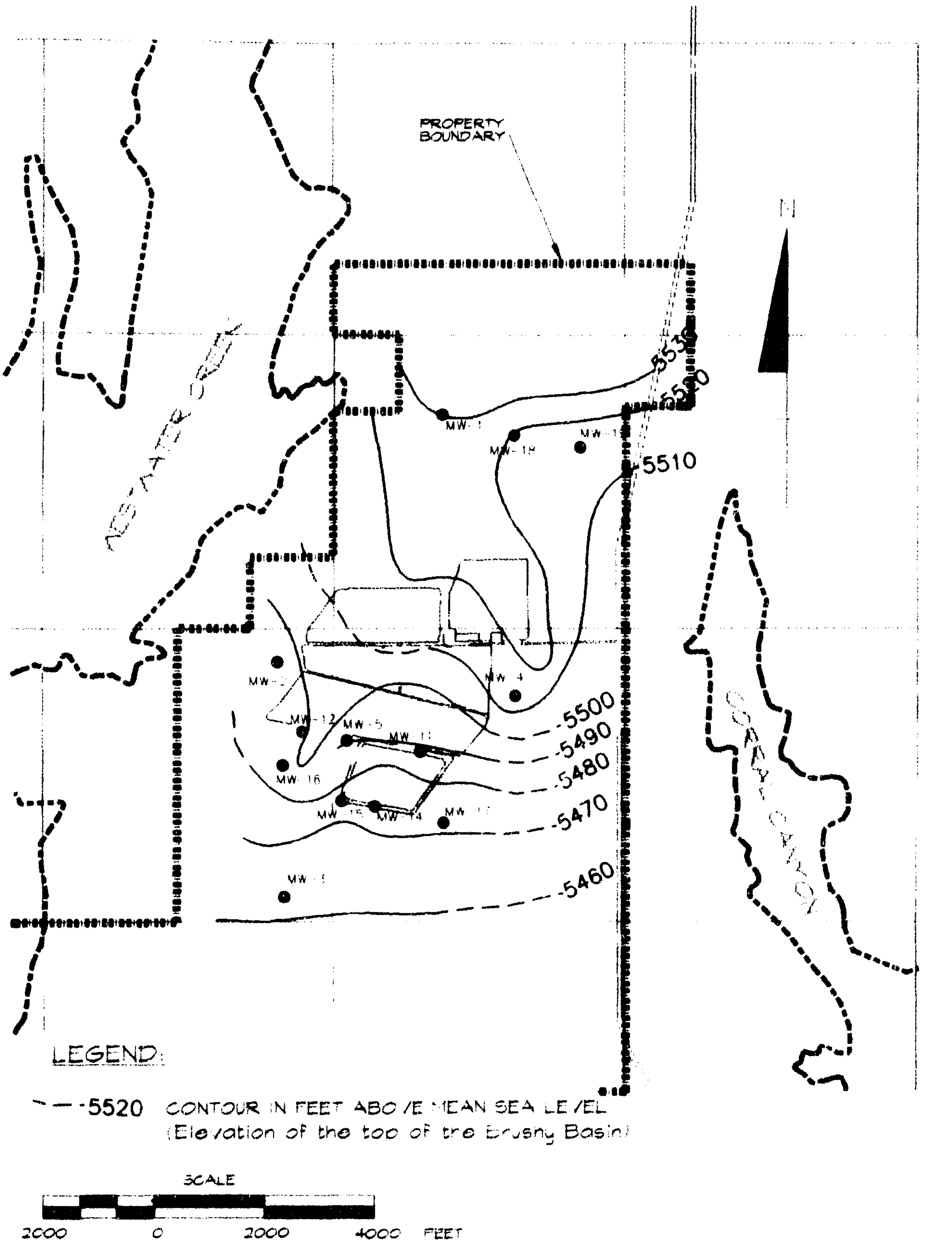


FIGURE 1.5.5-3: Topography of the Brushy Basin Formation

Table 1.5.5-1
Monitoring Well and Ground Water Elevation Data
White Mesa Uranium Mill

Well Name	Date Installed	Total Depth	Perforations	Water Level			Measuring Point	
				Date	Depth (ft.)	Elevation (ft.-MSL)	Above LDS (ft.)	Elevation (ft.-MSL)
WMMW-1	Sep-79	117'	92'-112'	11/19/92	75.45	5572.77	2.0	5648.22
WMMW-2	Sep-79	128.8'	85'-125'	11/19/92	110.06	5503.43	1.8	5613.49
WMMW-3	Sep-79	98'	67'-87'	11/19/92	83.74	5471.58	2.0	5555.32
WMMW-4	Sep-79	123.6'	92'-12'	11/19/92	92.42	5530.15	1.6	5622.57
WMMW-5	May-80	136'	95.5'-133.5'	11/19/92	108.32		0.6	5609.33
WMMW-6	May-80		This well was destroyed during construction of Cell 3.					
WMMW-7	May-80		This well was destroyed during construction of Cell 3.					
WMMW-8	May-80		This well was destroyed during construction of Cell 3.					
WMMW-11	Oct-82	135'	90.7'-130.4'	11/19/92	102.53	5508.55	2.4	5611.08
WMMW-12	Oct-82	130.3'	84'-124'	11/19/92	109.68	5499.77	0.9	5609.45
WMMW-13	Oct-82	118.5'	This well was destroyed during construction of Cell 4A.					
WMMW-14	Sep-89	129.1'	90'-120'	11/19/92	105.34	5491.05	0.0	5596.39
WMMW-15	Sep-89	138'	99'-129'	11/19/92	108.28	5490.34	0.8	5598.62
WMMW-16	Dec-92	91.5'	78.5'-88.5'	7/12/92	Dry		1.5	
WMMW-17	Dec-92	110'	90'-100'	11/30/92	87.56		1.5	
WMMW-18	Dec-92	148.5'	103.5'-133.5'	11/30/92	92.11		1.5	
WMMW-19	Dec-92	149'	101'-131'	10/12/92	85.00		1.5	
#9-1	May-80	33.5'	10'-30'	3/4/91	Dry		1.8	5622.83
#9-2	May-80	62.7'	39.7"-59.7"	3/4/91	Dry		2	5622.58
#10-2	May-80	33.5'	11.3'-31.3'	3/4/91	Dry		2	5633.58
#10-2	May-80	62.2'	39.2'-59.2'	3/4/91	Dry		2.1	5633.39

Notes:

1. Well locations provided on Figure 1.5.3-1.
2. LDS = leak detection system.
3. ft.-MSL = feet - mean sea level.

dapted from: Table 2.3, Hydrogeologic Evaluation

1.5.5.1 Perched Water Quality

Groundwater monitoring of the Burro Canyon formation saturated zone has been conducted at the White Mesa facility since 1979. Table 1.5.5-1 (Hydrogeologic Evaluation Table 2.3) provides a list of wells that have been constructed for monitoring purposes at the facility. Figure 1.5.3.1-1 indicates the locations of thes ells. The water quality data obtained from these wells are provided both in tabular and graphica rm in Appendix B of the Hydrogeologic Evaluation, with more recent data in the Semi-annual Effluent Report for July through December 1995 and the Semi-annual Effluent Report for January through June 1995 (Energy Fuels Nuclear, Inc).

Examination of the spatial distribution and temporal trends (or lack thereof) in concentrations of analyzed constituents provides three significant conclusions:

1. The quality of perched water throughout the site shows no discernible pattern in variation,

2. The water is generally of poor quality [moderately high values of chloride, sulfate, and totally dissolved solids (TDS)], and

3. Analytical results show that operations at the White Mesa Uranium Mill have not impacted the quality of the perched water of the Burro Canyon formation.

To arrive a these conclusions, comparisons of the water chemistries from the various wells were analyzed in the Hydrogeologic Evaluation by graphical techniques. The purpose of the comparisons was to determine if trends in chloride, which would be associated with water from the tailings ponds,

were increasing in the perched water of the Burro Canyon formation. The trilinear plot and the Stiff diagram were used to conduct a preliminary evaluation of differences or similarities in water quality data between wells. The following is a summary of the conclusions drawn in the Hydrogeologic Evaluation.

Temporal and Spatial Variations

The trilinear plots and Stiff diagrams presented in the Hydrogeologic Evaluation (Figures 2.7-2.10) show that the water from all wells is of the sulfate (anion) type. The cation definition of the water type is variable. Of the 13 wells analyzed for water chemistry, four fall in the calcium-sulfate type category, four fall in the (sodium plus potassium)-sulfate type, two samples classify as the magnesium-sulfate type. Five samples have no dominant cation type. However, these five samples tend to classify more closely to the (sodium plus potassium)-sulfate and calcium-sulfate types.

The spatial variability of water quality data within the Burro Canyon formation is illustrated on Hydrogeologic Evaluation Figures 2.7 through 2.13, and the data Tabled in Appendix B of the Hydrogeologic Evaluation. Upgradient Monitoring Wells WMMW-1, WMMW-18, and WMMW-19 varied in sulfate concentrations from 676 to 1736 milligrams per liter (mg/l). Likewise, chloride concentrations in these wells varied from 12 to 92 mg/l. Across the site, sulfate and chloride concentrations vary with no discernible pattern to the variations. Details regarding chemistry of the Burro Canyon formation water can be found in Appendix B of the Hydrogeologic Evaluation.

Variability of water within the Burro Canyon formation is the result of slow moving to nearly stagnant groundwater flow beneath the site. These conditions are likely leading to dissolution of minerals from the Brushy Basin Member and the formation of sulfate-dominated waters.

Statistical Analysis

Because of the variable groundwater chemistry in the Burro Canyon formation baseline data, comparison of individual well groundwater chemistries to a single background groundwater well is not an appropriate method of monitoring potential disposal cell leakage or groundwater impacts. Water quality baseline and comparisons to that baseline established on a well-by-well basis has been proposed in the POC, as this method will best provide a meaningful representation of changes in groundwater chemistry.

Based on a review of water quality data gathered from 1979 through 1992, which are presented in the Hydrogeologic Evaluation, and considering the apparent variability of chemical composition of perched water and the absence of any impact from operations, EFN proposes to apply, an intra-well approach for assessing water quality trends. This approach, described in Appendix C, the Points of Compliance (POC) report (Titan, 1994), involves determination of background concentrations for a number of selected wells.

1.6 GEOLOGY

The following text is copied, with minor revisions, from the Environmental Report (Dames and Moore, 1978b) (ER). The text has been duplicated herein for ease of reference and to provide background information concerning the site geology. ER Subsections used in the following text are shown in parentheses immediately following the subsection titles.

The site is near the western margin of the Blanding Basin in southeastern Utah and within the Monticello uranium-mining district. Thousands of feet of multi-colored marine and non-marine

sedimentary rocks have been uplifted and warped, and subsequent erosion has carved a spectacular landscape for which the region is famous. Another unique feature of the region is the wide-spread presence of unusually large accumulations of uranium-bearing minerals.

1.6.1 Regional Geology

The following descriptions of regional physiography; rock units; and structure and tectonics are reproduced from the ER for ease of reference and as a review of regional geology.

1.6.1.1 Physiography (ER Section 2.4.1.1)

The project site is within the Canyon Lands section of the Colorado Plateau physiographic province. To the north, this section is distinctly bounded by the Book Cliffs and Grand Mesa of the Uinta Basin; western margins are defined by the tectonically controlled High Plateaus section, and the southern boundary is arbitrarily defined along the San Juan River. The eastern boundary is less distinct where the elevated surface of the Canyon Lands section merges with the Southern Rocky Mountain province.

Canyon Lands has undergone epeirogenic uplift and subsequent major erosion has produced the region's characteristic angular topography reflected by high plateaus, mesas, buttes, structural benches, and deep canyons incised into flat-laying sedimentary rocks of pre-Tertiary age. Elevations range from approximately 3,000 feet (914 meters) in the bottom of the deeper canyons along the southwestern margins of the section to more than 11,000 feet (3,353 meters) in the topographically anomalous laccolithic Henry, Abajo and La Sal Mountains to the northeast. Except for the deeper

canyons and isolated mountain peaks, an average elevation in excess of 500 feet (1,524 meters) persists over most of the Canyon Lands section.

On a more localized regional basis, the project site is located near the w stern edge of the Blanding Basin, sometimes referred to as the Great Sage Plain (Eardly, 1958), lying east of the north-south trending Monument Uplift, south of the Abajo Mountains and adjacent to the northwesterly-trending Paradox Fold and Fault Belt (Figure 1.6-1). Topographically, the Abajo Mountains are the most prominent feature in the region, rising more than 4,000 feet (1,219 meters) above the broad, gently rolling surface of the Great Sage Plain.

The Great Sage Plain is a structural slope, capped by the resistant Burro Canyon formation and the Dakota Sandstone, almost horizontal in an east-west direction but descends to the south with a regional slope of about 2,000 feet (610 meters) over a distance of nearly 50 miles (80 kilometers). Though not as deeply or intricately dissected as other parts of the Canyon Lands, the plain is cut by numerous narrow and vertical-walled south-trending valleys 100 to more than 500 feet (30 to 152+ meters) deep. Water from the intermittent streams that drain the plain flow southward to the San Juan River, eventually joining the Colorado River and exiting the Canyon Lands section through the Grand Canyon.

1.6.1.2 Rock Units (ER Section 2.4.1.1)

The sedimentary rocks exposed in southeastern Utah have an aggregate thickness of about 6,000 to 7,000 feet (1,829 to 2,134 meters) and range in age from Pennsylvanian to Late Cretaceous. Older unexposed rocks are known mainly from oil well drilling in the Blanding Basin and Monument Uplift. These wells have encountered correlative Cambrian to Permian rock units of markedly

differing thicknesses but averaging over 5,000 feet (1,524 meters) in total thickness (Witkind, 1964). Most of the wells drilled in the region have bottomed in the Pennsylvanian Paradox Member of the Hermosa formation. A generalized stratigraphic section of rock units ranging in age from Cambrian through Jurassic and Triassic (?), as determined from oil-well logs, is shown in Table 1.6-1. Descriptions of the younger rocks, Jurassic through Cretaceous, are based on field mapping by various investigators and are shown in Table 1.6-2.

Paleozoic rocks of Cambrian, Devonian and Mississippian ages are not exposed in the southeastern Utah region. Most of the geologic knowledge regarding these rocks was learned from the deeper oil wells drilled in the region, and from exposures in the Grand Canyon to the southwest and in the Uinta and Wasatch Mountains to the north. A few patches of Devonian rocks are exposed in the San Juan Mountains in southwestern Colorado. These Paleozoic rocks are the result of periodic transgressions and regressions of epicontinental seas and their lithologies reflect a variety of depositional environments.

In general, the coarse-grained feldspathic rocks overlying the Precambrian basement rocks grade upward into shales, limestones and dolomites that dominate the upper part of the Cambrian. Devonian and Mississippian dolomites, limestones and interbedded shales unconformably overlay the Cambrian strata. The complete absence of Ordovician and Silurian rocks in the Grand Canyon, Uinta Mountains, southwest Utah region and adjacent portions of Colorado, New Mexico and Arizona indicate that the region was probably epeirogenically positive during these times.

The oldest stratigraphic unit that crops out in the region is the Hermos formation of Middle and Late Pennsylvanian age. Only the uppermost strata of this formation are exposed, the best exposure being in the canyon of the San Juan River at the "Goosenecks" where the river traverses the crest of the

Monument uplift. Other exposures are in the breached centers of the Lisbon Valley, Moab and Castle Valley anticlines. The Paradox Member of the Hermosa formation is sandwiched between a relatively thin lower unnamed member consisting of dark-gray shale siltstone, dolomite, anhydrite, and limestone, and an upper unnamed member of similar lithology but having a much greater thickness. Composition of the Paradox Member is dominantly a thick sequence of interbedded slat (halite), anhydrite, gypsum, and black shale. Surface exposures of the Paradox in the Moab and Castle Valley anticlines are limited to contorted residues of gypsum and black shale.

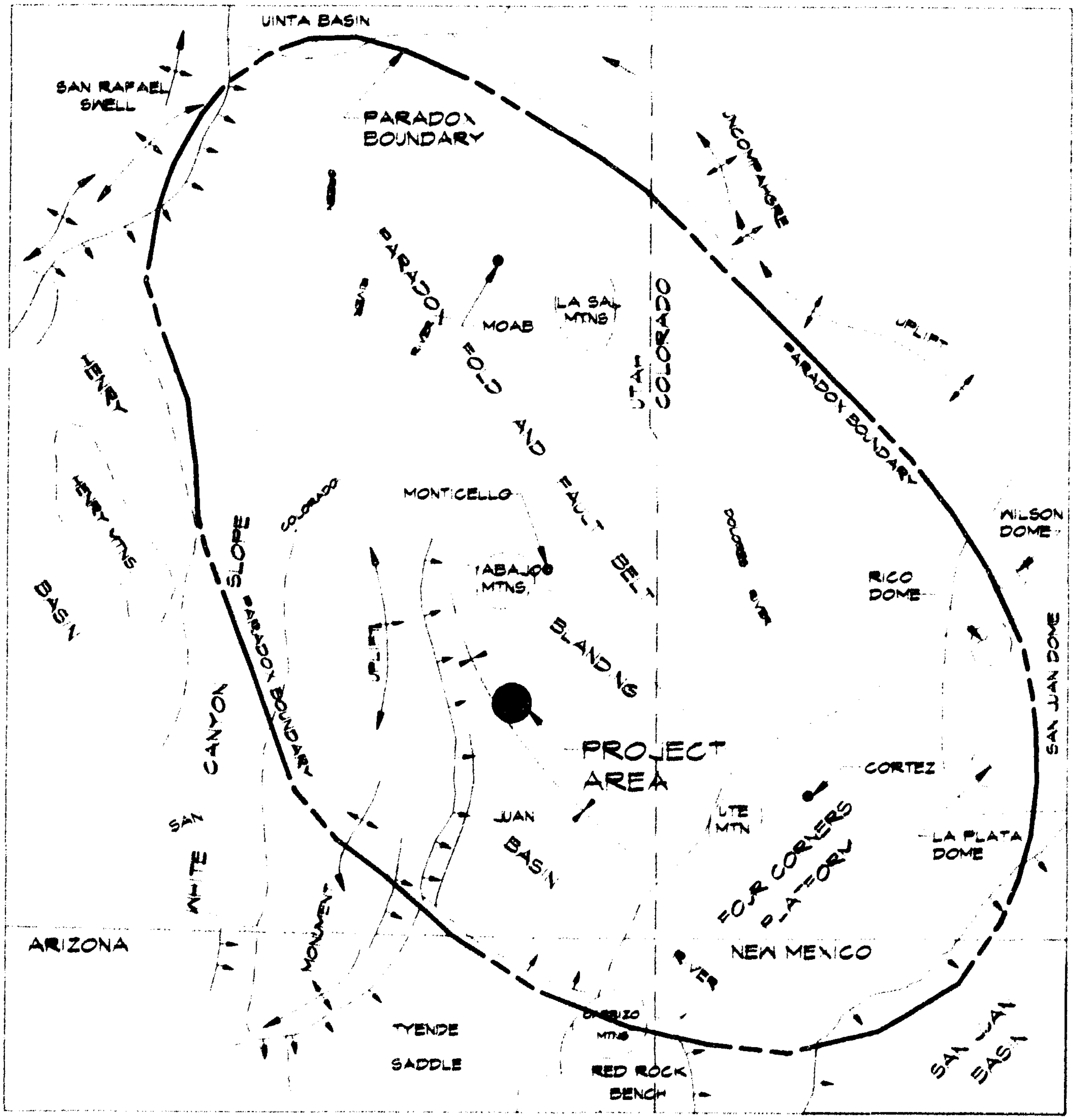
Conformably overlying the Hermosa is the Pennsylvanian and Permian (?) Rico formation, composed of interbedded reddish-brown arkosic sandstone and gray marine limestone. The Rico represents a transition zone between the predominantly marine Hermosa and the overlying continental Cutler formation of Permian age.

Two members of the Cutler probably underlying the region south of Blanding are, in ascending order, the Cedar Mesa Sandstone and the Organ Rock Tongue. The Cedar Mesa is a white to pale reddish-brown, massive, cross-bedded, fine-to medium-grained eolian sandstone. An irregular fluvial sequence of reddish-brown fine-grained sandstones, shaly siltstones and sandy shales comprise the Organ Rock Tongue.

The Moenkopi formation, of Middle (?) and Lower Triassic age, unconformably overlies the Cutler strata. It is composed of thin, evenly-bedded, reddish to chocolate-brown, ripple-marked, cross-laminated siltstone and sandy shales with irregular beds of massive medium-grained sandstone.

A thick sequence of complex continental sediments known as the Chinle formation unconformably overlies the Moenkopi. For the purpose of making lithology correlations in oil wells this formation

is divided into three units: The basal Shinarump Member, the Moss Back Member and an upper undivided thick sequence of variegated reddish-brown, reddish- to greenish-gray, yellowish-brown to light-brown bentonitic claystones, mudstones, sandy siltstone, fine-grained sandstone, and limestones. The basal Shinarump is dominantly a yellowish-grey, fine- to coarse-grained sandstone, conglomeratic sandstone and conglomerate characteristically filling ancient stream channel scours eroded into the Moenkopi surface. Numerous uranium deposits have been located in this member in the White Canyon mining district to the west of Comb Ridge. The Moss Back is typically composed of yellowish- to greenish-grey, fine- to medium-grained sandstone, conglomeratic sandstone and conglomerate. It commonly comprises the basal unit of the Chinle where the Shinarump was not deposited, and in a like manner, fills ancient stream channels scoured into the underlying unit.



BOUNDARY OF TECTONIC DIVISION

MONOCLINE SHOWING TRACE OF AXIS AND DIRECTION OF DIP

ANTICLINE SHOWING TRACE OF AXIS AND DIRECTION OF PLUNGE

SYNCLINE SHOWING TRACE OF AXIS AND DIRECTION OF PLUNGE

FIGURE 1.6.1

Tectonic Index Map

TABLE 16-1

GENERALIZED STRATIGRAPHIC SECTION OF SUBSURFACE ROCKS BASED ON OIL-WELL LOGS

(After Stokes, 1954, Witkind, 1964, Huff and Lesure, 1965, Johnson and Thordarson, 1966)

Era	Age	Stratigraphic Unit	Thickness* (ft.)	Description
MESOZOIC		Glen Canyon Group:		
	Jurassic and Triassic (?)	Navajo Sandstone	300 - 400	Buff to light gray, massive, cross-bedded, friable sandstone
	Triassic (?)	Kayenta Formation	100 - 150	Reddish-brown sandstone and mudstone and occasional conglomerate lenses
	Triassic	Wingate Sandstone	250 - 350	-brown, massive, cross-bedded, ...ined sandstone
		Chinle Formation:		
		Undivided	600 - 700	Variegated claystone with some thin beds of siltstone and limestone
		Moss Back Member	0 - 100	Light colored, conglomeratic sandstone and conglomerate
		Shinarump Member	0 - 20	Yellowish-gray, fine to coarse-grained sandstone: conglomeratic sandstone and conglomerate
		— Unconformity —		
	Middle (?) and Lower Triassic	Moenkopi Formation	50 - 100	Reddish-brown mudstone and fine-grained sandstone
		— Unconformity —		
PALEOZOIC	Permian	Cutler Formation:		
		Organ Rock Member	0 - 600	Reddish-brown, sandy mudstone
		Cedar Mesa Sandstone Member	1100 - 1400	Reddish-brown, massive, fine to medium-grained sandstone
	Pennsylvanian and Permian (?)	Rico Formation	450	Red and gray calcareous, sandy shale: gray limestone and sandstone
	Pennsylvanian	Hermosa Formation:		
		Upper Member	1000 - 1200	Gray, massive limestone: some shale and sandstone
		Paradox Member	1200	Halite, anhydrite, gypsum, shale, and siltstone
		Lower Member	200	Limestone, siltstone, and shale
		— Unconformity —		
	Mississippian	Leadville Limestone	500	White to tan sucrose to crystalline limestone
	Devonian	Ouray Limestone	100	Light gray and tan, thin-bedded limestone and dolomite
		Zilbert Formation	200	Gray and brown dolomite and limestone with thin beds green shale and sandstone
		— Unconformity —		
	Cambrian	Ophir Formation and Tintic Quartzite	600	Gray and brown limestone and dolomite, feldspathic sandstone and arkose

* To convert feet to meters, multiply by 0.3043. Average thickness given if range is not shown.

TABLE 1.6-2

GENERALIZED STRATIGRAPHIC SECTION OF EXPOSED ROCKS IN THE PROJECT VICINITY

(After Haynes et al. 1962, Witkind 1964, Huff and Lesure 1965)

ERA	SYSTEM	SERIES (Age)		STRATIGRAPHIC UNIT	THICKNESS* (ft)	LITHOLOGY
CENOZOIC	QUATERNARY	Holocene to Pleistocene		Alluvium	2 - 25+	Silt, sand and gravel in arroyos and stream valleys.
				Colluvium and Talus	0 - 15+	Slope wash, talus and rock rubble ranging from cobbles and boulders to massive blocks fallen from cliffs and outcrops of resistant rock
				Loess	0 - 22+	Reddish-brown to light-brown, unconsolidated, well-sorted silt to medium-grained sand; partially cemented with caliche in some area, reworked partly by water
				Unconformity		
MESOZOIC	CRETACEOUS	Upper Cretaceous		Mancos Shale	0 - 11(?)	Gray to dark-gray, fissile, thin-bedded marine shale with fossiliferous sandy limestone in lower strata.
				Dakota Sandstone	30 - 75	Light yellowish-brown to light gray-brown, thick bedded to cross-bedded sandstone, conglomeratic sandstone; interbedded thin lenticular gray carbonaceous claystone and impure coal; local course basal conglomerate.
				Unconformity		
		Lower Cretaceous		Burro Canyon Formation	50 - 150	Light-gray and light-brown, massive and cross-bedded conglomeratic sandstone and interbedded green and gray-green mudstone; locally contains thin discontinuous beds of silicified sandstone and limestone near top.
				Unconformity (?)		
	Jurassic	Upper Jurassic	Morrison Formation	Brushy Basin Member	200 - 450	Variegated gray, pale-green, reddish-brown, and purple bentonitic mudstone and siltstone containing thin discontinuous sandstone and conglomerate lenses.
				Westwater Canyon Member	0 - 250	Interbedded yellowish- and greenish-gray to pinkish-gray, fine- to course-grained arkosic sandstone and greenish-gray to reddish-brown sandy shale and mudstone.
				Recapture Member	0 - 200	Interbedded reddish-gray to light brown fine-to medium-grained sandstone and reddish-gray silty and sandy claystone.
				Salt Wash Member	0 - 350	Interbedded yellowish-brown to pale reddish-brown fine-grained to conglomeritic sandstones and greenish- and reddish-gray mudstone.
				Unconformity		
			San Rafael Group	Bluff Sandstone	0 - 150+	White to grayish-brown, massive, cross-bedded, fine- to medium-grained eolian sandstone.
				Summerville Formation	25 - 125	Thin-bedded, ripple-marked reddish-brown muddy sandstone and sandy shale.
				Entrada Sandstone	150 - 180	Reddish-brown to grayish-white, massive, cross-bedded, fine- to medium-grained sandstone.
		Middle Jurassic		Carmel Formation	20 - 100+	Irregularly bedded roddish-brown muddy sandstone and sandy mudstone with local thin beds of brown to gray limestone and reddish- to greenish-gray shale.
				Unconformity		

*To convert feet to meters, multiply feet by 0.3048.

In the Blanding Basin the Glen Canyon Group consists of three formations which are, in ascending order, the Wingate Sandstone, the Kayenta and the vajo Sandstone. All are conformable and their contacts are gradational. Commonly cropping out in sheer cliffs, the Late Triassic Wingate Sandstone is typically composed of buff to reddish-brown, massive, cross-bedded, well-sorted, fine-grained quartzose sandstone of eolian origin. Late Triassic (?) Kayenta is fluvial in origin and consists of reddish-brown, irregularly to cross-bedded sandstone, shaly sandstone and, locally, thin beds of limestone and conglomerate. Light yellowish-brown to light-gray and white, massive, cross-bedded, friable, fine- to medium-grained quartzose sandstone typifies the predominantly eolian Jurassic and Triassic (?) Navajo Sandstone.

Four formations of the Middle to Late Jurassic San Rafael Group unconformably overly the Navajo Sandstone. These strata are composed of alternating marine and non-marine sandstones, shales and mudstones. In ascending order, the formations are the Carmel formation, Entrada Sandstone, Summerville formation, and Bluff Sandstone. The Carmel usually crops out as a bench between the Navajo and Entrada Sandstones. Typically reddish-brown muddy sandstone and sandy mudstone, the Carmel locally contains thin beds of brown to gray limestone and reddish- to greenish-gray shale. Predominantly eolian in origin, the Entrada is a massive cross-bedded fine- to medium-grained sandstone ranging in color from reddish-brown to grayish-white that crops out in cliffs or hummocky slopes. The Summerville is composed of regular thin-bedded, ripple-marked, reddish-brown muddy sandstone and sandy shale of marine origin and forms steep to gentle slopes above the Entrada. Cliff-forming Bluff Sandstone is present only in the southern part of the Monticello district thinning northward and pinching out near Blanding. It is a white to grayish-brown, massive, cross-bedded eolian sandstone.

In the southeastern Utah region the Late Jurassic Morrison formation has been divided in ascending order into the Salt Wash, Recapture, Westwater Canyon, and Brushy Basin Members. In general, these strata are dominantly fluvial in origin but do contain lacustrine sediments. Both the Salt Wash and Recapture consist of alternating mudstone and sandstone; the Westwater Canyon is chiefly sandstone with some sandy mudstone and claystone lenses, and the heterogenous Brushy Basin consists of variegated bentonitic mudstone and siltstone containing scattered thin limestone, sandstone, and conglomerate lenses. As strata of the Morrison formation are the oldest rocks exposed in the project area vicinity and are one of the two principal uranium-bearing formations in southeast Utah, the Morrison, as well as younger rocks, are described in more detail in Section 1.6.2.2.

The Early Cretaceous Burro Canyon formation rests unconformably (?) on the underlying Brushy Basin Member of the Morrison formation. Most of the Burro Canyon consists of light-colored, massive, cross-bedded fluvial conglomerate, conglomerate sandstone and sandstone. Most of the conglomerates are near the base. Thin, even-bedded, light-green mudstones are included in the formation and light-grey thin-bedded limestones are sometimes locally interbedded with the mudstones near the top of the formation.

Overlying the Burro Canyon is the Dakota Sandstone of Upper Cretaceous age. Typical Dakota is dominantly yellowish-brown to light-gray, thick-bedded, quartzitic sandstone and conglomeratic sandstone with subordinate thin lenticular beds of mudstone, gray carbonaceous shale and, locally, thin seams of impure coal. The contact with the underlying Burro Canyon is unconformable whereas the contact with the overlying Mancos Shale is gradational from the light-colored sandstones to dark-grey to black shaly siltstone and shale.

Upper Cretaceous Mancos Shale is exposed in the region surrounding the project vicinity but not within it. Where exposed and weathered, the shale is light-gray or yellowish-gray, but is dark, to olive-gray where fresh. Bedding is thin and well developed; much of it is laminated.

Quaternary alluvium within the project vicinity is of three types: alluvial silt, sand and gravels deposited in the stream channels; colluvium deposits of slope wash, talus, rock rubble and large displaced blocks on slopes below cliff faces and outcrops of resistant rock; and alluvial and windblown deposits of silt and sand, partially reworked by water, on benches and broad upland surfaces.

1.6.1.3 Structure and Tectonics (ER Section 2.4.1.3)

According to Shoemaker (1954 and 1956), structural features within the Canyon Lands of southeastern Utah may be classified into three main categories on the basis of origin or mechanism of the stress that created the structure. These three categories are: (1) structures related to large-scale regional uplifting or downwarping (epeirogenic deformation) directly related to movements in the basement complex (Monument Uplift and the Blanding Basin); (2) structures resulting from the plastic deformation of thick sequences of evaporite deposits, salt plugs and salt anticlines, where the structural expression at the surface is not reflected in the basement complex (Paradox Fold and Fault Belt); and (3) structures that are formed in direct response to stresses induced by magmatic intrusion including local laccolithic domes, dikes and stocks (Abajo Mountains).

Each of the basins and uplifts within the project area region is an asymmetric fold usually separated by a steeply dipping sinuous monocline. Dips of the sedimentary beds in the basins and uplifts rarely exceed a few degrees except along the monocline (Shoemaker, 1956) where, in some

instances, the beds are nearly vertical. Along the Comb Ridge monocline, the boundary between the Monument Uplift and the Blanding Basin, approximately eight miles (12.9 kilometers) west of the project area, dips in the Upper Triassic Wingate sandstone and in the Chinle formation are more than 40 degrees to the east.

Structures in the crystalline basement complex in the central Colorado Plateau are relatively unknown but where monoclines can be followed in Precambrian rocks they pass into steeply dipping faults. It is probable that the large monoclines in the Canyon Lands section are related to flexure of the layered sedimentary rocks under tangential compression over nearly vertical normal or high-angle reverse faults in the more rigid Precambrian basement rocks (Kelley, 1955; Shoemaker, 1956; Johnson and Thordarson, 1966).

The Monument Uplift is a north-trending, elongated, upwarped structure approximately 90 miles (145 kilometers) long and nearly 35 miles (56 kilometers) wide. Structural relief is about 3,000 feet (914 meters) (Kelley, 1955). Its broad crest is slightly convex to the east where the Comb Ridge monocline defines the eastern boundary. The uniform and gently descending western flank of the uplift crosses the White Canyon slope and merges into the Henry Basin (Figure 1.6-1).

East of the Monument Uplift, the relatively equidimensional Blanding Basin merges almost imperceptibly with the Paradox Fold and Fault Belt to the north, the Four Corners Platform to the southeast and the Defiance Uplift to the south. The basin is a shallow feature with approximately 700 feet (213 meters) of structural relief as estimated on top of the Upper Triassic Chinle formation by Kelley (1955), and is roughly 40 to 50 miles (64 to 80 kilometers) across. Gentle folds within the basin trend westerly to northwesterly in contrast to the distinct northerly orientation of the Monument Uplift.

Situated to the north of the Monument Uplift and Blanding Basin is the most unique structural feature of the Canyon Lands section, the Paradox Fold and Fault Belt. This tectonic unit is dominated by northwest trending anticlinal folds and associated normal faults covering an area about 150 miles (241 kilometers) long and 65 miles (104 kilometers) wide. These anticlinal structures are associated with salt flowage from the Pennsylvanian Paradox Member of the Hermosa formation and some show piercement of the overlying younger sedimentary beds by plug-like salt intrusions (Johnson and Thordarson, 1966). Prominent valleys have been eroded along the crests of the anticlines where salt piercements have occurred or collapses of the central parts have resulted in intricate systems of step-faults and grabens along the anticlinal crests and flanks.

The Abajo Mountains are located approximately 20 miles (32 kilometers) north of the project area on the more-or-less arbitrary border of the Blanding Basin and the Paradox Fold and Fault Belt (Figure 1.6-1). These mountains are laccolithic domes that have been intruded into and through the sedimentary rocks by several stocks (Witkind, 1964). At least 31 laccoliths have been identified. The youngest sedimentary rocks that have been intruded are those of Mancos Shale of Late Cretaceous age. Based on this and other vague and inconclusive evidence, Witkind (1964), has assigned the age of these intrusions to the Late Cretaceous or early Eocene.

Nearly all known faults in the region of the project area are high-angle normal faults with displacements on the order of 300 feet (91 meters) or less (Johnson and Thordarson, 1966). The largest known faults within a 40-mile (64 kilometer) radius around Blanding are associated with the Shay graben on the north side of the Abajo Mountains and the Verdure graben on the south side. Respectively, these faults trend northeasterly and easterly and can be traced for approximate distances ranging from 21 to 34 miles (34 to 55 kilometers) according to Witkind (1964). Maximum displacements reported by Witkind on any of the faults is 320 feet (98 meters). Because of the

extensions of Shay and Verdure fault systems beyond the Abajo Mountains and other geologic evidence, the age of these faults is Late Cretaceous or post-Cretaceous and antedate the laccolithic intrusions (Witkind, 1964).

A prominent group of faults is associated with the salt anticlines in the Paradox Fold and Fault Belt. These faults trend northwesterly parallel to the anticlines and are related to the salt emplacement. Quite likely, these faults are relief features due to salt intrusion or salt removal by solution (Thompson, 1967). Two faults in this region, the Lisbon Valley fault associated with the Lisbon Valley salt anticline and the Moab fault at the southeast end of the Moab anticline have maximum vertical displacements of at least 5,000 feet (1,524 meters) and 2,000 feet (609 meters), respectively, and are probably associated with breaks in the Precambrian basement crystalline complex. It is possible that zones of weakness in the basement rocks represented by faults of this magnitude may be responsible for the beginning of salt flowage in the salt anticlines, and subsequent solution and removal of the salt by groundwater caused collapse within the salt anticlines resulting in the formation of grabens and local complex block faults (Johnson and Thordarson, 1966).

The longest faults in the Colorado Plateau are located some 155 to 210 miles (249 to 338 kilometers) west of the project area along the western margin of the High Plateau section. These faults have a north to northeast echelon trend, are nearly vertical and downthrown on the west in most places. Major faults included in this group are the Hurrican,Toroweap-Sevier, Paunsaugunt, and Paradise faults. The longest fault, the Toroweap-Sevier, can be traced for about 240 miles (386 kilometers) and may have as much as 3,000 feet (914 meters) of displacement (Kelley, 1955).

From the later part of the Precambrian until the middle Paleozoic the Colorado Plateau was a relatively stable tectonic unit undergoing gentle epeirogenic uplifting and downwarping during

which seas transgressed and regressed, depositing and then partially removing layers of sedimentary materials. This period of stability was interrupted by northeast-southwest tangential compression that began sometime during late Mississippian or early Pennsylvanian and continued intermittently into the Triassic. Buckling along the northeast margins of the shelf produced northwest-trending uplifts, the most prominent of which are the Uncompahgre and San Juan Uplifts, sometimes referred to as the Ancestral Rocky Mountains. Clearly, these positive features are the earliest marked tectonic controls that may have guided many of the later Laramide structures (Kelley, 1955).

Subsidence of the area southwest of the Uncompahgre Uplift throughout most of the Pennsylvanian led to the filling of the newly formed basin with an extremely thick sequence of evaporites and associated interbeds which comprise the Paradox Member of the Hermosa formation (Kelley, 1956). Following Paradox deposition, continental and marine sediments buried the evaporite sequence as epeirogenic movements shifted shallow seas across the region during the Jurassic, Triassic and much of the Cretaceous. The area underlain by the Paradox Member in eastern Utah and western Colorado is commonly referred to as the Paradox Basin (Figure 1.6-1). Renewed compression during the Permian initiated the salt anticlines and piercements, and salt flowage continued through the Triassic.

The Laramide orogeny, lasting from Late Cretaceous through Eocene time, consisted of deep-seated compressional and local vertical stresses. The orogeny is responsible for a north-south to northwest trend in the tectonic fabric of the region and created most of the principal basins and uplifts in the eastern-half of the Colorado Plateau (Grose, 1972; Kelley, 1955).

Post-Laramide epeirogenic deformation has occurred throughout the Tertiary; Eocene strata are flexed sharply in the Grand Hogback monocline, fine-grained Pliocene deposits are tilted on the

flanks of the Defiance Uplift, and Pleistocene deposits in Fisher Valley contain three angular unconformaties (Shoemaker, 1956).

1.6.2 Blanding Site Geology

The following descriptions of physiography and topography; rock units; structure; relationship of earthquakes to tectonic structure; and potential earthquake hazards to the project area are reproduced from the ER for ease of reference and as a review of the mill site geology. (See Figure 1.6-2)

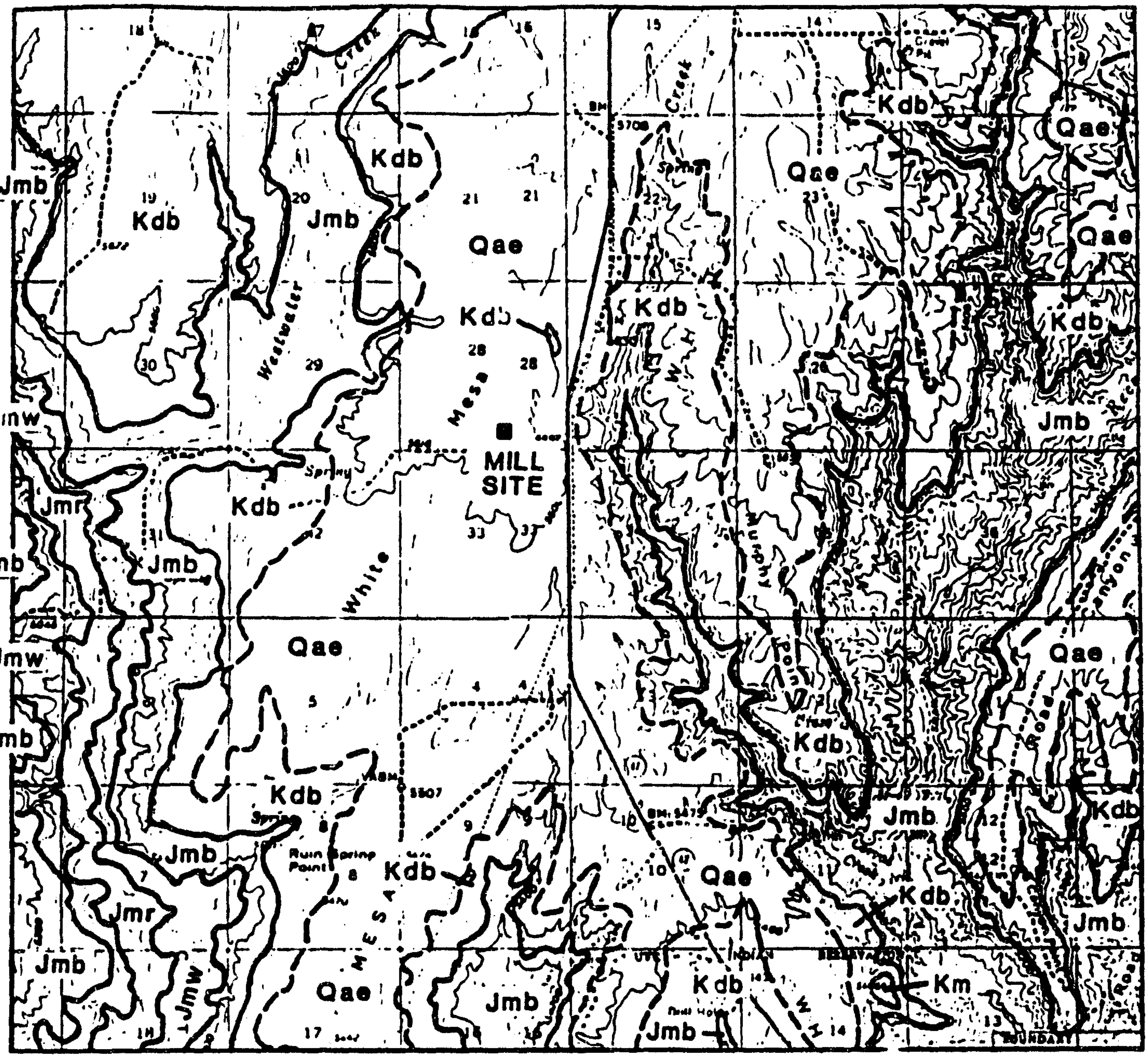
1.6.2.1 Physiography and Topography (ER Section 2.4.2.1)

The project site is located near the center of White Mesa, one of the many finger-like north-south trending mesas that make up the Great Sage Plain. The nearly flat upland surface of White Mesa is underlain by resistant sandstone caprock which forms steep prominent cliffs separating the upland from deeply entrenched intermittent stream courses on the east, south and west.

Surface elevations across the project site range from about 5,550 to 5,650 feet (1,692 to 1,722 meters) and the gently rolling surface slopes to the south at a rate of approximately 60 feet per mile (18 meters per 1.6 kilometer).

Maximum relief between the mesa's surface and Cottonwood Canyon on the west is about 750 feet (229 meters) where Westwater Creek joins Cottonwood Wash. These two streams and their tributaries drain the west and south sides of White Mesa. Drainage on the east is provided by Recapture Creek and its tributaries. Both Cottonwood Wash and Recapture Creeks are normally

intermittent streams and flow south to the San Juan River. However, Cottonwood Wash has been known to flow perennially in the project vicinity during wet years.



