40-8681

IUC INTERNATIONAL URANIUM (USA) CORPORATION

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September 15, 2000

VIA OVERNIGHT EXPRESS

Mr. William J. Sinclair
Director, Division of Radiation Control
Utah Department of Environmental Quality
P.O. Box 144850
168 North 1950 West
Salt Lake City, UT 84114-4850

Re: Submittal of Summary of Groundwater Background Water Quality and other Water Quality Studies for the White Mesa Mill

Dear Mr. Sinclair:

In accordance with our letter to you of December 22, 1999 regarding the November 30, 1999 draft Groundwater Discharge Permit (the "GWDP") for the White Mesa Mill (the "Mill"), and the updated submittal schedule of August 22, 2000, this letter transmits IUSA's report entitled Summary of Background Water Quality and other Water Quality Studies for the White Mesa Mill.

The enclosed summary report describes the forms of data that were used to generate historic water quality data and ongoing monitoring data for the Mill. In some cases, the report describes some of the details we have discussed in past meetings with UDEQ such as laboratory reports, Quality Assurance ("QA"), analytical methods, detection limits and whether or not the laboratory was certified at the time.

However, as we discussed, we do not enclose any raw data with this report. Although the age of such data may prevent location of all of the original raw data, IUSA has a significant amount of such data at the Mill. As Michelle Rehmann has discussed with Loren Morton, rather than having IUSA copy and transmit all of these raw data together with this report, IUSA will make such data available for Loren to review during his upcoming visit to the Mill set for September 26, 2000, to determine which data UDEQ would like to have copied for UDEQ records.

Also, IUSA understands that UDEQ will review all such readily available supporting reports or facts before determining if it is necessary for IUSA to also contact outside sources, such as laboratories, and searching NRC records, to provide any additional available supporting data.

As always, I can be reached at (303) 389-4130.

Yours truly,

David C. Frydenlund
Vice President and General Counsel

DCF:smc

Enclosure

cc/att: Larry Mize, UDEQ Division of Water Quality
Loren Morton, UDEQ Division of Radiation Control
Bill von Till, NRC

cc w/out att: Dianne Nielson, UDEQ
Dave Arrioti, S.E. Utah Health Department

Summary of Groundwater Background Water Quality And Other Water Quality Studies For the White Mesa Mill

September 15, 2000

Submitted by
International Uranium (USA) Corporation
to
Utah Division of Radiation Control

Prepared by
International Uranium (USA) Corporation
1050 17th Street, Suite 950
Denver, CO 80265

In accordance with letters from International Uranium (USA) Corporation (IUSA) dated December 22, 1999, and January 6, 2000, regarding the November 30, 1999 draft Groundwater Discharge Permit (the GWDP) for the White Mesa Mill (the Mill), this report summarizes the readily-available water quality data and data reports for groundwater beneath the Mill. This report is submitted as per the revised schedule for GWDP submittals dated August 22, 2000.

UDEQ and IUSA have agreed that in situations, such as where there may be a question as to the veracity and interpretation of background groundwater quality data, where the NRC has performed a similar regulatory function to what the State of Utah (State) itself would have done, it would be presumed that, subject to UDEQ review, the NRC's regulatory work product should generally be acceptable. In the specific case of historic groundwater data, it was agreed that the existing historic data found in reports provided to UDEQ should generally be acceptable, especially if independent laboratories (as opposed to on-site laboratories) had provided the analyses. As summarized below in this report, independent laboratories have provided nearly all of the analyses used to generate background water quality data, as well as ongoing monitoring data.

This summary report describes readily available groundwater data, including reports, Quality Assurance ("QA"), analytical methods, detection limits and whether or not the laboratory was certified at the time. IUSA and UDEQ have recognized that, while much of this information is described in reports such as the Mill's initial Environmental Report and Environmental Assessment, the age of such data has tended to prevent location of all of the original ("raw") data. UDEQ has agreed to review all such readily available supporting reports or facts before determining if it is necessary for IUSA to also contact outside sources, such as laboratories, and searching NRC records, to provide any additional available supporting data.