REFERENCES: GEOLOGY, IN PART, AFTER HAYNES ET AL., 1962. BASE MAP PREPARED FROM PORTIONS OF THE BLANDING, BRUSHY BASIN WASH, BLUFF, AND MONTEZUMA CREEK U.S.G.S. 15-MINUTE TOPOGRAPHIC QUADRANGLES.

EXPLANATION

Qae	LOESS
Km	MANCOS SHALE
Kdb	DAKOTA AND BURRO CANYON FORMATIONS (UNDIFFERENTIATED)
Jmb	MORRISON FORMATION: BRUSHY BASIN MEMBER
Jmw	WESTWATER CANYON MEMBER
Jmr	RECAPTURE MEMBER
—--	CONTACT, DASHED WHERE APPROXIMATE

N.

3000 0 3000 6000

SCALE IN FEET

ENERGY FUELS NUCLEAR, INC.
Colorado Plateau Operations
2754 Compass Drive, Ste 201 Grand Junction, CO 81506

FIGURE 1.6-2
White Mesa Millsite
Geology of Surrounding Area

DESIGN	DRAWN: R. Van Horn	SHEET
CHKD BY	DATE Feb 1997	of
APP	SCALE. As Shown	

After Umetco 1988

1.6.2.2 Rock Units (ER Section 2.4.2.2)

Only rocks of Jurassic and Cretaceous ages are exposed in the vicinity of the project site. These include, in ascending order, the Upper Jurassic Salt Wash, Recapture, Westwater Canyon, and Brushy Basin Members of the Morrison formation; the Lower Cretaceous Burro Canyon formation; and the Upper Cretaceous Dakota Sandstone. The Upper Cretaceous Mancos Shale is exposed as isolated remnants along the rim of Recapture Creek valley several miles southeast of the project site and on the eastern flanks of the Abajo Mountains some 20 miles (32 kilometers) north but is not exposed at the project site. However, patches of Mancos Shale may be present within the project site boundaries as isolated buried remnants that are obscured by a mantle of alluvial windblown silt and sand.

The Morrison formation is of particular economic importance in southeast Utah since several hundred uranium deposits have been discovered in the basal Salt Wash Member (Stokes, 1967).

In most of eastern Utah, the Salt Wash Member underlies the Brushy Basin. However, just south of Blanding in the project vicinity the Recapture Member replaces an upper portion of the Salt Wash and the Westwater Canyon Member replaces a lower part of the Brushy Basin. A southern limit of Salt Wash deposition and a northern limit of Westwater Canyon deposition has been recognized by Haynes et al. (1972) in Westwater Canyon approximately three to six miles (4.8 to 9.7 kilometers), respectively, northwest of the project site. However, good exposures of Salt Wash are found throughout the Montezuma Canyon area 13 miles (21 kilometers) to the east.

The Salt Wash Member is composed dominantly of fluvial fine-grained to conglomeratic sandstones, and interbedded mudstones. Sandstone intervals are usually yellowish-brown to pale reddish-brown

while the mudstones are greenish- and reddish-gray. Carbonaceous materials ("trash") vary from sparse to abundant. Cliff-forming massive sandstone and conglomeratic sandstone in discontinuous beds make up to 50 percent or more of the member. According to Craig et al. (1955), the Salt Wash was deposited by a system of braided streams flowing generally east and northeast. Most of the uranium-vanadium deposits are located in the basal sandstones and conglomeratic sandstones that fill stream-cut scour channels in the underlying Bluff Sandstone, or where the Bluff Sandstone has been removed by pre-Morrison erosion, in similar channels cut in the Summerville formation. Mapped thicknesses of this member range from zero to approximately 350 feet (0-107 meters) in southeast Utah. Because the Salt Wash pinches out in a southerly direction in Recapture Creek three miles (4.8 kilometers) northwest of the project site and does not reappear until exposed in Montezuma Canyon, it is not known for certain that the Salt Wash actually underlies the site.

The Recapture Member is typically composed of interbedded reddish-gray, white, and light-brown fine- to medium-grained sandstone and reddish-gray, silty and sandy claystone. Bedding is gently to sharply lenticular. Just north of the project site, the Recapture intertongues with and grades into the Salt Wash and the contact between the two cannot be easily recognized. A few spotty occurrences of uriniferous mineralization are found in sandstone lenses in the southern part of the Monticello district and larger deposits are known in a conglomeratic sandstone facies some 75 to 100 miles (121 to 161 kilometers) southeast of the Monticello district. Since significant ore deposits have not been found in extensive outcrops in more favorable areas, the Recapture is believed not to contain potential resources in the project site (Johnson and Thordarson, 1966).

Just north of the project site, the Westwater Canyon Member intertongues with and grades into the lower part of the overlying Brushy Basin Member. Exposures of the Westwater Canyon in Cottonwood Wash are typically composed of interbedded yellowish- and greenish-gray to pinkish-

gray, lenticular, fine- to coarse-grained arkosic sandstone and minor amounts of greenish-gray to reddish-brown sandy shale and mudstone. Like the Salt Wash, the Westwater Canyon Member is fluvial in origin, having been deposited by streams flowing north and northwest, coalescing with streams from the southwest depositing the upper part of the Salt Wash and the lower part of the Brushy Basin (Huff and Lesure, 1965). Several small and scattered uranium deposits in the Westwater Canyon are located in the extreme southern end of the Monticello district. Both the Recapture Member and the Westwater Canyon contain only traces of carbonaceous materials, are believed to be less favorable host rocks for uranium deposition (Johnson and Thordarson, 1966) and have very little potential for producing uranium reserves.

The lower part of the Brushy Basin is replaced by the Westwater Canyon Member in the Blanding area but the upper part of the Brushy Basin overlies this member. Composition of the Brushy Basin is dominantly variegated bentonitic mudstone and siltstone. Bedding is thin and regular and usually distinguished by color variations of gray, pale-green, reddish-brown, pale purple, and maroon. Scattered lenticular thin beds of distinctive green and red chert-pebble conglomeratic sandstone are found near the base of the member, some of which contain uranium-vanadium mineralization in the southernmost part of the Monticello district (Haynes et al., 1972). Thin discontinuous beds of limestone and beds of grayish-red to greenish-black siltstone of local extent suggest that much of the Brushy Basin is probably lacustrine in origin.

For the most part, the Great Sage Plain owes its existence to the erosion of resistant sandstones and conglomerates of the Lower Cretaceous Burro Canyon formation. This formation unconformably(?) overlies the Brushy Basin and the contact is concealed over most of the project area by talus blocks and slope wash. Massive, light-gray to light yellowish-brown sandstone, conglomeratic sandstone and conglomerate comprise more than two-thirds of the formation's thickness. The conglomerate

and sandstone are interbedded and usually grade from one to the other. However, most of the conglomerate is near the base. These rocks are massive cross-bedded units formed by a series of interbedded lenses, each lens representing a scour filled with stream-deposited sediments. In places the formation contains greenish-gray lenticular beds of mudstone and claystone. Most of the Burro Canyon is exposed in the vertical cliffs separating the relatively flat surface of White Mesa from the canyons to the west and east. In some places the resistant basal sandstone beds of the overlying Dakota Sandstone are exposed at the top of the cliffs, but entire cliffs of Burro Canyon are most common. Where the sandstones of the Dakota rest on sandstones and conglomerates of the Burro Canyon, the contact between the two is very difficult to identify and most investigators map the two formations as a single unit (Figure 1.6-2). At best, the contact can be defined as the top of a silicified zone in the upper part of the Burro Canyon that appears to be remnants of an ancient soil that formed during a long period of weathering prior to Dakota deposition (Huff and Lesure, 1965).

The Upper Cretaceous Dakota Sandstone disconformably overlies the Burro Canyon formation. Locally, the disconformity is marked by shallow depressions in the top of the Burro Canyon filled with Dakota sediments containing angular to sub-rounded rock fragments probably derived from Burro Canyon strata (Witkind, 1964) but the contact is concealed at the project site. The Dakota is composed predominantly of pale yellowish-brown to light gray, massive, intricately cross-bedded, fine- to coarse-grained quartzose sandstone locally well-cemented with silica and calcite; elsewhere it is weakly cemented and friable. Scattered throughout the sandstone are lenses of conglomerate, dark-gray carbonaceous mudstones and shale and, in some instances, impure coal. In general, the lower part of the Dakota is more conglomeratic and contains more cross-bedded sandstone than the upper part which in normally more thinly bedded and marine-like in appearance. The basal sandstones and conglomerates are fluvial in origin, whereas the carbonaceous mudstones and shales were probably deposited in back water areas behind beach ridges in front of the advancing Late

Cretaceous sea (Huff and Lesure, 1965). The upper sandstones probably represent littoral marine deposits since they grade upward into the dark-gray siltstones and marine shales of the Mancos Shale.

The Mancos shale is not exposed in the project vicinity. The nearest exposures are small isolated remnants resting conformably on Dakota Sandstone along the western rim above Recapture Creek 4.3 to 5.5 miles (6.9 to 8.9 kilometers) southeast of the project site. Additional exposures are found on the eastern and southern flanks of the Abajo Mountains approximately 16 to 20 miles (26 to 32 kilometers) to the north. It is possible that thin patches of Mancos may be buried at the project site but are obscured by the mantle of alluvial windblown silt and sand covering the upland surface. The Upper Cretaceous Mancos shale is of marine origin and consists of dark- to olive-gray shale with minor amounts of gray, fine-grained, thin-bedded to blocky limestone and siltstone in the lower part of the formation. Bedding in the Mancos is thin and well developed, and much of the shale is laminated. Where fresh, the shale is brittle and fissile and weathers to chips that are light- to yellowish-gray. Topographic features formed by the Mancos are usually subdued and commonly displayed by low rounded hills and gentle slopes.

A layer of Quaternary to Recent reddish-brown eolian silt and fine sand is spread over the surface of the project site. Most of the loess consists of subangular to rounded frosted quartz grains that are coated with iron oxide. Basically, the loess is massive and homogeneous, ranges in thickness from a dust coating on the rocks that form the rim cliffs to more than 20 feet (6 meters), and is partially cemented with calcium carbonate (caliche) in light-colored mottled and veined accumulations which probably represent ancient immature soil horizons.

1.6.2.3 Structure (E.R. Section 2.4.2.3)

The geologic structure at the project site is comparatively simple. Strata of the underlying Mesozoic sedimentary rocks are nearly horizontal; only slight undulations along the caprock rims of the upland are perceptible and faulting is absent. In much of the area surrounding the project site the dips are less than one degree. The prevailing regional dip is about one degree to the south. The low dips and simple structure are in sharp contrast to the pronounced structural features of the Comb Ridge Monocline to the west and the Abajo Mountains to the north.

The project area is within a relatively tectonically stable portion of the Colorado Plateau noted for its scarcity of historical seismic events. The epicenters of historical earthquakes from 1853 through 1986 within a 200-mile (320 km) radius of the site are shown in Figure 1.6-3. More than 1,146 events have occurred in the area, of which at least 45 were damaging; that is, having an intensity of VI or greater on the Modified Mercalli Scale. A description of the Modified Mercalli Scale is given in Table 1.6-3. All intensities mentioned herein refer to this table. Table 1.6-3 also shows a generalized relationship between Mercalli intensities and other parameters to which this review will refer. Since these relationships are frequently site specific, the table values should be used only for approximation and understanding. Conversely, the border between the Colorado Plateau and the Basin and Range Province and Middle Rocky Mountain Province some 155 to 240 miles (249 to 386 km) west and northwest, respectively, from the site is one of the most active seismic belts in the western United States.

Only 63 non-duplicative epicenters have been recorded within a 120 mile (200 km) radius of the project area (Figure 1.6-4). Of these, 50 had an intensity IV or less (or unrecorded) and two were recorded as intensity VI. The nearest event occurred in the Glen Canyon National Recreation Area

approximately 38 miles (63 km) west-northwest of the project area. The next closest event occurred approximately 53 miles (88 km) to the northeast. Just east of Durango, Colorado, approximately 99 miles (159 km) due east of the project area, an event having local intensity of V was recorded on August 29, 1941 (Hadsell, 1968). It is very doubtful that these events would have been felt in the vicinity of Blanding.

Three of the most damaging earthquakes associated with the seismic belt along the Colorado Plateau's western border have occurred in the Elsinore-Richfield are about 168 miles (270 km) northwest of the project site. All were of intensity VIII. On November 13, 1901, a strong shock caused extensive damage from Richfield to Parowan. Many brick structures were damaged; rockslides were reported near Beaver. Earthquakes with the ejection of sand and water were reported, and some creeks increased their flow. Aftershocks continued for several weeks (von Hake, 1977). Following several weeks of small foreshocks, a strong earthquake caused major damage in the Monroe-Elsinore-Richfield area on September 29, 1921. Scores of chimneys were thrown down, plaster fell from ceilings, and a section of a new two-story brick wall collapsed at Elsinore's schoolhouse. Two days later, on October 1, 1921, another strong tremor caused additional damage to the area's structures. Large rockfalls occurred along both sides of the Sevier Valley and hot springs were discolored by iron oxides (von Hake, 1977). It is probable that these shocks may have been perceptible at the project site but they certainly would not have caused any damage.

Seven events of intensity VII have been reported within 320 kilometers (km) around Blanding, Utah, which is the area shown in Figure 1.6-3. Of these, only two are considered to have any significance with respect to the project site. On August 18, 1912, an intensity VII shock damaged houses in northern Arizona and was felt in Gallup, New Mexico, and southern Utah. Rock slides occurred near the epicenter in the San Francisco Mountains and a 50-mile (80 km) earth crack was reported north

of the San Francisco Range (U. S. Geological Survey, 1970). Nearly every building in Dulce, New Mexico, was damaged to some degree when shook by a strong earthquake on January 22, 1966. Rockfalls and landslides occurred 10 to 15 miles (16 to 24 km) west of Dulce along Highway 17 where cracks in the pavement were reported (Hermann et al., 1980). Both of these events may have been felt at the project site but, again, would certainly not have caused any damage. Figure 1.6-4 shows the occurrence of seismic events within 200 km of Blanding.

TABLE 1.6-3

Modified Mercalli Scale, 1956 Version[a]

M§	Intensity	Effects	v † cm/s	g ‡
	I	Not felt. Marginal and long-period effects of large earthquakes (for details see text)		
3	II	Felt by persons at rest on upper floors, or favorably placed		
	III	Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.		0.0035-0.007
4	IV	Hanging objects swing. Vibration like passing of heavy trucks or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV wooden walls and frame creak		0.007-0.015
	V	Felt outdoors: direction estimated. Sleepers wakened. Liquids disturbed. Some spilled. Small unstable objects displaced or upset. Doors swing close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate	1-3	0.015-0.035
5	VI	Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc. off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D cracked. Small bells ring (church, school). Trees, bushes shaken (visibly, or heard to rustle - CFR)	3-7	0.035-0.07
6	VII	Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices (also unbraced parapets and architectural ornaments - CFR). Some cracks in masonry C. Waves on ponds, water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged	7-20	0.07-0.15
	VIII	Steering of motor cars affected. Damage to masonry C, partial collapse. Some damage to masonry B, none is masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down, loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes	20-80	0.15-0.35
7	IX	General panic. Masonry D destroyed, masonry C heavily damaged. Sometimes with complete collapse, masonry B seriously damaged. (General damage to foundations - CFR). Frame structures, if not bolted, shifted off foundations. Frames rocked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluviated areas sand and mud ejected, earthquake fountains, sand craters	80-200	0.35-0.7
8	X	Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly	200-500	0.7-1.2
	XI	Rails bent greatly. Underground pipelines completely out of service		>1.2
	XII	Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air	From Fig. 11.14	

Note: Masonry A, B, C, D. To avoid ambiguity of language, the quality of masonry, brick or otherwise, is specified by the following lettering (which has no connection with the conventional Class A, B, C construction)

- Masonry A: Good workmanship, mortar, and design reinforced, especially laterally, and bound together by using steel, concrete, etc., designed to resist lateral forces.
- Masonry B: Good workmanship and mortar; reinforced, but not designed to resist lateral forces.
- Masonry C: Ordinary workmanship and mortar, no extreme weaknesses such as non-ded-ia corners, but masonry is neither reinforced nor designed against horizontal forces.
- Masonry D: Week materials such as adobe, poor mortar, low standards of workmanship, week horizontally.

[a]From Richter (1958). 'Adapted with permission of W. H. Freeman and Company by Hunt (1984).

†Average peak ground velocity, cm/s

‡Average peak acceleration (away from source).

§Magnitude correlation

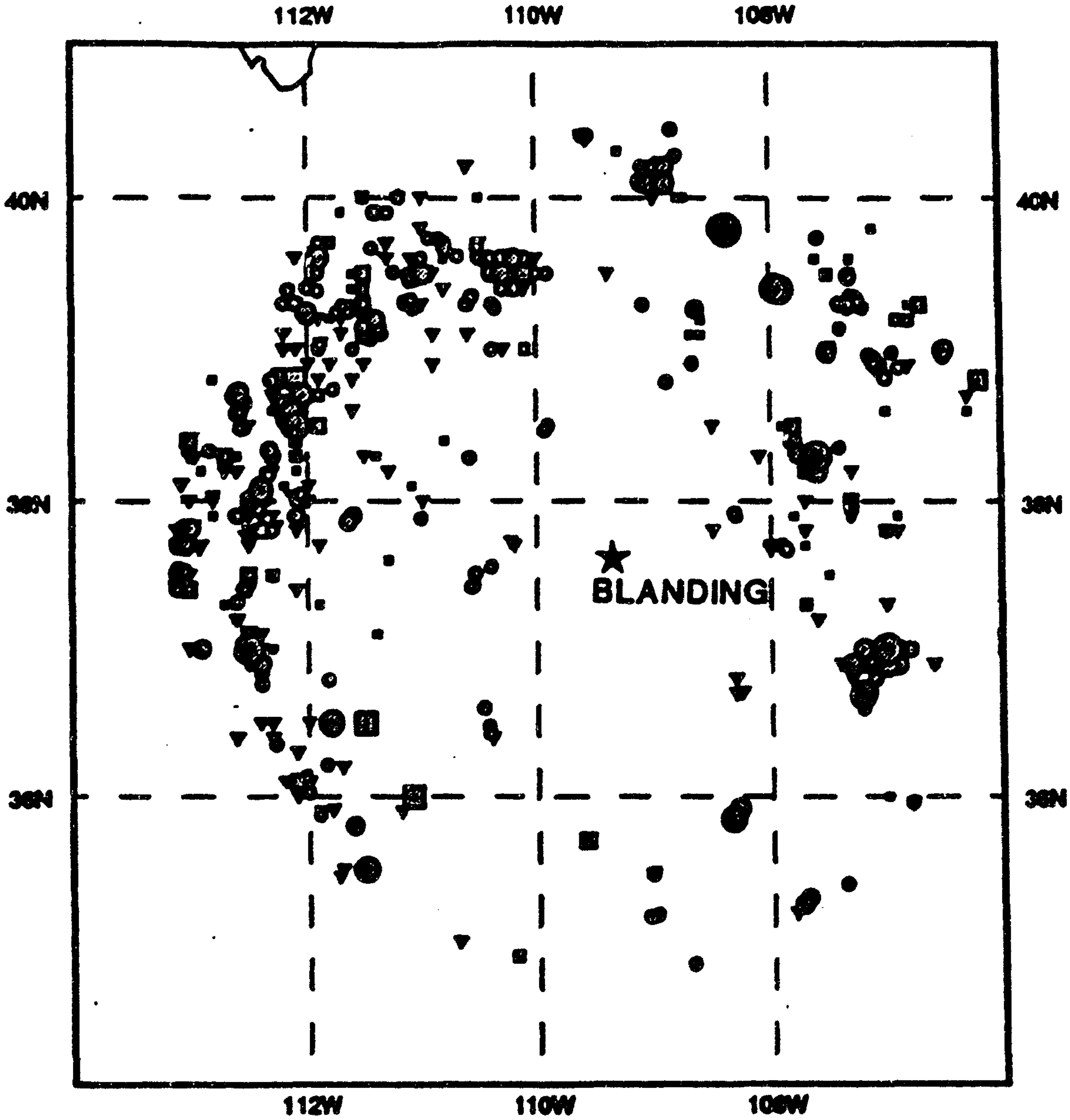
1.6.2.4 Relationship of Earthquakes to Tetonic Structures

The majority of recorded earthquakes in Utah have occurred along an active belt of seismicity that extends from the Gulf of California, through western Arizona, central Utah, and northward into western British Columbia. The seismic belt is possibly a branch of the active rift system associated with the landward extension of the East Pacific Rise (Cook and Smith, 1967). This belt is the Intermountain Seismic Belt shown in Figure 1.6-5 (Smith, 1978).

It is significant to note that the seismic belt forms the boundary zone between the Basin and Range - Great Basin Provinces and the Colorado Plateau - Middle Rocky Mountain Provinces. This block-faulted zone is about 47 to 62 miles (75 to 100 km) wide and forms a tectonic transition zone between the relatively simple structures of the Colorado Plateau and the complex fault-controlled structures of the Basin and Range Province (Cook and Smith, 1967).

Another zone of seismic activity is in the vicinity of Dulce, New Mexico, near the Colorado border. This zone, which coincides with an extensive series of tertiary intrusives, may also be related to the northern end of the Rio Grande Rift. This rift is a series of fault-controlled structural depressions extending southward from southern Colorado through central New Mexico and into Mexico. The rift is shown on Figure 1.6-5 trending north-south to the east of the project area.

Most of the events south of the Utah border of intensity V and greater are located within 50 miles (80 km) of post-Oligocene extrusives. This relationship is not surprising because it has been observed in many other parts of the world (Hadsell, 1968).



1146 EARTHQUAKES PLOTTED

MAGNITUDES		NO INTENSITY OR MAGNITUDE ▼	INTENSITIES	
<4.0	●		I-IV	•
5.0	●		V	•
6.0	●		VII	■
7.0	●		IX	■

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FIGURE 1.6-3
Seismicity within 320 KM
of the White Mesa Mill

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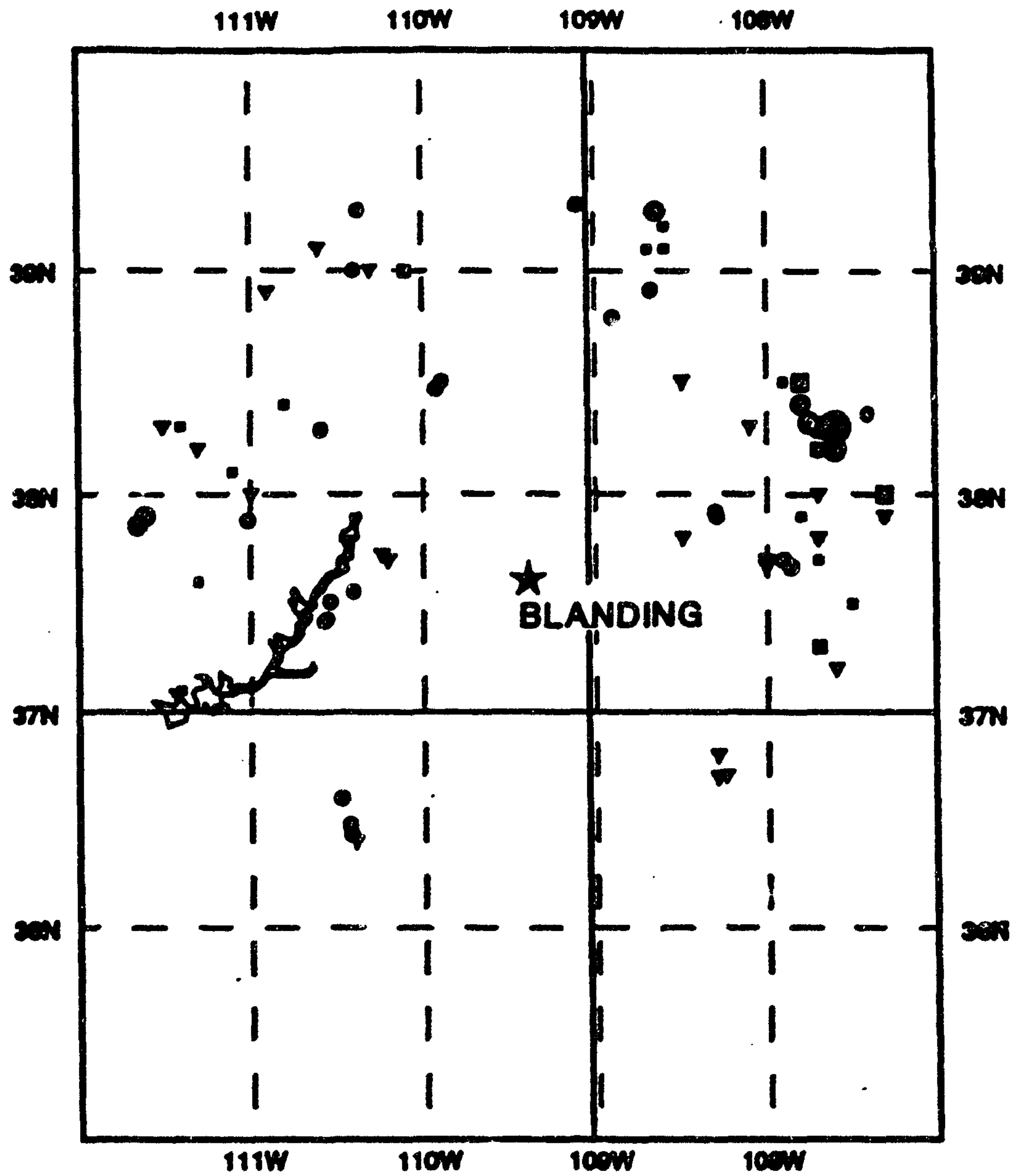
APP	SCALE: As Shown	



103 EARTHQUAKES PLOTTED

MAGNITUDES		NO INTENSITY OR MAGNITUDE ▼	INTENSITIES
<4.0	●		I-IV
5.0	●		V
6.0	●		VII
7.0	●		IX

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FIGURE 1.6-4
Seismicity within 200 KM
of the White Mesa Mill

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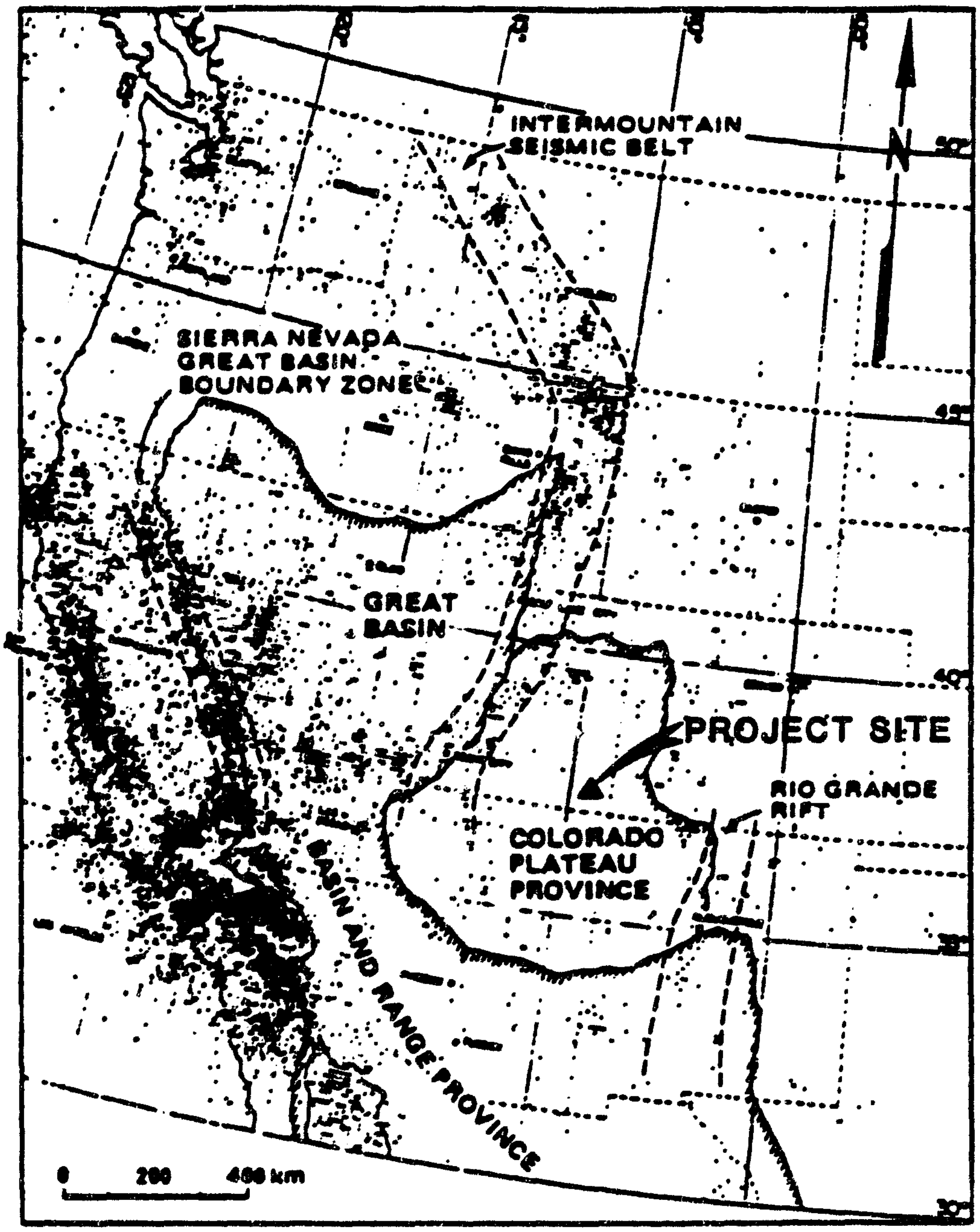

Modified from Smith, 1978

SHOWS RELATIONSHIP OF THE COLORADO PLATEAU PROVINCE TO MARCANAL BELTS

After Umetco #88

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FIGURE 1.6-5 Seismicity of the Western United States, 1950 to 1976		
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APP	SCALE: As Shown	

In Colorado, the Rio Grande Rift zone is one of three siesmotectonic provinces that may contribute energy to the study area. Prominent physiographic expression of the rift includes the San Luis Valley in southern Colorado. The valley is a half-graben structure with major faulting on the eastern flank. Extensional tectonics is dominant in the area and very large earthquakes with recurrence intervals of several thousand years have been projected (Kirkham and Rodgers, 1981). Mountainous areas to the west of the Rio Grande rift province include the San Juan Mountains. These mountains are a complex domicil uplift with extensive Oligocene and Miocene volcanic cover. Many faults are associated with the collapse of the calderas and apparently have not moved since. Faults of Neogene age exist in the eastern San Juan Mountains that may be related to the extension of the Rio Grande rift. Numerous small earthquakes have been felt or recorded in the western mountainous province despite an absence of major Neogene tectonic faults (Kirkham and Rodgers, 1981).

The third seismotectonic province in Colorado, that of the Colorado Plateau, extends into the surrounding states to the west and south. In Colorado, the major tectonic element that has been recurrently active in the Quaternary is the Uncompahgre uplift. Both flanks are faulted and earthquakes have been felt in the area. The faults associated with the Salt Anticlines are collapsed features produced by evaporite solution and flowage (Cater, 1970). Their non-tectonic origin and the plastic deformation of the salt reduces their potential for generating even moderate-sized earthquakes (Kirkham and Rodgers, 1981).

Case and Joesting (1972) have called attention to the fact that regional seismicity of the Colorado Plateau includes a component added by basement faulting. They inferred a basement fault trending northeast along the axis of the Colorado River through Canyonlands. This basement faulting may be part of the much larger structure that Hite (1975) examined and Warner (1978) named the Colorado lineament (Figure 1.6-6). This 1,300-mile (2,100 km) long lineament that extends from

northern Arizona to Minnesota is suggested to be a Precambrian wrench-fault system formed some 2.0 to 1.7 billion years before present. While it has been suggested that the Colorado lineament is a source zone for larger earthquakes (m = 4 to 6) in the west-central United States, the observed spatial relationship between epicenters and the trace of the lineament does not prove a casual relation (Brill and Nuttli, 1983). In terms of contemporary seismicity, the lineament does not act as a uniform earthquake generator. Only specific portions of the proposed structure can presently be considered seismic source zones and each segment exhibits seismicity of distinctive activity and character (Wong, 1981). This is a reflection of the different orientations and magnitudes of the stress fields along the lineament. The interior of the Colorado Plateau forms a tectonic stress province, as defined by Zoback and Zoback (1980), that is characterized by generally east-west tectonic compression. Only where extensional stresses from the Basin and Range province of the Rio Grande rift extend into the Colorado Plateau would the Colorado lineament in the local area be suspected of having the capability of generating a large magnitude earthquake (Wong, 1984). At the present time, the well defined surface expression of regional extension is far to the west and far to the east of the project area.

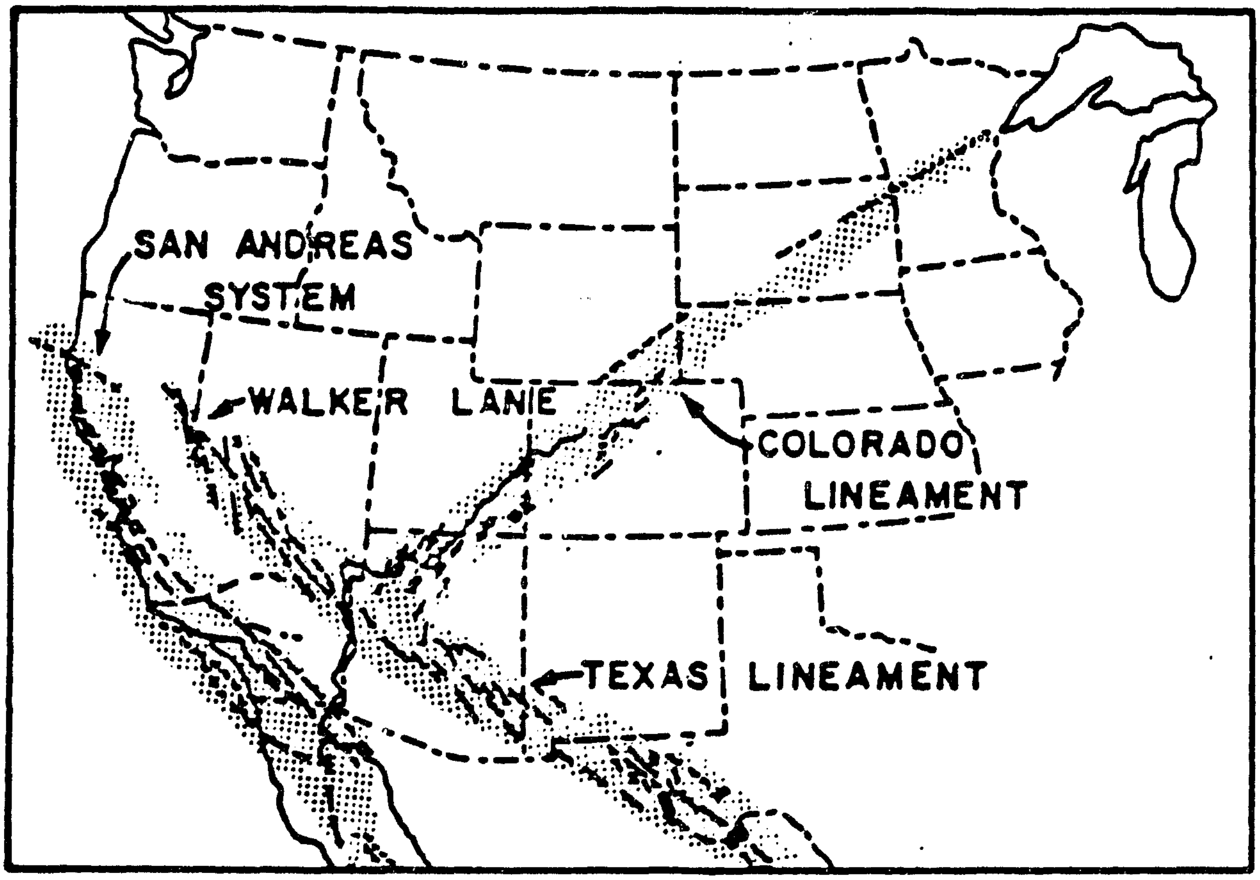
Recent work by Wong (1984) has helped define the seismicity of the whole Colorado Plateau. He called attention to the low level (less than M_L = 3.6) but high number (30) of earthquakes in the Capitol Reef Area from 1978 to 1980 that were associated with the Waterpocket fold and the Cainville monocline, two other major tectonic features of the Colorado Plateau. Only five earthquakes in the sequence were of M_L greater than 3, and fault plane solutions suggest the swarm was produced by normal faulting along northwest-trending Precambrian basement structures (Wong, 1984). The significance of the Capitol Reef seismicity is its relatively isolated occurrence within the Colorado Plateau and its location at a geometric barrier in the regional stress field (Aki, 1979). Stress concentration that produces earthquakes at bends or junctures of basement faults as indicated

by this swarm may be expected to occur at other locations in the Colorado Plateau Province. No inference that earthquakes such as those at Capitol Reef are precursors for larger subsequent events is implied.

1.6.2.5 Potential Earthquake Hazards to Project

The project site is located in a region known for its scarcity of recorded seismic events. Although the seismic history for this region is barely 135 years old, the epicentral pattern, or fabric, is basically set and appreciable changes are not expected to occur. Most of the larger seismic events in the Colorado Plateau have occurred along its margins rather than in the interior central region. Based on the region's seismic history, the probability of a major damaging earthquake occurring at or near the project site is very remote. Studies by Algermissen and Perkins (1976) indicate that southeastern Utah, including the site, is in an area where there is a 90 percent probability that a horizontal acceleration of four percent gravity (0.04g) would not be exceeded within 50 years.

Minor earthquakes, not associated with any seismic-tectonic trends, can presumably occur randomly at almost any location. Even if such an event with an intensity as high as VI should occur at or near the project site, horizontal ground accelerations would not exceed 0.10g but would probably range between 0.05 and 0.09g (Coulter et al., 1973; Trifunac and Brady, 1975). These magnitudes of ground motion would not pose significant hazards to the existing and proposed facilities at the Project Site.



SOURCE: WARNER, 1978

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FIGURE 1.6-6

Colorado Lineament

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1.6.3 Seismic Risk Assessment

In addition to general estimates of earthquake hazards, such as those offered by Dames and Moore (1978b), and summarized above, a more detailed analysis of the relationship between the project area and regional seismicity was performed. As can be seen in Figure 1.6-3, a map based on the seismologic data base from the National Geophysical Data Center of the National Oceanic and Atmospheric Administration (NOAA 1988), many events occur within the Intermountain Seismic Belt and within the Rio Grande rift. Since the Colorado Plateau Province (and particularly the Blanding basin portion, in which the project site lies) is a distinctly different tectonic province, the historical sample chosen for magnitude/frequency estimates was limited to a radius of about 120 miles (200 km) from the project. This sample included a region which is more representative of the seismicity of the Colorado Plateau.

Static and pseudostatic analyses were performed to establish the stability of the side slopes of the tailings soil cover. These analyses, together with analyses of radon flux attenuation, infiltration, freeze/thaw effects, and erosion protection, are summarized below, and are detailed in Appendix D, the Tailings Cover Design report (Titan, 1996).

The side slopes are designed at an angle of 5H:1V. Because the side slope along the southern section of Cell 4A is the longest and the ground elevation drops rapidly at its base, this slope was determined to be critical and is thus the focus of the stability analyses.

The computer software package GSLOPE, developed by MITRE Software Corporation, was used to determine the potential for slope failure. GSLOPE applies Bishop's Method of slices to identify the critical failure surface and calculate a factor of safety (FOS). The slope geometry and properties

of the construction materials and bedrock are input into the model. These data and drawings are included in the Stability Analysis of Side Slopes Calculation brief included as Appendix G of the Tailings Cover Design report. For this analysis, competent bedrock is designated at 10 feet below the lowest point of the foundation [i.e., at a 5,540-foot elevation above mean sea level (msl)]. This is a conservative estimate, based on the borehole logs supplied by Chen and Associates (1979), which indicate bedrock near the surface.

1.6.3.1 Static Analysis

For the static analysis, a Factor of Safety ("FOS") of 1.5 or more was used to indicate an acceptable level of stability. The calculated FOS is 2.91, which indicates that the slope should be stable under static conditions. Results of the computer model simulations are included in Appendix G of the Tailings Cover Design report.

1.6.3.2 Pseudostatic Analysis (Seismicity)

The slope stability analysis described above was repeated under pseudostatic conditions in order to estimate a FOS for the slope when a horizontal ground acceleration of 0.10g is applied. The slope geometry and material properties used in this analysis are identical to those used in the stability analysis. A FOS of 1.0 or more was used to indicate an acceptable level of stability under pseudostatic conditions. The calculated FOS is 1.903, which indicates that the slope should be stable under dynamic conditions. Details of the analysis and the simulation results are included in Appendix G of the Tailings Cover Design report.

In June of 1994, Lawrence Livermore National Laboratory ("LLNL") (1994) published a report on seismic activity in southern Utah, in which a horizontal ground acceleration of 0.12g was proposed for the White Mesa site. The evaluations made by LLNL were conservative to account for tectonically active regions that exist, for example, near Moab, Utah. Although, the LLNL report states that "...[Blanding] is located in a region known for its scarcity of recorded seismic events," the stability of the cap design slopes using the LLNL factor was evaluated. The results of a sensitivity analysis reveal that when considering a horizontal ground acceleration of 0.12g, the calculated FOS is 1.778 which is still above the required value of 1.0, indicating adequate safety under pseudostatic conditions. This analysis is also included in Appendix G of the Tailings Cover Design report.

1.7 BIOTA (ER Section 2.9)

1.7.1 Terrestrial (ER Section 2.9.1)

1.7.1.1 Flora (ER Section 2.9.1.1)

The natural vegetation presently occurring within a 25-mile (40-km) radius of the site is very similar to that of the potential, being characterized by pinyon-juniper woodland intergrading with big sagebrush (Artemisia tridentata) communities. The pinyon-juniper community is dominated by Utah juniper (Juniperus osteosperma) with occurrences of pinyon pine (Pinus edulis) as a codominant or subdominant tree species. The understory of this community, which is usually quite open, is composed of grasses, forbs, and shrubs that are also found in the big sagebrush communities. Common associates include galleta grass (Hilaria jamesii), green ephedra (Ephedra viridis), and broom snakewood (Gutierrezia sarothrae). The big sagebrush communities occur in deep, well-drained soils on flat terrain, whereas the pinyon-juniper woodland is usually found on shallow rocky

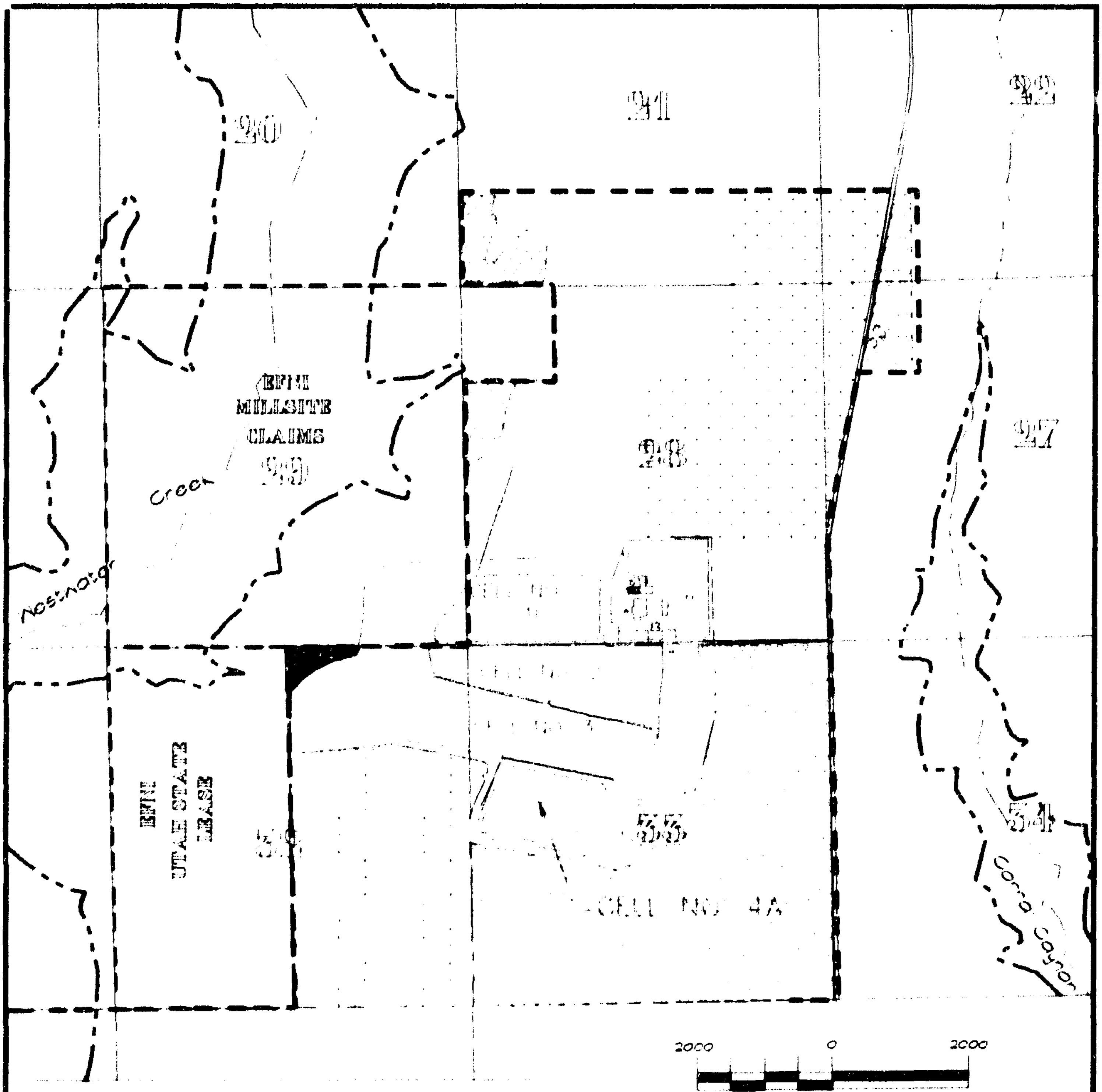
soil of exposed canyon ridges and slopes.