Pre-operational Background Samples and Original License

Pre-operational groundwater sampling began in July 1977. Analysis was performed by the Utah State Division of Environmental Health Analysis Lab No. 77061. One sample was split for duplicate analysis by Hazen research for selected water quality parameters. One replicate was analyzed for QA on radioactivity. Results available at the time of publication of the 1978 Environmental Report ("ER") were published in Table 2.6-6, and are provided in Attachment 1 (Dames & Moore, 1978). It should be noted that:

- The EPA laboratory certification was not in effect at this time.
- Detection limits were not reported with the analytical results.

Supplemental discussion of the pre-operational groundwater quality was published in the Final Environmental Statement ("ES") for the White Mesa Uranium Project (U.S.NRC, May 1979). Groundwater quality discussion from this document is provided in

Attachment 2. As described in the ES, groundwater data collected from January 1977 to May 1977, *prior to operation*, indicated that:

- Samples G1, G3, G4, and G5 were taken from springs within Cottonwood Creek, originating in the perched water zone. G2 was collected from a well completed in the Navajo Sandstone, and exceeded public drinking water standards for selenium, sulfate, iron and arsenic.
- Other wells completed in the Navajo Sandstone exceeded U.S.EPA recommendations for iron.
- Wells G6, G7 completed in the Dakota Sandstone exceeded public drinking water standards for iron, sulfate, lead and arsenic.

The original, 1979 license is provided in Attachment 3. Condition #37 does not state the location or frequency of groundwater well sampling, but specifies an effluent and environmental monitoring program in accordance with 10 CFR Part 40, Section 40.65.

The D'Appolonia Assessment of Groundwater Quality (September 9, 1981) evaluated temporal trends in sulfate, chloride, TDS, sodium, pH, Radium-226, bicarbonate, and calcium, comparing both pre-operational (Jan. 1979 to May 1980) and operational phase (June 1980 to Feb. 1981) data on the same plots. A copy is provided in Attachment 4. The evaluation was based on analyses reported by WAMCO Lab. Some limits of detection are inferred from the use of "less thans" in the data tables (also in Attachment 4).

Early Operational Sampling

The earliest semi-annual report that presented background groundwater data was issued around 1980. It should be noted that:

- The analyses were done by WAMCO Lab. The EPA laboratory certification program was not in effect at that time.
- Although detection limits were not specified with the analytical results, results reported as "less than" imply a detection limit.

Hard copies of the portions of the semiannual data from CORE Labs and WAMCO Lab covering sampling from April 1982 through October 1983 are included in Attachment 5.

1985 License

The 1985 license (Attachment 6) required that groundwater wells 1, 2, 3, 4, 5, 11, 12, 13, and the culinary water well have water levels measured and be analyzed for arsenic, selenium, sodium, Ra-226, Th-230, and Pb-210. It refers to the environmental monitoring program proposed in Section 5.5 of Umetco's renewal application (Attachment 7). The 1985 EA (provided in Attachment 8) also describes the groundwater quality monitoring program by referring to Section 5.5 of the 1985 Application.

1991 License

A portion of the 1991 License Amendment Application is provided in Attachment 9 (Titan, July 1994). Section 5.5.6.2 describes the groundwater monitoring program. Table 5.5-2 lists the parameters measured for wells 1, 2, 3, 4, 5, 11, 12, 14, 15. It does not state detection limits. The limits are available for review in raw data stored at the Mill, and will be presented to UDEQ during a site visit.

Titan Hydrogeologic Evaluation of White Mesa Mill

Sections of the 1994 Hydrogeologic Evaluation of White Mesa Mill are provided in Attachment 10 (Titan, September 1994). It reiterates that the water in the perched zone is poor quality, with no discernable temporal trends in quality (p23), that dissolving minerals from the Brushy Basin Member are the natural source forming sulfate dominated waters (p29), and adds that use of a single well to establish background may not be appropriate (p29). It introduces the idea of intra-well water quality comparisons "on a well-by-well basis" (p29).

The statistical "t-tests" on selected parameters on pre-operational sample populations (1980-1981) and operational sample populations (1990-92) in 4 wells around the Mill tailing cells showed inconsistency among trends from well to well. These t-tests were performed on a combination of the same WAMCO 1980-81 pre-operational data used by D'Appolonia, and later quarterly sampling data from CORE labs.

The t-test on WMMW-1, an upgradient well, indicated that chloride concentration had decreased significantly, while sulfate increased. The t-test on WMMW-3, a downgradient well, showed no change in chloride, and increase in sulfates. The t-test on WMMW-5, a well downgradient of Cell 3, showed chloride decreasing. The t-tests on other wells constructed later WMMW-12, 14, and 15, show decreasing chloride and inconsistency among the wells.

As a result, Titan reported that the water chemistry in the Brushy Basin Member was highly variable (p34), and there was no impact from operations (p34). Accordingly, the recommendation was made that background should be determined from a number of wells (p34), or on a well-specific basis.

Titan Point of Compliance Report

Sections of the Titan Point of Compliance Report ("POC Report") are provided in Attachment 11. A complete copy of this report has been sent to UDEQ previously. The POC Report recommended use of existing monitoring wells 5, 11, 12, 14 and 15, and possible addition of a new well adjacent to Cell 4. The POC locations utilized by IUC and approved by the NRC, which ultimately added existing well 17, were selected in accordance with EPA's RCRA Ground-Water Monitoring: Draft Technical Guidance (EPA 1992). Chloride, potassium and nickel were chosen as indicator parameters, with uranium added to the list based on agreement between the licensee and the NRC. Trace metals such as sodium, magnesium, calcium and arsenic were not selected as indicator parameters, because the presence of calcareous stringers and zones beneath the site would retard the movement of these metals making them an unreliable indicator of water quality. The same calcareous materials would also react with low pH solutions from potential tailing cell liner leaks, making pH an unreliable indicator.

This report introduced use of the combined Shewhart-CUSUM control chart method for evaluating the quarterly groundwater data. The Shewhart-CUSUM method involves plotting standardized constituent concentration data versus time, and comparison of the data for each parameter against a predefined upper bound (based on standard deviations) rather than against a static background mean concentration. All of the charts presented in this report were constructed with a starting sampling date of March 24, 1994, so they would cover the same time period. The mean and standard deviation were calculated using all water quality data collected before March 24, 1994. The data points used included the earliest samples dated October 31, 1979, and quarterly samples every period thereafter up to March 1994.

1997 EA and License

Sections of the 1997 NRC EA are provide in Attachment 12. The NRC recommended groundwater monitoring in accordance with the POC approach in the September 1994 Titan POC Report. This sampling has been performed, and data are transmitted to NRC, with copies sent to UDEQ, in semi-annual effluent reports.

Table 1
White Mesa Mill Groundwater Laboratory Contractors

A summary of the laboratories providing analyses pertinent to groundwater background or groundwater monitoring is as follows:

Years	Laboratory	EPA Region 8 Certified	Utah Certified
1977-1978	Utah State Division of Environmental Health		
1978	CDM/Acculabs		
1979-Nov 1981	WAMCO		
Jan 1982-October 1983	CORE Labs		
June 1984	U.C.C. Metals Division Development Laboratory		
Dec 1985 -Sept 1986	EDA Instruments		
May 1987-March 1994	Barringer Labs		
Approx. 1994	Start of EPA Lab Certification Program for Groundwater		
1994-1997	Barringer Labs		
1997-present	Energy Labs	Since 1995	In progress

Table 2
Comparison of Mill Pre-Operational Groundwater Quality to Utah Groundwater Protection Standards