Seven community types are present on the project site (Table 1.7-1 and Figure 1.7-1). Except for the small portions of pinyon-juniper woodland and the big sagebrush community types, the majority of the plant communities within the site boundary have been disturbed by past grazing and/or treatments designed to improve the site for rangeland. These past treatments include chaining, plowing, and reseeding with crested wheatgrass (Agropyron desertorum). Controlled big sagebrush communities are those lands containing big sagebrush that have been chained to stimulate grass production. In addition, these areas have been seeded with crested wheatgrass. Both grassland communities I and II are the result of chaining and/or plowing and seeding with crested wheatgrass. The reseeded grassland II community is in an earlier stage of recovery from disturbance than the reseeded grassland I community. The relative frequency, relative cover, relative density, and importance values of species sampled in each community are presented in Dames and Moore (1978b), Table 2.8-2. The percentage of vegetative cover in 1977 was lowest on the reseeded grassland II community (10.7%) and highest on the big sagebrush community (33%) (Table 1.7-2).

Based upon dry weight composition, most communities on the site were in poor range condition in 1977 (Dames & Moore (1978), Tables 2.8-3 and 2.8-4). Pinyon-juniper, big sagebrush, and controlled big sagebrush communities were in fair condition. However, precipitation for 1977 at the project site was classed as drought conditions (Dames & Moore (1978b), Section 2.8.2.1). Until July, no production was evident on the site.

No designated or proposed endangered plant species occur on or near the project site (Dames & Moore (1978b), Section 2.8.2.1). Of the 65 proposed endangered species in Utah, six have documented distributions on San Juan County. A careful review of the habitat requirements and

known distributions of these species indicates that, because of the disturbed environment, these species would probably not occur on the project site.



- Pinyon-Juniper
- Reseeded Grassland I
- Reseeded Grassland II
- Big Sagebrush
- Controlled Big Sagebrush
- Disturbed

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FIGURE 1.7-1
Vegetation Community Types on the White Mesa Site

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TABLE 1.7-1

Community Types and Expanse Within the Project site Boundary

Community Type	Expanse	
	Ha	Acres
Pinyon-juniper Woodland	5	13
Big Sagebrush	113	278
Reseeded Grassland I	177	438
Reseeded Grassland II	121	299
Tamarisk-salix	3	7
Controlled Big Sagebrush	230	569
Disturbed	17	41

TABLE 1.7-?

Ground Cover For Each Community Within the Project Site Boundary

Community Type	Percentage of Each Type of Cover		
	Vegetative Cover	Litter	Bare Ground
Pinyon-juniper Woodland[a]	25.9	15.6	55.6
Big Sagebrush	33.3	16.9	49.9
Reseeded Grassland I	15.2	24.2	61.0
Reseeded Grassland II	10.7	9.5	79.7
Tamarisk-salix	12.0	20.1	67.9
Controlled Big Sagebrush	17.3	15.3	67.4
Disturbed	13.2	7.0	80.0

[a]Rock covered 4.4% of the ground.

1.7.1.2 Fauna (ER Section 2.9.1.2)

Wildlife data have been collected through four seasons at several locations on the site. The presence of a species was based on direct observations, trappings and signs such as the occurrence of scat, tracks, or burrows. A total of 174 vertebrate species potentially occur within the vicinity of the mill (Dames & Moore (1978b), Appendix D), 78 of which were confirmed (Dames & Moore (1978b), Section 2.8.2.2).

Although seven species of amphibians are thought to occur in the area, the scarcity of surface water limits the use of the site by amphibians. The tiger salamander (Ambystoma tigrinum) was the only species observed. It appeared in the pinyon-juniper woodland west of the project site (Dames & Moore (1978b), Section 2.8.2.2).

Eleven species of lizards and five snakes potentially occur in the area. Three species of lizards were observed: the sagebrush lizard (Sceloparas graciosus), western whiptail (Cnemidophorus tigris), and the short-horned lizard (Phrynosoma douglassi) (Dames & Moore (1978b), Section 2.8.2.2). The sagebrush and western whiptail lizard were found in sagebrush habitat, and the short-horned lizard was observed in the grassland. No snakes were observed during the field work.

Fifty-six species of birds were observed in the vicinity of the project site (Table 1.7-3). The abundance of each species was estimated by using modified Emlen transects and roadside bird counts in various habitats and seasons. Only four species were observed during the February sampling. The most abundant species was the horned lark (Eremophila aepestis) followed by the common raven (Corvus corax), which were both concentrated in the grassland. Avian counts increased drastically in May. Based on extrapolation of the Emlen transect data, the avian density

on grassland of the project site during spring was about 123 per 100 acres (?05 per square kilometer). Of these individuals, 94 percent were horned larks and western meadowlarks (Sturnella neglecta). This density and species composition are typical of rangeland habitats. In late June the species diversity declined somewhat i grassland but peaked in all other habitats. By October the overall diversity decreased but again remained the highest in grassland.

Raptors are prominent in the western United States. Five species were observed in the vicinity of the site (Table 1.7-3). Although no nests of these species were located, all (except the golden eagle, Aquila chrysaetos) have suitable nesting habitat in the vicinity of the site. The nest of a prairie falcon (Falco mexicanus) was found about 3/4 mile (1.2 km) east of the site. Although no sightings were made of this species, members tend to return to the same nests for several years if undisturbed (Dames & Moore (1978b), Section 2.8.2.2).

Of several mammals that occupy the site, mule deer (Odocoileus hemionus) is the largest species. The deer inhabit the project vicinity and adjacent canyons during winter to feed on the sagebrush and have been observed migrating through the site to Murphy Point (Dames & Moore (1978b), Section 2.8.2.2). Winter deer use of the project vicinity, as measured by browse utilization, is among the heaviest in southeastern Utah [25 days of use per acre (61 days of use per hectare) in the piny n-juniper-sagebrush habitats in the vicinity of the project site]. In addition, this area is heavily used as a migration route by deer traveling to Murphy Point to winter. Daily movement during winter periods by deer inhabiting the area has also been observed between Westwater Creek and Murphy Point. The present size of the local deer herd is not known.

Other mammals present at the site include the coyote (Canis latrans), red fox (Vulpes vulpes), gray fox (Urocyon cineroargenteus), striped skunk (Mephitis mephitis), badger (taxidea taxus), longtail

weasel (Mustela frenata), and bobcat (Lynx rufus). Nine species of rodents were trapped or observed on the site, the deer mouse (Peromyscus maniculatus) having the greatest distribution and abundance. Although desert cottontails (Sylvilagus auduboni) were uncommon in 1977, black-tailed jackrabbits (Lepus californicus) were seen during all seasons.

Three currently recognized endangered species of animals could occur in the project vicinity. However, the probability of these animals occurring near the site is extremely low. The project site is within the range of the bald eagle (Haliaeetus leucocephalus) and the American peregrine falcon (Falco peregrinus anatum), but the lack of aquatic habitat indicates a low probability of these species occurring on the site. Although the black-footed ferret (Musetela nigripes) once ranged in the vicinity of the site, it has not been sighted in Utah since 1952, and the Utah Division of Wildlife feels it is highly unlikely that this animal is present (Dames & Moore (1978b), Section 2.8.2.2).

1.7.2 Aquatic Biota (ER Section 2.9.2)

Aquatic habitat at the project site ranges temporally from extremely limited to nonexistent due to the aridity, topography and soil characteristics of the region and consequent dearth of perennial surface water. Two small catch basins (Dames & Moore (1978b), Section 2.6.1.1), approximately 20 m in diameter, are located on the project site, but these only fill naturally during periods of heavy rainfall (spring and fall) and have not held rainwater during the year-long baseline water quality monitoring program. One additional small basin was completed in 1994 to serve as a diversionary feature for migrating waterfowl. Although more properly considered features of the terrestrial environment, they essentially represent the total aquatic habitat on the project site. When containing water, these catch basins probably harbor algae, insects, other invertebrate forms, and amphibians.

TABLE 1.7-3
Birds Observed in the Vicinity of the White Mesa Project

Species	Relative Abundance and Status[a]	Species	Relative Abundance and Status[a]
Mallard	CP	Pinyon Jay	CP
Pintail	CP	Bushtit	CP
Turkey Vulture	US	Bewick's Wren	CP
Red-tailed Hawk	CP	Mockingbird	US
Golden Eagle	CP	Mountain Bluebird	CS
Marsh Hawk	CP	Black-tailed Gnatcatcher	H
Merlin	UW	Ruby-crowned Kinglet	CP
American Kestrel	CP	Loggerhead Shrike	CS
Sage Grouse	UP	Starling	CP
Scaled Quail	Not Listed	Yellow-rumped Warbler	CS
American Coot	CS	Western Meadowlark	CP
Killdeer	CP	Red-winged Blackbird	CP
Spotted Sandpiper	CS	Brewer's Blackbird	CP
Mourning Dove	CS	Brown-headed Cowbird	CS
Common Nighthawk	CS	Blue Grosbeak	CS
White-throated Swift	CS	House Finch	CP
Yellow-bellied Sapsucker	CP	American Goldfinch	CP
Western Kingbird	CS	Green-tailed Towhee	CS
Ash-throated Flycatcher	CS	Rufous-sided Towhee	CP
Say's Phoebe	CS	Lark Sparrow	CS
Horned Lark	CP	Black-throated Sparrow	CS
Violet-green Swallow	CS	Sage Sparrow	UC
Barn Swallow	CS	Dark-eyed Junco	CW
Cliff Swallow	CS	Chipping Sparrow	CS
Scrub Jay	CP	Brewer's Sparrow	CS
Black-billed Magpie	CP	White-crowned Sparrow	CS
Common Raven	CP	Song Sparrow	CP
Common Crow	CW	Vesper Sparrow	CS

[a]W. H. Behle and M. L. Perry, *Utah Birds*, Utah Museum of Natural History, University of Utah, Salt Lake City, 1975.

Relative Abundance	Status
C = Common	P = Permanent
U = Uncommon	S = Summer Resident
H = Hypothetical	W = Winter Visitant

<u>Source</u>: Dames & Moore (1978b), Table 2.8-5

They may also provide a water source for small mammals and birds. Similar ephemeral catch and seepage basins are typical and numerous to the northeast of the project site and south of Blanding.

Aquatic habitat in the project vicinity is similarly limited. The three adjacent streams (Corral Creek, Westwater Creek, and an unnamed arm of Cottonwood Wash) are only intermittently active, carrying water primarily in the spring during increased rainfall and snowmelt runoff, in the autumn, and briefly during localized but intense electrical storms. Intermittent water flow most typically occurs in April, August, and October in those streams. Again, due to the temporary nature of these steams, their contribution to the aquatic habitat of the region is probably limited to providing a water source for wildlife and a temporary habitat for insect and amphibian species.

No populations of fish are present on the project site, nor are any known to exist, in its immediate vicinity. The closest perennial aquatic habitat to the mill appears to be a small irrigation basin (approximately 50 m in diameter) about 3.8 miles (6 km) upgrade to the northeast. This habitat was not sampled for biota and it has been reported that the pond is intermittent and probably does not harbor any fish species.

The closest perennial aquatic habitat known to support fish populations is the San Juan River 18 miles (29 km) south of the project site. Five species of fish Federally designated (or proposed) as endangered or threatened occur in Utah (Table 1.7-4). One of the five species, the woundfin (Plegopterus argentissiumus), does not occur in southeastern Utah where the mill site is located. The Colorado squawfish (Ptychocheilus lucius) and humpback chub (Gila cypha), however, are reported as inhabiting large river systems in southeastern Utah. The bonytail chub (Gila elegans), classified as threatened by the State and proposed as endangered by Federal authorities, is also limited in its distribution to main channels or large rivers. The humpback sucker (razorback sucker; Xyrauchen

texanus), protected by the State and proposed as threatened by the Federal authorities, is found in southeastern Utah inhabiting backwater pools and quiet areas of mainstream rivers. The closest habitat suitable for the Colorado squawfish, humpback chub, bonytail chub, and humpback sucker is the San Juan River 18 miles (29 km) south of the site.

TABLE 1.7-4

Threatened and Endangered Aquatic Species Occurring in Utah

Species	Habitat	Listing	Occurrence in Southeastern Utah
Woundfin *Plegopterus Argentissimus*	Silty streams; muddy, swift-current areas; Virgin River critical habitat[a]	Federal - endangered[b] State - threatened	No
Humpback Chub *Gila Cypha*	Large river systems, eddies, and backwater	Federal - endangered[b] State - threatened	Yes
Colorado River Squawfish *Ptychocheilus Lucius*	Main channels of large river systems in Colorado drainage	Federal - endangered[b] State - threatened	Yes
Bonytail Chub *Gila Elegans*	Main channels of large river systems in Colorado drainage	Federal - proposed endangered[c] State - threatened	Yes
Humpback Sucker (razorback sucker) *Xyrauchen Texanus*	Backwater pools and quiet-water areas of main rivers	Federal - proposed threatened[c] State - threatened	Yes

a "Endangered and Threatened Wildlife and Plants," *Fed. Regist.* 42(211): 57329 (1977).

b "Endangered and Threatened Wildlife and Plants," *Fed. Regist.* 42(135): 36419-39431 (1977).

c "Endangered and Threatened Wildlife and Plants," *Fed. Regist.* 43(79): 17375-17377 (1978).

1.8 NATURAL RADIATION

The following sections describe background levels of natural radiation and refer the reader to recent reports containing current radiation monitoring data.

1.8.1 Background (ER Section 2.10)

Radiation exposure in the natural environment is due to cosmic and terrestrial radiation and to the inhalation of radon and its daughters. Measurements of the background environmental radioactivity were made at the mill site using thermoluinescent dosimeters (TLDs). The results indicate an average total body dose of 142 millirems per year, of which 68 millirems is attributable to cosmic radiation and 74 millirems to terrestrial sources. The cosmogenic radiation dose is estimated to be about 1 millirem per year. Terrestrial radiation originates from the radionuclides potassium-40, rubidium-87, and daughter isotopes from the decay of uranium-238, thorium-232, and, to a lesser extent, uranium-235. The dose from ingested radionuclides is estimated at 18 millirems per year to the total body. The dose to the total body from all sources of environmental radioactivity is estimated to be about 161 millirems per year.

The concentration of radon in the area is estimated to be in the range of 500 to 1,000 pCi/m^3, based on the concentration of radium-226 in the local soil. Exposure to this concentration on a continuous basis would result in a dose of up to 625 millirems per year to the bronchial epithelium. As ventilation decreases, the dose increases; for example, in unventilated enclosures, the comparable dose might reach 1,200 millirems per year.

The medical total body dose for Utah is about 75 millirems per year per person. The total dose in the area of the mill from natural background and medical exposure is estimated to be 236 millirems per year.

1.8.2 Current Monitoring Data

The most recent data for radon, gamma, vegetation, air and stock sampling, groundwater, surface water, meteorological monitoring, and soil sampling discussed in the following sections are found in the Semi-Annual Effluent Reports for July through December 1995 (Semi-Annual Effluent Report, 1995) (Energy Fuels Nuclear, Inc. 1996) and the Semi-Annual Effluent Report for January through June 1995 (Semi-Annual Effluent Report, 1995) (Energy Fuels Nuclear, Inc., 1995), which are reproduced in Appendix A.

1.8.2.1 Environmental Radon

Until 10 CFR 20 standards were reduced to 0.1 pCi/l, environmental radon concentrations were determined by using Track Etch detectors. There was one detector at each of five environmental monitoring stations with a duplicate at BHV-2, the nearest residence. See Appendix A, the Semi-Annual Effluent reports, for maps showing these locations. After 1995, with concurrence of the NRC, environmental radon concentrations are no longer measured at these locations due to the lack of sensitivity of available monitoring methods to meet the new 10 CFR 20 standard of 0.1 pCi/l.

1.8.2.2 Environmental Gamma

Gamma radiation levels are determined by Thermal Luminescent Dosimeters (TLDs). The TLDs are placed at the five environmental stations located around the perimeter boundary of the mill site discussed above. The badges are exchanged quarterly. The data are presented in Appendix A.

1.8.2.3 Vegetat Samples

Vegetation samples are collected at three locations around the mill periphery. The sampling locations are northeast, northwest, and southwest of the mill facility. Vegetation samples are collected during early spring, late spring, and fall. Vegetation results are included in Appendix A. No trends are apparent, as the Ra-226 and Pb-210 concentrations at each sampling location have remained consistent.

1.8.2.4 Environmental Air Monitoring and Stack Sampling

Air monitoring at the White Mesa Mill is conducted at five high volume (40 standard cubic feet per minute) stations located around the periphery of the mill. These locations are shown in Appendix A. BHV-1 is located at the northern mill boundary at the meteorological station site. BHV-2 is further north at the nearest residence. BHV-3 is the background station located approximately three to five miles due east of the mill. BHV-4 is south of Cell 3 and BHV-5 is just south of the ore storage pad. Appendix A, the Semi-Annual Effluent reports, contain air monitoring data.

The results of the first quarter 1996 stack samples are presented in Appendix A. These samples were collected during the period between January 27, 1996 and February 3, 1996. Samples were collected

from the North Yellowcake Dryer, the South Yellowcake Dryer, and the Yellowcake Baghouse. The Demister Stack and Grizzly Stack were not sampled because they were not in operation during that time. The material being processed during that time for recovery of the source material content was a uranium calcium fluoride solid in powder form, which requires no grinding. No second quarter 1996 gas samples were collected on any process stack, because material processing and drying operations ceased on March 23, 1996. Graphical representation of uranium release rate is presented in Appendix A. The south yellowcake dryer and yellowcake baghouse have only been sampled twice. No graphs had been generated for those data.

Pursuant to NRC License Amendment No. 41 for the White Mesa Mill Source Material License No. SUA-1358, air particulate radionuclide monitoring at BHV-3 was discontinued at the end of the third quarter 1995. Sufficient data were accumulated over a 12-year period to adequately establish background radionuclide concentrations. As a result of Amendment No. 41, the air particulate radionuclide concentrations at each monitoring site are calculated by subtracting the appropriate quarterly background average. Appendix A tables show the radionuclide concentrations at each location with background concentrations subtracted, and the results of the dose calculations, including the 50-year dose commitment to the nearest residence. Appendix A shows the yearly dose to the nearest resident, which is very low. No apparent trends are evident.

1.8.2.5 Groundwater

Appendix A tables list the groundwater monitoring data and the Quality Control (QC) results. No trends are apparent.

1.8.2.6 Surface Water

The results of surface water monitoring are presented in Appendix A. Cottonwood Creek is sampled Semi-annually and Westwater Creek is sampled on an annual basis. No water flowed in Westwater Creek during 1996. No trends are apparent.

1.8.2.7 Meteorological Monitoring

The Semi-Annual Air Quality and Meteorology Monitoring Report provided by Enecotech is included in Appendix A.

2.0 EXISTING FACILITY

The following sections describe the construction history of the White Mesa Mill; the mill and mill tailings management facilities; mill operations including the mill circuit and tailings management; and both operational and environmental monitoring.

2.1 Facility Construction History

The White Mesa uranium/vanadium mill was developed in the late 1970's by Energy Fuels Nuclear, Inc. (EFN) as an outlet for the many small mines that are located in the Colorado Plateau and for the possibility of milling Arizona Strip ores. At the time of its construction, it was anticipated that high uranium prices would stimulate ore production. However, prices started to decline about the same time as mill operations commenced.

As uranium prices fell, producers in the region were affected and mine output declined. After about two and one-half years, the White Mesa Mill ceased ore processing operations altogether, began solution recycle, and entered a total shutdown phase. In 1984, a majority ownership interest was acquired by Union Carbide Corporation's (UCC) Metals Division which later became Umetco Minerals Corporation (Umetco), a wholly-owned subsidiary of UCC. This partnership continued until May 26, 1994 when EFN reassumed complete ownership.

2.1.1 Mill and Tailings Management Facility

The Source Materials License Application for the White Mesa Mill was submitted to the U. S. Nuclear Regulatory Commission (NRC) on February 8, 1978. Between this date and the date the

first ore was fed to the mill grizzly on May 6, 1980, several actions were taken including: increasing mill design capacity, permit issuance from the Environmental Protection Agency and the State of Utah, archeological clearance for the mill and tailings areas, and an NRC pre-operational inspection on May 5, 1980.

Construction on the tailings area began on August 1, 1978 with the movement of earth from the area of Cell 2. Cell 2 was completed on May 4, 1980, Cell 1-I on June 29, 1981, and Cell 3 on September 2, 1982. In January of 1990 an additional cell, designated 4A, was completed and placed into use solely for solution storage and evaporation.

2.2 Facility Operations

In the following subsections, an overview of mill operators and operating periods are followed by descriptions of the operations of the mill circuit and tailings management facilities.

2.2.1 Operating Periods

The White Mesa Mill was operated by EFN from the initial start-up date of May 6, 1980 until the cessation of operations in 1983. Umetco, as per agreement between the parties, became the operator of record on January 1, 1984. The White Mesa Mill was shut down during all of 1984. The mill operated at least part of each year from 1985 through 1990. Mill operations were again ceased during the years of 1991 through 1994. EFN reacquired sole ownership on May 26, 1994 and the mill operated again during 1995 and 1996. Typical employment figures for the mill are 118 during uranium-only operations and 138 during uranium/vanadium operations.

2.2.2 Mill Circuit

While originally designed for a capacity of 1,500 dry tons per day (dtpd.), the mill was boosted to the present rated design of 1980 dtpd. prior to commissioning.

The mill uses an atmospheric hot acid leach followed by counter current decantation (CCD). This in turn is followed by a clarification stage which precedes the solvent extraction (SX) circuit. Kerosene containing iso-decanol and tertiary amines extract the uranium and vanadium from the aqueous solution in the SX circuit. Salt and soda ash are then used to strip the uranium and vanadium from the organic phase.

After extraction of the uranium values from the aqueous solution in SX, uranium is precipitated with anhydrous ammonia, dissolved, and re-precipitated to improve product quality. The resulting precipitate is then washed and dewatered using centrifuges to produce a final product called "yellowcake." The yellowcake is dried in a hearth dryer and packaged in drums weighing approximately 800 to 1,000 lbs. for shipping to converters.

After the uranium values are stripped from the pregnant solution in SX, the vanadium values are transferred to tertiary amines contained in kerosene and concentrated into an intermediate product called vanadium product liquor (VPL). An intermediate product, ammonium metavanadate (AMV), is precipitated from the VPL using ammonium sulfate in batch precipitators. The AMV is then filtered on a belt filter and, if necessary, dried. Normally, the AMV cake is fed to fusion furnaces when it is converted to the mill's primary vanadium product, V_2O_5 tech flake, commonly called "black flake."

The mill processed 1,511,544 tons of ore and other materials from May 6, 1980 to February 4, 1983. During the second operational period from October 1, 1985 through December 7, 1987, 1,023,393 tons were processed. During the third operational period from July 1988 through November 1990, 1,015,032 tons were processed. During the fourth operational period from August 1995 through January 1996, 203,317 tons were processed. The fifth and most recent operational period from May 1996 through September 1996, processed 3,868 tons of calcium fluoride material. Inception to date material processed through September 1996 totals 3,757,154 tons. This total is for all processing periods combined.

2.2.3 Tailings Management Facilities

Tailings produced by the mill typically contain 30 percent moisture by weight, have an in-place dry density of 74.2 pounds per cubic foot, have a size distribution with a predominant -325 mesh size fraction, and have a high acid and flocculent content.

The tailings facilities at White Mesa currently consist of four cells as follows:

- Cell 1, constructed with a 30-millimeter (ml) PVC earthen-covered liner, is used for the evaporation of process solution.
- Cell 2, constructed with a 30-millimeter (ml) PVC earthen-covered liner, is used for the storage of barren tailings sands.
- Cell 3, constructed with a 30-millimeter (ml) PVC earthen-covered liner, is used for the storage of barren tailings sands and solutions.
- Cell 4A, constructed with a 40-millimeter (ml) HDPE liner, is currently used only for the storage of solutions.

Total estimated design capacity of Cells 2, 3, and 4A is approximately six million (mm) cubic yards.

2.2.3.1 Tailings Management

Constructed in shallow valleys or swale areas, the lined tailings facilities provide storage below the existing grade and reduce potential exposure. Because the cells are separate and distinct, individual tailings cells may be reclaimed as they are filled to capacity. This phased reclamation approach minimizes the amount of tailings exposed at any given time and reduces potential exposure to a minimum.

The perimeter discharge method involves setting up discharge points around the east, north, and west boundaries of the cell. This results in low cost disposal at first, followed by higher disposal costs toward the end of the cell's life. The disadvantage to this method is that reclamation activities cannot take place until near the end of the cell's life. This disadvantage was recognized and led to the development of the final grade method.

Slurry disposal has taken place in both Cells 2 and 3. Tails placement accomplished in Cell 2 was by means of the above described perimeter discharge method, while in Cell 3 the final grade method, described below, has been employed.

The final grade method used in Cell 3 calls for the slurry to be discharged until the tailings surface comes up to final grade. The discharge points are set up in the east end of the cell and the final grade surface is advanced to the slimes pool area. When the slimes pool is reached, the discharge points are then moved to the west end of the cell and worked back to the middle. An advantage to using the final grade method is that maximum beach stability is achieved by (1) allowing water to drain from the sands to the maximum extent, and (2) allowing coarse sand deposition to help provide

stable beaches. Another advantage is that radon release and dust prevention measures (through the placement of the initial layer of the final cover) are applied as expeditiously as possible.

2.2.3.2 Liquid Management

As a zero-discharge facility, the White Mesa Mill must evaporate all of the liquids utilized during processing. This evaporation takes place in three areas:

- Cell 1, which is used for solutions only;
- Cell 3, in which tailings and solutions exist; and
- Cell 4A, which is currently for the evaporation of tailings solutions only.

The original engineering design indicated a net water gain into the cells would occur during mill operations. As anticipated, this has been proven to be the case. In addition to natural evaporation, spray systems have been used at various times to enhance evaporative rates and for dust control. To minimize the net water gain, solutions are recycled from the active tailings cells to the maximum extent possible. Solutions from Cells 3 and 4 are brought back to the CCD circuit where metallurgical benefit can be realized. Recycle to other parts of the mill circuit are not feasible due to the acid content of the solution.

2.3 Monitoring Programs

Operational monitoring is defined as those monitoring activities that take place only during operations. This is contrasted with environmental monitoring, which is performed whether or not the mill is in operation.

2.3.1 Operational Monitoring

In the mill facilities area, the operational monitoring programs consist of effluent gas stack sampling; daily inspection of process tanks, lines and equipment; and daily inspection of tailing impoundments and leak detection systems. Quarterly effluent gas stack samples are collected on all mill process stacks when those process systems are operating. These include the yellowcake dryers No. 1 and No. 2, the vanadium dryer stack, their respective scrubber stacks, the demister stack, and the grizzly stack.

A visual inspection is made daily by supervisory personnel of all process tanks and discharge lines in the mill and of the tailings management area. In the event of a failure in one of the normal process streams, corrective actions are taken to ensure that there are no discharges to the environment.

Leak detection systems ("LDS") under each tailings cell are monitored for the presence of solution weekly. If sufficient solution is present in the LDS of Cells 2, 3, or 4 to be pumped, the solution is sampled and analyzed for nickel, chlorides, sulfates, potassium, selenium, and pH.

2.3.2 Environmental Monitoring

Environmental monitoring consists of the following: groundwater and surface water samples; air particulate samples, gamma radiation measurements, soil, and vegetation samples. Refer to the Semi-annual Effluent Reports contained in Appendix A for sampling location, frequency and analytical results.

Groundwater

Wells MW-6, MW-7, and MW-8 were plugged because they were under Cell 3, as was MW-13, under Cell 4A. Wells MW-9 and MW-10 are dry and have been excluded from the monitoring program. The ten monitoring wells in or near the uppermost aquifer are MW-1, MW-2, MW-3, MW-4, MW-5, MW-11, MW-12, MW-14, MW-15 and MW-17. These wells vary in depth from 94 to 189 feet. Flow rates in these wells vary from 15 gallons per month to 10 gallons per hour. The culinary well (one of the supply wells) is completed in the Navajo aquifer, at a depth of approximately 1,800 feet below the ground surface.

The groundwater monitoring program consists of parameters measured quarterly and semi-annually. Quarterly parameters include: pH, specific conductance, temperature, depth to water, chlorides, sulfates, total dissolved solids (TDS), nickel, potassium, and U-natural. The parameters measured on a semi-annual basis, in addition to the quarterly parameters, are: arsenic, selenium, sodium, radium-226, thorium-230, and lead-210. Semi annual parameters which all measured are: all physical chemical criteria of quarterly sampling as well as additional analyte parameters as, Se Na and Radionuclides Ra-226, Th-230, and Pb216.

Surface Water

Surface water samples are taken from the two nearby streams, Westwater Creek and Cottonwood Creek. Cottonwood Creek usually contains running water, but has also been dry on occasion. Westwater Creek rarely contains running water, and when it does, it is from precipitation runoff. Water samples are collected quarterly from Cottonwood Creek and analyzed for TDS and total suspended solids (TSS). Additional semi-annual water samples are collected at a minimum of four

(4) months apart. These samples are analyzed for TDS, TSS, dissolved and suspended U-nat, Ra-226, and Th-230.

Currently the program includes sampling water from Westwater Creek once a year, if the creek is flowing. However, if water is not running, an alternate soil sample is collected from the creek bed. Water samples from Westwater Creek are analyzed for TDS, TSS, Dissolved and Suspended U-nat, Ra-226, and Th-230. If a soil sample is collected, it is analyzed for U-nat and Ra-226 (per License Condition 24C).

Radiation

Natural radiation monitoring includes air particulate sampling, gamma radiation measurements, and vegetation and soil sampling. Air particulate monitoring is conducted continuously at four monitoring stations located around the periphery of the mill. Gamma radiation measurements, vegetation sampling, and soil sampling are conducted at five locations. See Section 1.8 for details concerning the monitoring program.

Gamma radiation levels are determined at the five environmental monitoring stations and are reported quarterly, with duplicate samples collected at the nearest residence.

Approximately five pounds of "new growth" vegetation samples are collected from areas "northeast of the mill, northwest of the mill, and southwest of the mill" during early spring, late spring, and late fall. Sample collection areas vary depending on the growth year (i.e. in low or no moisture years it may take an area several acres in size to collect five pounds of vegetation, while in "wet" years a much smaller area is needed). Vegetation is analyzed for radium-226 and lead-210.

Soils are sampled at each of the five environmental monitoring stations annually in August. The soils are analyzed for U-natural and radium-226.

3.0 RECLAMATION PLAN

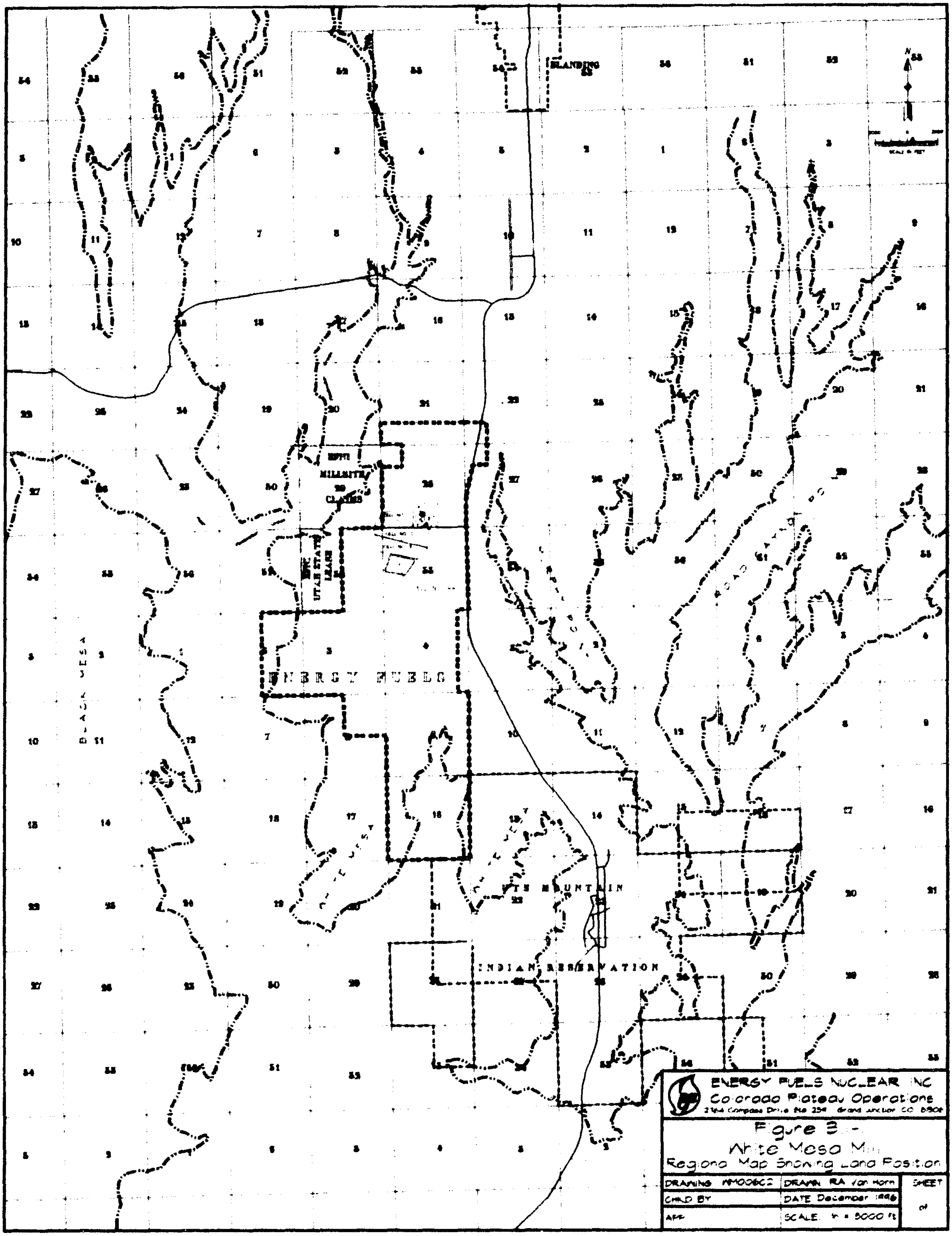
This section provides an overview of the mill location and property; details the facilities to be reclaimed; and describes the design criteria applied in this reclamation plan. Reclamation Plans and Specifications are presented in Attachment A. Attachment B presents the quality plan for construction activities. Attachment C presents cost estimates for reclamation.

3.1 Location and Property Description

The White Mesa Mill is located six miles south of Blanding, Utah on US Highway 191 on a parcel of land encompassing all or part of Sections 21, 22, 27, 28, 29, 32, and 33 of T37S, R22E, and Sections 4, 5, 6, 8, 9, and 16 of T38S, R22E, Salt Lake Base and Meridian described as follows (Figure 3.1-1):

> The south half of Section 21; the southeast quarter of the southeast quarter of Section 22; the northwest quarter of the northwest quarter and lots 1 and 4 of Section 27 all that part of the southwest quarter of the northwest quarter and the northwest quarter southwest quarter of Section 27 lying west of Utah State Highway 163; the northeast quarter of the northwest quarter, the south half of the northwest quarter, the northeast quarter and the south half of Section 28; the southeast quarter of the southeast quarter of Section 29; the east half of Section 32 and all of Section 33, Township 37 South, Range 22 East, Salt Lake Base and Meridian. Lots 1 through 4, inclusive, the south half of the north half, the southwest quarter, the west half of the southeast quarter, the west half of the east half of the southeast quarter and the west half of the east half of the east half of the southeast quarter of Section 4; Lots 1 through 4, inclusive, the south half of the north half and the south half of Section 5 (all); Lots 1 and 2, the

south half of the northeast quarter and the south half of Section 6 (E1/2); the northeast quarter of Section 8; all of Section 9 and all of Section 16, Township 38 South, Range 22 East, Salt Lake Base and Meridian. Containing approximately 4,871 acres.


BLANDING
EFN MILLSITE 20 CLAIMS
EFN UTAH STATE LEASE
ENERGY FUELS
UTE MOUNTAIN
INDIAN RESERVATION
ENERGY FUELS NUCLEAR INC
Colorado Plateau Operations
Figure 3
White Mesa Mill
Regional Map Showing Land Position
DRAWING WM006C2
DRAWN RA Van Horn
SHEET
CHKD BY
DATE December 1996
APP
SCALE 1" = 5000 ft

3.2 Facilities to be Reclaimed

See Figure 3.2-1 for a general layout of the mill yard and related facilities and the restricted area boundary.

3.2.1 Summary of Facilities to be Reclaimed

The facilities to be reclaimed include the following:

- Cell 1 (evaporative), Cells 2 and 3 (tailings) and Cell 4A (solutions only).
- Mill buildings and equipment.
- On-site contaminated areas.
- Off-site contaminated areas (i.e., potential areas affected by windblown tailings).

The reclamation of the above facilities will include the following:

- Placement of materials and debris from mill decommissioning in tailings Cells 2 and 3.
- Placement of contaminated soils, crystals, and synthetic liner material from Cell 1 in tailings Cells 2 and 3.
- Placement of contaminated soils, crystals and synthetic liner material from Cell 4A in tailings Cells 2 and 3.
- Placement of an engineered multi-layer cover on Cells 2 and 3.
- Construction of runoff control and diversion channels as necessary.
- Reconditioning of mill and ancillary areas.
- Reclamation of borrow sources.

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3.2.2 Tailings and Evaporative Cells

The following subsections describe the cover design and reclamation procedures for Cells 1I, 2, 3, and 4A. Complete engineering details and text are presented in the Tailings Cover Design report, Appendix D.

3.2.2.1 Soil Cover Design

A six-foot thick soil cover for the uranium tailings in Cell 2 and Cell 3 was designed using on-site materials that will contain tailings and radon emissions in compliance with regulations of the United States Nuclear Regulatory Commission ("NRC") and by reference, the Environmental Protection Agency ("EPA"). The cover consists of a one-foot thick layer of clay, available from within the site boundaries (Section 16), below two feet of random fill, available from stockpiles on site. The clay is underlain by three feet (minimum) random fill soil, also available on site. In addition to the soil cover, a minimum three inch (on the cover top) to 12-inch (on the cover slopes) layer of riprap material will be placed over the compacted random fill to stabilize slopes and provide long-term erosion resistance.

Uranium tailings soil cover design requirements for regulatory compliance include:

- Attenuate radon flux to an acceptable level (20 picoCuries-per meter squared-per second [$pCi/m^2/sec$]) (NRC, 1989);
- Minimize infiltration into the reclaimed tailings cells;
- Maintain a design life of up to 1,000 years or to the extent reasonably achievable, and in any case for at least 200 years; and
- Provide long-term slope stability and geomorphic durability to withstand erosional forces of

wind, the probable maximum flood event, and a horizontal ground acceleration of 0.1g due to seismic events.

Several models/analyses were utilized in simulating the soil cover effectiveness: radon flux attenuation, hydrologic evaluation of infiltration, freeze/thaw effects, soil cover erosion protection, and static and pseudostatic slope stability analyses. These analyses and results are discussed in detail in Sections 3.3.1 through 3.3.5, and calculations are also shown in the Tailings Cover Design report, Appendix D. The soil cover (from top to the bottom) will consist of: (1) minimum of three inches of riprap material; (2) two feet of compacted random fill; (3) one foot of compacted clay; and (4) minimum three feet of compacted random fill soil.

The final grading plan is presented in Section 5, Figure 5.1-1. As indicated on the figures, the top slope of the soil cover will be constructed at 0.2 percent and the side slopes, as well as transitional areas between cells, will be graded to five horizontal to one vertical (5H:1V).

A minimum of three feet random fill is located beneath the compacted fill and clay layers (see cross-sections on Figures 5.1-2 and 5.1-3). The purpose of the fill is to raise the base of the cover to the desired subgrade elevation. In many areas, the required fill thickness will be much greater. However, the models and analyses presented in the Tailings Cover Design report (Appendix D) were performed conservatively, assuming only a three-foot layer. For modeling purposes, this lower, random fill layer was considered as part of the soil cover for performing the radon flux attenuation calculation, as it effectively contributes to the reduction of radon emissions (see Section 3.3.1). The fill was also evaluated in the slope stability analysis (see Section 3.3.6). However, it is not defined as part of the soil cover for other design calculations (infiltration, freeze/thaw, and cover erosion).

3.2.2.2 Cell 1-I

Cell 1-I, used solely for evaporation of process liquids, is the northernmost existing cell and is located immediately west of the mill. It is also the highest cell in elevation, as the natural topography slopes to the south. The drainage area above and including the cell is 216 acres. This includes drainage from the mill site.

Cell 1-I will be evaporated to dryness. The synthetic liner and raffinate crystals will then be removed and placed in the tailings cells. Any contaminated soils below the liner will be removed and also placed in the tailings cells. Based on current regulatory criteria, the current plan calls for excavation of the residual radioactive materials to be designed to ensure that the concentration of radium-226 in land averaged over any area of 100 square meters does not exceed the background level by more than:

- 5 pCi/g, averaged over the first 15 cm of soil below the surface, and
- 15 pCi/g, averaged over a 15 cm thick layer of soil more than 15 cm below the surface.

Cell 1-I will then be breached and converted to a sedimentation basin. All runoff from the mill area and immediately north of the cell will be routed into the sedimentation basin and will discharge onto the natural ground via the channel located at the southwest corner of the basin. The channel is designed to accommodate the PMF flood.

The HEC-1 model was used to determine the PMF and route the flood through the sedimentation basin. The peak flow was determined to be 1,987 cubic feet per second (cfs). A 100-foot wide channel will discharge the flow to the natural drainage. During the local storm PMF event, the maximum discharge through the channel will be 746 cfs. The entire flood volume will pass through

the discharge channel in approximately four hours.

At peak flow, the velocity in the discharge channel will be 3.5 feet per second (fps). The maximum flow depth will be 2.2 feet. Twenty-four inches of riprap having a nominal (D_{50}) size of 12 inches will be placed on the bottom and up the sides of the channel. A free board depth of 0.5 feet will be maintained for the PMP event.

3.2.2.3 Cell 2

Cell 2 will be filled with tailings and covered with a multi-layered engineered cover to a minimum cover thickness of six feet. The final cover will drain to the south at a 0.2 percent gradient.

The cover will consist of a minimum of three feet of random fill, followed by a clay radon barrier of one foot in thickness, and two feet of upper random fill for protection of the radon barrier. A minimum of three inches of rock will be utilized as armor against erosion. Side slopes will be graded to a 5:1 slope and will have one foot of rock armor protection.

3.2.2.4 Cell 3

Cell 3 will be filled with tailings, debris and contaminated soils and covered with the same multi-layered engineered cover as Cell 2.