Utah Groundwater Protection Standard		Samples from Perched Zone
Parameter	mg/liter[1]	mg/liter
Arsenic	0.05	<0.001-0.003
Barium	2.0	0.01-0.46
Cadmium	0.005	**<0.001-0.007**
Chromium	0.1	0.001-0.051
Copper	1.3	<0.01-0.03
Lead	0.015	<0.01
Mercury	0.002	<0.0005
Selenium	0.05	<0.001-0.039
Silver	0.1	0.001-0.01
Zinc	5.0	<0.01-0.82
Ammonia as N	30.0	<0.01-2.6
Chloride	250.0	2.5-47
Fluoride	4.0	0.19-0.56
Nitrate (as N)	10.0	<0.1-0.1
Nitrate +Nitrite	10.0	
Sulfate	500.0	**220-2100**
pH	6.5-8.5	6.5-8.6
TDS Class IA	<500	**627-3254**
Radium-226	5 pCi/l	0.0±0.4 to 1.9±1.0
Uranium	30 pCi/l	**(gross alpha) 0.0±0.4 to 27±6**

1. Unless other units are specifically noted.

ATTACHMENT 1

ENVIRONMENTAL REPORT

WHITE MESA URANIUM PROJECT

SAN JUAN COUNTY, UTAH

FOR

ENERGY FUELS NUCLEAR, INC.

Prepared By

DAMES & MOORE

January 30, 1978

09973-015-14

statistical frequency analysis was performed on the meteorological data, but this 4.5 in (114 mm) rainfall was certainly an extremely unusual event, most probably generated by a general-type storm system, since high runoff occurred for several days both before and after the peak flow event.

The PMF hydrograph shown on Plate 2.6-9 is the result of the thunderstorm PMP, i.e. 7 in (178 mm) of rainfall in 1 hour. Although the PMP associated with a general-type storm produces more rainfall, 9.8 in (249 mm), the intensity is much less since the duration is much longer at 48 hours. The PMF hydrograph from such a rainfall would result in more volume of runoff than the PMF thunderstorm but the peak discharge would be less, therefore being less critical as far as flooding potential is concerned. Also, since the flood of record on Cottonwood Wash occurred in August, no snowmelt baseflow was added to the above PMF estimate. If the snowmelt component were included it would produce a negligible change in the peak flood flows shown.

2.6.3 Water Quality

Water quality determinations are being made of surface and ground waters in and around the proposed mill site to evaluate and describe the existing conditions and to be able to make predictions of possible future impacts on the water quality as a result of the planned action.

Sampling stations are located to provide baseline water quality conditions up gradient and down gradient from the site for both subsurface and surface waters. These locations were chosen to be as representative of specific conditions as possible and the frequency of sampling was selected to provide a statistically valid sampling.

The water quality parameters chosen for analysis represent the major chemical, physical and radiological properties that would be important for possible intended uses of the water and would be appropriate to monitor during the life of the project to detect possible changes in water quality.

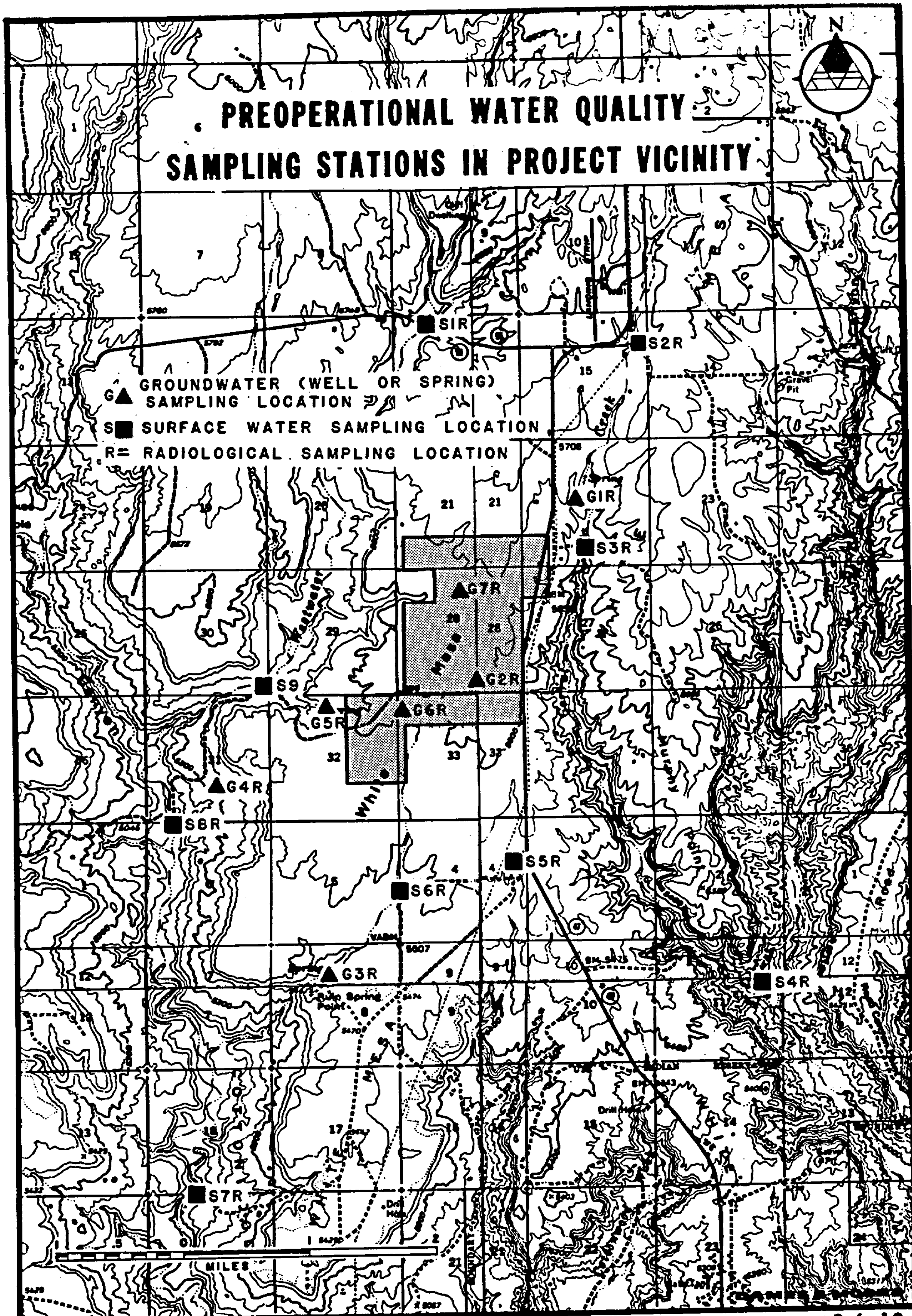
PREOPERATIONAL WATER QUALITY
SAMPLING STATIONS IN PROJECT VICINITY
G▲ GROUNDWATER (WELL OR SPRING) SAMPLING LOCATION
S■ SURFACE WATER SAMPLING LOCATION
R= RADIOLOGICAL SAMPLING LOCATION
S1R
S2R
G1R
S3R
G7R
G2R
S9
G5R
G6R
G4R
S8R
S5R
S6R
G3R
S4R
S7R
MILES
N