3.2.2.5 Cell 4A

Cell 4A will be evaporated to dryness and the crystals, synthetic liner and any contaminated soils placed in tailings. Non-contaminated materials in cell 4A dikes will be used to reduce the southern

slopes of Cell 3 from the current 3:1 to 5:1.

3.2.3 Mill Decommissioning

A general layout of the mill area is shown in Figure 3.2.3-1.

3.2.3.1 Mill Building and Equipment

The uranium and vanadium sections, including ore reclaim, grinding, pre-leach, leach, CCD, SX, and precipitation and drying circuits will be decommissioned as follows:

All equipment including instrumentation, process piping, electrical control and switchgear, and contaminated structures will be removed. Contaminated concrete foundations will be demolished and removed or covered with soil as required. Uncontaminated equipment, structures and waste materials from mill decommissioning may be disposed of by sale, transferred to other company-owned facilities, transferred to an appropriate off-site solid waste site, or disposed of in one of the tailings cells. Contaminated equipment, structures and waste materials from mill decommissioning, contaminated soils underlying the mill areas, and ancillary contaminated materials will be disposed of in tailings cells.

Debris and scrap will have a maximum dimension of 20 feet and a maximum volume of 30 cubic feet. Material exceeding these limits will be reduced to within the acceptable limits by breaking, cutting or other approved methods. Empty drums, tanks or other objects having a hollow volume greater than five cubic feet will be reduced in volume by at least 70 percent. If volume reduction is not feasible, openings shall be made in the object to allow soils or other approved material to enter the object.

Debris and scrap will be spread across the designated areas to avoid nesting and to reduce the volume of voids present in the placed mass. Stockpiled soils, and/or other approved material shall be placed over and into the scrap in sufficient amounts to fill the voids between the large pieces and the volume within the hollow pieces to form a coherent mass.

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3.2.3.2 Mill Site

Contaminated areas on the mill site will be primarily superficial and includes the ore storage area and surface contamination of some roads. All ore will have been previously removed from the ore stockpile area. All contaminated materials will be excavated and be disposed in one of the tailings cells. The depth of excavation will vary depending on the extent of contamination and will be governed by the criteria in Section 4.3.2.1.

Windblown material is defined as mill-derived contaminants dispersed by wind to surrounding areas. Windblown contaminated material detected by a gamma survey using the criteria in Section 4.3.2.1 will be excavated and disposed in one of the tailings cells.

Disturbed areas will be covered, graded and vegetated as required. The proposed grading plan for the mill site and ancillary areas is shown on Figure A-3.2-1 in Attachment A.

3.3 Design Criteria

The design criteria summaries in this section are adapted from Tailings Cover Design, White Mesa Mill (Titan, 1996). A copy of the Tailings Cover Design report is included as Appendix D. It contains all of the calculations used in design discussed in this section.

3.3.1 Regulatory Criteria

Information contained in 10 CFR Part 20, Appendix A, 10 CFR Part 40, and 40 CFR Part 192 was used as criteria in final designs under this reclamation plan. In addition, the following documents also provided guidance:

- Environmental Protection Agency (EPA), 1994, "The Hydrologic Evaluation of Landfill Performance (HELP) Model, Version 3." EPA/600/R-94/168b, September.
- Nuclear Regulatory Commission (NRC), 1989, "Regulatory Guide 3.64 (Task WM-503-4) Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers," March.
- NRC, 1980, "Final Staff Technical Position Design of Erosion Protection Covers for Stabilization of Uranium Mill Tailings Sites," August.
- NUREG/CR-4620, Nelson, J. D., Abt, S. R., et. al., 1986, "Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments," June.
- NUREG/CR-4651, 1987, "Development of Riprap Design Criteria by Riprap Testing in Flumes: Phase 1," May.
- U. S. Department of Energy, 1988, "Effect of Freezing and Thawing on UMTRA Covers," Albuquerque, New Mexico, October.

3.3.2 Radon Flux Attenuation

The Environmental Protection Agency (EPA) rules in 40 Code of Federal Regulation (CFR) Part 192 require that a "uranium tailings cover be designed to produce reasonable assurance that the radon-222 release rate would not exceed 20 pCi/m^2/sec for a period of 1,000 years to the extent reasonably achievable and in any case for at least 200 years when averaged over the disposal area over at least a one year period" (NRC, 1989). NRC regulations presented in 10 CFR Part 40 also restrict radon flux to less than 20 pCi/m^2/sec. The following sections present the analyses and design for a soil cover which meets this requirement.

3.3.2.1 Predictive Analysis

The soil cover for the tailings cells at White Mesa Mill was evaluated for attenuation of radon gas

using the digital computer program, RADON, presented in the NRC's Regulatory Guide 3.64 (Task WM 503-4) entitled "Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers." The RADON model calculates radon-222 flux attenuation by multi-layered earthen uranium mill tailings covers, and determines the minimum cover thickness required to meet NRC and EPA standards. The RADON model uses the following soil properties in the calculation process:

- Soil layer thickness [centimeters (cm)];
- Soil porosity (percent);
- Density [grams-per-cubic centimeter (gm/cm^3)];
- Weight percent moisture (percent);
- Radium activity (piC/g);
- Radon emanation coefficient (unitless); and
- Diffusion coefficient [square centimeters-per-second (cm^2/sec)].

Physical and radiological properties for tailings and random fill were analyzed by Chen and Associates (1987) and Rogers and Associates (1988). Clay physical data from Section 16 was analyzed by Advanced Terra Testing (1996) and Rogers and Associates (1996). See Appendix D for laboratory test data results.

The RADON model was performed for the following cover section (from top to bottom):

- two feet compacted random fill;
- one foot compacted clay; and
- a minimum of three feet random fill occupying the freeboard space between the tailings and clay layer.

The top one foot of the lower random fill clay layer and two foot upper random fill are compacted to 95 percent maximum dry density. The top riprap layer was not included as part of the soil cover for the radon attenuation calculation.

The results of the RADON modeling exercise show that the uranium tailings cover configuration will attenuate radon flux emanating from the tailings to a level of 17.6 pCi/m^2/sec. This number was conservatively calculated as it takes into account the freeze/thaw effect on the uppermost part (6.8 inches) of the cover (Section 3.3.4). The soil cover and tailing parameters used to run the RADON model, in addition to the RADON input and output data files, are presented in Appendix D as part of the Radon Calculation brief (See Appendix B in the Tailings Cover Design report, included herewith in its entirety as Appendix D). Based on the model results, the soil cover design of six-foot thickness will meet the requirements of 40 CFR Part 192 and 10 CFR Part 40.

3.3.2.2 Empirical Data

Radon gas flux measurements have been made at the White Mesa Mill tailings piles over Cells 2 and 3 (see Appendix D). Currently these cells are partially covered with three to four feet of random fill. Radon flux measurements, averaged over the covered areas, were as follows (EFN, 1996):

	1994	1995
Cell 2	7.7 pCi/m^2/sec	6.1 pCi/m^2/sec
Cell 3	7.5 pCi/m^2/sec	11.1 pCi/m^2/sec

Empirical data suggest that the random fill cover, alone, is currently providing an effective barrier to radon flux. Thus, the proposed tailings cover configuration, which is thicker, moisture adjusted, contains a clay layer, and is compacted, is expected to attenuate the radon flux to a level below that

predicted by the RADON model. The field radon flux measurements confirm the conservatism of the cover design. This conservatism is useful, however, to guarantee compliance with NRC regulations under long term climatic conditions over the required design life of 200 to 1,000 years.

3.3.3 Infiltration Analysis

The tailings ponds at White Mesa Mill are lined with synthetic geomembrane liners which under certain climatic conditions, could potentially lead to the long-term accumulation of water from infiltration of precipitation. Therefore, the soil cover was evaluated to estimate the potential magnitude of infiltration into the capped tailings ponds. The Hydrologic Evaluation of Landfill Performance (HELP) model, Version 3.0 (EPA, 1994) was used for the analysis. HELP is a quasi two-dimensional hydrologic model of water movement across, into, through, and out of capped and lined impoundments. The model utilizes weather, soil, and engineering design data as input to the model, to account for the effects of surface storage, snowmelt, run-off, infiltration, evapotranspiration, vegetative growth, soil moisture storage, lateral subsurface drainage, and unsaturated vertical drainage on the specific design, at the specified location.

The soil cover was evaluated based on a two-foot compacted random fill layer over a one-foot thick, compacted clay layer. The soil cover layers were modeled based on material placement at a minimum of 95 percent of the maximum dry density, and within two percent of the optimum moisture content per American Society for Testing and Materials (ASTM) requirements. The top riprap layer and the bottom random fill layer were not included as part of the soil cover for infiltration calculations. These two layers are not playing any role in controlling the infiltration through the cover material.

The random fill will consist of clayey sands and silts with random amounts of gravel and rock-size

materials. The average hydraulic conductivity of several samples of random fill was calculated, based on laboratory tests, to be 8.87 x 10^{-7} cm/sec. The hydraulic conductivity of the clay source from Section 16 was measured in the laboratory to be 3.7 x 10^{-8} cm/sec. Geotechnical soil properties and laboratory data are presented in Appendix D.

Key HELP model input parameters include:

- Blanding, Utah, monthly temperature and precipitation data, and HELP model default solar radiation, and evapotranspiration data from Grand Junction, Colorado. Grand Junction is located northeast of Blanding in similar climate and elevation;

- Soil cover configuration identifying the number of layers, layer types, layer thickness, and the total covered surface area;

- Individual layer material characteristics identifying saturated hydraulic conductivity, porosity, wilting point, field capacity, and percent moisture; and

- Soil Conservation Service runoff curve numbers, evaporative zone depth, maximum leaf area index, and anticipated vegetation quality.

Water balance results, as calculated by the HELP model, indicate that precipitation would either run-off the soil cover or be evaporated. Thus, model simulations predict zero infiltration of surface water through the soil cover, as designed. These model results are conservative and take into account the freeze/thaw effects on the uppermost part (6.8 inches) of the cover (See Section 1.3 of the Tailings Cover Design report, Appendix D). The HELP model input and output for the tailings soil cover are presented in the HELP Model calculation brief included in Appendix D.

3.3.4 Freeze/Thaw Evaluation

The tailings soil cover of one foot of compacted clay covered by two feet of random fill was evaluated for freeze/thaw impacts. Repeated freeze/thaw cycles have been shown to increase the bulk soil permeability by breaking down the compacted soil structure.

The soil cover was evaluated for freeze/thaw effects using the modified Berggren equation as presented in Aitken and Berg (1968) and recommended by the NRC (U.S. Department of Energy, 1988). This evaluation was based on the properties of the random fill and clay soil, and meteorological data from both Banding, Utah and Grand Junction, Colorado.

The results of the freeze/thaw evaluation indicate that the anticipated maximum depth of frost penetration on the soil cover would be less than 6.8 inches. Since the random fill layer is two feet thick, the frost depth would be confined to this layer and would not penetrate into the underlying clay layer. The performance of the soil cover to attenuate radon gas flux below the prescribed standards, and to prevent surface water infiltration, would not be compromised. The input data and results of the freeze/thaw evaluation are presented in the Effects of Freezing on Tailings Covers Calculation brief included as Appendix E in the Tailings Cover Design report, which is included herewith as Appendix D.

3.3.5 Soil Cover Erosion Protection

A riprap layer was designed for erosion protection of the tailings soil cover. According to NRC guidance, the design must be adequate to protect the soil/tailings against exposure and erosion for 200 to 1,000 years (NRC, 1990). Currently, there is no standard industry practice for stabilizing tailings for 1,000 years. However, by treating the embankment slopes as wide channels, the

hydraulic design principles and practices associated with channel design were used to design stable slopes that will not erode. Thus, a conservative design based on NRC guidelines was developed. Engineering details and calculations are summarized in the Erosion Protection Calculation brief provided in Appendix F in the Tailings Cover Design report, which is included herewith as Appendix D.

Riprap cover specifications for the top and side slopes were determined separately as the side slopes are much steeper than the slope of the top of the cover. The size and thickness of the riprap on the top of the cover was calculated using the Safety Factor Method (NUREG/CR-4651, 1987), while the Stephenson Method (NUREG/CR-4651, 1987) was used for the side slopes. These methodologies were chosen based on NRC recommendations (1990).

By the Safety Factor Method, riprap dimensions for the top slope were calculated in order to achieve a slope "safety factor" of 1.1. For the top of the soil cover, with a slope of 0.2 percent, the Safety Factor Method indicated a median diameter (D_{50}) riprap of 0.28 inches is required to stabilize the top slope. However, this dimension must be modified based on the long-term durability of the specific rock type to be used in construction. The suitability of rock to be used as a protective cover must be assessed by laboratory tests to determine the physical characteristics of the rocks. The sandstones from the confluence of Westwater and Cottonwood Canyons require an oversizing factor of 25 percent. Therefore, riprap created from this sandstone source should have a D_{50} size of a t least 0.34 inches and should have an overall layer thickness of at least three inches on the top of the cover.

Riprap dimensions for the side slopes were calculated using Stephenson Method equations. The side slopes of the cover are designed at 5H:1V. At this slope, Stephenson's Method indicated the unmodified riprap D_{50} of 3.24 inches is required. Again, assuming that the on-site sandstone will be used, the modified D_{50} size of the riprap should be at least 4.05 inches with an overall layer

thickness of at least 12 inches.

The potential of erosion damage due to overland flow, sheetflow, and channel scouring on the top and side slopes of the cover, including the riprap layer, has been evaluated. Overland flow calculations were performed using site meteorological data, cap design specifications, and guidelines set by the NRC (NUREG/CR-4620, 1986). These calculations are included in Appendix F of the Tailings Cover Design report. According to the guidelines, overland flow velocity estimates are to be compared to "permissible velocities," which have been suggested by the NRC, to determine the potential for erosion damage. When calculated, overland flow velocity estimates exceed permissible velocities, additional cover protection should be considered. The permissible velocity for the tailings cover (including the riprap layer) is 5.0 to 6.0 feet per-second (ft./sec.) (NUREG/CR-4620). The overland flow velocity calculated for the top of the cover is less than 2.0 ft./sec., and the calculated velocity on the side slopes is 4.9 ft./sec. Therefore, the erosion potential of the slopes, due to overland flow/channel scouring, is within acceptable limits and no additional erosion protection is required.

3.3.6 Slope Stability Analysis

Static and pseudostatic analyses were performed to establish the stability of the side slopes of the tailings soil cover. The side slopes are designed at an angle of 5H:1V. Because the side slope along the southern section of Cell 4A is the longest and the ground elevation drops rapidly at its base, this slope was determined to be critical and is thus the focus of the stability analyses.

The computer software package GSLOPE, developed by MITRE Software Corporation, has been used for these analyses to determine the potential for slope failure. GSLOPE applies Bishop's Method of slices to identify the critical failure surface and calculate a factor of safety (FOS). The

slope geometry and properties of the construction materials and bedrock are input into the model. These data and drawings are included in the Stability Analysis of Side Slopes Calculation brief included in Appendix G of the Tailings Cover Design report. For this analysis, competent bedrock is designated at 10 feet below the lowest point of the foundation [i.e., at a 5,540-foot elevation above mean sea level (msl)]. This is a conservative estimate, based on the borehole logs supplied by Chen and Associates (1979), which indicate bedrock near the surface.

3.3.6.1 Static Analysis

For the static analysis, a Factor of Safety ("FOS") of 1.5 or more was used to indicate an acceptable level of stability. The calculated FOS is 2.91, which indicates that the slope should be stable under static conditions. Results of the computer model simulations are included in Appendix G of the Tailings Cover Design report.

3.3.6.2 Pseudostatic Analysis (Seismicity)

The slope stability analysis described above was repeated under pseudostatic conditions in order to estimate a FOS for the slope when a horizontal ground acceleration of 0.10g is applied. The slope geometry and material properties used in this analysis are identical to those used in the stability analysis. A FOS of 1.0 or more was used to indicate an acceptable level of stability under pseudostatic conditions. The calculated FOS is 1.903, which indicates that the slope should be stable under dynamic conditions. Details of the analysis and the simulation results are included in Appendix G of the Tailings Cover Design report.

In June of 1994, Lawrence Livermore National Laboratory ("LLNL") published a report entitled Seismic Hazard Analysis of Title II Reclamation Plans, (Lawrence Livermore National Laboratory,

1994) which included a section on seismic activity in southern Utah. In the LLNL report, a horizontal ground acceleration of 0.12g was proposed for the White Mesa site. The evaluations made by LLNL were conservative to account for tectonically active regions that exist, for example, near Moab, Utah. Although, the LLNL report states that "...[Blanding] is located in a region known for its scarcity of recorded seismic events," the stability of the cap design slopes using the LLNL factor was evaluated. The results of a sensitivity analysis reveal that when considering a horizontal ground acceleration of 0.12g, the calculated FOS is 1.778 which is still above the required value of 1.0, indicating adequate safety under pseudostatic conditions. This analysis is also included in Appendix G of the Tailings Cover Design report.

3.3.7 Cover Material/Cover Material Volumes

Construction materials for reclamation will be obtained from on-site locations. Fill material will be available from the stockpiles that were generated from excavation of the cells for the tailings facility. If required, additional materials are available locally to the west of the site. A clay material source, identified in Section 16 at the southern end of the White Mesa Mill site, will be used to construct the one-foot compacted clay layer. Riprap material will be produced from on-site sandstone.

Detailed material quantities calculations are provided in Attachment C, Cost Estimates for Reclamation of White Mesa Mill Facilities, as part of the volume and costing exercise.

ATTACHMENT A

PLANS AND SPECIFICATIONS

FOR

RECLAMATION

OF

WHITE MESA FACILITIES

BLANDING, UTAH

PREPARED BY

ENERGY FUELS NUCLEAR, INC.

THREE PARK CENTRAL

1515 ARAPAHOE STREET, SUITE 900

DENVER, COLORADO 80202

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1.0 GENERAL

The specifications presented in this section cover the reclamation of the White Mesa Mill facilities.

2.0 CELL 1-I RECLAMATION

2.1 Scope

The reclamation of Cell 1-I consists of evaporating the cell to dryness, removing raffinate crystals, synthetic liner and any contaminated soils. A sedimentation basin will then be constructed and a drainage channel provided.

2.2 Removal of Contaminated Materials

2.2.1 Raffinate Crystals

Raffinate crystals will be removed from Cell 1-I and transported to the tailings cells. It is anticipated that the crystals will have a consistency similar to a granular material when brought to the cells, with large crystal masses being broken down for transport. Placement of the crystals will be performed as a granular fill, with care being taken to avoid nesting of large sized material. Voids around large material will be filled with finer material or the crystal mass broken down by the placing equipment. Actual placement procedures will be evaluated by the QC officer during construction as crystal materials are brought and placed in the cells.

2.2.2 Synthetic Liner

The PVC liner will be cut up, folded (when necessary), removed from Cell 1-I, and transported to the tailings cells. The liner material will be spread as flat as practical over the designated area. After placement, the liner will be covered as soon as possible with at least one foot of soil, crystals or other materials for protection against wind, as approved by the QC officer.

2.2.3 Contaminated Soils

The extent of contamination of the mill site will be determined by a scintillometer survey. If necessary, a correlation between scintillometer readings and U-nat/Radium-226 concentrations will be developed. Scintillometer readings can then be used to define cleanup areas and to monitor the cleanup. Soil sampling will be conducted to confirm that the cleanup results in a concentration of Radium-226 averaged over any area of 100 square meters that does not exceed the background level by more than:

- 5 pCi/g averaged over the first 15 cm of soils below the surface, and
- 15 pCi/g averaged over a 15 cm thick layer of soils more than 15 cm below the surface

Where surveys indicate the above criteria have not been achieved, the soil will be removed to meet the criteria. Soil removed from Cell 1-I will be excavated and transported to the tailings cells. Placement and compaction will be in accordance with Section 4.0 of these Plans and Specifications.

2.2.4 Sedimentation Basin

Cell 1-I will then be breached and constructed as a sedimentation basin. All runoff from the mill area and immediately north of the cell will be routed into the sedimentation basin and will discharge onto the natural ground via the channel located at the southwest corner of the basin. The channel is designed to accommodate the PMF flood.

A sedimentation basin will be constructed in Cell 1-I as shown in Figure A2.2.4-1. Grading will be performed to promote drainage and proper functioning of the basin. The drainage channel out of the sedimentation basin will be constructed to the lines and grades as shown.

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3.0 MILL DECOMMISSIONING

The following subsections detail decommissioning plans for the mill buildings and equipment; the mill site; and windblown contamination.

3.1 Mill

The uranium and vanadium processing areas of the mill, including all equipment, structures and support facilities, will be decommissioned and disposed of in tailings or buried on site as appropriate. All equipment, including tankage and piping, agitation equipment, process control instrumentation and switchgear, and contaminated structures will be cut up, removed and buried in tailings prior to final cover placement. Concrete structures and foundations will be demolished and removed or covered with soil as appropriate. These decommissioned areas would include, but not be limited to the following:

- Coarse ore bin and associated equipment, conveyors and structures.
- Grind circuit including semi-autogeneous grind (SAG) mill, screens, pumps and cyclones.
- The three preleach tanks to the east of the mill building, including all tankage, agitation equipment, pumps and piping.
- The seven leach tanks inside the main mill building, including all agitation equipment, pumps and piping.
- The counter-current decantation (CCD) circuit including all thickeners and equipment, pumps and piping.
- Uranium precipitation circuit, including all thickeners, pumps and piping.

- The two yellow cake dryers and all mechanical and electrical support equipment, including uranium packaging equipment.
- The clarifiers to the west of the mill building including the preleach thickener (PLT) and claricone.
- The boiler and all ancillary equipment and buildings.
- The entire vanadium precipitation, drying and fusion circuit.
- All external tankage not included in the previous list including reagent tanks for the storage of acid, ammonia, kerosene, water, dry chemicals, etc. and the vanadium oxidation circuit.
- The uranium and vanadium solvent extraction (SX) circuit including all SX and reagent tankage, mixers and settlers, pumps and piping.
- The SX building.
- The mill building.
- The office building.
- The shop and warehouse building.
- The sample plant building.

The sequence of demolition would proceed so as to allow the maximum use of support areas of the facility such as the office and shop areas. It is anticipated that all major structures and large equipment will be demolished with the use of hydraulic shears. These will speed the process, provide proper sizing of the materials to be placed in tailings, and reduce exposure to radiation and other safety hazards during the demolition. Any uncontaminated or decontaminated equipment to be considered for salvage will be released in accordance with the terms of License Condition 14. As with the equipment for disposal, any contaminated soils from the mill area will be disposed of in the tailings facilities in accordance with Section 4.0 of the Specifications.

3.2 Mill Site

Contaminated areas on the mill site will be primarily superficial and include the ore storage area and surface contamination of some roads. All ore will have been previously removed from the ore stockpile area. All contaminated materials will be excavated and be disposed in one of the tailings cells in accordance with Section 4.0 of these Plans and Specifications. The depth of excavation will vary depending on the extent of contamination and will be based on the criteria in Section 2.2.3 of these Plans and Specifications.

All ancillary contaminated materials including pipelines will be removed and will be disposed of by disposal in the tailing cells in accordance with Section 4.0 of these Plans and Specifications.

Disturbed areas will be covered, graded and vegetated as required. The proposed grading plan for the mill site and ancillary areas is shown on Figure 3.2-1.

3.3 Windblown Contamination

Windblown contamination is defined as mill derived contaminants dispersed by the wind to surrounding areas. The potential areas affected by windblown contamination will be surveyed using scintillometers taking into account historical operational data from the Semi-annual Effluent Reports (Appendix A) and other guidance such as prevailing wind direction and historical background data.

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3.3.1 Guidance

The necessity for remedial actions will be based upon an evaluation prepared by EFN, and approved by the NRC, of the potential health hazard presented by any windblown materials identified. The assessment will be based upon analysis of all pertinent radiometric and past land use information and will consider the feasibility, cost-effectiveness, and environmental impact of the proposed remedial activities and final land use. All methods utilized will be consistent with the guidance contained in NUREG-5849: "Manual for Conducting Radiological Surveys in Support of License Termination."

3.3.2 General Methodology

The facility currently monitors soils for the presence of Ra-226, such results being presented in the second semi-annual effluent report for each year. Guideline values for these two materials will be determined and will form the basis for the cleanup of the White Mesa Mill site and surrounding areas. For purposes of determining possible windblown contamination, areas used for processing of uranium ores as well as the tailings and evaporative facilities will be excluded from the initial scoping survey, due to their proximity to the uranium recovery operations. Those areas include:

- The mill building, including CCD, PLT area, uranium drying and packaging, clarifying, and preleach.
- The SX building, including reagent storage immediately to the east of the SX building.
- The ore pad and ore feed areas.
- Tailings Cells No. 2, 3, and 4A.
- Evaporative cell No. 1-I.

The remaining areas of the mill will be divided up into two areas for purposes of windblown determinations:

- The restricted area, less the above areas; and,
- A halo around the restricted area.

The restricted area, as shown on Figure A3.2-1 will be initially surveyed on a 30 x 30 meter grid as described below in Section 3.3.3. The halo around the restricted area will also be initially surveyed on a 50 x 50 meter grid using methodologies described below in Section 3.3.3. Any areas which are found to have elevated activity levels will be further evaluated as described in Sections 3.3.4 and 3.3.5.

3.3.3 Scoping Survey

The scoping survey will be conducted using a calibrated Mount Sopris Model SC-132 scintillometer (or equivalent) capable of detecting radiation at levels less than or equal to 25 percent of the guideline value. The meter will be swung from side to side at an elevation of six (6) inches above the ground level while walking a path within the grid shown in Figure A-3.3-1. These paths will be designed so that a minimum of 10 percent of the area within the grid sidelines will be scanned, using an average coverage area for the scintillometer of one (1) meter wide. Grids where hotspots are encountered or where readings of 75 percent of the guideline level are found will be reclassified as affected areas, and will be subject to further characterization as described below. Grids where no readings exceed 75 percent of the guideline value will be classified as unaffected, and therefore will not require remediation. It is assumed that by following methodologies that would be utilized during the final survey, that the classification of these areas would stand and would require no further survey confirmation.

A sufficient quantity of QA samples will be taken to provide a correlation between the meter readings and the actual Ra-226 concentrations in the soil.

3.3.4 Characterization and Remediation Control Surveys

After the entire subarea has been classified as affected or unaffected, the affected areas will be further scanned to identify areas of elevated activity requiring cleanup. Such areas will be flagged and sufficient soils removed to, at a minimum, meet activity criteria. Following such remediation, the area will be scanned again to ensure compliance with activity criteria. A calibrated Mount Sopris SC-132 scintillometer (or equivalent) capable of detecting activity levels of less than or equal to 25 percent of the guideline values will be used to scan all the areas of interest.

3.3.5 Final Survey

After remediation, the affected areas deemed to be in compliance with standards will then undergo a final survey, utilizing a 10 x 10 meter grid system with sample point locations as shown in Figure A-3.3-2. Again a calibrated Mount Sopris SC-132 scintillometer (or equivalent) capable of detecting activity levels of less than or equal to 25 percent of the guideline values will be used, and will be held at a one meter distance above the systematic sample locations. As with the scoping survey, a statistically significant quantity of QA samples will be taken at randomly selected points to provide a correlation between the meter readings and the actual Ra-226 concentrations in the soil.

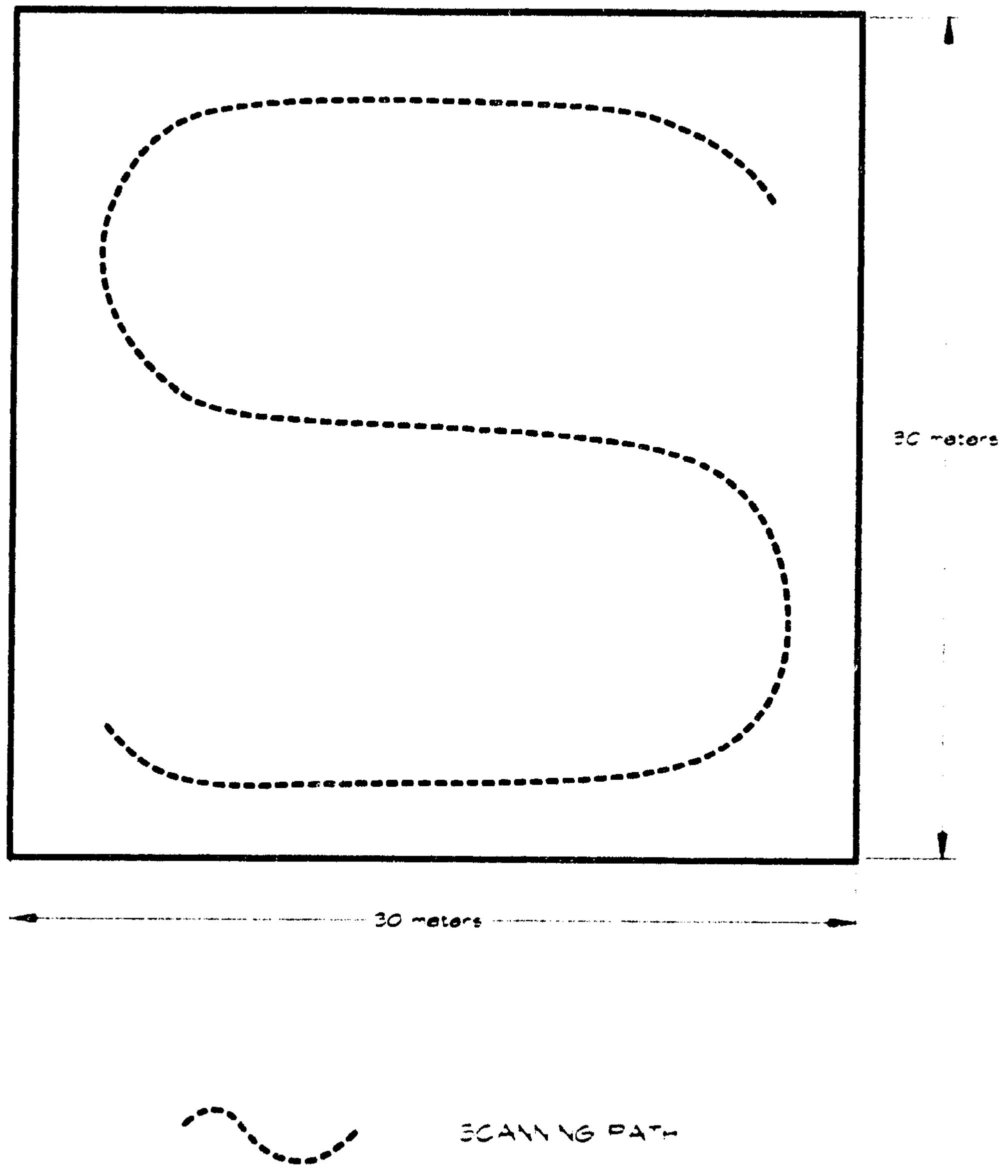

FIGURE A-3.3-1
TYPICAL SCANNING PATH
SCOPING SURVEY

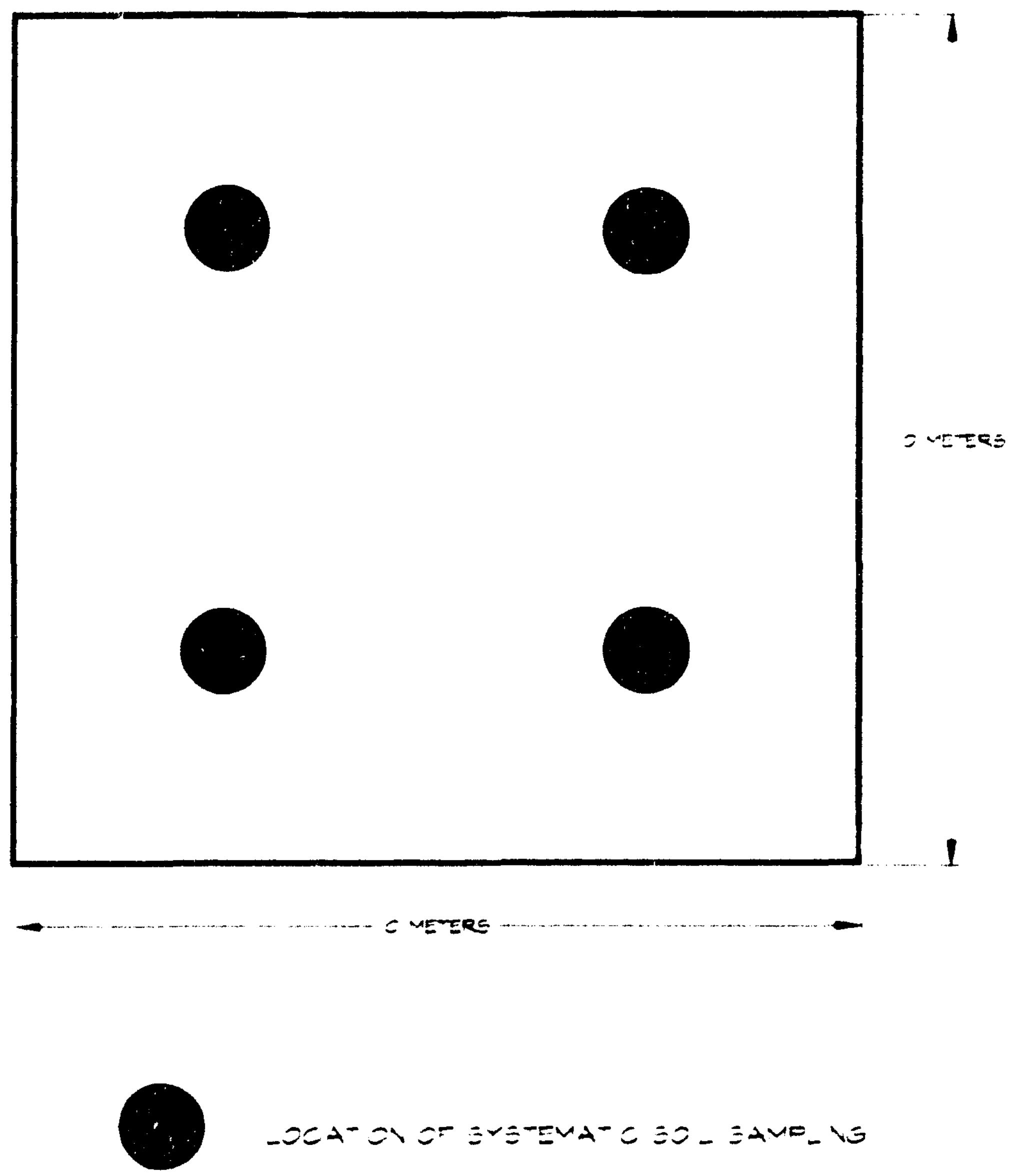

FIGURE A-3.3-2
STANDARD SAMPLING PATTERN FOR
SYSTEMATIC SURVEY OF SOIL

4.0 PLACEMENT METHODS

4.1 Scrap and Debris

The scrap and debris will have a maximum dimension of 20 feet and a maximum volume of 30 cubic feet. Scrap exceeding these limits will be reduced to within the acceptable limits by breaking, cutting or other approved methods. Empty drums, tanks or other objects having a hollow volume greater than five cubic feet will be reduced in volume by at least 70 percent. If volume reduction is not feasible, openings will be made in the object to allow soils, tailings and/or other approved materials to enter the object at the time of covering on the tailings cells. The scrap, after having been reduced in dimension and volume, if required, will be placed on the tailings cells as directed by the QC officer.

Any scrap placed will be spread across the top of the tailings cells to avoid nesting and to reduce the volume of voids present in the disposed mass. Stockpiled soils, contaminated soils, tailings and/or other approved materials will be placed over and into the scrap in sufficient amount to fill the voids between the large pieces and the volume within the hollow pieces to form a coherent mass. It is recognized that some voids will remain because of the scrap volume reduction specified, and because of practical limitations of these procedures. Reasonable effort will be made to fill the voids. The approval of the Site Manager or a designated representative will be required for the use of materials other than stockpiled soils, contaminated soils or tailings for the purpose of filling voids.

4.2 Contaminated Soils and Raffinate Crystals

The various materials will not be concentrated in thick deposits on top of the tailings, but will be spread over the working surface as much as possible to provide relatively uniform settlement and consolidation characteristics of the cleanup materials.

4.3 Compaction Requirements

The scrap, contaminated soils and other materials for the first lift will be placed over the existing tailings surface to a depth of up to four feet thick in a bridging lift to allow access for placing and compacting equipment. The first lift will be compacted by the tracking of heavy equipment, such as a Caterpillar D6 Dozer (or equivalent), at least four times prior to the placement of a subsequent lift. Subsequent layers will not exceed two feet and will be compacted to the same requirements.

During construction, the compaction requirements for the crystals will be reevaluated based on field conditions and modified by the Site Manager or a designated representative, with the agreement of the NRC Project Manager.

The contaminated soils and other cleanup materials after the bridging lift will be compacted to at least 80 percent of standard Proctor maximum density (ASTM D-698).

5.0 CELLS 2, 3, AND 4A

5.1 Earth Cover

A multi-layered earthen cover will be placed over tailings Cells 2, 3, and 4A. The general grading plan is shown on Drawing 5.1-1. Reclamation cover cross-sections are shown on Drawings 5.1-2 and 5.1-3.

5.2 Materials

5.2.1 Physical Properties

The physical properties of materials for use as cover soils will meet the following:

Random Fill (upper and lower layers)
These materials will be mixtures of clayey sands and silts with random amounts of gravel and size material. In the initial bridging lift, rock sizes of up to 24 inches in diameter will be allowed. On all other random fill lifts, rock sizes will be limited to 12 inches in diameter, with at least 30 percent of the material finer than 40 seive. For that portion passing the No. 40 sieve, these soils will classify as CL, SC, MC or SM materials under the Unified Soil Classification System.

Clay Layer Materials
Clays will have at least 40 percent passing the No. 200 sieve. The minimum liquid limit of these soils will be 25 and the plasticity index will be 15 or greater. These soils will classify as CL or CH materials under the Unified Soil Classification System.

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5.2.2 Borrow Sources

The sources for soils for the cover materials are as follows:

1. Random Fill - stockpiles from previous cell construction activities currently located to the east and west of the tailing facilities.

2. Clay - will be imported from borrow areas located in Section 16, T38S, R22E, SLM.

3. Rock Armor - will be produced by using oversize materials in the random fill piles, using crushing and screening as necessary to produce proper size fractions.

5.3 Cover Construction

5.3.1 General

Placement of cover materials will be based on a schedule determined by analysis of settlement data, piezometer data and equipment mobility considerations. Settlement plates and piezometers will be installed and monitored in accordance with Section 5.4 of these Plans and Specifications.

5.3.2 Placement and Compaction

5.3.2.1 Methods

The distribution and gradation of the materials throughout each fill layer will be such that the fill will, as far as practicable, be free of lenses, pockets, streaks or layers of material differing

substantially in texture, gradation or moisture content from the surrounding material. Successive loads of material will be placed on the fill so as to produce the best practical distribution of material.

If the compacted surface of any layer of fill is too dry or smooth to bond properly with the layer of material to be placed thereon, it will be moistened and/or reworked with a harrow, scarifier, or other suitable equipment to a sufficient depth to provide relatively uniform moisture content and a satisfactory bonding surface before the next succeeding layer of earthfill is placed. If the compacted surface of any layer of earthfill in-place is too wet, due to precipitation, for proper compaction of the earthfill material to be placed thereon, it will be reworked with harrow, scarifier or other suitable equipment to reduce the moisture content to the required level shown in Table 5.3.2.1-1. It will then be recompacted to the earthfill requirements.

No material will be placed when either the materials, or the underlying material, is frozen or when ambient temperatures do not permit the placement or compaction of the materials to the specified density, without developing frost lenses in the fill.

5.3.2.2 Moisture and Density Control

As far as practicable, the materials will be brought to the proper moisture content before placement on tailings, or moisture will be added to the material by sprinkling on the earthfill. Each layer of the fill will be conditioned so that the moisture content is uniform throughout the layer prior to and during compaction. The moisture content of the compacted fill will be within the limits of standard optimum moisture content as shown in Table 5.3.2.1-1. Material that is too dry or too wet to permit bonding of layers during compaction will be rejected and will be reworked until the moisture content is within the specified limits. Reworking may include removal, re-harrowing, reconditioning, rerolling, or combinations of these procedures.

Density control of compacted soil will be such that the compacted material represented by samples having a dry density less than the values shown in Table 5.3.2.1-1 will be rejected. Such rejected material will be reworked as necessary and rerolled until a dry density equal to or greater than the percent of its standard Proctor maximum density shown in Table 5.3.2.1-1.

To determine that the moisture content and dry density requirements of the compacted fill are being met, field and laboratory tests will be made at specified intervals taken from the compacted fills as specified in Section 7.4, "Frequency of Quality Control Tests."

5.4 Monitoring Cover Settlement

5.4.1 Temporary Settlement Plates

5.4.1.1 General

Temporary settlement plates will be installed in the tailings Cells. At the time of cell closure, a monitoring program will be proposed to the NRC. Data collected will be analyzed and the reclamation techniques and schedule adjusted accordingly.

TABLE A-5.3.2.1-1

Placement and Compaction Criteria
Reclamation Cover Materials

Cover Layer	Maximum Lift Thickness	Per Cent Compaction	Allowable Placement Moisture Content from Optimum Moisture Content
Lower Random Fill	3 Feet Bridging Lift	80	± 2
	1 Foot	90	± 2
Clay Layer	1 Foot	95	0 to + 3
Upper Random Fill	2 Feet	95	± 2
Riprap			
Top of Tails	3 Inches		
Slope	1 Inch		

Note:

Percent Compaction is based on standard Proctor dry density (ASTM D-698).

Optimum moisture content of a soil will be determined by ASTM D-698 methods.

5.4.1.2 Installation

At the time of cell closure or during the placement of interim cover, the temporary settlement plates will consist of a corrosion resistant steel plate 1/2 inch thick and three foot square to which a three inch diameter corrosion resistant pipe has been welded.

The installation will consist of leveling an area on the existing surface of the tailings, and placing the base plate directly on the tailings. A minimum three feet of initial soil or tailings cover will be placed on the base plate for a minimum radial distance of five feet from the pipe.

5.4.1.3 Monitoring Settlement Plates

Monitoring of settlement plates will be in accordance with the program submitted to and approved by the NRC. Settlement observations will be made in accordance with Quality Control Procedure QC-16-WM, "Monitoring of Temporary Settlement Plates."

6.0 ROCK PROTECTION

6.1 General

The side slopes of the reclaimed cover will be protected by rock surfacing. Drawings 5.1-1, 5.1-2, and 5.1-3 show the location of rock protection with the size, thickness and gradation requirements for the various side slopes.

A riprap layer was designed for erosion protection of the tailings soil cover. According to NRC guidance, the design must be adequate to protect the soil/tailings against exposure and erosion for

200 to 1,000 years (NRC, 1990). Currently, there is no standard industry practice for stabilizing tailings for 1,000 years. However, by treating the embankment slopes as wide channels, the hydraulic design principles and practices associated with channel design were used to design stable slopes that will not erode. Thus, a conservative design based on NRC guidelines was developed. Engineering details and calculations are summarized in the Tailings Cover Design report (Appendix D).

Riprap cover specifications for the top and side slopes were determined separately as the side slopes are much steeper than the slope of the top of the cover. The size and thickness of the riprap on the top of the cover was calculated using the Safety Factor Method (NUREG/CR-4651, 1987), while the Stephenson Method (NUREG/CR-4651, 1987) was used for the side slopes. These methodologies were chosen based on NRC recommendations (1990).

By the Safety Factor Method, riprap dimensions for the top slope were calculated in order to achieve a slope "safety factor" of 1.1. For the top of the soil cover, with a slope of 0.2 percent, the Safety Factor Method indicated a median diameter (D_{50}) riprap of 0.28 inches is required to stabilize the top slope. However, this dimension must be modified based on the long-term durability of the specific rock type to be used in construction. The suitability of rock to be used as a protective cover must be assessed by laboratory tests to determine the physical characteristics of the rocks. The sandstones from the confluence of Westwater and Cottonwood Canyons require an oversizing factor of 25 percent. Therefore, riprap created from this sandstone source should have a D_{50} size of at least 0.34 inches and should have an overall layer thickness of at least three inches on the top of the cover.