PLATE 2.6-10

TABLE 2.6-6

WATER QUALITY OF GROUND WATERS AND SPRINGS IN PROJECT VICINITY

Location	Spring in Corral Ck		Blanding Mill Site Well in Navajo Sandstone				
Station No.	G1R		G2R				
Collection Date	7/25/77	11/10/77	1/27/77[1]	5/4/77[2]	7/25/77	12/05/77	12/05/77[3]
Field Specific Conductivity (umhos/cm)			--	--	400		
Field pH			--	--	6.9		
Dissolved Oxygen			--	--	--		
Temperature (°C)			--	--	22.2		
Estimated Flow, gpm			--	--	20		
Determination (mg/l)							
pH	LOW FLOW COULD NOT LOCATE SPRING	LOW FLOW COULD NOT LOCATE SPRING	8.0	7.9	7.7	ANALYSIS NOT YET COMPLETED BY COMMERCIAL TESTING LABORATORY	ANALYSIS NOT YET COMPLETED BY COMMERCIAL TESTING LABORATORY
TDS (@180°C)			244	245	1110		
Redox Potential			--	--	220		
Alkalinity (as $CaCO_3$)			189	180	224		
Hardness, total (as $CaCO_3$)			196	--	208		
Carbonate (as CO_3)			0.0	--	0		
Aluminum, dissolved			--	--	<0.01		
Ammonia (as N)			0.0	--	<0.1		
Arsenic, total			0.014	--	<0.01		
Barium, total			<0.0	--	0.13		
Boron, total			0.040	--	<0.1		
Cadmium, total			0.0	--	0.004		
Calcium, dissolved			51	49	51		
Chloride			0.0	50?	<1		
Sodium, dissolved			8.0	--	5.3		
Silver, dissolved			0.0	--	<0.002		
Sulfate, dissolved (as SO_4)			24	17	17		
Vanadium, dissolved			--	--	<0.002		
Manganese, dissolved			0.020	--	0.03		
Chromium, total			0.0	--	0.02		
Copper, total			0.0	--	0.005		
Fluoride, dissolved			0.17	0.1	0.22		
Iron, total			0.54	--	0.61		
Iron, dissolved			--	--	0.57		
Lead, total			0.0	--	0.02		
Magnesium, dissolved			17	19	18		
Mercury, total			0.0	00	0.002		
Molybdenum, dissolved			--	--	<0.01		
Nitrate (as N)			0.05	0.12	<0.05		
Phosphorus, total (as P)			(ortho) 0.03	--	<0.01		

[1]Utah State Division of Health Analysis, Lab No. 77061
[2]Partial analysis by Hazen Research, Inc., Sample No. HRI-11503
[3]Replicate sample analyzed for Quality Assurance on radioactivity