Riprap dimensions for the side slopes were calculated using Stephenson Method equations. The side slopes of the cover are designed at 5H:1V. At this slope, Stephenson's Method indicated the unmodified riprap D_{50} of 3.24 inches is required. Again assuming that the on-site sandstone will be

used, the modified D_{50} size of the riprap should be at least 4.05 inches with an overall layer thickness of at least 12 inches.

The potential of erosion damage due to overland flow, sheetflow, and channel scouring on the top and side slopes of the cover, including the riprap layer, has been evaluated. Overland flow calculations were performed using site meteorological data, cap design specifications, and guidelines set by the NRC (NUREG/CR-4620, 1986). According to the guidelines, overland flow velocity estimates are to be compared to "permissible velocities," which have been suggested by the NRC, to determine the potential for erosion damage. If calculated overland flow velocity estimates exceed permissible velocities, additional cover protection should be considered. The permissible velocity for the tailings cover (including the riprap layer) is 5.0 to 6.0 feet per second (ft./sec.) (NUREG/CR-4620). The overland flow velocity calculated for the top of the cover is less than 2.0 ft./sec., and the calculated velocity on the side slopes is 4.9 ft./sec. Therefore, the erosion potential of the slopes, due to overland flow/channel scouring, is within acceptable limits and no additional erosion protection is required. See Appendix D for details.

6.2 Materials

Materials utilized for riprap applications will meet the following specifications:

Location	D_{50} Size	D_{100} Size	Layer Thickness
Top Surface	0.4"	0.6"	3"
Slope Surface	4"	8"	12"

During construction of the tailings facilities, significant quantities of oversize was produced through drilling and blasting, as the rocks of the Burro Canyon/Dakota were too hard to rip. As these materials will have to be segregated from the random fill for some applications, it is anticipated that all rock requirements will be met by crushing and screening the random fill oversize.

Riprap quality will be evaluated by methods presented in NUREG/CR-4620 "Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundment." Size adjustment will be made in the riprap for materials not meeting the quality criteria.

6.3 Placement

Riprap material will be hauled to the reclaimed surfaces and placed on the surfaces using scrapers, in a manner to minimize segregation of the material. Placement of the riprap will avoid accumulation of riprap sizes less than the minimum D_{50} size and nesting of the larger sized rock. The riprap layer will have at least two passes by a D-7 Dozer (or equivalent) in order to key the rock for stability.

7.0 QUALITY CONTROL/QUALITY ASSURANCE

7.1 Quality Plan

A Quality Plan has been developed for construction activities for the White Mesa Project. The Quality Plan includes the following:

1. QC/QA Definitions, Methodology and Activities.
2. Organizational Structure.

3. Surveys, Inspections, Sampling and Testing.
4. Changes and Corrective Actions.
5. Documentation Requirements.
6. Quality Control Procedures.

7.2 Implementation

The Quality Plan will be implemented upon initiation of reclamation work.

7.3 Quality Control Procedures

Quality control procedures have been developed for reclamation and are presented in Attachment B of this Reclamation Plan. Procedures will be used for all testing, sampling and inspection functions.

7.4 Frequency of Quality Control Tests

The frequency of the quality control tests for earthwork will be as follows:

1. The frequency of the field density and moisture tests will be not less than one test for each 5,000 cubic yards of placed fill material (clay or random fill).

2. There will be at least two field density and moisture tests for each lift of fill material placed.

3. Gradations and Atterberg limits of compacted fill materials will be performed at a frequency of not less than each 10,000 cubic yards of placed clay or each 20,000 cubic yards of compacted random fill.

4. Frequency of laboratory standard Proctor compaction tests will be such that maximum densities are determined for the range of materials being placed in the fill; however, frequency of compaction tests will not be less than one test for each 5,000 cubic yards of compacted fill material.

5. For riprap materials, each load of material will be checked against standard piles for gradation prior to transport to the tailings piles.

ATTACHMENT B

QUALITY PLAN

FOR

CONSTRUCTION ACTIVITIES

WHITE MESA PROJECT

BLANDING, UTAH

PREPARED BY

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1.0 GENERAL

1.1 SCOPE OF QUALITY PLAN

The following Quality Plan for Construction Activities ("Quality Plan") describes how the Construction Quality Control/Quality Assurance ("QC/QA") activities are implemented.

This Quality Plan includes the following:

(1) Organizational Structure;

(2) Surveys, Inspections, Sampling and Testing;

(3) Changes and Corrective Actions; and

(4) Documentation Requirements.

1.2 QUALITY PLAN OBJECTIVES

The objectives of the Quality Plan are as follows:

(1) Quality Control: To verify that the construction is in accordance with the Plans and Specifications.

(2) Quality Assurance: To provide cross-checks and auditing functions on Quality Control.

(3) Monitoring: To provide the required information and data to evaluate the effects of Construction Activities.

1.3 DEFINITIONS

Compliance Report: A report prepared by the QC Officer ("QCO") upon completion of a Construction Segment. A Compliance Report requires the approval of the Site Manager. Any subsequent Construction Segment that is dependent upon successful completion of a specific Construction Segment cannot be initiated until a Compliance Report is prepared and approved for the previous dependent Construction Segment. Compliance Reports are to be completed on Form No. F-23 which is attached in Part V.

Construction Task: A basic construction feature of a Construction Project involving a specific Construction Activity.

Construction Project: The total authorized/approved Project that requires several Construction Segments to complete.

Design Change: Changes made in a Construction Project that alters or changes the intent of the Plans and Specifications. Design changes require approval of the Design Engineer and the Site Manager or a designated representative. Design Changes are to be reported on Form No. F-26, which is attached in Part V.

Field Change: Changes made during construction to fit field conditions that do not alter the intent of the Plans and Specifications. Field Changes require approval of the Site Manager or a designated representative. Field Changes are to be reported on Form No. F-25, which is attached in Part V.

Final Construction Report: A report prepared by the Site Manager or a designated representative upon completion of a Construction Project. This report will be submitted to the NRC.

1.4 QUALITY CONTROL/QUALITY ASSURANCE

1.4.1 Methodology

1.4.1.1 Flow of Activities

Figure 1 shows the general relationships of Quality Control and Quality Assurance activities in the performance of the Construction Activities for a given work area. The Quality Control Activities implemented with standardized QC procedures, provide the necessary tests and observations for the construction, sampling and monitoring process. Quality Assurance audits and reviews will provide oversight of the QC Activities.

1.4.1.2 Compliance Reports

For each project, the Quality Plan requires a Compliance Report at the successful completion of a Construction Segment. The Construction Tasks making up a Construction Segment will be determined to be in compliance with the Plans and Specifications by the QCO. A Compliance Report will then be prepared by the QCO with a copy to the NRC Project Manager, and submitted to the Site Manager for approval, before the next dependent phase of construction can begin. The Site Manager will review Quality Control data, Quality Assurance documentation, and review any observations before approving the Compliance Report.

After the Construction Project has been completed, a Final Construction Report will be prepared by the Site Manager or a designated representative for submittal to the NRC.

1.4.2 Quality Control

1.4.2.1 General

Quality Control ("QC") will be conducted by the QCO or a designated representative. Hereinafter referred to as the QCO. The QCO will implement the QC Program.

1.4.2.2 Quality Control Activities

Quality Control requirements for a Construction Project are presented in the Specifications.

The Quality Control Activities will be implemented with standardized Quality Control Procedures. The Quality Control Procedures include field sampling, testing, observations and monitoring procedures, and laboratory testing procedures. The Quality Control Procedures are listed and are included in Part VI.

1.4.3 Quality Assurance

1.4.3.1 General

Quality Assurance ("QA") will be conducted by the QAO or a designated representative. The QAO will implement the QA Program.

1.4.3.2 Quality Assurance Activities

The QA functions will be implemented by the QAO by performing the following activities.

1.4.3.2.1 Pre-qualification of QC Technicians

Each QC Technician ("QCT") will be pre-qualified by a QAO, who is a knowledgeable specialist in the area of qualification. The QAO will determine the areas of expertise of the respective technician and maintain a QA file on the technician. Areas of competency will be identified and training needs noted for the respective technician.

1.4.3.2.2 Verification of Effectiveness of QC Program

The effectiveness of the QC Program will be verified by the QAO by performing the following audits:

(1) Test and Sampling Procedures. Test procedures will be audited on a quarterly basis by appropriate specialists. This will entail direct observation of test methods and sampling, and performing random duplicate tests.

(2) Equipment. Equipment will be inspected and checked regularly. Calibration certificates will be verified and maintained in the files.

(3) Calculations and Documentation. Calculations from tests and monitoring will be spot checked randomly from the files. Documentation will be checked for accuracy and completeness.

1.4.4 Documentation

Each QA activity and audit will be documented in writing. Audit reports will be prepared by the QAO and submitted to the Site Manager. These will be kept in the White Mesa project files, and made available for review by the NRC Project Manager.

1.5 MONITORING

Monitoring functions fall under the responsibilities of · QCO. Scheduled monitoring and observations shall be made at the intervals required in the Plans and Specifications by Quality Control Technicians ("QCTs") under the direction of the QCO. Monitoring records will be reviewed by the QCO and will be available for review by the NRC. The QAO will audit monitoring records on an unscheduled basis. Monitoring records originals will be maintained in the White Mesa Project Files.

2.0 ORGANIZATIONAL STRUCTURE

2.1 SCOPE

The following items are covered in this section:

(1) A description of the Quality Control Organization.

(2) The classification, qualifications, duties, responsibilities and authority of personnel.

(3) The individual who will be responsible for overall management at the site for Quality Control.

(4) The specific authority and responsibility of all other personnel regarding the Quality Plan.

(5) A program for information flow among workers, construction management and inspectors about various QC/QA, and health and safety requirements.

2.2 ORGANIZATION

A schematic diagram of the organization for implementation of the Quality Plan is shown on Figure B-2. The Site Manager, the QCO, and the QAO, play major roles.

2.3 DUTIES AND QUALIFICATIONS OF PERSONNEL

2.3.1 Personnel Designations

The Site Manager or a designated representative will be referred to as the "Site Manager."

The Quality Control Officer or a designated representative will be referred to as the "QC Officer ("QCO")."

The Quality Assurance Officer or a designated representative will be referred to as the "QA Officer ("QAO")."

2.3.2 Site Manager

2.3.2.1 Duties, Responsibilities and Authority

The Site Manager will oversee the Construction Project and will be responsible for the conduct, direction and supervision of the Work. As shown on the organizational chart, the Site Manager

will have ultimate responsibility for all construction and QC/QA Activities. The Site Manager will appoint all personnel, and interact as required with the QAO, the QCO and the NRC Project Manager.

2.3.3 Designated Representative for Site Manager

In the absence of the Site Manager, a designated representative will assume the duties of the Site Manager.

2.3.4 Quality Control Officer ("QCO")

2.3.4.1 Duties, Responsibilities and Authority

The QCO will be responsible for overall implementation and management of the Quality Control Program for the Construction Project. The QCO will supervise Field and Laboratory Quality Control Technicians, and will coordinate with the Document Control Manager, the Office Staff and the Health and Safety Officer. The QCO will have specific authority and responsibility with regard to all other personnel for the Quality Plan. The QCO will have the authority to reject work or material, to require removal or placement, to specify and require appropriate corrective actions if it is determined that the Quality Control/Quality Assurance, personnel, instructions, controls, tests, records are not conforming to the Plans and Specifications. The signature of the QCO is required on all Compliance Reports ("CR's") required in the Specifications.

The QCO will be familiar with the existing White Mesa Facilities, and QC/QA methodology. Responsibilities of the QCO will include the following:

(1) Provide overall surveillance of Quality Control requirements.

(2) Be familiar with all documents, requirements, equipment and procedures relating to project construction.

(3) Provide and document Quality Control Technician ("QCT") training.

(4) Evaluate and approve all reports.

(5) Assure schedules are met and adequately documented.

(6) Schedule data reduction activities.

(7) Arrange consultation with additional staff, the QAO, Site Manager, and/or NRC Project Manager to help find solutions to unsolved problems.

(8) Identify invalid, unacceptable, or unusable data.

(9) Take corrective action if Quality Control procedures indicate the construction is not meeting the requirements of the Specifications.

(10) Assure all documentation is complete, accurate, and up to date.

(11) Interact and cooperate with QA Technicians

2.3.5 Designated Representative for QCO

In the absence of the QCO, a designated representative will assume the duties of the QCO. In addition, the designated representative may be assigned some of the duties, responsibilities and authority of the QCO.

2.3.6 Quality Assurance Officer ("QAO")

2.3.6.1 Duties

The QAO, who may be an independent consultant, will implement the Quality Assurance functions which includes pre-qualification of QCTs, verification of test procedures and results by spot retests, equipment checks, and review of calculations and documentation and Compliance Reports (CR's). The QAO should be familiar with the construction process and be qualified in construction testing.

Responsibilities of the QAO will include the following:

(1) Be familiar with all documents, requirements, equipment and procedures relating to project construction.
(2) Certify that the QCO is qualified to conduct the various test and monitoring procedures and observations, and document same.
(3) Through spot checks, retests, equipment checks and review of calculations and documentation verify test procedures, monitoring and observations are being performed correctly and accurately in accordance with the Specifications.
(4) Consult with the QCO, and the Site Manager to help solve problems.
(5) Prepare QA reports for review by the Site Manager and NRC Project Manager.

2.3.7 Designated Representative of the Quality Assurance Officer

In the absence of the Quality Assurance Officer ("QAO"), the designated representative of the QAO will assume the duties of the QAO. In addition, certain specialists may be designated to assume some of the duties of the QAO.

2.3.8 NRC Project Manager

The NRC Project Manager will represent the NRC's interests in the Construction Project. The NRC Project Manager may choose to review selected procedures, personnel qualifications, equipment, calculations, and documentation.

2.3.9 Quality Control Technicians ("QCT")

2.3.9.1 Duties

The Quality Control Technicians ("QCTs) for implementation of the Quality Plan will be classified as follows:

(1) Construction Quality Control Technicians - Field.
(2) Construction Quality Control Technicians - Laboratory.

A QCT may be qualified for and perform the duties in more than one classification.

2.3.9.2 Qualifications

The QCO will supervise (or may appoint a supervisor) for each classification to provide scheduling, oversee equipment calibrations, enforce documentation requirements, and provide for preliminary document review. The number of QCTs in each classification will depend on the project needs as the work progresses.

The Construction QCTs will satisfactorily complete a training program and receive on-the-job training as required under the direction of the QCO.

A procedure verification program will be implemented by the QAO for all Construction QCTs.

2.4 PROGRAM FOR INFORMATION FLOW

2.4.1 Review of Documents

The Plans and Specifications for the Construction Project describe the work to be performed, the QC/QA, and the monitoring requirements. These documents will be reviewed and approved in depth by licensee personnel, including the QCO and Site Manager.

2.4.2 Information Flow

2.4.2.1 Internal Information Flow

As shown on the Organization Chart (Figure B-2), the Construction Superintendent gives instructions to the Construction Foremen, who supervise the construction workers. The Construction Superintendent may directly supervise all or some of the construction workers.

The QCO monitors the construction work and completes the forms and reports as given in the Quality Control Procedures. The QCO ensures that all key personnel receive the required information.

Section 4.0 below, "Changes and Corrective Actions," outlines the procedure for implementing changes and corrective actions.

2.4.2.2 Information Flow to NRC

All reports of sampling, tests, inspections and construction records will be maintained in the White Mesa Project files. These documents will be available to the NRC Project Manager at all times. The NRC Project Manager will have the right to inspect and reproduce any documents as needed.

A list of the required reports is shown on Table B-I. These reports will be kept in the White Mesa Project Files.

3.0 SURVEYS, INSPECTIONS, SAMPLING AND TESTING

3.1 SCOPE

The following items are covered in this Section:

(1) Methods and procedures for surveys, inspections, sampling and testing during various construction tasks.

(2) The necessary qualifications of individuals performing surveys, inspections, sampling and testing.

(3) The number and type of surveys, inspections and/or tests to be conducted.

TABLE B-1
REQUIRED REPORTS

REPORT TYPE	FREQUENCY	ORIGINATOR	APPROVAL
Construction Activities	Daily during Construction	QC Technician	QC Officer
Sampling, Field and Laboratory Testing	Report for each respective test	QC Technician	QC Officer
*Compliance Report	Upon completion of Construction Segment	QC Officer	Site Manager
*Final Construction Report	After completion of the Construction Project	QC Officer Site Manager	Site Manager

* Reports to be submitted to the NRC

3.2 QUALITY CONTROL PROCEDURES

Quality Control Procedures will be written to meet the following objectives:

(1) To describe the equipment, calibration and methods/procedures to be followed in performing surveys, sampling and testing.

(2) To describe the procedures to observe construction activities.

(3) To describe the procedures for monitoring.

All Quality Control Procedures for sampling, testing, and monitoring will be conducted by the QCO and/or QCTs. The results will be reviewed and approved by the QCO before being delivered to the Document Control Officer ("DCO") for reproduction, distribution, and filing.

All boundary surveys will be made and documented by a registered land surveyor. Construction surveys will be made and documented by appropriately trained QCTs.

3.3 FREQUENCY AND TYPE

The number and type of survey, observations, inspections and/or tests are specified in the Plans and Specifications.

4.0 CHANGES AND CORRECTIVE ACTIONS

4.1 SCOPE

The methodology for dealing with changes and corrective actions is detailed in this Section.

4.2 AUTHORITY OF PERSONNEL

The Site Manager and/or the QCO will have the authority to reject material or work, to require removal or replacement, to specify and require appropriate actions if it is determined that the Quality Control/Quality Assurance, personnel, instructions, controls, tests, records are not conforming to the Plans and Specifications.

4.3 METHODOLOGY

4.3.1 Field and Design Changes

Changes in locations or alignments of construction features that do not alter design concepts will be approved by the Site Manager or a designated representative. These changes will require a Field Change Order (Form F-25).

Changes in design concepts will be approved and documented by the Design Engineer, will be approved by the Site Manager. These changes will require a Design Change Order (Form F-26).

All changes will be recorded in the Final Construction Report including "as-built" drawings for the work.

4.3.2 Corrective Actions

The QCO will require corrective actions if tests and observations indicate the work is not conforming to the intent of the Plans and Specifications. Appropriate corrective actions will be determined by

reviewing pertinent Quality Control records. Contemplated corrective actions will be brought to the attention of the Site Manager and the Construction Superintendent.

5.0 DOCUMENTATION

5.1 SCOPE

Documentation requirements will include the following:

(1) The identification of the person who has authority to provide for the submittal and/or storage of all survey, test and inspection reports.

(2) Specification of reporting requirements, forms, formats, and distribution of reports.

(3) A description of record keeping to document construction methods and results, surveys, sampling, testing and inspection of construction. Samples of forms and records will be included.

(4) Documentation of corrective actions.

5.2 PERSONNEL

5.2.1 Document Control Officer ("DCO")

5.2.1.1 Duties

The Document Control Officer ("DCO") will be appointed by the Site Manager. Responsibilities will include:

(1) Maintaining permanent files for the Construction Project. All tests, surveys, monitoring and report originals will be maintained in the project files.

(2) Instituting and overseeing data reproduction and distribution. A distribution list will be prepared for each project number and will be reviewed and approved by the QCO.

5.3 FORMS

All test results, sampling, surveys, and monitoring will be documented on the forms for those particular procedures where applicable. Specific surveys require a notebook prepared for data recording. Each Construction Field QCT will complete a Construction Activities report for each day's work. Forms will be completed so that all important data are recorded. Data required on all forms and notebooks includes project number, date, technician's signature, and the signature of the supervisor or a designee, who has reviewed and approved the work. The DCO will return all incomplete forms to the appropriate supervisor to be properly filled out.

Forms F-23, F-25, and F-26 follow.

Form No. F-26

DESIGN CHANGE ORDER

Project No. ______________ Date ________________

Drawing No. ______________

Specification No. ____________

Design feature

____

____

____

Change in design

____

____

____

____

Reason

____

____

____

Initiated by: ________________________________

Approvals:

Site Manager ________________________________

NRC Project Manager ___________________________

Design Engineer ______________________________

Form No. F-25

FIELD CHANGE ORDER

Project No. ______________ Date ________________

Drawing No. ______________

Specification No. ____________

Design feature

____

____

____

____

Modifications

____

____

____

____

Reason

____

____

____

____

Initiated by: ________________________________

Approved by: ________________________________

Site Manager

Form No. F-23

COMPLIANCE REPORT

Project No. ______________ Date ________________

Construction Segment ____

____

Drawing No. ______________

Specification No. _____________

Description of Completed Construction Segment

____

____

____

____

____

____

____

____

____

____

____

____

By: QC Officer __________________________________

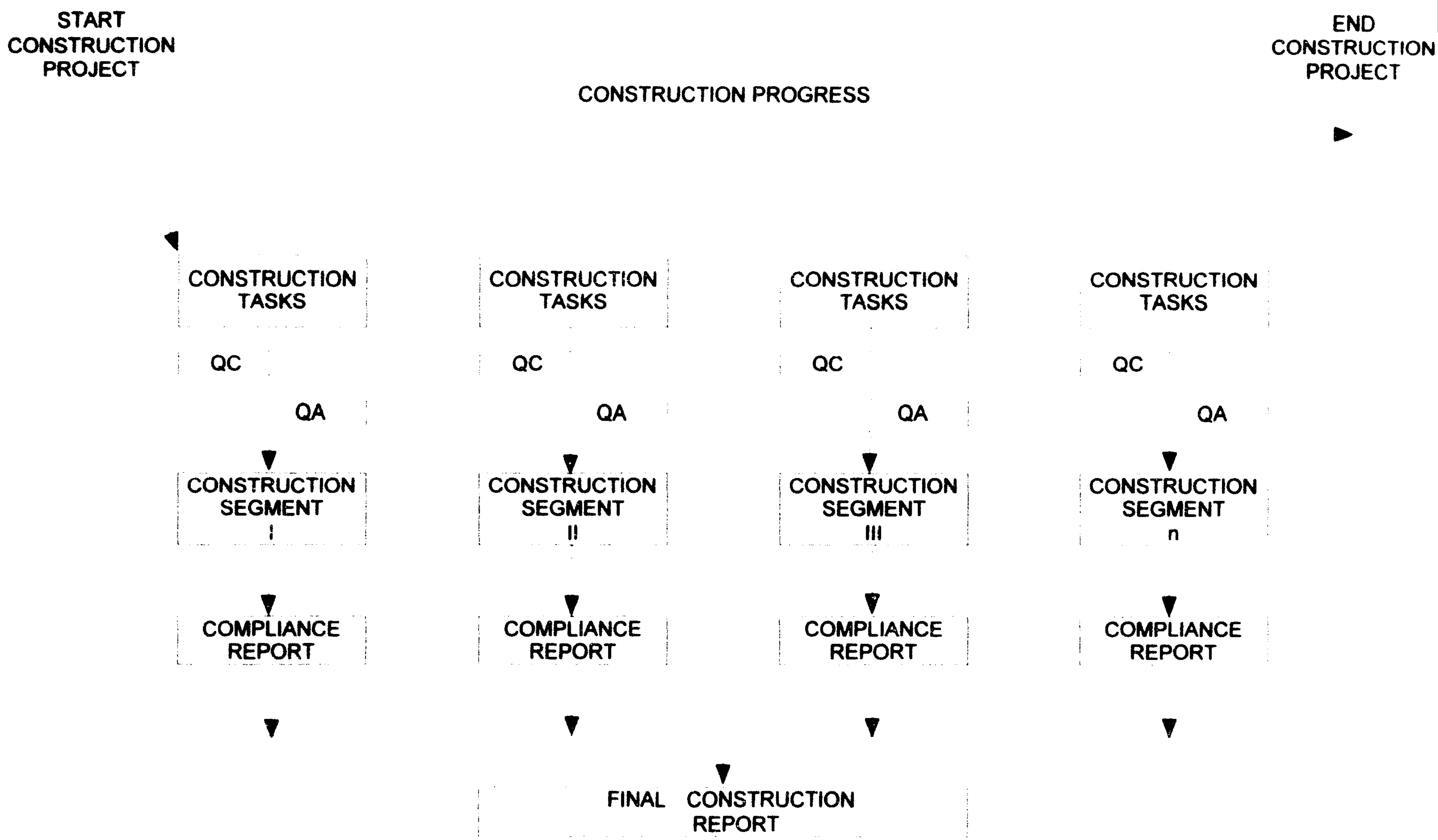
Approvals

Site Manager __________________________________

NRC Project Manager ____________________________

FIGURE B-1

TYPICAL FLOW CHART FOR CONSTRUCTION PROJECT



ATTACHMENT C

COST ESTIMATES

FOR

RECLAMATION

OF

WHITE MESA FACILITIES

BLANDING, UTAH

PREPARED BY

ENERGY FUELS NUCLEAR, INC.

THREE PARK CENTRAL

1515 ARAPAHOE STREET, SUITE 900

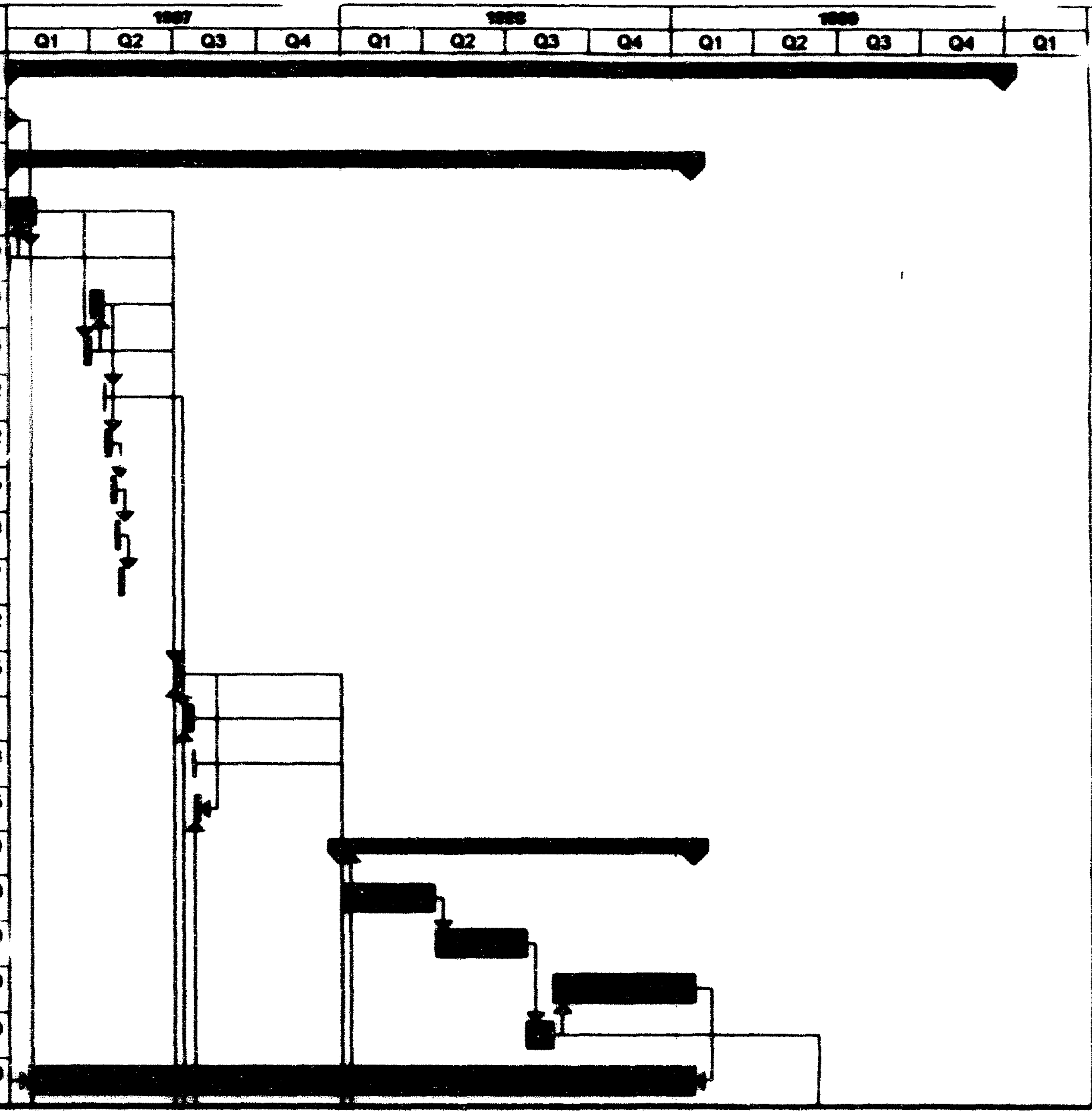
DENVER, COLORADO 80202

White Mesa Mill
Surety Requirements Summary
Revision of 12/1/96

Description	Factor	Amount
Mill Decommissioning		1,484,551
Cell 2		1,735,852
Cell 3		2,215,999
Cell 4A		114,756
Cell 1		738,371
Miscellaneous(w/o LTC)		2,045,035
Subtotal Direct Costs		8,334,564
Profit Allowance	10.00%	833,456
Contingency	15.00%	1,250,185
Licencing & Bonding	2.00%	166,691
Long Term Care Fund		585,300
Total Surety Requirement		11,170,196

Amounts are in 1996 Dollars

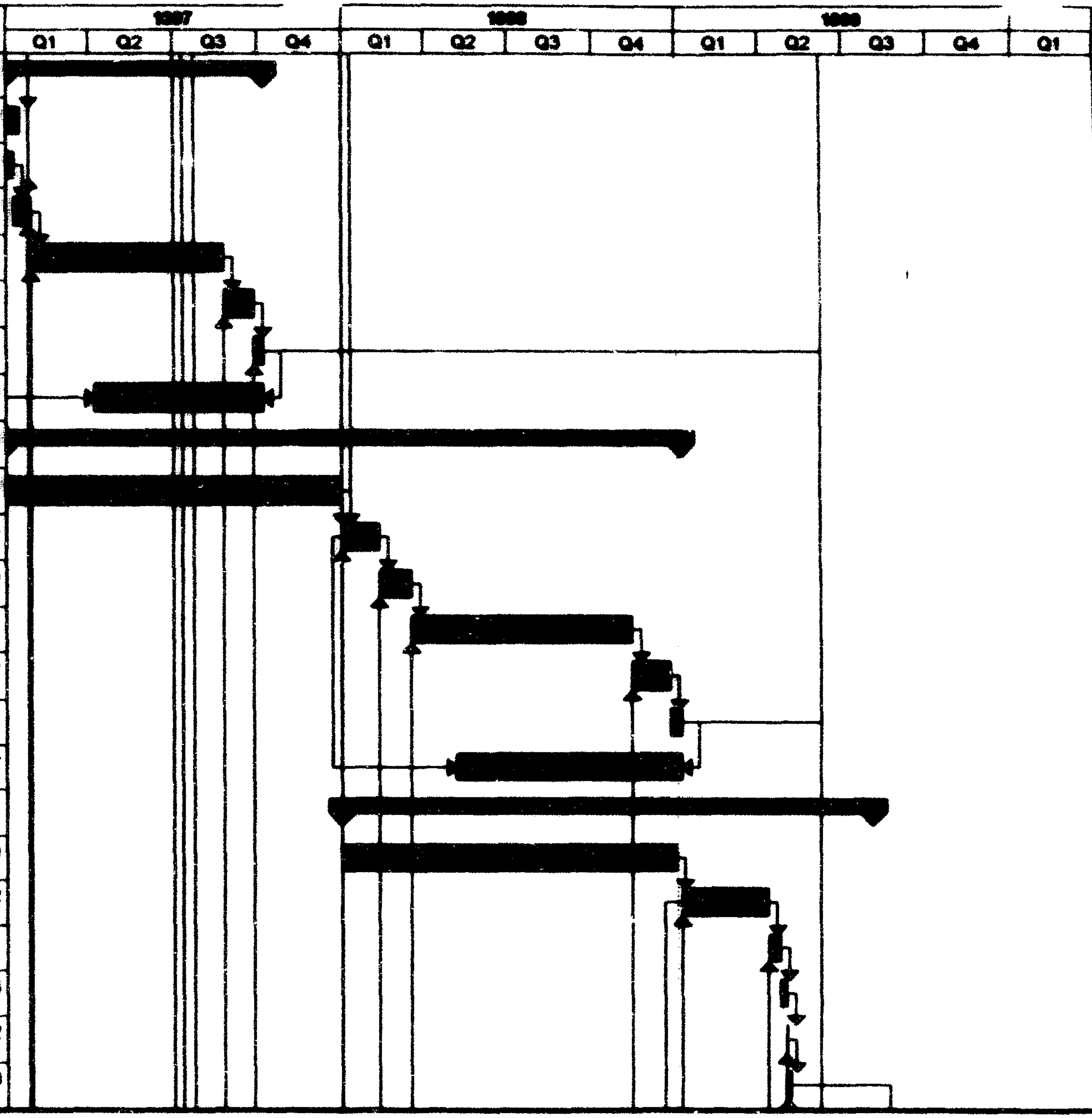
ID	Task Name	Total Cost
1	TOTAL RECLAMATION & DECON	[illegible]
2	Project Start	$0
3	MILL DECOMMISSIONING	$1,494,611
4	Mill Building Demolition	$284,630
5	Ore Feed Demolition	$14,229
6	SX Building Demolition	$280,249
7	CCD Circuit Removal	$74,874
8	Sample Plant Removal	$29,882
9	Boiler Demolition	$46,392
10	Vanadium Oxidation Circuit Re	$15,865
11	Main Shop/Warehouse	$83,370
12	Office Building	$62,427
13	Misc Tankage & Spare Parts	$7,342
14	Mill Yard Decontamination	$72,565
15	Ore Storage Pad Decontaminat	$53,891
16	Equipment Storage Area	$19,488
17	Revegetate Mill Yard & Ore Pa	$30,225
18	Windblown Contamination	$309,880
19	Scoping survey	$29,000
20	Characterization Survey	$37,800
21	Final Status Survey	$59,400
22	Windblown Cleanup	$183,780
23	Quality Control	$129,880



Project:
Date: 12/1/96

Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Milestone | Rolled Up Progress

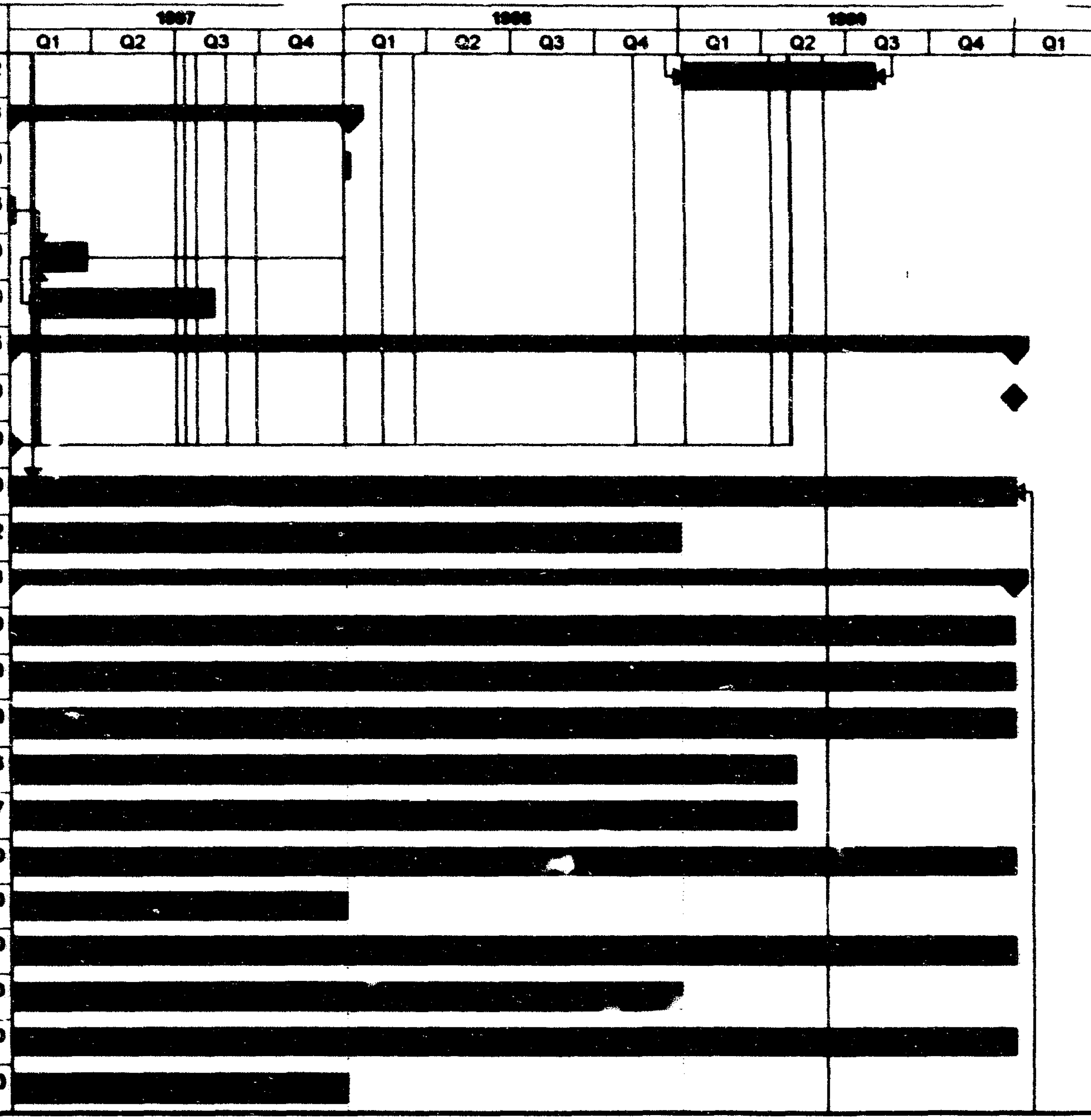
ID	Task Name	Total Cost
24	RECLAMATION OF CELL 2	$1,736,882
25	Obtain Permit for Section 16	$50,000
26	Place Remainder of Bridging Li	$91,854
27	Place Lower Random Fill (12")	$110,788
28	Clay Layer	$797,315
29	Upper Random Fill	$225,800
30	Rock Armour on top	$425,186
31	Quality Control	$85,100
32	RECLAMATION OF CELL 3	$2,216,880
33	Dewatering of Cell 3	$30,000
34	Lower Random Fill	$283,983
35	Lower Random Fill (12")	$214,880
36	Clay Layer	$857,151
37	Upper Random Fill	$259,732
38	Rock Armour	$583,081
39	Quality Control	$87,172
40	RECLAMATION OF CELL 1	$736,371
41	Dewatering	$30,600
42	Crystal Removal	$500,882
43	Contaminated Materials Remov	$71,771
44	Topsoil Application	$35,984
45	Construct Channels	$1,082
46	Rock Protection	$24,980



Project:
Date: 12/1/96

Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Milestone | Rolled Up Progress

ID	Task Name	Total Cost
47	Quality Control	$73,532
48	CELL 4A WORK	$114,786
49	Dewatering	$5,000
50	Remove Fencing	$1,936
51	Remove Liner to Cell 3	$87,670
52	Quality Control	$20,150
53	MISCELLANEOUS ITEMS	$2,636,336
54	Long Term Care Fund Allowan	$585,300
55	Butler Machinery Mobilization	$131,000
56	Temporary Office Facilities	$97,500
57	Wheel Wash Facilities	$150,672
58	Managerial Support	$1,686,863
59	Manager/Engineer	$380,000
60	Radiation Safety Officer	$225,000
61	Secretary	$90,000
62	Clerk	$58,486
63	Environmental Technician	$93,577
64	Maintenance Foreman	$165,000
65	Chemist	$45,000
66	Security	$180,000
67	Safety Engineer	$80,000
68	Misc Materials and Suppli	$234,000
69	Health Physics Costs (Mill	$134,800



Project:
Date: 12/1/96

Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Milestone | Rolled Up Progress

ID	Task Name	Total Cost	1997				1998				1999				
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
70	ProjectCompletion	$0													

Project:
Date: 12/1/96

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress

E/PROJECT .... Date .... Calc by .... Sheet ..... of .....

MILL DECOMMISSIONING

1) REMOVAL OF CONTAMINATED MATERIALS FROM MILL YARD.

ASSUME:

- 18" (1.5 feet) WILL HAVE TO BE REMOVED
- AREA (FROM CAD) = 1,643,453 ft^2 = 37.8 ACRES

Therf VOLUME MOVED = [1,643,453 × 1.5] ÷ 27 = 91,302 yd^3

SAY **91,300 yd^3**

$\frac{91,300 \text{ yd}^3}{355 \text{ yd/hr}}$ = **257 hours**

HAUL ROUTE # 2

2) REMOVAL OF CONTAMINATED MATERIALS FROM ORE PAD

ASSUME:

- 18" WILL HAVE TO BE REMOVED
- AREA (from CAD) = 976,780 ft^2 = 22.4 ACRES.

Therf VOLUME MOVED = [976,780 × 1.5] ÷ 27 = 54,265 yd^3

SAY **54,300 yd^3**

$\frac{54,300 \text{ yd}^3}{287 \text{ yd/hr}}$ = **189 hours**

HAUL ROUTE # 3

JE/PROJECT.......... ....Date..........Calc by..........Sheet.....of..........

MILL DECOMMISSIONING

3) DEMOLITION EQUIPMENT
- KAMATSU PC400 (OR CAT EQUIVALENT) WITH La Bounty Shears (hydraulic)
- CAT 245 BACKHOE W/ GRAPPLES.
- 769C ROCK TRUCKS
- 988 LOADER

4) DEMOLITION CREW.
- HEAVY EQUIPMENT OPERATORS - PC400, 245, 4-769C, 988
- DUST CONTROL - 2
- MECHANICS - CUTTING UP OF DEBRIS TO REMOVE VOIDS 4
-

5) TOOL & EXPENDABLE ALLOWANCE, COVERING THE FOLLOWING:
- SAFETY GEAR
- HAND TOOLS
- BOTTLED GASES & TORCHES.
- ALLOW 10^{00}/ MAN HOUR FOR ALL BUT H.E. OPERATORS

[redacted]

NE/PROJECT .... Date .... Calc by .... Sheet ..... of .....

MILL DECOMMISSIONING

6) DEMOLITION TIME ESTIMATES. (SHEAR & GRAPPLE)

• MILL BUILDING	20 days
• COARSE ORE	2 days
• SX BUILDING	10 days
• CCD, PLT, CLARIFIER	5 days
• SAMPLE PLANT	1 day
• BOILER	5 days
• Vanadium Oxidation	2 days
• SHOP / WAREHOUSE	4 days
• OFFICE BUILDING	3 days
• MISC TANKAGE & "NORTH FORTY"	4 days

7) FOUNDATION DEMOLITION

- ASSUME THAT MEANS 020-750-0440 OVER ENTIRE AREA OF STRUCTURE WILL SUFFICE @ \$3.20/ft^2
- AREAS ARE AS FOLLOWS. (FROM CAD)

	AREA, ft^2	EST \$
MILL BUILDING	37,500	120,000
SX BUILDING	55,970	179,100
SHOP / WAREHOUSE	19,280	61,700
OFFICE	12,100	38,700
SAMPLE PLANT	4,200	13,400
DIESEL SHOP	2050	6,600
BOILER	2900	9,300

- LABOR \$2.69, EQUIP \$0.51

JOB/PROJECT .... Date .... Calc by .... Sheet ...... of ......

MILL DECOMMISSIONING

B) REVEGITATION

ASSUME . . .

- MILL YARD AREA = 1,643,453 ft^2
- ORE PAD AREA = 976,780 ft^2
- PLACE 6"
- 637 ROUTE #4 APPROXIMATES HAUL

therefore $\left[\left[1,643,453 + 976,780\right] ft^2 \times \tfrac{1}{2} ft\right] \div 27 \, ft^3/yd^3 = 48,522 \, yd^3$

say **48,600 yd^3**

$\therefore \quad \dfrac{48,600 \, yd^3}{368 \, yd^3/hr} =$ **132 "637" hours**

MILL DECOMMISSIONING
WIND BLOWN CONTAMINATION

1) SCOPING SURVEY

- INITIAL SURVEY WILL BE CONDUCTED ON AN AREA TO BE DETERMINED BUT APPROXIMATED BY A PERIMETER APPROXIMATELY 1000' OUT SIDE OF THE RESTRICTED AREA BOUNDARIES.

- AREA BY CAD : 38,728 M sq ft
  - INCLUDES TAILS, MILLYARD & ORE PAD

Therefore AREA THAT REQUIRES WIND BLOWN SURVEY IS

		M ft²
AREA OF WINDBLOWN SURVEY		38,728
less	Cell 4A	1,909
	Cell 3	3,234
	Cell 2	2,987
	Cell 1	2,576
	Mill Yard	1,643
	Ore Storage	977
		25,402

- ASSUME PLACEMENT OF STANDARD NRC/EPA 10 × 10 m grid (1076 ft²)
- ASSUME SCOPING SURVEY COMPLETED BY SCANNING WITH μR METER HELD CLOSE TO GROUND WHILE TRAVERSING AT ± 0.5 m/sec AS PER GUIDANCE IN NUREG 5849
- SURVEY CREW OF 2 CAPABLE OF SETTING 500 GRID POINTS / DAY

25,402 M ft² ÷ 1076 ft² = 23,600 GRID POINTS

23,600 ÷ 500/day = 47.2 days

say **47 days**

- SCANNING CREW CONSISTS OF 2 & CAN COVER

1.5 m/sec × 0.5 efficiency × 60 sec/min × 60 min/hr × 5 hr. =

13,500 m/day

- Assume 30 m path for each 10×10 m grid to cover 10% of SURFACE AREA (NUREG 5849)

Therefore TEAM SURVEYS (SCANS) 13,500 ÷ 30 = 450 GRIDS/DAY

[illegible] INC.

E/PROJECT .... Date .... Calc by .... Sheet ...... of ......

MILL DECOMMISSIONING
WIND BLOWN CONTAMINATION (CONT)

1) SCOPING SURVEY (CONTINUED)

SCANNING THEREFORE TAKES
23,600 ÷ 450 = 52½ DAYS

say **53 DAYS.**

- MAP PREPARATION & DATA REDUCTION WILL TAKE SCANNING CREW ANOTHER 20 days
- WILL ALSO REQUIRE 100 CONFIRMATORY SOIL SAMPLES

2) CHARACTERIZATION SURVEY OF AFFECTED AREAS DEFINED IN #1
ASSUME:
- 20% OF AREA WILL REQUIRE ADDITIONAL SAMPLING
- PROBING WILL BE USED, 4 PER 10x10 M GRID
- SOIL SAMPLES WILL BE REQUIRED ON 10% OF ABOVE
  - UNAT & R[illegible]
  - $50 / SAMPLE.

25,402 ÷ 1076 × .20 = 4721 SAMPLES (PROBE)
4721 × 0.10 = 472 SOIL SAMPLES.

- CREW CAN TAKE 100 PROBE SAMPLES / DAY
- CREW CAN OBTAIN 25 SOIL SAMPLES / DAY

[illegible] PROBING TAKES 4721 ÷ 100 = **47 DAYS**
SOIL SAMPLES TAKE 472 ÷ 25 = **19 DAYS**

- MAP PREPARATION & DATA REDUCTION TAKE ANOTHER 5 days

3) REMEDIATION CONTROL SURVEY
- PROVIDED BY QA/QC CONTRACTOR AS WITH OTHER TASKS

4) FINAL STATUS SURVEY

- IN ORDER TO GAIN FINAL RELEASE, WILL REQUIRE 4 GAMMA ESTIMATES PER EACH 100 m² GRID SQUARE IN THE AFFECTED AREA (20% of AREA)
- 200 RANDOM SOIL SAMPLES WILL BE GATHERED FROM THE UNAFFECTED AREAS (80% of AREA)
- WILL REQUIRE 100 CONFIRMATORY SAMPLES FOR THE AFFECTED AREA

NE/PROJECT .... Date .... Calc by .... Sheet ..... of .....

MILL DECOMMISSIONING
WIND BLOWN CONTAMINATION (CONT)

4) Continued

Therefore

$25{,}402 \div 1076\ ft^2/100m^2$	=	23,607	GRIDS TOTAL
$23{,}607 \times 0.20$	=	4,721	GRIDS AFFECTED
$4{,}721 \times 4$	=	18,886	GAMMA ESTIMATES.

- CREW CAN TAKE 100 PROBE SAMPLES / DAY
  $\therefore\ 18886 \div 100 = 188.8$ days say 190 days
- CREW CAN TAKE 25 SOIL SAMPLES / DAY
  $\therefore\ [200 + 100] \div 25 = 12$ days.

○ ASSUME 20 additional DAYS FOR DATA REDUCTION : REPORT GENERATION

NE/PROJECT.......... Date.......... Calc by.......... Sheet.......of..........

MILL DECOMISSIONING
WIND BLOWN CONTAMINATION (CONT)

5) CLEAN-UP.

- ASSUME 20% OF AREA SURVEYED REQUIRES CORRECTIVE ACTION
- 6" OF SOIL WILL BE STRIPPED

Therefore 25.402 ft^2 x 0.20 x 0.5 ft = 2,540,000 ft^3

or 94,080 yd^3

say **94,100 yd^3**

- AS IT IS NOT KNOWN WHAT AREAS MAY BE CONTAMINATED, ASSUME THE USE OF 637 HAUL ROUTE #6 TO BE CONSERVATIVE.
- BECAUSE OF THE POTENTIAL FOR IRREGULAR & DISCONNECTED AREAS, EFFICIENCY WILL BE ONLY 50% OF REGULAR 637 EFFICIENCY.

Therefore 277 yd^3/hr x 0.50 = 138.5 yd^3/hr

say **138 yd^3/hr**

Therefore 94,100 yd^3 ÷ 138 yd^3/hr = 681 scraper hours

say **680 hours**

United States
Nuclear Regulatory Commission

Using CPI U (for urban consumers, across the U.S. - not the Denver-area CPI).

.19% is applied to long-term care fund for each additional month beyond August 1996

September, October, and November = 3 x .19 = .57%

November calculation would = $580,871 x 1.0057 = $584,182

Get on mailing list for Bureau of Labor Statistics - Call Richard Turtil at
301, 415, 6721
to get e-mail address for the Bureau.

assumed for minimum fee):
minimum gw monitoring (once every 3 years)
Annual site inspection
Very little maintenance

fee set with assumption that U.S. Govt. will be long-term custodian.

Example

Last available data is for August 1996 CPI-U = 157.3
December 1978 CPI-U = 67.7

$$\$250{,}000 \times \frac{August\text{'}96CPI-U}{December\text{'}78CPI-U}$$

= $580,871 Through August 1996.

Other data: July 1996 CPI-U = 157

The Consumer Price Index has increased .19% from July to August, 1996.

United States
Nuclear Regulatory Commission

Today's dollars:

$$\$250{,}000 \times \frac{\text{November '96 CPI-U}}{\text{December '78 CPI-U}}$$

However, CPI-U data for September, October, November '96 not available at this time.

- **Procedure for Determining Minimum Long-Term Care Fund**
  - **Cost adjustment for most recent months for which CPI data does not exist is based on last available CPI-U figure, and applied to remaining months**

CELL 1 (EVAPORATIVE)

VOLUME & RESOURCE CALCULATIONS

1) SURFACE AREA (from CAD) = 2,575,703 ft^2
= 59.1 Acres

2) CALCULATION OF CRYSTAL VOLUMES
- BASED ON AS-BUILTS & KNOWN ELEVATION OF CRYSTALS FROM AERIAL MAPPING, ASSUME AVERAGE THICKNESS = 3 ft
- SOIL OVER PVC LINER (AS BUILT) = 1½ feet
- LINER IS PICKED UP WITH ABOVE SOIL COVER

Therefore 2,575,703 ft^3 × [3.0 + 1.5] ft = 11,590,663 ft^3
= 429,293 yd^3
say **429,300 yd^3**

3) VOLUME OF CONTAMINATED MATERIALS UNDER LINER
- ASSUME AVERAGE OF 1 FOOT UNDER LINER OVER ENTIRE AREA OF CELL

= 2,575,703 ft^3
= 95,396 yd^3
say **95,500 yd^3**

4) TIME REQUIRED TO REMOVE CRYSTALS TO CELL 3 DISPOSAL AREA
- ASSUME SPREAD OF 4 769C TRUCKS, 1 245 BACKHOE
- USE HAUL ROUTE No 1 FOR EFFICIENCY CALCS.

Therefore 429,300 yd^3 ÷ 199 yd^3/truck-hour = **2157 TRUCK HOURS**
= **539 FLEET HOURS**

CELL 1 (EVAPORATIVE)

5) TIME REQUIRED TO REMOVE CONTAMINATED MATERIALS UNDER LINER

- ASSUME 637 SCRAPERS (4 each) ARE USED
- USE HAUL ROUTE #1 FOR EFFICIENCY

Therefore $95{,}500\ yd^3 \div 310\ yd^3/hour$ = **308 SCRAPER HOURS**

= **77 "FLEET" HOURS**

NE/PROJECT White Mesa Recl. Date 10/6/96 Calc by R A Van Horn Sheet 1 of

VOLUME CALCULATIONS
CELL 2

1) Area of Cell 2 (from CAD) = 2,986,660 ft^2
= 68.56 Acres

2) Area of Cell 2 still open (Estimate @ 20%) = 597,332 ft^2
= 13.72 Acres

3) Assume the following:
- Bridging lift is placed using random fill primarily from the piles to the west of tails
- Piles designated as "clay" will be used in conjunction with grading to bring the top of fill to design elevations using mechanical compaction to 95%
- Clay will be mined, blended, & hauled from borrow areas in Section 16
- The upper 2 feet of random fill will be placed utilizing the remaining "clay" & fines from "random fill" piles.
- Rock for top & side slope armour will be produced by crushing & screening operations on random fill oversize.

4) Random fill (bridging layer) left to place
From (2), [597,332 × 3] ÷ 27 = 66,370 yd^3
say 66,400 yd^3

5) Bring lower random fill up to engineering elevations.
= Full area of cell × 1 foot thick ÷ 27 ft^3/yd
= [2,986,660 ft^2 × 1 foot] ÷ $\frac{27 ft^3}{yd^3}$ = 110,617 yd^3
say 110,700 yd^3

CELL 2 (Cont)

6) PLACEMENT OF CLAY LAYER (1 foot thick)

$= \text{Full Area of Cell} \times 1\,ft \div 27\,ft^3/yd^3$

$= [2{,}986{,}660\,ft^2 \times 1\,foot] \div \frac{27\,ft^3}{1\,yd^3} = 110{,}617\,yd^3$

say **110,700 yd^3**

7) UPPER RANDOM FILL VOLUME:

$= \text{Full Area of Cell} \times 2\,Feet \div 27\,ft^3/yd^3$

$= [2{,}986{,}660\,ft^2 \times 2\,ft] \div 27\,ft^3/yd^3 = 221{,}234\,yd^3$

say **221,300 yd^3**

8) ARMOR PROTECTION - TOP OF CELL

$= \text{Area Cell } 2 \times 0.5\,ft \div 27\,ft^3/yd^3$

$= [2{,}986{,}660\,ft^2 \times 0.5\,ft] \div 27\,ft^3/yd^3 = 55{,}308\,yd^3$

say = **55,400 yd^3**

9)

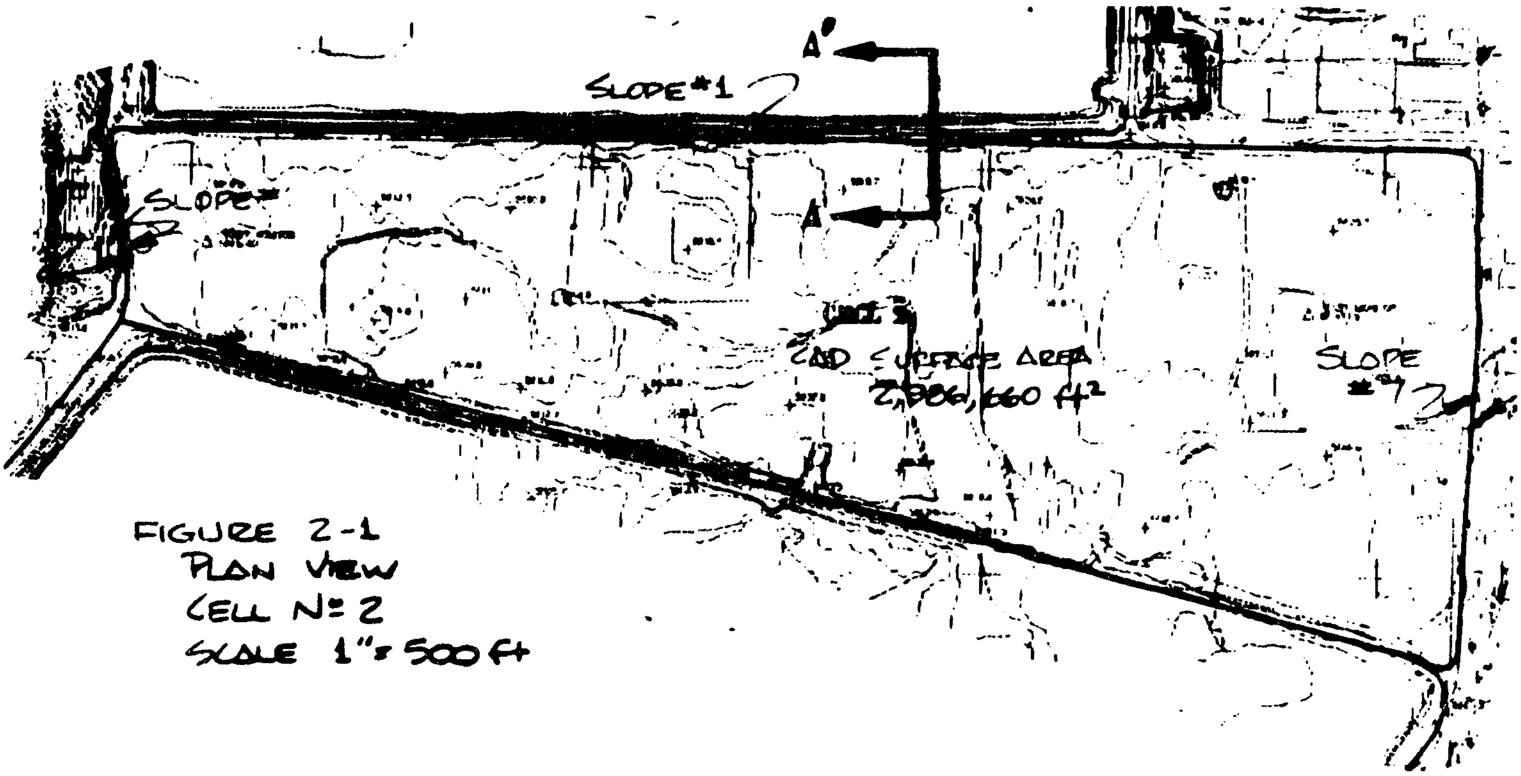


FIGURE 2-1
PLAN VIEW
CELL No 2
SCALE 1" = 500 ft

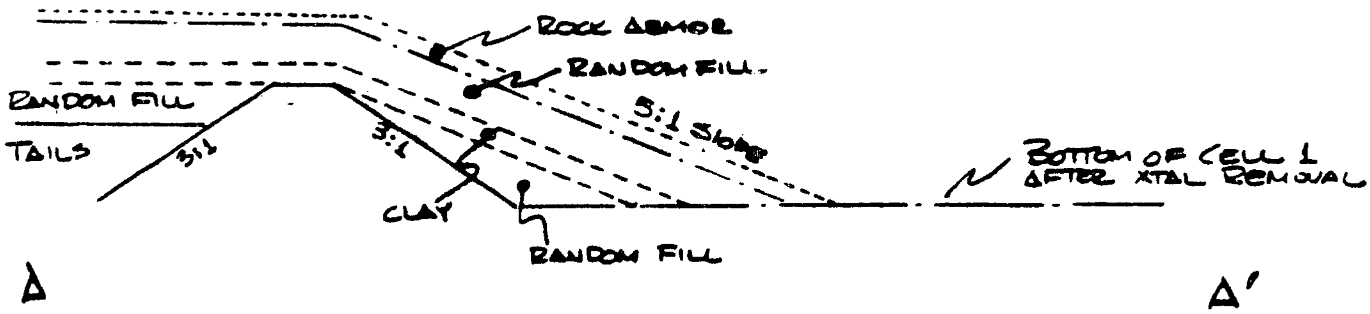


FIGURE 2-2
TYPICAL SECTION THRU DIKE

NE/PROJECT White Mesa Rec.. Date........ Calc by........ Sheet...... of......

VOLUME CALCULATIONS
CELL 2

9) CELL 2 NORTH DIKE (SLOPE #1), AREA COMMON WITH CELL 1

- AVERAGE HEIGHT 12 FEET
- LENGTH 2,600 FEET

a) RANDOM FILL WEDGE $= \left[\frac{12 \times 12 \times 5}{2} - \frac{12 \times 12 \times 3}{2}\right] \times 2600$

$= 374,400 \text{ ft}^3$

$= 13,867 \text{ yd}^3$

say **13,900 yd³**

b) CLAY LAYER $= \left[\frac{13 \times 13 \times 5}{2} - \frac{12 \times 12 \times 5}{2}\right] \times 2600$

$= 162,500 \text{ ft}^3$

$= 6,018 \text{ yd}^3$

say **6,100 yd³**

c) UPPER RANDOM FILL $= \left[\frac{15 \times 15 \times 5}{2} - \frac{13 \times 13 \times 5}{2}\right] \times 2600$

$= 364,000 \text{ ft}^3$

$= 13,481 \text{ yd}^3$

say **13,500 yd³**

d) ROCK ARMOUR $= \left[\frac{16 \times 16 \times 5}{2} - \frac{15 \times 15 \times 5}{2}\right] \times 2600$

$= 201,500 \text{ ft}^3$

$= 7,463 \text{ yd}^3$

say **7,500 yd³**

NAME/PROJECT WHITE MESA RECL Date .... Calc by .... Sheet ..... of .....

VOLUME CALCULATIONS
CELL 2

10) CELL 2 NORTH DIKE (SLOPE #2), AREA COMMON WITH MILL YARD

- AVERAGE HEIGHT 1 foot
- LENGTH 900 feet

a) RANDOM FILL WEDGE $= \left[\frac{1\times1\times5}{2} - \frac{1\times1\times3}{2}\right]\times 900$

$= 900\ ft^3$

$= 33\ yd^3$

say $\boxed{100\ yd^3}$

b) CLAY LAYER $= \left[\frac{2\times2\times5}{2} - \frac{1\times1\times5}{2}\right]\times 900$

$= 6{,}750\ ft^3$

$= 250\ yd^3$

say $\boxed{300\ yd^3}$

c) Upper Random Fill $= \left[\frac{4\times4\times5}{2} - \frac{2\times2\times5}{2}\right]\times 900$

$= 27{,}000\ ft^3$

$= \boxed{1000\ yd^3}$

d) ROCK ARMOUR $= \left[\frac{5\times5\times5}{2} - \frac{4\times4\times5}{2}\right]\times 900$

$= 20{,}250\ ft^3$

$= 750\ yd^3$

say $\boxed{800\ yd^3}$

NE/PROJECT White Mesa Recl. Date........ Calc by........ Sheet.... of....

VOLUME CALCULATIONS
CELL 2

11) CELL 2 WEST DIKE (SLOPE = 3)

- AVERAGE HEIGHT 2 FEET
- LENGTH 500 FEET

a) RANDOM FILL WEDGE $= \left[\frac{2\times2\times5}{2} - \frac{2\times2\times3}{2}\right] \times 500$

$= 2000 \text{ ft}^3$

$= 74 \text{ yd}^3$

say $\boxed{100 \text{ yd}^3}$

b) CLAY LAYER $= \left[\frac{3\times3\times5}{2} - \frac{2\times2\times5}{2}\right] \times 500$

$= 6,250 \text{ ft}^3$

$= 231 \text{ yd}^3$

say $\boxed{300 \text{ yd}^3}$

c) UPPER RANDOM FILL $= \left[\frac{5\times5\times5}{2} - \frac{3\times3\times5}{2}\right] \times 500$

$= 20,000 \text{ ft}^3$

$= 741 \text{ yd}^3$

say $\boxed{800 \text{ yd}^3}$

d) ROCK ARMOUR $= \left[\frac{6\times6\times5}{2} - \frac{5\times5\times5}{2}\right] \times 500$

$= 13,750 \text{ ft}^3$

$= 509 \text{ yd}^3$

say $\boxed{600 \text{ yd}^3}$

NE/PROJECT White Mesa Recl. Date .... Calc by .... Sheet ....of ....

Volume Calculations
Cell 2

12) Cell 2 East Dike (Slope #4)

- Average Height 1 Foot
- Length 1,250 Feet

a) Random Fill Wedge $= \left[\frac{1\times1\times5}{2} - \frac{1\times1\times3}{2}\right] \times 1250$

$= 1250\ ft^3$

$= 46\ yd^3$

say $\boxed{100\ yd^3}$

b) Clay Layer $= \left[\frac{2\times2\times5}{2} - \frac{1\times1\times5}{2}\right] \times 1250$

$= 1875\ ft^3$

$= 69\ yd^3$

say $\boxed{100\ yd^3}$

c) Upper Random Fill $= \left[\frac{4\times4\times5}{2} - \frac{2\times2\times5}{2}\right] \times 1250$

$= 7{,}500\ ft^3$

$= 278\ yd^3$

say $\boxed{300\ yd^3}$

d) Rock Armour $= \left[\frac{5\times5\times5}{2} - \frac{4\times4\times5}{2}\right] \times 1250$

$= 28{,}125$

$= 1042\ yd^3$

say $\boxed{1{,}100\ yd^3}$

NE/PROJECT WHITE MESA MILL Date .... Calc by RVH .... Sheet ..... of .....

VOLUME CALCULATIONS
CELL 2

3) CELL 2 SOUTH DIKE (SLOPE #5) [COMMON WITH CELL 3]

- AVERAGE HEIGHT = 3 FEET
- LENGTH = 3500 FEET

(a) RANDOM FILL WEDGE

$$= \left[\frac{3 \times 3 \times 5}{2} - \frac{3 \times 3 \times 3}{2}\right] \times 3500$$

$= 31,500\ ft^3$

$= 1167\ yd^3$

say **1200 yd^3**

(b) CLAY LAYER

$$= \left[\frac{4 \times 4 \times 5}{2} - \frac{3 \times 3 \times 5}{2}\right] \times 3500$$

$= 61,250\ ft^3$

$= 2268\ yd^3$

say **2300 yd^3**

(c) UPPER RANDOM FILL

$$= \left[\frac{6 \times 6 \times 5}{2} - \frac{4 \times 4 \times 5}{2}\right] \times 3500$$

$= 175,000\ ft^3$

$= 6481\ yd^3$

say **6,500 yd^3**

(d) ROCK ARMOUR

$$= \left[\frac{7 \times 7 \times 5}{2} - \frac{6 \times 6 \times 5}{2}\right] \times 3500$$

$= 113,750\ ft^3$

$= 4212\ yd^3$

say **4,200 yd^3**

E/PROJECT White Mesa Recl Date .... Calc by RVH .... Sheet ....of.......

CELL 2 RECLAMATION

CAT 631 RESOURCE REQUIREMENTS

	Volume	Route	Yds/Hr	%	Equip hrs
Cell 2 Bridging Lift					
Tailings Surface	66,400	5	296	100%	224.3
				TOTAL	224.3
Cell 2 Lower Random Fill					
Tailings surface	110,700	5	296	67%	250.6
Tailings Surface	110,700	4	368	33%	99.3
Slope 1	13,900	5	296	100%	47.0
Slope 2	100	4	368	100%	0.3
Slope 3	100	5	296	100%	0.3
Slope 4	100	4	368	100%	0.3
Slope 5	1,200	5	296	100%	4.1
				TOTAL	401.7
Cell 2 Upper Random Fill					
Tailings surface	221,300	5	296	67%	500.9
Tailings Surface	221,300	4	368	33%	198.4
Slope 1	13,500	5	296	100%	45.6
Slope 2	1,000	4	368	100%	2.7
Slope 3	800	5	296	100%	2.7
Slope 4	300	4	368	100%	0.8
Slope 5	6,500	5	296	100%	22.0
				TOTAL	773.2
Cell 2 Rock Armour					
Tailings Surface	55,400	5	296	100%	187.2
Slope 1	7,500	5	296	100%	25.3
Slope 2	800	5	296	100%	2.7
Slope 3	600	5	296	100%	2.0
Slope 4	1,100	5	296	100%	3.7
Slope 5	4,200	5	296	100%	14.2
				TOTAL	235.1

VOLUME CALCULATIONS
CELL 3

1) AREA OF CELL 3 FROM CAD = 3,234,252 ft^2
= **74.25 ACRES**

2) AREA OF RANDOM FILL (BRIDGING LIFT) ALREADY PLACED =
= 831,820 ft^2
= **19.55 ACRES**

3) ASSUME THE FOLLOWING :

- BRIDGING LIFT IS PLACED USING RANDOM FILL PILES FROM THE WEST OF TAILS UTILIZING ROUTE #6
- STOCKPILES DESIGNATED AS "CLAY" WILL BE USED IN CONJUNCTION WITH GRADING & MECHANICAL COMPACTION TO BRING THE TOP OF FILL TO ENGINEERED ELEVATIONS
- CLAYS FOR THE RADON BARRIER WILL BE MINED, BLENDED, PREPARED & HAULED FROM BORROW AREAS IN SECTION 16.
- THE 2 FOOT THICK RANDOM FILL LAYER ABOVE THE CLAY WILL BE PLACED UTILIZING THE REMAINING "CLAY" STOCKPILED IMMEDIATELY EAST & WEST OF TAILS & FINES FROM RANDOM FILL PILES.
- ROCK FOR TOP & SIDE SLOPE ARMOUR WILL BE PROVIDED BY CRUSHING & SCREENING OPERATIONS ON OVERSIZE MATERIALS IN THE RANDOM FILL PILES.

4) RANDOM FILL ([illegible]ING LAYER) LEFT TO PLACE :

FROM (1) & (2) ...

$$(3,234,252\ ft^2 - 831,820\ ft^2) \times 3\ ft \div 27\ \frac{ft^3}{yd^3}$$

$$= 2,382,432 \times 3 \div 27 = 264,715\ yd^3$$

say **264,800 yd^3**

JE/PROJECT White Mesa Recl Date 10/8/96 Calc by R. Van Horn Sheet 2 of 2

Volume Calculations
Cell 3

5) Bring Lower Random Fill up to Engineering Elevations

$= \text{Full Area of Cell} \times 1 \text{ foot thick} \div 27\ ft^3/yd^3$

$= 3{,}234{,}252\ ft^2 \times 1 \text{ foot} \div 27\ ft^3/yd^3$

$= 119{,}787\ yd^3$

say $\boxed{119{,}800\ yd^3}$

6) Placement of Clay Layer (1 foot thick)

$= \text{Full Area of Cell} \times 1\ ft \div 27\ ft^3/yd^3$

$= 3{,}234{,}252\ ft^2 \times 1\ ft \div 27\ ft^3/yd^3 = 119{,}787\ yd^3$

say $\boxed{119{,}800\ yd^3}$

7) Upper Random Fill Volume:

$= \text{Full Area of Cell} \times 2\ ft \text{ thick} \div 27\ ft^3/yd^3$

$= 3{,}234{,}252\ ft^2 \times 2\ ft \div 27\ ft^3/yd^3 = 239{,}574\ yd^3$

say $\boxed{239{,}600\ yd^3}$

8) Armour Protection

$= \text{Full Area of Cell} \times 0.5\ ft \text{ thick} \div 27\ ft^3/yd^3$

$= 3{,}234{,}252\ ft^2 \times 0.5\ ft \div 27\ ft^3/yd^3$

$= 59{,}894\ yd^3$

say $\boxed{59{,}900\ yd^3}$

VOLUME CALCULATIONS
CELL 3

9) CELL 3 WEST DIKE (SLOPE #6), 2 foot high, 1100 feet long

RANDOM FILL (WEDGE) $= \left[(2 * 2 * 5/2) - (2 * 2 * 3/2)\right] * 1{,}100$

$= 4400 \text{ ft}^3$

$= 163 \text{ yd}^3$

say **200 yd³**

CLAY LAYER $= \left[\frac{3 \times 3 \times 5}{2} - \frac{2 \times 2 \times 5}{2}\right] \times 1{,}100$

$= 13{,}750 \text{ ft}^3$

$= 509 \text{ yd}^3$

say **600 yd³**

UPPER RANDOM FILL $= \left[\frac{5 \times 5 \times 5}{2} - \frac{3 \times 3 \times 5}{2}\right] \times 1{,}100$

$= 44{,}000 \text{ ft}^3$

$= 1630 \text{ yd}^3$

say **1,700 yd³**

RIP RAP LAYER $= \left[\frac{6 \times 6 \times 5}{2} - \frac{5 \times 5 \times 5}{2}\right] \times 1{,}100$

$= 30{,}250 \text{ ft}^3$

$= 1120 \text{ yd}^3$

say **1200 yd³**

Volume Calculations
Cell 3

10) Cell 3 South Dike (Slope #7),
- 16 foot Average height
- 1,750 feet long

a) Random Fill Wedge $= \left[\frac{16 \times 16 \times 5}{2} - \frac{16 \times 16 \times 3}{2}\right] \times 1750$

$= 448,000 \text{ ft}^3$

$= 16,592 \text{ yd}^3$

say **16,600 yd³**

b) Clay Layer $= \left[\frac{17 \times 17 \times 5}{2} - \frac{16 \times 16 \times 5}{2}\right] \times 1,750$

$= 144,375 \text{ ft}^3$

$= 5347 \text{ yd}^3$

say **5400 yd³**

c) Upper Random Fill $= \left[\frac{19 \times 19 \times 5}{2} - \frac{17 \times 17 \times 5}{2}\right] \times 1750$

$= 315,000 \text{ ft}^3$

$= 11,667 \text{ yd}^3$

say **11,700 yd³**

d) Rip Rap Armour $= \left[\frac{20 \times 20 \times 5}{2} - \frac{19 \times 19 \times 5}{2}\right] \times 1,750$

$= 170,625 \text{ ft}^3$

$= 6,319 \text{ yd}^3$

say **6400 yd³**

NE/PROJECT White Mesa Recl Date ______ Calc by ______ Sheet 5 of ______

Volume Calculations
Cell 3

11) Cell 3 South Dike (Slope #8), Area Common with Cell 4A
- 39 foot average height
- 1700 feet long

a) Random Fill Wedge $= \left[\frac{39 \times 39 \times 5}{2} - \frac{39 \times 39 \times 3}{2}\right] \times 1{,}700$

$= 2{,}585{,}700\ ft^3$

$= 95{,}767\ yd^3$

say **95,800 yd^3**

b) Clay Layer $= \left[\frac{40 \times 40 \times 5}{2} - \frac{39 \times 39 \times 5}{2}\right] \times 1{,}700$

$= 335{,}750\ ft^3$

$= 12{,}435\ yd^3$

say **12,500 yd^3**

c) Upper Random Fill $= \left[\frac{42 \times 42 \times 5}{2} - \frac{40 \times 40 \times 5}{2}\right] \times 1{,}700$

$= 697{,}000\ ft^3$

$= 25{,}814\ yd^3$

say **25,900 yd^3**

d) Rip-Rap Armour $= \left[\frac{43 \times 43 \times 5}{2} - \frac{42 \times 42 \times 5}{2}\right] \times 1700$

$= 361{,}250\ ft^3$

$= 13{,}379\ yd^3$

say **13,400 yd^3**

Name/PROJECT White Mesa Cell Date 10/6/96 Calc by .... Sheet 6 of ....

Volume Calculations
Cell 3

12) Cell 3 East Dike (Slope #9)

- Average Height 6 Feet
- 800 Long

a) Random Fill Wedge $= \left[\frac{6 \times 6 \times 5}{2} - \frac{6 \times 6 \times 3}{2}\right] \times 800$

$= 28{,}800 \text{ ft}^3$

$= 1067 \text{ yd}^3$

say $\boxed{1100 \text{ yd}^3}$

b) Clay Layer $= \left[\frac{7 \times 7 \times 5}{2} - \frac{6 \times 6 \times 5}{2}\right] \times 800$

$= 26{,}000 \text{ ft}^3$

$= 963 \text{ yd}^3$

say $\boxed{1{,}000 \text{ yd}^3}$

c) Upper Random Fill $= \left[\frac{9 \times 9 \times 5}{2} - \frac{7 \times 7 \times 5}{2}\right] \times 800$

$= 64{,}000 \text{ ft}^3$

$= 2{,}370 \text{ yd}^3$

say $\boxed{2{,}400 \text{ yd}^3}$

d) RipRap Armour $= \left[\frac{10 \times 10 \times 5}{2} - \frac{9 \times 9 \times 5}{2}\right] \times 800$

$= 38{,}000$

$= 1407 \text{ yd}^3$

say $\boxed{1500 \text{ yd}^3}$

JOB/PROJECT White Mesa Mill Date .... Calc by RM .... Sheet ...... of ......

CELL 3 RECLAMATION

CAT 651 RESOURCE REQUIREMENTS

	Volume	Route	Yds/Hr	%	Equip hrs
Cell 3 Bridging Lift					
Tailings Surface	264,800	6	277	100%	956.0
				TOTAL	956.0
Cell 3 Lower Random Fill					
Tailings surface	119,800	6	296	100%	404.7
Slope 6	200	6	296	100%	0.7
Slope 7	16,600	6	368	100%	45.1
Slope 8	95,800	6	296	100%	323.6
Slope 9	1,100	6	368	100%	3.0
				TOTAL	777.2
Cell 3 Upper Random Fill					
Tailings surface	239,600	6	296	100%	809.5
Slope 6	1,700	6	296	100%	5.7
Slope 7	11,700	6	368	100%	31.8
Slope 8	25,900	6	296	100%	87.5
Slope 9	2,400	6	368	100%	6.5
				TOTAL	941.0
Cell 3 Rock Armour					
Tailings Surface	59,900	6	296	100%	202.4
Slope 6	1,200	6	296	100%	4.1
Slope 7	6,400	6	296	100%	21.6
Slope 8	13,400	6	296	100%	45.3
Slope 9	1,500	6	296	100%	5.1
				TOTAL	278.4

NE/PROJECT.............. Date.............. Calc by.............. Sheet.......of..........

CELL 4A WORK

1) ASSUMPTIONS

- ANY XTALS ARE PICKED UP WITH LINER
- AVERAGE OF 1 FOOT UNDER LINER WILL GO TO CELL 3
- ALL DIKE MATERIAL IS UNCONTAMINATED & CAN BE UTILIZED FOR CELL 3 COVER, THEREFORE, NO COST IS PLACED AGAINST ITS REMOVAL
- AREA OF CELL FOR VOLUME ESTIMATES IS 1,909 M ft^2
- CRYSTALS ESTIMATED TO BE 6" THICK OVER ENTIRE AREA

Transfer

QUANTITY OF CONTAMINATED MATERIAL =

$$\left[1,909,000 \times \left[6/12 + 12/12\right]\right] \div 27\ ft^3/yd^3 = 106,055$$

say $\boxed{106,100\ yd^3}$

and

BASED ON HAUL ROUTE B PROFILE, EFFICIENCY = $175\ yd^3$/truck hour

$$106100\ yd^3 \div 175\ yd^3 = 606 \text{ TRUCK HOURS}$$

$$= 303 \text{ FLEET HOURS (2 TRUCKS)}$$

ID	Resource Name	Group	Max. Units	Peak	Std. Rate	Ovt. Rate	Cost	Work
1	637 scraper		4	8	$146/h	$68/h	$876,192	6813h
2	D8N Dozer w/ripper		2	2	$70/h	$34/h	$275,100	3930h
3	D7 Dozer		2	2	$60/h	$28/h	$118,127	1963h
4	825 Compactor		1	1	$69/h	$30/h	$204,911	2984h
5	651 Waterwagon		1	2	$76/h	$36/h	$283,684	3746h
6	14G Motorgrader		2	2	$50/h	$24/h	$196,821	3948h
7	980C Loader		1	1	$67/h	$32/h	$58,316	868h
8	5000 gal water truck		1	1	$41/h	$18/h	$46,933	1132h
9	Highway Trucks (12yd)		20	8	$32/h	$0/h	$482,875	15104h
10	Operators		50	34.5	$12/h	$0/h	$686,564	56740h
11	Permits and Licences		1	[illegible]	$0/h	$0/h	[illegible]	[illegible]
12	Seeding per Acre		100	0	$0/h	$0/h	$0	0h
13	Dewatering Costs		50	35	$0/h	$0/h	$65,000	######
14	Quality contol contract		2	2.6	$62/h	$0/h	$374,914	6647h
15	769 Haul Truck		4	10	$62/h	$28/h	$276,679	4477h
16	988 Loader		2	3	$96/h	$48/h	$139,316	1461h
17	Rock Production Cost		100	82.1	$0/h	$0/h	$780,067	######
18	Wheelwash costs		10	10	$0/h	$0/h	$50,000	80h
19	245 Excavator		1	2	$167/h	$80/h	$161,842	963h
20	DP Rock per 100 yd3		100	0	$0/h	$0/h	$0	0h
21	Long Term Care Fund		100	58.53	$0/h	$0/h	$585,300	1h
22	Mechanics		25	12	$19/h	$0/h	$44,121	2292h
23	Small tools		100	1.92	$0/h	$0/h	$4,800	28.88h
24	65 Ton Crane		2	1	$47/h	$0/h	$9,002	190h
25	30 Ton Crane		1	1	$41/h	$0/h	$3,914	96h
26	Mobilization per 10k dolla		20	0	$0/h	$0/h	$131,000	0h
27	Manager/Engineer		1	1	$120,000/y	$0/h	$360,000	6240h
28	Radiation Safety Officer		1	1	$75,000/y	$0/h	$225,000	6240h
29	Secretary		1	1	$30,000/y	$0/h	$90,000	6240h
30	Clerk		1	1	$25,000/y	$0/h	$58,486	4866h
31	Engineer		1	0	$75,000/y	$0/h	$0	0h
32	Environmental Technicia		1	1	$40,000/y	$0/h	$93,577	4866h
33	Maintneance Foreman		1	1	$55,000/y	$0/h	$165,000	6240h
34	Security Personnel		3	3	$20,000/y	$0/h	$180,000	18720h
35	Safety Engineer		1	1	$40,000/y	$0/h	$80,000	4160h
36	Chemist		1	1	$45,000/y	$0/h	$45,000	2080h
37	Misc Supplies		1	1	$1,500/w	$0/h	$234,000	6240h
38	Butler Maintenance Cost		100	30	$10/h	$0/h	$483,220	48322h
39	Additional Clay per 10k y		100	0	$0/h	$0/h	$0	0h
40	Health Physics Program		100	1	$2,400/w	$0/h	$134,800	2080h
41	PC400 w/shear		1	2	$204/h	$0/h	$78,336	384h
42	Concrete Removal per 1		100	56.97	$0/h	$0/h	$470,304	######
43	Soil Samples per 100		100	5	$0/h	$0/h	$58,600	58.06h
44	Survey crew		2	2	$13/h	$0/h	$11,438	915h
45	Sample Crew		4	4	$13/h	$0/h	$74,238	5938h
46	Office trailers(Technical)		10	5	$125/w	$0/h	$97,500	31200h

ID	Task Name	Total Cost
1	TOTAL RECLAMATION & DECOM	$8,919,823
2	Project Start	$0
3	MILL DECOMMISSIONING	$1,484,511
4	Mill Building Demolition	$284,630

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
10	Operators	9	$16,456	$7,536	$0	$16,456	1368h	0h	623h	0h	1368h
15	769 Haul Truck	4	$30,562	$0	$0	$30,562	640h	0h	0h	0h	640h
16	988 Loader	1	$15,910	$0	$0	$15,910	160h	0h	0h	0h	160h
19	245 Excavator	1	$17,115	$0	$0	$17,115	160h	0h	0h	0h	160h
22	Mechanics	6	$18,480	$156,560	$0	$18,480	960h	0h	8133h	0h	960h
23	Small tools	9.6	$0	$40,680	$0	$0	0h	0h	0h	0h	0h
24	65 Ton Crane	1	$7,581	$25,623	$0	$7,581	160h	0h	854h	0h	160h
25	30 Ton Crane	1	$3,296	$2,760	$0	$3,296	80h	0h	68h	0h	80h
38	Butler Maintenance Cost	9	$13,680	$0	$0	$13,680	1368h	0h	0h	0h	1368h
41	PC400 w/shear	1	$32,640	$0	$0	$32,640	160h	0h	0h	0h	160h
42	Concrete Removal per 1000 ft2	37.5	$120,000	$0	$0	$120,000	1h	0h	0h	0h	1h

ID	Task Name	Total Cost
5	Ore Feed Demolition	$14,229

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
10	Operators	7	$1,366	$835	$0	$1,366	112h	0h	69h	0h	112h
15	769 Haul Truck	4	$3,056	$0	$0	$3,056	64h	0h	0h	0h	64h
16	988 Loader	1	$1,591	$0	$0	$1,591	16h	0h	0h	0h	16h
19	245 Excavator	1	$1,712	$0	$0	$1,712	16h	0h	0h	0h	16h
22	Mechanics	4	$1,232	$61,254	$0	$1,232	64h	0h	3182h	0h	64h
23	Small tools	6.64	$0	$15,910	$0	$0	0h	0h	0h	0h	0h
25	30 Ton Crane	1	$0	$2,760	$0	$0	0h	0h	68h	0h	0h
38	Butler Maintenance Cost	9	$1,120	$0	$0	$1,120	112h	0h	0h	0h	112h
41	PC400 w/shear	1	$3,264	$0	$0	$3,264	16h	0h	0h	0h	16h

ID	Task Name	Total Cost
6	SX Building Demolition	$250,249

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
10	Operators	7	$6,776	$2,505	$0	$6,776	560h	0h	207h	0h	560h
15	769 Haul Truck	4	$19,776	$0	$0	$19,776	320h	0h	0h	0h	320h
16	988 Loader	1	$7,965	$0	$0	$7,965	80h	0h	0h	0h	80h
19	245 Excavator	1	$8,560	$0	$0	$8,560	80h	0h	0h	0h	80h
22	Mechanics	4	$6,160	$122,526	$0	$6,160	320h	0h	6365h	0h	320h
23	Small tools	3.2	$0	$31,820	$0	$0	0h	0h	0h	0h	0h
24	65 Ton Crane	1	$0	$6,383	$0	$0	0h	0h	130h	0h	0h
25	30 Ton Crane	1	$0	$2,760	$0	$0	0h	0h	68h	0h	0h
38	Butler Maintenance Cost	7	$5,600	$0	$0	$5,600	560h	0h	0h	0h	560h
41	PC400 w/shear	1	$16,320	$0	$0	$16,320	80h	0h	0h	0h	80h
42	Concrete Removal per 1000 ft2	56.97	$179,104	$0	$0	$179,104	560h	0h	0h	0h	560h

ID	Task Name	Total Cost
7	CCD Circuit Removal	$74,074

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
10	Operators	9	$3,812	$2,505	$0	$3,812	315h	0h	207h	0h	315h
15	769 Haul Truck	4	$7,416	$0	$0	$7,416	120h	0h	0h	0h	120h
16	988 Loader	1	$2,983	$0	$0	$2,983	30h	0h	0h	0h	30h
19	245 Excavator	1	$3,280	$0	$0	$3,280	30h	0h	0h	0h	30h
22	Mechanics	6	$3,465	$102,102	$0	$3,465	180h	0h	5304h	0h	180h

ID	Task Name	Total Cost

"CCD Circuit Removal" continued

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
23	Small tools	1.8	$0	$26,520	$0	$0	0h	0h	0h	0h	0h
24	65 Ton Crane	1	$1,421	$3,191	$0	$1,421	30h	0h	68h	0h	30h
25	30 Ton Crane	1	$618	$5,520	$0	$618	15h	0h	138h	0h	15h
38	Butler Maintenance Cost	9	$3,150	$0	$0	$3,150	315h	0h	0h	0h	315h
42	Concrete Removal per 1000 ft2	15	$48,000	$0	$0	$48,000	480h	0h	0h	0h	480h

8 Sample Plant Removal $20,862

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
10	Operators	7	$678	$1,258	$0	$678	56h	0h	104h	0h	56h
15	769 Haul Truck	4	$1,978	$0	$0	$1,978	32h	0h	0h		32h
16	988 Loader	1	$786	$0	$0	$786	8h	0h	0h		8h
19	245 Excavator	1	$856	$0	$0	$856	8h	0h	0h	0h	8h
22	Mechanics	6	$824	$27,230	$0	$824	40h	0h	1415h	0h	40h
23	Small tools	0.48	$0	$7,600	$0	$0	0h	0h	0h	0h	0h
25	30 Ton Crane	1	$0	$4,160	$0	$0	0h	0h	104h	0h	0h
38	Butler Maintenance Cost	7	$560	$0	$0	$560	56h	0h	0h	0h	56h
41	PC400 w/shear	1	$1,632	$0	$0	$1,632	8h	0h	0h	0h	8h
42	Concrete Removal per 1000 ft2	4.2	$13,440	$0	$0	$13,440	33.6h	0h	0h	0h	33.6h