RM78-682-B

UNC

MAR 10 1999

PREOPERATIONAL WATER QUALITY DATA
WHITE MESA URANIUM PROJECT

WATER QUALITY PARAMETER	UNITS	WELL NO. 1 1st QUARTER OCT. 1979	WELL NO. 1 2nd QUARTER JAN. 1980	WELL NO. 1 3rd QUARTER APR. 1980	WELL NO. 2 1st QUARTER OCT. 1979	WELL NO. 2 2nd QUARTER JAN. 1980	WELL NO. 2 3rd QUARTER APR. 1980	WELL NO. 3 1st QUARTER OCT. 1979	WELL NO. 3 2nd QUARTER JAN. 1980	WELL NO. 3 3rd QUARTER APR. 1980	WELL NO. 4 1st QUARTER OCT. 1979	WELL NO. 4 2nd QUARTER JAN. 1980	WELL NO. 4 3rd QUARTER APR. 1980
FIELD VALUES													
Temperature	°C	13.5	10	12	15.0	10	13	16.5	9.5	12	13.5	10.5	11
pH	S.U.	8.6	7.4	6.8	7.2	7.2	6.9	7.3	6.8	6.5	7.1	7.1	6.8
Acidity	mg/l $CaCO_3$	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Total Alkalinity	mg/l $CaCO_3$	160	230	262	256	296	364	228	292	340	340	374	388
Specific Conductance	μmhos/cm @ 25°C	-	1520	1480	-	1620	2390	-	3000	4020	-	3130	3850
LABORATORY VALUES													
Specific Conductance	μmhos/cm	948	1300	-	1270	1590	-	3260	3160	-	3360	3470	-
Bicarbonate	mg/l HCO_3	195	281	320	312	361	444	276	356	415	415	456	473
Carbonate	mg/l CO_3	0	0	0	0	0	0	0	0	0	0	0	0
Chloride	mg/l	2.5	14	13	5.0	18	13	12.6	25	30	20.1	34	47
Fluoride	mg/l	0.56	0.34	0.24	0.30	0.33	0.23	0.36	0.42	0.25	0.25	0.29	0.19
Ammonia	mg/l NH_3-N	<0.05	1.9	<0.01	<0.05	1.4	<0.01	0.06	2.6	0.36	<0.05	1.4	<0.01
Nitrate	mg/l NO_3-N	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.1	<0.1	<0.1
Total Phosphate	mg/l PO_4-P	0.02	0.09	0.10	0.01	0.15	0.13	0.04	0.18	0.17	0.02	0.12	0.12
Sulfate	mg/l	220	520	520	240	630	650	930	2100	1900	1220	1700	2100
Total Dissolved Solids	mg/l @ 180°C	627	882	1219	855	1060	1828	2102	2530	3254	2984	2830	3154
Total Suspended Solids	mg/l @ 105°C	N/A	344	981	N/A	240	183	N/A	168	225	N/A	167	88
Total Hardness	mg/l $CaCO_3$	250	566	522	311	451	663	946	1270	1460	1502	1610	1570
Chemical Oxygen Demand	mg/l	43	17	40	5	13	50	42	24	50	10	<1	38
Total Organic Carbon	mg/l	11	6	6	6	4	2	13	8	9	4	2	5
METALS (DISSOLVED)													
Aluminum	mg/l	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1
Arsenic	mg/l	<0.001	0.001	0.002	0.003	0.003	0.003	<0.001	0.001	0.003	<0.001	<0.001	0.001
Barium	mg/l	0.41	0.12	0.05	0.46	0.02	0.04	0.40	<0.01	0.04	0.34	<0.01	0.04
Boron	mg/l	0.6	1.1	1.3	1.1	1.1	2.1	1.[illegible]	2.4	2.8	1.6	2.6	2.4
Cadmium	mg/l	0.002	<0.001	<0.001	0.003	<0.001	<0.001	0.006	<0.001	<0.001	0.007	<0.001	<0.001
Calcium	mg/l	64	110	130	96	110	165	243	365	410	352	395	390
Chromium-Hexavalent	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	0.01	<0.01	<0.01	0.12
Chromium-Total	mg/l	0.015	0.006	0.002	0.023	0.017	0.002	0.047	0.043	0.002	0.029	0.051	<0.001
Copper	mg/l	<0.01	<0.01	0.02	<0.01	<0.01	0.03	<0.01	<0.01	0.03	<0.01	<0.01	0.03
Iron	mg/l	0.04	0.29	0.51	<0.01	0.06	0.09	<0.01	1.28	3.50	0.29	1.77	0.09
Iron - Total	mg/l	NA	2.27	3.57	NA	1.46	0.75	NA	3.47	4.60	NA	6.4	5.85
Lead	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Magnesium	mg/l	16	39	49	20	36	57	73	91	110	164	150	150
Manganese	mg/l	0.03	0.16	0.21	0.50	0.18	0.30	0.05	1.20	1.79	0.85	1.00	0.98
Manganese - Total	mg/l	NA	0.18	0.21	NA	0.24	0.26	NA	1.16	1.61	NA	0.98	0.93
Mercury	mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.005	<0.0005	<0.0005	<0.0005	<0.0005
Molybdenum	mg/l	<0.01	<0.01	0.19	<0.01	<0.01	0.10	<0.01	<0.01	0.09	<0.01	<0.01	0.13
Potassium	mg/l	8.9	8.5	7.8	7.4	10	10	16.7	16	18	11.3	11	11
Selenium	mg/l	0.003	0.001	<0.001	0.039	0.017	<0.001	0.004	<0.001	<0.001	0.001	<0.001	<0.001
Silicon	mg/l	8.4	<1.0	2.7	12	<1.0	4.2	16	<1.0	5.7	13	<1.0	4.4
Silver	mg/l	0.002	0.003	0.003	0.003	0.005	0.005	0.004	<0.001	0.005	0.007	0.010	0.004
Sodium	mg/l	106	130	160	154	215	285	282	345	405	342	285	315
Strontium	mg/l	3.7	6.7	7.6	6.0	9.0	9.3	5.5	5.8	7.1	14	15	11.3
Uranium (U)	mg/l	0.002	0.0396	0.0043	0.004	0.0123	.0067	0.014	0.0197	0.0219	0.004	0.0044	0.0036
Vanadium	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	mg/l	<0.01	0.21	0.12	0.07	0.53	0.26	0.82	0.05	0.06	0.13	0.38	0.14
Cations	meq/l	9.3	14.6	17.7	13.3	18.1	25.6	31.0	41.1	47.6	46.2	44.7	45.8
Anions	meq/l	7.8	15.8	16.4	10.3	19.5	21.2	198.[illegible]	50.2	47.2	32.8	43.8	52.8
$\frac{\text{Cations-Anions}}{\text{Cations+Anions}} \times 100$	%	8.7	-4.1	3.6	13.0	-3.9	9.4	-73.0	-10.0	0.4	17.0	1.0	-7.1
RADIONUCLIDES (DISSOLVED)													
Radium-226	pCi/l	0.5±0.4	0.0±0.4	1.9±1.0	0.7±0.5	0.0±0.4	1.8±0.9	0.6±0.4	0.4±0.5	1.1±0.8	0.6±0.4	0.1±0.5	0.6±0.5
Thorium-230	pCi/l	0.3±0.5	10±8	0.0±2.3	0.3±0.5	0.0±2.9	0.0±3.5	0.4±0.5	0.0±3.1	2.6±3.6	0.4±0.5	0.0±5.4	0.0±2.1
Lead-210	pCi/l	0.0±0.6	—	0.0±3.7	0.0±0.6	—	0.0±4.3	0.0±0.6	—	0.0±3.8	0.0±0.6	—	0.0±3.4
Polonium-210	pCi/l	0.6±0.6	—	0.0±0.5	0.1±0.5	—	0.6±0.6	0.7±0.7	—	0.9±0.6	0.2±0.5	—	0.4±0.5
Gross Alpha	pCi/l	2.2±1.7	5.0±3.7	27±6	7.6±3.6	2.2±3.3	7.1±4.3	4.9±4.4	11±6	21±10	0.0±6.4	8.0±5.9	0.1±4.3
Gross Beta	pCi/l	1±10	0.0±27	42±12	17±11	0.0±31	0±21	0±22	0.0±33	0±41	0±40	0.0±32	27±42