9 Boiler Demolition $46,392

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
10	Operators	7	$3,388	$2,940	$0	$3,388	280h	0h	243h	0h	280h
15	769 Haul Truck	4	$9,888	$0	$0	$9,888	160h	0h	0h	0h	160h
16	988 Loader	1	$3,978	$0	$0	$3,978	40h	0h	0h	0h	40h
19	245 Excavator	1	$4,279	$0	$0	$4,279	40h	0h	0h	0h	40h
22	Mechanics	6	$4,620	$41,264	$0	$4,620	240h	0h	3182h	0h	240h
23	Small tools	2.4	$0	$15,910	$0	$0	0h	0h	0h	0h	0h
24	65 Ton Crane	1	$0	$9,620	$0	$0	0h	0h	208h	0h	0h
25	30 Ton Crane	1	$0	$1,400	$0	$0	0h	0h	35h	0h	0h
38	Butler Maintenance Cost	7	$2,800	$0	$0	$2,800	280h	0h	0h	0h	280h
41	PC400 w/shear	1	$8,160	$0	$0	$8,160	40h	0h	0h	0h	40h
42	Concrete Removal per 1000 ft2	2.9	$9,280	$0	$0	$9,280	116h	0h	0h	0h	116h

10 Vanadium Oxidation Circuit Removal $15,805

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
10	Operators	7	$1,356	$3,182	$0	$1,356	112h	0h	263h	0h	112h
15	769 Haul Truck	4	$3,955	$0	$0	$3,955	64h	0h	0h	0h	64h
16	988 Loader	1	$1,581	$0	$0	$1,581	16h	0h	0h	0h	16h
19	245 Excavator	1	$1,712	$0	$0	$1,712	16h	0h	0h	0h	16h
22	Mechanics	6	$1,846	$34,034	$0	$1,846	96h	0h	1768h	0h	96h
23	Small tools	0.96	$960	$8,840	$0	$960	1h	0h	781.45h	0h	1h
24	65 Ton Crane	1	$0	$9,620	$0	$0	0h	0h	208h	0h	0h
25	30 Ton Crane	1	$0	$2,280	$0	$0	0h	0h	55h	0h	0h
38	Butler Maintenance Cost	7	$1,120	$0	$0	$1,120	112h	0h	0h	0h	112h
41	PC400 w/shear	1	$3,264	$0	$0	$3,264	16h	0h	0h	0h	16h

11 Main Shop/Warehouse $93,370

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
10	Operators	7	$2,710	$0	$0	$2,710	224h	0h	0h	0h	224h

ID	Task Name	Total Cost

"Main Shop/Warehouse" continued

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
15	769 Haul Truck	4	$7,910	$0	$0	$7,910	128h	0h	0h	0h	128h
16	988 Loader	1	$3,182	$0	$0	$3,182	32h	0h	0h	0h	32h
19	245 Excavator	1	$3,423	$0	$0	$3,423	32h	0h	0h	0h	32h
22	Mechanics	6	$3,696	$0	$0	$3,696	192h	0h	0h	0h	192h
23	Small tools	1.92	$1,920	$0	$0	$1,920	15.37h	0h	0h	0h	15.37h
38	Butler Maintenance Cost	7	$2,240	$0	$0	$2,240	224h	0h	0h	0h	224h
41	PC400 w/shear	1	$6,520	$0	$0	$6,520	32h	0h	0h	0h	32h
42	Concrete Removal per 1000 ft2	19.3	$61,760	$0	$0	$61,760	617.6h	0h	0h	0h	617.6h

12 Office Building $82,427

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
10	Operators	7	$2,033	$0	$0	$2,033	168h	0h	0h	0h	168h
15	769 Haul Truck	4	$5,933	$0	$0	$5,933	96h	0h	0h	0h	96h
16	988 Loader	1	$2,387	$0	$0	$2,387	24h	0h	0h	0h	24h
19	245 Excavator	1	$2,567	$0	$0	$2,567	24h	0h	0h	0h	24h
22	Mechanics	6	$2,772	$0	$0	$2,772	144h	0h	0h	0h	144h
23	Small tools	1.44	$1,440	$0	$0	$1,440	11.52h	0h	0h	0h	11.52h
38	Butler Maintenance Cost	7	$1,680	$0	$0	$1,680	168h	0h	0h	0h	168h
41	PC400 w/shear	1	$4,896	$0	$0	$4,896	24h	0h	0h	0h	24h
42	Concrete Removal per 1000 ft2	12.1	$38,720	$0	$0	$38,720	290.4h	0h	0h	0h	290.4h

13 Misc Tankage & Spare Parts $7,342

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
10	Operators	7	$678	$0	$0	$678	56h	0h	0h	0h	56h
15	769 Haul Truck	4	$1,978	$0	$0	$1,978	32h	0h	0h	0h	32h
16	988 Loader	1	$796	$0	$0	$796	8h	0h	0h	0h	8h
19	245 Excavator	1	$856	$0	$0	$856	8h	0h	0h	0h	8h
22	Mechanics	6	$924	$0	$0	$924	48h	0h	0h	0h	48h
23	Small tools	0.46	$480	$0	$0	$480	1h	0h	0h	0h	1h
41	PC400 w/shear	1	$1,632	$0	$0	$1,632	8h	0h	0h	0h	8h

14 Mill Yard Decontamination $72,505

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
1	637 scraper	4	$37,406	$66,380	$0	$37,406	257h	0h	480h	0h	257h
2	D8N Dozer w/ripper	1	$4,540	$8,262	$0	$4,540	65h	0h	123h	0h	65h
3	D7 Dozer	1	$3,872	$7,040	$0	$3,872	65h	0h	123h	0h	65h
5	651 Waterwagon	1	$4,924	$8,881	$0	$4,924	65h	0h	123h	0h	65h
6	14G Motorgrader	1	$3,224	$5,872	$0	$3,224	65h	0h	123h	0h	65h
10	Operators	9	$6,256	$13,915	$0	$6,256	517h	0h	1150h	0h	517h
16	966 Loader	1	$6,464	$11,765	$0	$6,464	65h	0h	123h	0h	65h
38	Butler Maintenance Cost	10	$5,820	$11,060	$0	$5,820	582h	0h	1105h	0h	582h

15 Ore Storage Pad Decontamination $53,991

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
1	637 scraper	4	$27,500	$29,986	$0	$27,500	188h	0h	215h	0h	188h
2	D8N Dozer w/ripper	1	$3,352	$3,627	$0	$3,352	48h	0h	54h	0h	48h
3	D7 Dozer	1	$2,850	$3,085	$0	$2,850	48h	0h	54h	0h	48h
5	651 Waterwagon	1	$3,636	$3,890	$0	$3,636	48h	0h	54h	0h	48h
6	14G Motorgrader	1	$2,381	$2,578	$0	$2,381	48h	0h	54h	0h	48h

ID	Task Name	Total Cost

"Ore Storage Pad Decon/ ination" continued

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
10	Operators	9	$5,191	$5,880	$0	$5,191	429h	0h	485h	0h	429h
	988 Loader	1	$4,773	$5,165	$0	$4,773	48h	0h	54h	0h	48h
38	Butler Maintenance Cost	10	$4,290	$4,850	$0	$4,290	429h	0h	485h	0h	429h

16 Equipment Storage Area $19,468

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
1	637 scraper	4	$10,043	$9,626	$0	$10,043	68h	0h	68h	0h	68h
2	D8N Dozer w/ripper	1	$1,187	$1,142	$0	$1,187	17h	0h	17h	0h	17h
3	D7 Dozer	1	$1,013	$974	$0	$1,013	17h	0h	17h	0h	17h
5	651 Waterwagon	1	$1,298	$1,227	$0	$1,298	17h	0h	17h	0h	17h
6	14G Motorgrader	1	$843	$812	$0	$843	17h	0h	17h	0h	17h
10	Operators	9	$1,863	$1,863	$0	$1,863	154h	0h	154h	0h	154h
16	988 Loader	1	$1,690	$1,626	$0	$1,690	17h	0h	17h	0h	17h
38	Butler Maintenance Cost	10	$1,540	$1,540	$0	$1,540	154h	0h	154h	0h	154h

17 Revegetate Mill Yard & Ore Pad $30,225

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
1	637 scraper	4	$19,213	$27,902	$0	$19,213	132h	0h	200h	0h	132h
2	D8N Dozer w/ripper	1	$2,305	$3,350	$0	$2,305	33h	0h	50h	0h	33h
3	D7 Dozer	1	$1,966	$2,866	$0	$1,966	33h	0h	50h	0h	33h
6	14G Motorgrader	1	$1,637	$2,387	$0	$1,637	33h	0h	50h	0h	33h
10	Operators	7	$2,786	$4,236	$0	$2,786	231h	0h	350h	0h	231h
38	Butler Maintenance Cost	10	$2,310	$3,500	$0	$2,310	231h	0h	350h	0h	231h

18 Windblown Contamination $309,980

19 Scoping survey $29,000

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
43	Soil Samples per 100	1	$5,000	$0	$0	$5,000	1h	0h	0h	0h	1h
44	Survey crew	2	$9,400	$0	$0	$9,400	752h	0h	0h	0h	752h
46	Sample Crew	2	$14,600	$0	$0	$14,600	1168h	0h	0h	0h	1168h

20 Characterization Survey $37,800

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
43	Soil Samples per 100	4.72	$23,600	$0	$0	$23,600	1h	0h	0h	0h	1h
46	Sample Crew	2	$14,200	$0	$0	$14,200	1136h	0h	0h	0h	1136h

21 Final Status Survey $59,400

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
43	Soil Samples per 100	3	$15,000	$0	$0	$15,000	6d	0h	0d	0h	6d
46	Sample Crew	4	$44,400	$0	$0	$44,400	3552h	0h	0h	0h	3552h

22 Windblown Cleanup $183,780

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
1	637 scraper	4	$98,974	$0	$0	$98,974	680h	0h	0h	0h	680h
2	D8N Dozer w/ripper	1	$11,873	$0	$0	$11,873	170h	0h	0h	0h	170h
3	D7 Dozer	1	$10,127	$0	$0	$10,127	170h	0h	0h	0h	170h
6	14G Motorgrader	1	$8,432	$0	$0	$8,432	170h	0h	0h	0h	170h

ID	Task Name	Total Cost

"Windblown Cleanup" continued

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
10	Operators	7	$14,380	$0	$0	$14,380	1190h	0h	0h	0h	1190h
38	Butler Maintenance Cost	7	$11,900	$0	$0	$11,900	1190h	0h	0h	0h	1190h
43	Soil Samples per 100	5	$25,000	$0	$0	$25,000	8.06h	0h	0h	0h	8.06h
44	Survey crew	2	$2,036	$0	$0	$2,036	163h	0h	0h	0h	163h
46	Sample Crew	2	$1,036	$0	$0	$1,036	83h	0h	0h	0h	83h

23 Quality Control $128,960

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
14	Quality contol contractor	6.5	$128,960	$0	$0	$128,960	2080h	0h	0h	0h	2080h

24 **RECLAMATION OF CELL 2** $1,736,862

25 Obtain Permit for Section 16 $50,000

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
11	Permits and Licences	50	$50,000	$10,000	$0	$50,000	4000h	0h	0h	0h	4000h

26 Place Remainder of Bridging Lift $61,854

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
1	637 scraper	4	$32,603	$43,109	$0	$32,603	224h	0h	306h	0h	224h
2	D8N Dozer w/ripper	1	$3,911	$5,239	$0	$3,911	56h	0h	78h	0h	56h
3	D7 Dozer	1	$3,336	$4,470	$0	$3,336	56h	0h	78h	0h	56h
4	825 Compactor	1	$3,846	$5,118	$0	$3,846	56h	0h	78h	0h	56h
5	651 Waterwagon	1	$4,242	$5,632	$0	$4,242	56h	0h	78h	0h	56h
6	14G Motorgrader	1	$2,778	$3,724	$0	$2,778	56h	0h	78h	0h	56h
10	Operators	9	$6,098	$8,458	$0	$6,098	504h	0h	698h	0h	504h
38	Butler Maintenance Cost	10	$5,040	$6,980	$0	$5,040	504h	0h	698h	0h	504h

27 Place Lower Random Fill (12") $110,788

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
1	637 scraper	4	$58,511	$80,218	$0	$58,511	402h	0h	576h	0h	402h
2	D8N Dozer w/ripper	1	$6,984	$9,672	$0	$6,984	100h	0h	144h	0h	100h
3	D7 Dozer	1	$5,957	$8,253	$0	$5,957	100h	0h	144h	0h	100h
4	825 Compactor	1	$6,867	$9,449	$0	$6,867	100h	0h	144h	0h	100h
5	651 Waterwagon	1	$7,575	$10,397	$0	$7,575	100h	0h	144h	0h	100h
6	14G Motorgrader	1	$4,960	$6,875	$0	$4,960	100h	0h	144h	0h	100h
10	Operators	9	$10,914	$15,670	$0	$10,914	902h	0h	1295h	0h	902h
38	Butler Maintenance Cost	10	$9,020	$12,950	$0	$9,020	902h	0h	1295h	0h	902h

28 Clay Layer $797,315

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
1	637 scraper	4	$0	$138,952	$0	$0	0h	0h	996h	0h	0h
2	D8N Dozer w/ripper	1	$61,460	$16,726	$0	$61,460	880h	0h	240h	0h	880h
3	D7 Dozer	1	$0	$14,270	$0	$0	0h	0h	240h	0h	0h
4	825 Compactor	1	$60,430	$16,330	$0	$60,430	880h	0h	240h	0h	880h
5	651 Waterwagon	1	$66,660	$17,978	$0	$66,660	880h	0h	240h	0h	880h
6	14G Motorgrader	1	$43,648	$11,887	$0	$43,648	880h	0h	240h	0h	880h
7	980C Loader	1	$59,250	$0	$0	$59,250	880h	0h	0h	0h	880h
8	5000 gal water truck	1	$18,242	$9,636	$0	$18,242	440h	0h	240h	0h	440h
9	Highway Trucks (12yd)	8	$225,080	$0	$0	$225,080	7040h	0h	0h	0h	7040h

ID	Task Name	Total Cost

"Clay Layer" continued

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
10	Operators	13.5	$143,748	$39,120	$0	$143,748	11880h	0h	2400h	0h	11880h
38	Butler Maintenance Cost	10	$118,800	$24,000	$0	$118,800	11880h	0h	2400h	0h	11880h
39	Additional Clay per 10k yds	0	$0	$262,500	$0	$0	0h	0h	0h	0h	0h

29 Upper Random Fill $225,809

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
1	637 scraper	4	$112,510	$123,048	$0	$112,510	773h	0h	882h	0h	773h
2	D8N Dozer w/ripper	1	$13,479	$14,846	$0	$13,479	193h	0h	221h	0h	193h
3	D7 Dozer	1	$11,407	$12,686	$0	$11,407	193h	0h	221h	0h	193h
4	825 Compactor	1	$13,253	$14,592	$0	$13,253	193h	0h	221h	0h	193h
5	651 Waterwagon	1	$14,620	$15,956	$0	$14,620	193h	0h	221h	0h	193h
6	14G Motorgrader	1	$9,573	$10,551	$0	$9,573	193h	0h	221h	0h	193h
8	5000 gal water truck	1	$8,002	$8,730	$0	$8,002	193h	0h	221h	0h	193h
10	Operators	10	$23,366	$26,741	$0	$23,366	1931h	0h	2210h	0h	1931h
38	Butler Maintenance Cost	10	$19,310	$22,100	$0	$19,310	1931h	0h	2210h	0h	1931h

30 Rock Armour on top $425,186

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
1	637 scraper	4	$34,204	$10,324	$0	$34,204	235h	0h	74h	0h	235h
2	D8N Dozer w/ripper	1	$4,121	$1,276	$0	$4,121	59h	0h	18h	0h	59h
3	D7 Dozer	1	$3,515	$1,089	$0	$3,515	59h	0h	18h	0h	59h
4	825 Compactor	1	$4,052	$1,247	$0	$4,052	59h	0h	18h	0h	59h
5	651 Waterwagon	1	$4,489	$1,372	$0	$4,489	59h	0h	18h	0h	59h
6	14G Motorgrader	1	$2,926	$907	$0	$2,926	59h	0h	18h	0h	59h
10	Operators	13	$6,413	$8,034	$0	$6,413	530h	0h	664h	0h	530h
17	Rock Production Cost	68.4	$360,186	$0	$0	$360,186	3613.35h	0h	0h	0h	3613.35h
38	Butler Maintenance Cost	10	$5,300	$6,640	$0	$5,300	530h	0h	664h	0h	530h

31 Quality Control $65,100

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
14	Quality contol contractor	1	$65,100	$65,100	$0	$65,100	1050h	0h	1050h	0h	1050h

32 RECLAMATION OF CELL 3 $2,216,900

33 Dewatering of Cell 3 $30,000

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
13	Dewatering Costs	30	$30,000	$20,000	$0	$30,000	62400h	0h	20000h	0h	62400h

34 Lower Random Fill $263,983

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
1	637 scraper	4	$130,146	$175,225	$0	$130,146	956h	0h	1256h	0h	956h
2	D8N Dozer w/ripper	1	$16,602	$21,159	$0	$16,602	239h	0h	315h	0h	239h
3	D7 Dozer	1	$14,237	$18,063	$0	$14,237	239h	0h	315h	0h	239h
4	825 Compactor	1	$16,412	$20,670	$0	$16,412	239h	0h	315h	0h	239h
5	651 Waterwagon	1	$18,104	$22,743	$0	$18,104	239h	0h	315h	0h	239h
6	14G Motorgrader	1	$11,854	$15,030	$0	$11,854	239h	0h	315h	0h	239h
10	Operators	9	$26,027	$34,255	$0	$26,027	2151h	0h	2631h	0h	2151h
38	Butler Maintenance Cost	10	$21,510	$26,310	$0	$21,510	2151h	0h	2631h	0h	2151h

ID	Task Name	Total Cost
35	Lower Random Fill (12")	$214,880

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
1	637 scraper	4	$113,082	$80,776	$0	$113,082	777h	0h	578h	0h	777h
2	D8N Dozer w/ripper	1	$13,619	$9,740	$0	$13,619	195h	0h	146h	0h	195h
3	D7 Dozer	1	$11,616	$8,310	$0	$11,616	195h	0h	146h	0h	195h
4	825 Compactor	1	$13,391	$9,515	$0	$13,391	195h	0h	146h	0h	195h
5	651 Waterwagon	1	$14,771	$10,460	$0	$14,771	195h	0h	146h	0h	195h
6	14G Motorgrader	1	$9,672	$6,922	$0	$9,672	195h	0h	146h	0h	195h
10	Operators	10	$21,190	$15,778	$0	$21,190	1752h	0h	1304h	0h	1752h
38	Butler Maintenance Cost	10	$17,520	$13,040	$0	$17,520	1752h	0h	1304h	0h	1752h

ID	Task Name	Total Cost
36	Clay Layer	$857,151

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
1	637 scraper	4	$0	$147,323	$0	$0	0h	0h	1056h	0h	0h
2	D8N Dozer w/ripper	1	$71,376	$17,733	$0	$71,376	1022h	0h	264h	0h	1022h
3	D7 Dozer	1	$0	$15,130	$0	$0	0h	0h	264h	0h	0h
4	825 Compactor	1	$70,181	$17,324	$0	$70,181	1022h	0h	264h	0h	1022h
5	651 Waterwagon	1	$77,417	$19,061	$0	$77,417	1022h	0h	264h	0h	1022h
6	14G Motorgrader	1	$50,691	$12,603	$0	$50,691	1022h	0h	264h	0h	1022h
7	980C Loader	0	$0	$0	$0	$0	0h	0h	0h	0h	0h
8	5000 gal water truck	1	$21,186	$10,420	$0	$21,186	511h	0h	264h	0h	511h
9	Highway Trucks (12yd)	8	$261,307	$0	$0	$261,307	8176h	0h	0h	0h	8176h
10	Operators	13.5	$166,944	$31,944	$0	$166,944	13797h	0h	2640h	0h	13797h
38	Butler Maintenance Cost	10	$137,970	$26,400	$0	$137,970	13797h	0h	2640h	0h	13797h
39	Additional Clay per 10k yds	0	$0	$262,500	$0	$0	0h	0h	2983.2h	0h	0h

ID	Task Name	Total Cost
37	Upper Random Fill	$259,732

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
1	637 scraper	4	$136,963	$124,164	$0	$136,963	941h	0h	890h	0h	941h
2	D8N Dozer w/ripper	1	$16,412	$14,979	$0	$16,412	235h	0h	223h	0h	235h
3	D7 Dozer	1	$13,900	$12,780	$0	$13,900	235h	0h	223h	0h	235h
4	825 Compactor	1	$16,137	$14,633	$0	$16,137	235h	0h	223h	0h	235h
5	651 Waterwagon	1	$17,801	$16,101	$0	$17,801	235h	0h	223h	0h	235h
6	14G Motorgrader	1	$11,656	$10,646	$0	$11,656	235h	0h	223h	0h	235h
10	Operators	9	$25,604	$24,265	$0	$25,604	2116h	0h	2007h	0h	2116h
38	Butler Maintenance Cost	10	$21,160	$20,070	$0	$21,160	2116h	0h	2007h	0h	2116h

ID	Task Name	Total Cost
38	Rock Armour	$503,081

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
1	637 scraper	4	$40,463	$10,324	$0	$40,463	278h	0h	74h	0h	278h
2	D8N Dozer w/ripper	1	$4,869	$1,276	$0	$4,869	70h	0h	19h	0h	70h
3	D7 Dozer	1	$4,170	$1,089	$0	$4,170	70h	0h	19h	0h	70h
4	825 Compactor	1	$4,807	$1,247	$0	$4,807	70h	0h	19h	0h	70h
5	651 Waterwagon	1	$5,303	$1,372	$0	$5,303	70h	0h	19h	0h	70h
6	14G Motorgrader	1	$3,472	$4,774	$0	$3,472	70h	0h	100h	0h	70h
10	Operators	13	$7,580	$8,900	$0	$7,580	628h	0h	743h	0h	628h
17	Rock Production Cost	82.1	$426,090	$0	$0	$426,090	5747h	0h	0h	0h	5747h
38	Butler Maintenance Cost	10	$6,280	$7,430	$0	$6,280	628h	0h	743h	0h	628h

ID	Task Name	Total Cost
39	Quality Control	$87,172

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
14	Quality contol contractor	1	$87,172	$87,172	$0	$87,172	1400h	0h	1400h	0h	1400h

40 RECLAMATION OF CELL 1 $738,371

41 Dewatering $30,000

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
13	Dewatering Costs	30	$30,000	$0	$0	$30,000	62400h	0h	0h	0h	62400h

42 Crystal Removal $500,992

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
2	D8N Dozer w/ripper	1	$37,644	$48,698	$0	$37,644	539h	0h	725h	0h	539h
3	D7 Dozer	1	$32,168	$20,746	$0	$32,168	539h	0h	362h	0h	539h
5	651 Waterwagon	1	$40,829	$26,136	$0	$40,829	539h	0h	362h	0h	539h
6	14G Motorgrader	1	$26,734	$17,282	$0	$26,734	539h	0h	362h	0h	539h
10	Operators	10	$65,219	$74,524	$0	$65,219	5390h	0h	6158h	0h	5390h
15	769 Haul Truck	4	$133,303	$171,836	$0	$133,303	2157h	0h	2898h	0h	2157h
16	988 Loader	1	$53,598	$69,346	$0	$53,598	539h	0h	725h	0h	539h
19	245 Excavator	1	$57,657	$74,530	$0	$57,657	539h	0h	725h	0h	539h
38	Butler Maintenance Cost	10	$53,900	$28,980	$0	$53,900	5390h	0h	2898h	0h	5390h

43 Contaminated Materials Removal $71,771

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
1	637 scraper	4	$44,829	$0	$0	$44,829	308h	0h	0h	0h	308h
2	D8N Dozer w/ripper	1	$5,378	$24,316	$0	$5,378	77h	0h	362h	0h	77h
5	651 Waterwagon	1	$5,833	$13,068	$0	$5,833	77h	0h	181h	0h	77h
6	14G Motorgrader	1	$3,819	$8,641	$0	$3,819	77h	0h	181h	0h	77h
10	Operators	10	$6,522	$37,244	$0	$6,522	539h	0h	3078h	0h	539h
38	Butler Maintenance Cost	10	$5,390	$30,780	$0	$5,390	539h	0h	3078h	0h	539h

44 Topsoil Application $35,984

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
1	637 scraper	4	$22,415	$0	$0	$22,415	154h	0h	0h	0h	154h
2	D8N Dozer w/ripper	1	$2,724	$24,316	$0	$2,724	39h	0h	362h	0h	39h
5	651 Waterwagon	1	$2,954	$13,068	$0	$2,954	39h	0h	181h	0h	39h
6	14G Motorgrader	1	$1,934	$8,641	$0	$1,934	39h	0h	181h	0h	39h
10	Operators	10	$3,267	$37,244	$0	$3,267	270h	0h	3078h	0h	270h
38	Butler Maintenance Cost	10	$2,700	$30,780	$0	$2,700	270h	0h	3078h	0h	270h

45 Construct Channels $1,092

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
2	D8N Dozer w/ripper	1	$419	$403	$0	$419	6h	0h	6h	0h	6h
10	Operators	1	$73	$73	$0	$73	6h	0h	6h	0h	6h
38	Butler Maintenance Cost	10	$600	$600	$0	$600	60h	0h	60h	0h	60h

46 Rock Protection $24,990

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
3	D7 Dozer	1	$894	$860	$0	$894	15h	0h	15h	0h	15h
5	651 Waterwagon	1	$1,136	$1,093	$0	$1,136	15h	0h	15h	0h	15h

ID	Task Name	Total Cost

"Rock Protection" continued

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
6	14G Motorgrader	1	$744	$716	$0	$744	15h	0h	15h	0h	15h
10	Operators	6	$1,428	$1,428	$0	$1,428	118h	0h	118h	0h	118h
15	769 Haul Truck	4	$3,584	$3,441	$0	$3,584	58h	0h	58h	0h	58h
16	988 Loader	1	$1,482	$1,435	$0	$1,482	15h	0h	15h	0h	15h
17	Rock Production Cost	2.8	$14,532	$36,756	$0	$14,532	32h	0h	32h	0h	32h
38	Butler Maintenance Cost	10	$1,180	$1,180	$0	$1,180	118h	0h	118h	0h	118h

47 Quality Control $73,532

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
14	Quality contol contractor	1	$73,532	$73,532	$0	$73,532	1186h	0h	1186h	0h	1186h

48 CELL 4A WORK $114,786

49 Dewatering $5,000

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
13	Dewatering Costs	5	$5,000	$5,000	$0	$5,000	200h	0h	200h	0h	200h

50 Remove Fencing $1,936

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
10	Operators	4	$1,936	$1,936	$0	$1,936	160h	0h	160h	0h	160h

51 Remove Liner to Cell 3 $87,670

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
10	Operators	3	$10,980	$13,262	$0	$10,980	909h	0h	1096h	0h	909h
15	769 Haul Truck	2	$37,461	$32,513	$0	$37,461	606h	0h	540h	0h	606h
16	988 Loader	1	$30,130	$13,164	$0	$30,130	303h	0h	137h	0h	303h
38	Butler Maintenance Cost	10	$9,090	$10,980	$0	$9,090	909h	0h	1098h	0h	909h

52 Quality Control $20,150

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
14	Quality contol contractor	6.3	$20,150	$20,150	$0	$20,150	325h	0h	325h	0h	325h

53 MISCELLANEOUS ITEMS $2,630,336

54 Long Term Care Fund Allowance $585,300

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
21	Long Term Care Fund	58.53	$585,300	$551,200	$0	$585,300	1h	0h	0h	0h	1h

55 Butler Machinery Mobilization $131,000

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
26	Mobilization per 10k dollars	13.1	$131,000	$131,000	$0	$131,000	0h	0h	0h	0h	0h

56 Temporary Office Facilities $97,500

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
46	Office trailers(Technical)	5	$97,500	$0	$0	$97,500	31200h	0h	0h	0h	31200h

ID	Task Name	Total Cost
57	Wheel Wash Facilities	$150,672

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
10	Operators	2	$100,672	$0	$0	$100,672	8320h	0h	0h	0h	8320h
18	Wheelwash costs	10	$50,000	$0	$0	$50,000	80h	0h	0h	0h	80h

ID	Task Name	Total Cost
58	Managerial Support	$1,866,863
59	Manager/Engineer	$360,000

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
27	Manager/Engineer	1	$360,000	$280,731	$0	$360,000	6240h	0h	4866h	0h	6240h

ID	Task Name	Total Cost
60	Radiation Safety Officer	$225,000

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
28	Radiation Safety Officer	1	$225,000	$175,457	$0	$225,000	6240h	0h	4866h	0h	6240h

ID	Task Name	Total Cost
61	Secretary	$90,000

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
29	Secretary	1	$90,000	$70,183	$0	$90,000	6240h	0h	4866h	0h	6240h

ID	Task Name	Total Cost
62	Clerk	$58,486

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
30	Clerk	1	$58,486	$58,486	$0	$58,486	4866h	0h	4866h	0h	4866h

ID	Task Name	Total Cost
63	Environmental Technician	$93,577

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
32	Environmental Technician	1	$93,577	$93,577	$0	$93,577	4866h	0h	4866h	0h	4866h

ID	Task Name	Total Cost
64	Maintenance Foreman	$165,000

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
33	Maintenance Foreman	1	$165,000	$55,000	$0	$165,000	6240h	0h	2080h	0h	6240h

ID	Task Name	Total Cost
65	Chemist	$45,000

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
35	Chemist	1	$45,000	$45,000	$0	$45,000	2080h	0h	2080h	0h	2080h

ID	Task Name	Total Cost
66	Security	$180,000

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
34	Security Personnel	3	$180,000	$110,596	$0	$180,000	18720h	0h	11502h	0h	18720h

ID	Task Name	Total Cost
67	Safety Engineer	$80,000

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
36	Safety Engineer	1	$80,000	$40,000	$0	$80,000	4160h	0h	2080h	0h	4160h

ID	Task Name	Total Cost
68	Misc Materials and Supplies	$234,000

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
37	Misc Supplies	1	$234,000	$182,475	$0	$234,000	6240h	0h	4866h	0h	6240h

ID	Task Name	Total Cost
69	Health Physics Costs (Mill Decom)	$134,800

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
49	Health Physics Program Costs	1	$134,800	$112,000	$0	$134,800	2080h	0h	1760h	0h	2080h

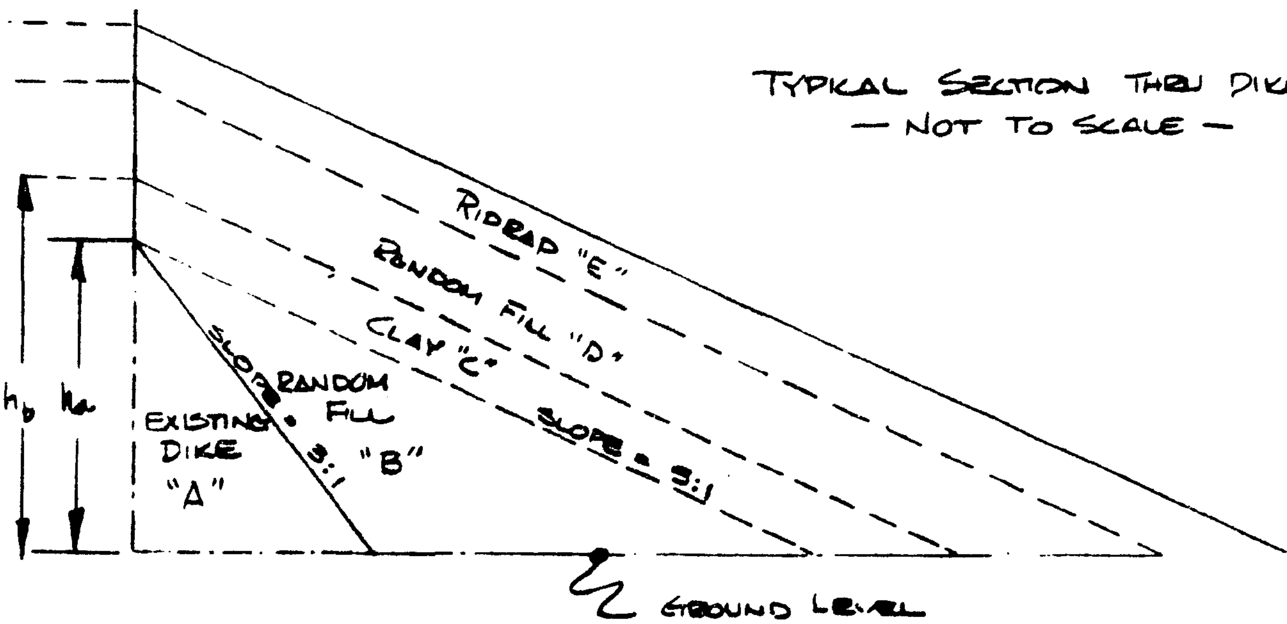
ID	Task Name	Total Cost
70	ProjectCompletion	$0
		$8,910,823

E/PROJECT WHITE MESA RECL .... Date .... Calc by .... Sheet ...... of ......

CALCULATION OF SLOPE VOLUMES

Slope No.		Height feet	Length feet	EXISTING DIKE "A"		WEDGE "B"		CLAY "C"		RANDOM FILL "D"		RIPRAP "E"	
				AREA	VOL (YD)	AREA	VOL (YD)	AREA	VOL (YD)	AREA	VOL (YD)	AREA	VOL (YD)
1	Cell 2 North dike	12	2,600	216.0	20,800	144.0	13,867	62.5	6,019	140.0	13,481	77.5	7,468
2	Cell 2 North Dike	1	900	1.5	50	1.0	33	7.5	250	30.0	1,000	22.5	750
3	Cell 2 West Dike	2	500	6.0	111	4.0	74	12.5	231	40.0	741	27.5	509
4	Cell 2 East Dike	1	1,250	1.5	69	1.0	46	7.5	347	30.0	1,389	22.5	1,042
5	Cell 2 South Dike	3	3,500	0.0	0	9.0	1,167	17.5	2,269	50.0	6,481	32.5	4,213
6	Cell 3 West Dike	2	1,100	6.0	244	4.0	163	12.5	509	40.0	1,630	27.5	1,120
7	Cell 3 South Dike	16	1,750	384.0	24,889	256.0	16,593	82.5	5,347	180.0	11,667	97.5	6,319
8	Cell 3 South Dike	39	1,700	2,281.5	143,650	1,521.0	95,767	197.5	12,435	410.0	25,815	212.5	13,380
9	Cell 3 East Dike	6	800	54.0	1,600	36.0	1,067	32.5	963	80.0	2,370	47.5	1,407
10	Cell 4 West dike	23	1,200	793.5	35,267	529.0	23,511	117.5	5,222	250.0	11,111	132.5	5,889
11	Cell 4 South Dike	31	1,400	1,441.5	74,744	961.0	49,830	157.5	8,167	330.0	17,111	172.5	8,944
12	Cell 4 East Dike	14	1,300	294.0	14,156	196.0	9,437	72.5	3,491	160.0	7,704	87.5	4,213
	Total Material Requirements		18,000		313,581		211,954		45,250		100,500		55,250

NOTE:
Values shown in the "Area" column are the CROSS SECTIONAL AREA for the component in SQUARE FEET.
Values shown in the "Volume" column are the component's area x length converted to CUBIC YARDS.



AREA "A" $= [h_a * 3h_a] / 2$

AREA "B" $\{[h_b * 5h_b]/2\}$ — Area A

AREA "C" $= \{[h_c * 5h_c]/2\} - \{[h_b * 5h_b]/2\}$

IE/PROJECT.................................Date......................Calc by.......................................Sheet.......of..........

ROCK PRODUCTION COSTS

1) ASSUMPTIONS

- ALL ROCK NECESSARY FOR ARMOUR WILL BE SANDSTONE FROM LOCAL SOURCES
- OVERSIZE FROM RANDOM FILL STOCKPILES TO THE WEST OF TAILS WILL BE PROCESSED TO PROVIDE RIP-RAP
- FALL-BACK POSITION WOULD BE TO MINE (QUARRY) DAKOTA SS ON SITE.
- FOR PURPOSES OF THIS ESTIMATE, ALL ROCK COSTS WILL BE THE SAME
- ROCK WILL BE PRODUCED DURING HANDLING OF RANDOM FILL AND WILL BE STOCKPILED
- ONLY PIECE OF MOBILE EQUIPMENT WILL BE A FULL TIME FEL (980 OR EQUIV) FOR HANDLING & STOCKPILE
- WILL UTILIZE :
  - 35" x 46" JAW CRUSHER w/ VIBRATING ~~GRIZZLEY~~ FEEDER
  - 5' x 16' OVERHEAD VIBRATING SCREEN
  - 3 OPERATORS.
- PRODUCTION WILL BE 50 yd^3/hr.

2) COSTS

- CRUSHER/FEEDER	=	$110.00/hr
- SCREEN PLANT	=	$48.00/hr
- LOADER	=	$65.00/hr.
- OPERATORS	=	$36.30/hr
		$259.30/hr

Therefore $259.30 ÷ 50 yd^3/hr = **$5.19/yd^3**

or **$5,190 / 1000 yd^3**

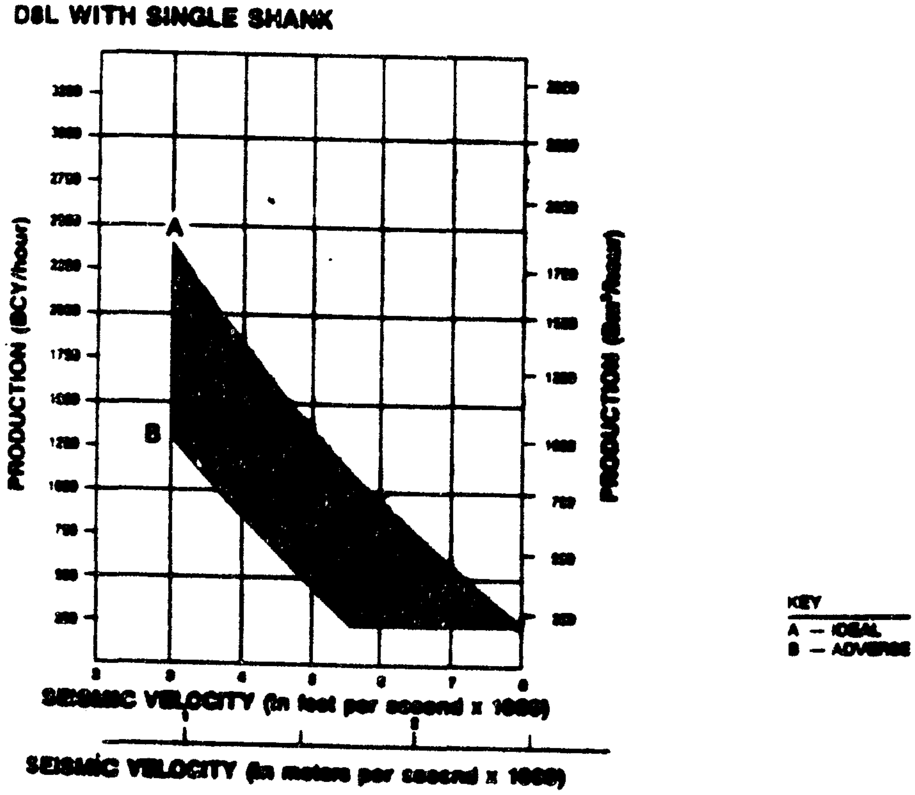
E/PROJECT WHITE MESA BELL Date .... Calc by .... Sheet ..... of .....

CLAY PRODUCTION COSTS
– SECTION 16 SOURCE –

1). CLAY PRODUCTION

- CLAYS WILL BE RIPPED FROM SOURCE @ SECTION 16
- APPROX 400 VERTICAL FEET OF BRUSHY BASIN EXPOSURE
- FROM CAT HAND BOOK ...

  MAX SEISMIC VELOCITY OF CLAY ≥ 6000 ft/sec



- BASED ON THE ABOVE, D8 CAT SHOULD BE ABLE TO PRODUCE AT LEAST 250 BCY/HOUR WITH AN AVERAGE OF –

  500 BCY/HR

- WE WILL ASSUME THAT THE CAT IS UTILIZED EVERY DAY OF CLAY PRODUCTION FOR RIPPING AND OR DOZING/BLENDING/PREPARATION.

CLAY PRODUCTION COSTS
— SECTION 16 SOURCE —

1) CLAY PRODUCTION [CONTINUED]

DAILY COST =

D8 DOZER – \$67.17/hr for 8 hours
= **\$537.36/day**

LABOR = \$12.00/hr for 8 hours
= **\$96.00/day**

TOTAL = \$634.80/day
say **\$650/day**

ASSUME 8 haul units × 136 yd³/day each = 1088 yd³/day

$\frac{\$650}{1088}$ = **\$0.60/yd³**

IE/PROJECT White Mesa Rec Date .... Calc by .... Sheet ...... of ......

Clay Production Costs
Section 16 Source

2) Haulage from Section 16 to Tailings Cells.

- Haul Profile from Sec 16

#	Segment Length	Grade
1	2000'	4.0%
2	1,800'	11.0%
3	4,200'	1.8%
4	5,600'	0.5%
5	5,700'	1.4%
6	5,200'	0.8%
Total	24,500'	

= 4.6 Mile Trip, 9.2 Mile Round Trip

- From Means (22-266-1250) Haulage for a 10 Mile Round Trip will yield an efficiency of 136 YD/Day/Unit
- Unit is assumed to be a 40 ton tractor w/ 20 YD^3 trailer.
- Utilize Means equipment cost, but adjust labor

Means estimate based on \$20.70/hour

Local Davis-Bacon Rate (DOE) = \$12.10/hour

Therefore labor needs to be reduced by

$$\frac{12.10}{20.70} = 0.58$$

Therefore Haulage Cost = $\frac{\$1.22}{yd} \times 0.58 =$ \$0.71/yd^3 for labor

3.83/yd^3 for equip

\$4.54/yd^3 total

[illegible] INC.

PROJECT White Mesa Recl Date .... Calc by .... Sheet ..... of .....

CLAY PRODUCTION COSTS
SECTION 16 SOURCE

3) LOADING @ SECTION 16
- ASSUME USE OF 980 LOADERS
- BASED ON BUTLER MACHINERY COSTS, RATE = \$64.71 /hr.
- FROM MEANS (22-238-1650) EFFICIENCY = 185 yd^3/hr
- BASED ON 8 TRUCK HAULAGE SPREAD

Therefore:

AVERAGE DAILY PRODUCTION = $\frac{136\ yd^3}{\text{UNIT DAY}} \times \frac{8\ \text{UNITS}}{1} = \boxed{\frac{1{,}088\ yd^3}{\text{day}}}$

DIRECT LOADING COST:

LABOR → \$12.10 /hr * 8 hr = \$96.80
EQUIP → 64.71 /hr * 8 hr = 517.68
TOTAL 614.48

$\frac{\$614.88}{1\ \text{day}} \times \frac{1\ \text{day}}{1088\ yd^3} = \boxed{\$0.56 / yd^3}$

4) ROAD MTCE FROM SECTION 16 to TAILS AREA

ASSUME:
- 16G MAINTAINER 4 HOURS / DAY
- 5000 GAL H_2O TRUCK 4 HOURS / DAY

= [16G @ 70.06 /hr × 4 hr] + [5000 gal TRUCK @ 39.50/hr × 4 hr]

= \$280 + 158

= \$438 /day

plus LABOR AT \$97.00 /day

= \$535.00 /day for 1088 yd^3

$\boxed{= \$0.49 / yd^3}$

NE/PROJECT White Mesa Rel Date ... Calc by RVM Sheet ... of ...

CLAY COSTS

5) PLACEMENT COSTS

ASSUME FOLLOWING EQUIPMENT SPREAD

825 C COMPACTOR	$65.62/HOUR	8 HR/DAY
16G MAINTAINER	$70.06/HR	8 HR/DAY
651 WATER WAGON	$72.20/HR	8 HR/DAY
3 OPERATORS	$12.10/HR	8 HR/DAY

DAILY COSTS...

	EQUIPMENT	LABOR	TOTAL
COMPACTOR	$525	$97	$622
MAINTAINER	$560	$97	$657
651 H_2O WAGON	$578	$97	$675

= $1954/day

or over 1088 yd³/day = **$1.80/yd³**

E/PROJECT.................................... Date.................... Calc by.................................... Sheet.......of..........

CLAY COSTS.

6) SUMMARY OF COSTS @ 1088 yd^3/day rate

	\$/day	\$/yd
CLAY PRODUCTION		
RIPPING	\$650	\$0.60
LOADING	\$615	\$0.56
HAULAGE	\$4,940	\$4.54
ROAD MTCE	\$535	\$0.49
CLAY PLACEMENT		
GRADING	\$657	\$0.60
H_2O CONTENT	\$675	\$0.62
COMPACTION	\$622.	\$0.57
	\$8694	\$7.98/yd^3

7). SUMMARY OF CLAY REQUIREMENTS

	YD^3	DAYS	HOURS
CELL 2 TOP	110,700	102	816
CELL 2 SIDESLOPES	9,116	8	64
CELL 3 TOP	119,800	110	880
CELL 3 SLOPES	19,254	18	142
TOTALS	258,870	238	1902

PROJECT WHITE MESA BCL Date .... Calc by .... Sheet ...... of ......

CLAY PRODUCTION COSTS
(CHECK CALCULATION)

- ASSUME USE OF MEANS HEAVY CONSTRUCTION COSTS ADJUSTED FOR PREVAILING LABOR RATES (DAVIS-BACON)

MEANS → 20.70/hr
DB → 12.10/hr ∴ 58% of MEANS

DESCRIP.	MEANS No	L	Adjusted	EQUIPMENT	TOTAL
RIPPING	22-242-5040	0.28	0.16	1.08	1.24
LOADING	22-238-1650	0.19	0.11	0.61	0.72
HAULAGE	22-266-1250	1.22	0.71	3.83	4.54
			total		6.50/yd³

12/96

EQUIPMENT COSTS - NEW FUEL & EQUIP RENTAL

	RATE		MTCE	FUEL	FUEL @	TOTAL
	MONTHLY	HOURLY	EXPENDABLES	USAGE	$0.86	COST
637E Scraper	21,630	122.90	2.01	24.0	20.64	145.55
D8N Dozer	10,815	61.45	1.08	8.5	7.31	69.84
D7H Dozer	9,270	52.67	0.88	7.0	6.02	59.57
825C Compactor	9,785	55.60	1.03	14.0	12.04	68.67
980 F Loader	10,300	58.52	1.08	9.0	7.74	67.34
988 F Loader	15,450	87.78	1.34	12.0	10.32	99.44
769C Haul Truck	9,270	52.67	1.39	9.0	7.74	61.80
245B Excavator	16,480	93.64	1.29	14.0	12.04	106.96
651 Water Wagon	10,300	58.52	1.75	18.0	15.48	75.75
5000 gal Water Truck	5,665	32.19	0.67	10.0	8.60	41.46
14G Maintaniner	7,725	43.89	0.98	5.5	4.73	49.60
16G Maintainer	11,330	64.38	1.13	8.5	7.31	72.82

11/96

EQUIPMENT COSTS WITH 3% INCREASE

	RATE		MTCE	FUEL	FUEL @	TOTAL
	MONTHLY	HOURLY	EXPENDABLES	USAGE	$0.76	COST
637E Scraper	21,630	122.90	2.01	24.0	18.24	143.15
D8N Dozer	10,815	61.45	1.08	8.5	6.46	68.99
D7H Dozer	9,270	52.67	0.88	7.0	5.32	58.87
825C Compactor	9,785	55.60	1.03	14.0	10.64	67.27
980 F Loader	10,300	58.52	1.08	9.0	6.84	66.44
988 F Loader	15,450	87.78	1.34	12.0	9.12	98.24
769C Haul Truck	9,270	52.67	1.39	9.0	6.84	60.90
245B Excavator	16,480	93.64	1.29	14.0	10.64	105.56
651 Water Wagon	10,300	58.52	1.75	18.0	13.68	73.95
5000 gal Water Truck	5,665	32.19	0.67	10.0	7.60	40.46
14G Maintaniner	7,725	43.89	0.98	5.5	4.18	49.05
16G Maintainer	11,330	64.38	1.13	8.5	6.46	71.97

WEESE PETROLEUM
BOX 888
DOVE CREEK, COLORADO 81324
970-677-2424
NOVEMBER 25, 1996

ENERGY FUELS
ATTENTION: RICK VANHORTON

IE: BID PRICE OF DIESEL FUEL DELIVERED TO BLANDING, UTAH

#2 DIESEEL FUEL	$.8143
FREIGHT	$.0425
	$.8559
#1 DIESEL FUEL	$.9143
FREIGHT	$.0425
	$.9559

PRICE SUBJECT TO CHANGES WITH RACK PRICES

RECEIVED
NOV 26 1996
R.A. VAN HO

RECEIVED
[illegible] 2 6 1996
R.A. VAN HORN

DATE: 11-26-96

TO: Jim Fisher

FAX #: 1-970-677-2747

FROM: Johnny Dufur) Sierra Petroleum INC

COMMENTS: #2 Red Dsl Delivery To Blanding Mill site Price per gal .8418 Plus Utah ERT .0050 Total Price .8468

Thanks Johnny

MINE/PROJECT White Mesa Reclamation Date 6/21/95 Calc by R Van Horn Sheet ____ of ____

EQUIPMENT OPERATING COSTS INCLUDING FUEL CONSUMPTION

Based on the Butler Machinery Quote of 5/8/95, EFNI is responsible for:

- Tires
- Ground Engaging Components (GEC)
- Fuel

Based on the length of the project, EFNI would qualify for a 15% discount off of the quoted Butler rates. This analysis assumes that the discount, when taken with no credit for the lower overtime rates, will more than offset the tire and GEC costs. Fuel consumption (shown in gal/hr) has been added at rates quoted in the area for off-road diesel fuels.

	RATE		MTCE	FUEL	FUEL @	TOTAL
	MONTHLY	HOURLY	EXPENDABLES	USAGE	$0.76	COST
631E Scraper	21,000	119.32	1.95	24.0	18.24	139.51
D8N Dozer	10,500	54.66	1.05	8.5	6.46	67.17
D7H Dozer	9,000	51.14	0.85	7.0	5.32	57.31
825C Compactor	9,500	55.96	1.00	14.0	10.64	65.62
980 F Loader	10,000	56.82	1.05	9.0	6.84	64.71
988 F Loader	15,000	85 23	1.30	12.0	9.12	95.65
769C Haul Truck	9,000	51.14	1.55	9.0	6.84	59.55
245B Excavator	16,000	90.91	1.25	14.0	10.64	102.80
651 Water Wagon	10,000	56.82	1.70	18.0	13.68	72.20
5000 gal Water Truck	5,500	31.25	0.65	10.0	7.60	39.50
14G Maintainer	7,500	42.61	0.95	5.5	4.18	47.74
16G Maintainer	11,000	62.50	1.10	8.5	6.46	70.06

Fuel consumption is based on the Cat Performance Handbook using medium load factors

WEESE PETROLEUM
BOX 888
DOVE CREEK, COLORADO 81324
970-677-2424

ENERGY FUELS
BID PRICE TO BLANDING, UTAH

45000 GALLONS RED DIESEL

$.7521 PER GALLON PER TRANSPORT

PRICE IS SUBJECT TO CHANGE WITH INCREASE OR DECREASE OF RACK PRICE.
EFFECTIVE JUNE 22, 1995 TO JUNE 22, 1998.

THANK YOU.

SINCERELY,

Constance L. Weese

CONSTANCE L. WEESE

FAX TRANSMISSION

BUTLER MACHINERY COMPANY
1351 PAGE DRIVE, PO BOX 9559
FARGO ND 58106
800-873-8858
701-298-1727
FAX: 701-298-1717

RECEIVED
NOV 22 1996
R.A. VAN HORN

To:	RICK VAN HORN ENERGY FUELS	Date:	November 22, 1996
Fax #:		Pages:	1, including this cover sheet.
From:	JOEL NIKLE		

COMMENTS:

RICK:

PER OUR TELEPHONE CONVERSATION YESTERDAY REFERENCE OUR PROPOSAL DATED MAY 8, 1995, BUTLER MACHINERY COMPANY AGREES TO A 3% INCREASE FOR ALL RATES QUOTED.

THESE NEW RATES WOULD BE VALID UNTIL THE END OF 1996.

IF YOU HAVE ANY QUESTIONS, PLEASE GIVE ME A CALL.

SINCERELY,

BUTLER MACHINERY COMPANY

JOEL NIKLE
RENTAL FLEET MANAGER

JM:jw

Butler CAT

Butler Machinery Co.
1351 Page Drive
PO Box 9559
Fargo, ND 58106
(701) 232-0033
FAX (701) 298-1717

FAX TRANSMISSION NOTE

DATE: May 8, 1995

TO: Mr. Rick Van Horn

FROM: Joel Nikle

NUMBER OF PAGES 5 (INCLUDING THIS PAGE)

IN CASE OF PROBLEM, CALL: Joel (701) 232-0033

( ) IF CHECKED, PLEASE CONFIRM RECEIPT OF DOCUMENT.

COMMENTS:

Butler Machinery Company • (701) 232-0033 • FAX (701) 280-1717 • 1351 Page Dr. • Box 9559 • Fargo, ND 58106

MAY 8, 1995

ENERGY FUELS NUCLEAR, INC.
ATTN: RICK VAN HORN
2764 COMPOSS DRIVE, SUITE 101
GRAND JUNCTION, CO 81506

DEAR RICK:

THANK YOU FOR THE INVITATION TO QUOTE ENERGY FUELS NUCLEAR, INC. (EFNI) THE EQUIPMENT NEEDED FOR THEIR MINING PROJECT IN BLANDING, UTAH. BUTLER MACHINERY COMPANY (BUTLER) RESPECTFULLY SUBMITS OUR PROPOSAL FOR A MAINTAINED FLEET OF CATERPILLAR MACHINES.

LISTED ON ATTACHMENT A, YOU WILL FIND THE MODELS, QUANTITIES, MONTHLY RENTAL RATES, HOURS ALLOWED PER MONTH, EXCESS HOUR CHARGE, GUARANTEED NUMBER OF MONTHS RATES ARE BASED UPON, TOTAL FREIGHT CHARGES AND THE MAINTENANCE RATE PER HOUR FOR MATERIALS ONLY.

ALL RATES SHOWN ON ATTACHMENT A DO NOT INCLUDE ANY STATE, LOCAL, PROPERTY OR ANY OTHER TAXES THAT MAY BE APPLICABLE.

RATES ARE BASED UPON ELECTRIC HOUR METER READINGS WHICH ARE ATTACHED TO THE DASH OF EACH MACHINE. RATES ARE BASED ON 176 HOURS OF USE EACH MONTH. EXCESS HOUR CHARGES, IF ANY, WILL BE CALCULATED AND INVOICED AT THE END OF THE PROJECT. THERE WOULD BE NO CREDIT ISSUED FOR ANY HOURS UNDER THE ALLOWED DURING THE TERM OF THIS PROPOSAL. IF EFNI ELECTS TO DOUBLE SHIFT MACHINES, THEN BUTLER WOULD INVOICE THOSE HOURS AT THE END OF EACH MONTH. (TO FIGURE THE DOUBLE SHIFT RATES, TAKE THE EXCESS HOUR RATE SHOWN ON ATTACHMENT A TIMES THE NUMBER OF HOURS).

RATES ARE BASED UPON A MINIMUM GUARANTEE OF 3 MONTHS AND A PACKAGE DEAL. IF EFNI WERE TO GUARANTEE A LONGER RENTAL TERM FOR ALL MACHINES LISTED ON ATTACHMENT A, THEN BUTLER WOULD ALLOW THE FOLLOWING ADDITIONAL DISCOUNTS ON THE MONTHLY RENTAL RATES AND EXCESS HOUR CHARGES RETROACTIVE TO DAY ONE: 1. FOR A MINIMUM OF 6 MONTHS RENT, DEDUCT 5%. 2. FOR A MINIMUM OF 9 MONTHS RENT, DEDUCT 10%, OR 3. FOR A MINIMUM OF 12 MONTHS RENT, DEDUCT 15%.

MAINTENANCE:

THE MAINTENANCE RATES PER HOUR LISTED ON ATTACHMENT A INCLUDES THE MATERIAL PART ITEMS ONLY, SUCH AS AIR, OIL, AND FUEL FILTERS, LUBRICANT OILS, GREASE, ANTI-FREEZE, BATTERIES, FAN BELTS, LIGHTS AND MAKE-UP OILS. BUTLER WOULD INVOICE EFNI ACTUAL HOURS USED ON MACHINES AT THE END OF EACH MONTH.

Fargo, 58108	Bismarck, 58502	Minot, 58702	Grand Forks, 58208	Rapid City, 57709	Sioux Falls, 57101	Aberdeen, 57401	Sioux City, 51101
I-29 & 32nd Ave. S.	I-94 Box 181	Hwy 2, Bypass E	1201 S. 48th St.	I-90, Commerce Ave.	I-29, Exit 81	[illegible] E. Highway 12	315 1st St.
P.O. Box 9558	P.O. Box 737	P.O. Box [illegible]	P.O. Box 12208	P.O. Box 2070	P.O. Box 1307	P.O. Box 36	(712) 277-1308
(701) 280-3130	(701) 223-[illegible]	(701) 852-[illegible]	(701) [illegible]	(605) 342-4850	(605) 336-3210	(605) 225-6240	Lift Truck Only

OUR MONTHLY MAINTENANCE CHARGE WOULD BE $20,750.00, WHICH INCLUDES OUR LABOR, SPECIALIZED LUBE TRUCKS, SUPPORT VEHICLES AND EQUIPMENT, SPECIALIZED TOOLING, SCHEDULED OIL SAMPLING, PARTS TRAILERS AND INVENTORIES, MILEAGE AND TRAVEL EXPENSE. BUTLER WILL PROVIDE TWO (2) FULL-TIME MAINTENANCE TECHNICIANS ON SITE FIFTY (50) HOURS PER WEEK ON A SCHEDULE TO BE DETERMINED, MONDAY THROUGH FRIDAY. EFNI WOULD HAVE TO SCHEDULE THE MACHINES AVAILABLE FOR A TIME FRAME YET TO BE DETERMINED ADEQUATE FOR BUTLER MAINTENANCE PERSONNEL TO PERFORM THE REQUIRED MAINTENANCE. BUTLER WOULD INVOICE EFNI FOR THE MONTHLY MAINTENANCE CHARGE AT THE BEGINNING OF EACH MONTH.

REPAIRS:

BUTLER WOULD BE RESPONSIBLE FOR ALL REPAIRS INCLUDING PARTS AND LABOR ON OUR MACHINES OTHER THAN FAILURES CAUSED BY DAMAGES OR MIS-USE. REPAIRS INCLUDE ITEMS AS MINOR AS STARTERS, ALTERNATORS, WATER PUMPS, HYDRAULIC HOSES, ETC. TO THE MAJOR ITEMS SUCH AS ENGINES, TRANSMISSIONS, DIFFERENTIALS, BRAKES, HYDRAULIC PUMPS AND CYLINDERS, ETC. IF TIME PERMITS AND EFNI REQUESTS BUTLER'S TECHNICIAN TO PERFORM REPAIRS OR MAINTENANCE ON THEIR MACHINES, OUR HOURLY CHARGE WOULD BE $45.00 PER HOUR 'S MATERIALS.

FREIGHT:

FREIGHT CHARGES INCLUDE BOTH DELIVERY AND RETURN, ASSEMBLY, AND DISASSEMBLY OF EQUIPMENT.

EFNI'S RESPONSIBILITIES INCLUDE:

OPERATORS. PROVIDE THE OPERATORS AS NEEDED TO OPERATE MACHINES AS STATED IN CATERPILLAR'S OPERATING GUIDE. BUTLER WILL PROVIDE, AT NO EXPENSE TO EFNI, QUALIFIED TRAINING INSTRUCTORS FOR THE PURPOSES OF TRAINING OPERATORS. THIS TRAINING WOULD TAKE PLACE ON THE JOBSITE AT THE INITIAL START UP OF THE JOB AND WOULD INCLUDE CLASSROOM, WALK AROUND, AND IN IRON DEMONSTRATIONS.

FUEL. SUPPLY AND FILL ALL FUEL FOR EQUIPMENT INCLUDING BUTLER'S SERVICE VEHICLES.

DAMAGES. THIS INCLUDES GLASS BREAKAGE, BENT HANDRAILS, STEP LADDERS, FENDERS, ETC. BUTLER'S NORMAL POLICY FOR REPAIRING DAMAGES TO RENTAL MACHINES IS TO REPAIR THEM WHEN THE RENTAL PERIOD IS COMPLETED, HOWEVER, IF THE DAMAGED ITEM IS OF A SAFETY CONCERN, WE WOULD REPAIR THE DAMAGES AS SOON AS POSSIBLE AFTER THEY OCCURRED. AN ITEMIZED LIST OF THE PARTS AND LABOR REQUIRED WOULD BE PROVIDED TO EFNI PRIOR TO STARTING THE ''PAIR, AND INVOICED AT CURRENT LIST PRICES PLUS FREIGHT UPON COMPLETION.

UNDERCARRIAGE AND TIRES: EFNI WOULD BE RESPONSIBLE FOR ALL TIRE WEAR INCLUDING TIRE DAMAGES ON THE MACHINES WITH AN ASTERISK LISTED ON ATTACHMENT A. EQUIPMENT WOULD HAVE TO BE RETURNED WITH SAME BRAND AND MODEL TIRES AS WHEN DELIVERED, OR PRORATED ACCORDINGLY BY PERCENTAGE OF TIRE WEAR AND CONDITION AT TERMINATION OF RENTAL PERIOD.

UPON DELIVERY OF MACHINES, A REPRESENTATIVE OF BUTLER, A REPRESENTATIVE OF EFNI AND A REPRESENTATIVE FROM AN INDEPENDENT TIRE DEALER OR MANUFACTURER WOULD JOINTLY VERIFY IN WRITING THE CONDITION, PERCENTAGE OF WEAR, AND TIRE VALUE. UPON TERMINATION OF RENTA', WE WOULD AGAIN HAVE THE REPRESENTATIVES MENTIONED ABOVE DETERMINE THE CONDITION, PERCENTAGE OF WEAR, AND TIRE VALUES. ANY DIFFERENCES NOTED, WOULD THEN BE CHARGED OR CREDITED TO EFNI INCLUDING BOTH MATERIALS AND LABOR.

UNDERCARRIAGE WEAR ON ALL TRACK TYPE MACHINES WOULD BE BUTLER'S EXPENSE.

GROUND ENGAGING TOOLS:

EFNI WOULD BE RESPONSIBLE FOR ALL PARTS RELATING TO GROUND ENGAGING TOOLS (G.E.T.), I.E. CUTTING EDGES, RIPPER TIPS AND PROTECTORS, BUCKET TIPS AND \PTERS, EDGES BETWEEN ADAPTERS, WEAR PLATES ON BOTTOM OF BUCKETS AND . MOUNTING HARDWARE. BUTLER WOULD INSTALL THESE ITEMS ON AN AS NEEDED BASIS AT THE CURRENT CATERPILLAR LIST PRICE PLUS FREIGHT AT NO ADDITIONAL LABOR COSTS. ALL MACHINES WOULD BE DELIVERED WITH NEW G.E.T. ITEMS AND ARE TO BE RETURNED WITH NEW.

WE WISH TO THANK EFNI AND YOU FOR GIVING US THE OPPORTUNITY TO PRESENT OUR PROPOSAL AND FOR ALL THE CONSIDERATION WE RECEIVE.

SINCERELY YOURS,

BUTLER MACHINERY COMPANY

JOEL W. NIKLE
RENTAL FLEET MANAGER

JWN/del
cc: OSCAR SWENSON, RENTAL FLEET MARKETING MANAGER

ATTACHMENT A
ENERGY FUELS NUCLEAR, INC.
EQUIPMENT NEEDED FOR JOB IN BLANDING, UTAH
MAY 8, 1995

MODEL	QTY	MONTHLY RENTAL RATE	HOURS ALLOWED PER MONTH	EXCESS HOUR CHARGE	MINIMUM GUARANTEED NUMBER OF MONTHS RATE BASED UPON	TOTAL** FREIGHT CHARGES TO & FROM	MAINTENANCE RATE PER HOUR
*637E	4	$21,000 EA.	176 EA.	$66 EA.	3 EA.	$10,000 EA.	$1.95 EA.
D9N/RIPPER	1	13,000	176	42	3	8,000	1.30
D8N/RIPPER	1	10,500	176	34	3	7,000	1.05
D7H/RIPPER	1	9,000	176	28	3	6,000	.85
825C	1	9,500	176	30	3	7,000	1.00
980F	1	10,000	176	32	3	7,000	1.05
988F	1	15,000	176	48	3	8,000	1.30
769C	4	9,000 EA.	176 EA.	28 EA.	3 EA.	7,000 EA.	1.35 EA.
45B	1	16,000	176	50	3	12,000	1.25
0,000 GALLON ATER WAGON	1	10,000	176	30	3	8,000	1.70
,000 GALLON ATER WAGON	1	5,500	176	18	3	3,000	.65
3G/RIPPER	1	7,500	176	24	3	5,000	.95
5G/RIPPER	1	11,000	176	34	3	6,000	1.10

* PLUS TIRE WEAR

** INCLUDES ASSEMBLY AND DISASSEMBLY

ENERGY FUELS NUCLEAR, INC.
Cost Estimate

NE/PROJECT Mill Decom Date 9/30/96 Calc by R Ven Horn Sheet ... of ...

HYDRAULIC SHEAR COSTS.

SOURCE –
POWER MOTIVE OF GRAND JUNCTION
GROVER THOMPSON 241-1550

They carry La Bounty Shears, the same unit that ENVIROTECH USED AT URAVAN.

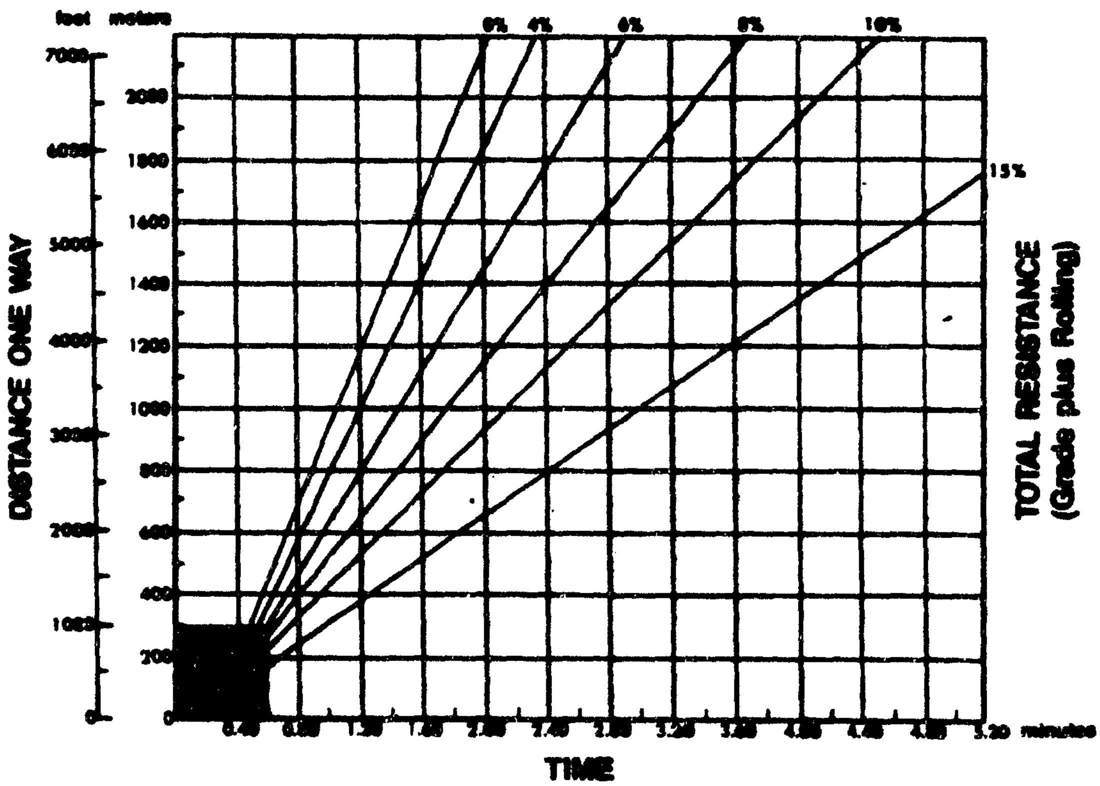
- PURCHASE PRICE FOR SHEAR – \$121,500.00
- RENTAL OF UNIT ON KAMATSU PC400 (ie cat 235) would run \$25,900.00 /month (+ wear items)
- WEAR ITEMS COST \$10,000/month.

PROJECT White Mesa Reel Date............ Calc by RVH .... Sheet...... of ....

EQUIPMENT EFFICIENCIES

EMPTY

Off-Highway Trucks | 789C Travel Time
• 18.00-33 Tires



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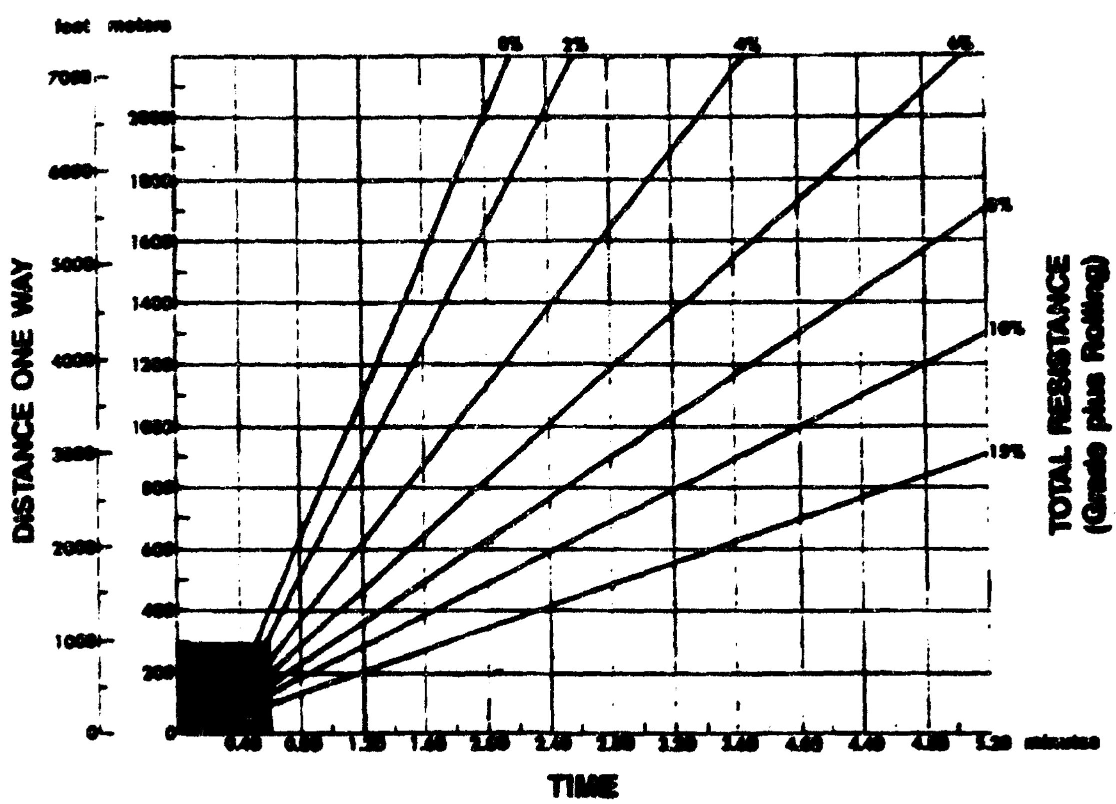


[illegible] INC

SITE/PROJECT White Mesa Rell Date .... Calc by RVH Sheet ..... of .....

TRAVEL TIMES FOR CAT 769C TRUCKS
BASED ON PROJECTED HAUL ROUTES

Haul Segment	Distance Feet	Distance Meters	Rolling Resistance	Grade %	Avg Speed MPH	Time Min
1a	200	67	7.5	0.0	7.6	0.30
1b	500	167	5.0	0.0	12.6	0.45
1c	200	67	3.0	2.5	9.1	0.25
1d	1400	467	3.0	0.0	18.7	0.85
1e	250	83	3.0	0.0	9.5	0.30
1f	250	83	3.0	0.0	11.4	0.25
1g	1400	467	3.0	0.0	22.7	0.70
1h	200	67	3.0	(2.5)	11.4	0.20
1i	400	133	5.0	0.0	13.0	0.35
1j	200	67	7.5	0.0	9.1	0.25
						3.90
2a	200	67	7.5	0.0	7.6	0.30
2b	2150	717	3.0	(0.5)	24.4	1.00
2c	250	83	5.0	0.0	9.5	0.30
2d	250	83	5.0	0.0	11.4	0.25
2e	2250	750	3.0	+0.5	26.9	0.95
2f	200	67	7.5	0.0	9.1	0.25
						3.05
3a	250	83	7.5	0.0	8.1	0.35
3b	3300	1100	3.0	-0.5	25.0	1.50
3c	250	83	5.0	0.0	9.5	0.30
3d	250	83	5.0	0.0	11.4	0.25
3e	3300	1100	3.0	+0.5	28.8	1.30
3f	250	83	7.5	0.0	9.5	0.30
						4.00

769C TRUCK EFFICIENCY

NOMINAL CAPACITY 25

HAUL ROUTE	TRAVEL TIME	FIXED TIME	EFFICIENCY	MINUTES PER TRIP	TRIPS/ HOUR	YARDS/ HOUR
1	3.90	2.50	85%	7.5	8.0	199
2	3.05	2.50	85%	6.5	9.2	230
3	4.00	2.50	85%	7.6	7.8	196

[illegible]/PROJECT White Mesa Rel. Date........ Calc by........ Sheet.... of....

637 SCRAPER EFFICIENCY

NOMINAL CAPACITY 31

HAUL ROUTE	TRAVEL TIME	FIXED TIME	EFFICIENCY	MINUTES PER TRIP	TRIPS/ HOUR	YARDS/ HOUR
1	3.90	1.20	85%	6.0	10.0	310
2	3.25	1.20	85%	5.2	11.5	355
3	4.30	1.20	85%	6.5	9.3	287
4	3.10	1.20	85%	5.1	11.9	368
5	4.15	1.20	85%	6.3	9.5	296
6	4.50	1.20	85%	6.7	8.9	277
7	3.75	1.20	85%	5.8	10.3	319

NE/PROJECT White Mesa Recl .... Date .... Calc by .... Sheet ..... of .....

EQUIPMENT EFFICIENCIES

TRAVEL TIMES FOR CAT 631 SCRAPERS
BASED ON PROJECTED HAUL ROUTES

Haul Segment	Distance Feet	Distance Meters	Rolling Resistance	Grade %	Avg Speed MPH	Time Min
1a	200	67	7.5	0.0	9.1	0.25
1b	500	167	5.0	0.0	12.8	0.45
1c	200	67	5.0	2.5	9.1	0.25
1d	1400	467	3.0	0.0	18.7	0.85
1e	250	88	3.0	0.0	9.5	0.30
1f	250	88	3.0	0.0	11.4	0.25
1g	1400	467	3.0	0.0	21.2	0.75
1h	200	67	5.0	(2.5)	11.4	0.20
1i	400	133	5.0	0.0	15.0	0.35
1j	200	67	7.5	0.0	9.1	0.25
						[illegible]
2a	200	67	7.5	0.0	9.1	0.25
2b	2150	717	3.0	(0.5)	22.2	1.10
2c	250	88	5.0	0.0	9.5	0.30
2d	250	88	5.0	0.0	11.4	0.25
2e	2250	750	3.0	+0.5	23.2	1.10
2f	200	67	7.5	0.0	9.1	0.25
						[illegible]
3a	250	88	7.5	0.0	8.1	0.35
3b	3300	1100	3.0	-0.5	25.4	1.60
3c	250	88	5.0	0.0	9.5	0.30
3d	250	88	5.0	0.0	11.4	0.25
3e	3300	1100	3.0	+0.5	25.0	1.50
3f	250	88	7.5	0.0	9.5	0.30
						4.30
4a	350	117	7.5	-3.5	11.4	0.35
4b	1450	483	3.0	0.0	19.4	0.85
4c	250	88	5.0	0.0	9.5	0.30
4d	250	88	5.0	0.0	11.4	0.25
4e	1700	567	3.0	0.0	22.7	0.85
4f	500	167	7.5	+3.5	11.4	0.50
						3.10
5a	1400	467	7.5	-2.75	15.9	1.00
5b	1350	450	3.0	0.0	14.3	0.80
5c	250	88	5.0	0.0	9.5	0.30
5d	250	88	5.0	0.0	11.4	0.25
5e	2250	750	3.0	0.0	28.2	1.10
5f	700	233	7.5	+5.5	11.4	0.70
						4.15
6a	600	200	7.5	0.0	11.4	0.60
6b	900	300	3.0	-3.3	20.5	0.50
6c	1450	483	3.0	0.0	19.4	0.85
6d	400	133	5.0	0.0	11.4	0.40
6e	400	133	5.0	0.0	11.4	0.40
6f	1450	483	3.0	0.0	22.0	0.75
6g	900	300	3.0	+3.3	17.0	0.60
6h	450	150	7.5	0.0	12.8	0.40
						4.50
7a	750	250	7.5	-1.5	12.2	0.70
7b	1600	533	3.0	0.0	20.2	0.90
7c	350	117	5.0	0.0	11.4	0.35
7d	350	117	5.0	0.0	11.4	0.35
7e	1600	533	3.0	0.0	22.7	0.80
7f	750	250	7.5	+1.5	13.1	0.65
						[illegible]

ENERGY FUELS NUCLEAR, INC.
Cost Estimate

E/PROJECT.................Date.................Calc by.................Sheet.......of..........

FUEL USAGE

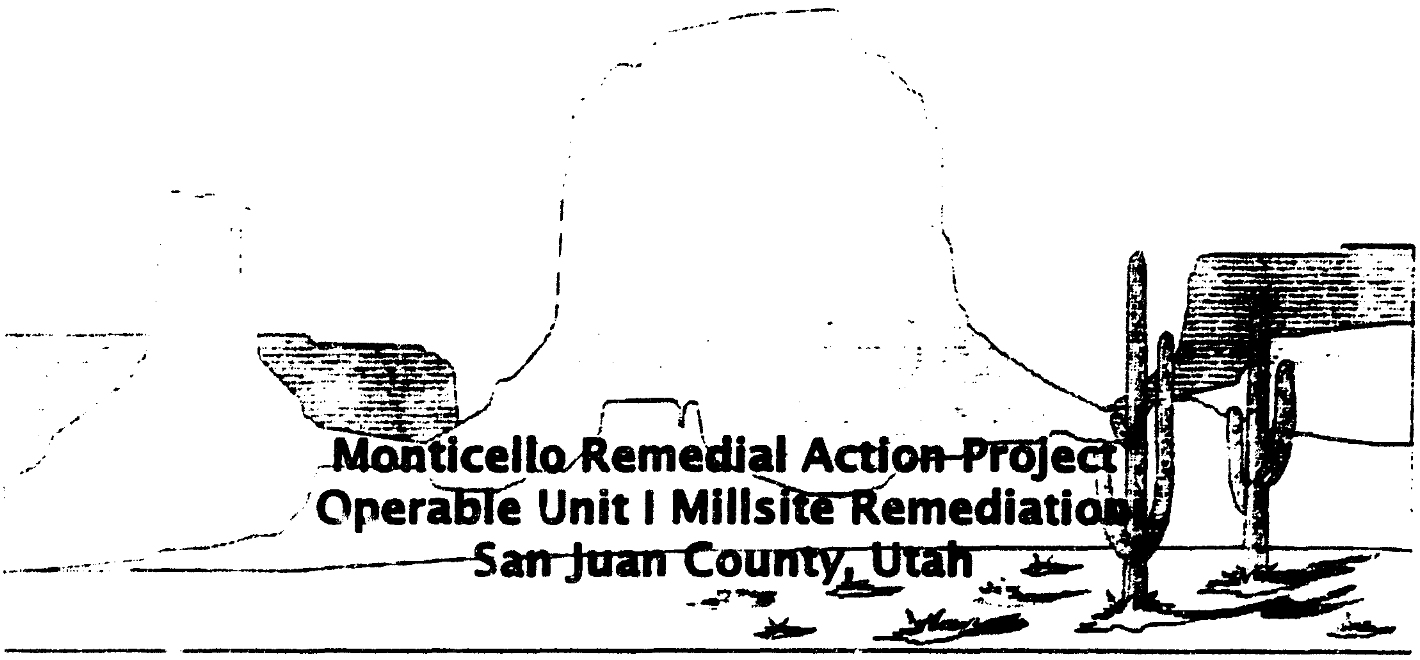
1) BASED ON STATUS OF SCHEDULE ON 11/18/96, THE FOLLOWING FUEL REQUIREMENTS ARE IDENTIFIED:

Unit	Hours	gal/hour	total gal
637 SCRAPERS	6013	24.0	72,312
D8 DOZER	3939	8.5	33,481
D7 DOZER	2257	7.0	15,799
825 COMPACTOR	2984	14.0	41,776
651 H_2O WAGON	4019	18.0	72,342
14G GRADER	4085	5.5	22,467
980 LOADER	866	9.0	7794
988 LOADER	1509	12.0	18,108
769 TRUCKS	5513	9.0	49,617
245 EXCAVATOR	953	14.0	13,342
KAMATSU	384	14.0	5,376
5000 gal H_2O TRUCK	1132	10.0	11,320
HIWAY TRUCKS	15,104	10.0	151,040
			514,775

Request for Proposal
1348

for

Rust Geotech
U.S. Department of Energy
Grand Junction Projects Office



May 1995

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REQUEST FOR PROPOSAL RFP-1348

WMX

RUST **Rust Geotech Inc.**

A WMX Technologies Company
P.O. Box 14000 • 2597 B¾ Road
Grand Junction, Colorado 81502-5504

Phone 970 248 6000
Fax 970 248 6040

May 22, 1995

COVER LETTER

FOR

REQUEST FOR PROPOSAL RFP-1348

TO ALL OFFERORS

SUBJECT: Request for Proposal (RFP) #1348 for Construction of an RCRA-Type Repository in Monticello, Utah

Dear Offerors:

Rust Geotech Inc., Operating Contractor for the U.S. Department of Energy (DOE), Grand Junction, Colorado, cordially invites your firm to submit a proposal for the subject construction project.

This solicitation includes the following documents:

I. Cover Letter and Payment and Performance Bond Forms.

II. Exhibit A) Statement of Work and Drawings in support of the repository and associated construction, remediation, operation and maintenance.

III. Exhibit B) General Proposal Instructions: This document contains general administrative information pertaining to the proposal as a whole as well as evaluation criteria.

IV. Exhibit C) Business Proposal Instructions: This document covers business data such as pricing, terms, period of performance, and includes the following:

a. Schedule A — DOL Wage Decision UT940009, Dated September 9, 1994.

b. Schedule B — Notice of Requirements for Affirmative Action.

c. Schedule C — Unit price/lump sum proposal.

d. Schedule D — Minimum Requirements for Small Business and Small Disadvantaged Business Subcontracting Plan.

e.	Schedule E	Contract Pricing Proposal Cover Letter (Form 1411).
f.	Schedule F	Proposal Bond
g.	Schedule G	Proposal Representations and Certifications (GJ-PROC-113). These are to be executed by an official authorized to bind the offeror and are made a part of this proposal. Return one completed and signed copy with your proposal.
h.	Schedule H	Organizational Conflicts of Interest (GJPO-PPM-1333). This is to be executed by an official authorized to bind the offeror and is made a part of this proposal. Return one completed and signed copy with your proposal.
i.	Schedule I	Terms and Conditions (GJ-PROC-111), dated May, 1995. These Terms and Conditions will be included in any subcontract resulting from this solicitation.

VI. Exhibit D) Technical Proposal Instructions. This document contains a list of technical information and documentation required. Pricing is NOT to be included in this technical proposal.

VII. Site Specific Specifications: Engineering Document E02926AB.

VIII. Signature Page with Subcontract Schedule

Performance of the Work by the Subcontractor

The Subcontractor shall perform on the work site, and with its own organization, work equivalent to at least twelve (12) percent of the total amount of work to be performed under the subcontract. This percentage may be reduced by supplemental agreement to this subcontract if, during the performance of the work, the Subcontractor requests a reduction and the Contractor determines it would be in the best interest of the Government to do so.

Pre-Proposal Conference and Site Inspection

A pre-proposal conference and inspection of the work site(s) will be conducted on June 13, 1995, beginning at 9:00 A.M. at the Rust Geotech Office in Monticello, Utah. Answers to questions addressed to the Subcontract Administrator, received no later than June 8, 1995, will be addressed. All questions, including those arising during the site

inspection, shall be submitted in writing to the Subcontract Administrator; a written response will be sent to all prospective offerors.

Schedules

Refer to detailed sections within the Specifications to acquire scheduling data.
The construction schedule shall be as follows:

Start Date	Completion Date
November 1, 1995	June 30, 2000

Estimate

The Rust in-house estimate for the total solicitation package is between $25,000,000.00 and $50,000,000.00. The in-house estimate will not be revealed.

If any of the documentation that you submit for this proposal is considered proprietary to your firm, please so identify. Geotech will take every precaution to ensure the security of the information. See the General Proposal Instructions, Exhibit B, for additional information.

Your response is due no later than close of business, 4:30 P.M. MST, July 19, 1995. Should your firm desire not to offer a proposal, please send notification of your decision. Response should be transmitted as follows:

U.S. Mail:

Rust Geotech Inc.
ATTN: S. H. Johnson
Subcontracts
P.O. Box 14000
Grand Junction, CO 81502-5536

Air or Surface Carriers:

Rust Geotech Inc.
ATTN: S. H. Johnson
Subcontracts
2597 B 3/4 Road
Grand Junction, CO 81503

Labels identifying the RFP, and defined as Technical Proposal and Business Proposal, should be affixed to the outside of the respective proposal packages.

Should any additional information be required, please contact the undersigned at 970/248-6113.

Sincerely,

Stephen H. Johnson
Subcontract Administrator

shj/ib

rfpcov:ou1

SCHEDULE A

RFP - 1348

DOL WAGE DECISIONS

General Decision Number UT940009

Superseded General Decision No. UT930009

State: Utah

Construction Type:
HEAVY

County(ies):

BEAVER	IRON	SEVIER
CARBON	JUAB	UINTAH
DAGGETT	KANE	WASHINGTON
EMERY	PIUTE	WAYNE
GARFIELD	SAN JUAN	
GRAND	SAN PETE	

HEAVY CONSTRUCTION PROJECTS

Modification Number	Publication Date
0	02/11/1994
1	04/01/1994
2	09/09/1994

COUNTY(ies):

BEAVER	IRON	SEVIER
CARBON	JUAB	UINTAH
DAGGETT	KANE	WASHINGTON
EMERY	PIUTE	WAYNE
GARFIELD	SAN JUAN	
GRAND	SAN PETE	

* BOIL0182B 01/01/1994

	Rates	Fringes
BOILERMAKERS	18.48	7.89

CARP0722B 10/01/1993

	Rates	Fringes
MILLWRIGHTS	19.27	2.65

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* IRON0027G 07/01/1994

	Rates	Fringes
IRONWORKERS:		
Structural	17.75	4.46

SUUT2007A 03/01/1988

	Rates	Fringes
CARPENTERS	10.81	
CEMENT MASONS	11.52	
ELECTRICIANS	14.52	2.71
IRONWORKERS:		
Reinforcing	11.00	
LABORERS (including pipelayers)	7.65	1.60
PIPEFITTERS	12.60	
POWER EQUIPMENT OPERATORS:		
Backhoes	10.00	
Cranes	10.43	
Dozers	13.10	
Graders	12.67	
Loaders	11.26	
Scrapers	10.00	
Trackhoes	10.00	
Tractors	9.42	
TRUCK DRIVERS	9.42	

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after

award only as provided in the labor standards contract clauses (29 CFR 5.5(a)(1)(v)).

In the listing above, the "SU" designation means that rates listed under that identifier do not reflect collectively bargained wage and fringe benefit rates. Other designations indicate unions whose rates have been determined to be prevailing.

END OF GENERAL DECISION