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TABLE 2.6-6 (Continued)

Location	Spring in Cottonwood Creek		Spring in Cottonwood Creek		Spring in Westwater Creek		Abandoned Stock Well	
Station No.	G3R		G4R		G5R		G6R	
Collection Date	7/25/77	11/10/77	7/25/77	11/10/77	7/25/77	11/10/77	7/25/77	11/10/77
Field Specific Conductivity (umhos/cm)	NOT ENOUGH WATER TO ADQUATELY SAMPLE	950	2400	760	NO WATER TO SAMPLE	NO WATER TO SAMPLE	UNABLE TO SAMPLE	UNABLE TO SAMPLE
Field pH		7.4	6.4	6.7				
Dissolved Oxygen		--	--	--				
Temperature (°C)		13.5	24	70				
Estimated flow, gpm		.5	10	2				
Determination (mg/l)								
pH		7.8	7.0	8.1				
TDS (@180°C)		975	1270	780				
Redox Potential		260	240	260				
Alkalinity (as $CaCO_3$)		187	643	252				
Hardness, total (as $CaCO_3$)		477	232	264				
Carbonate (as CO_3)		0	0	0				
Aluminum, dissolved		<0.1	0.06	0.4				
Ammonia (as N)		<0.1	0.13	<0.1				
Arsenic, total		--	<0.01	--				
Barium, total		<0.2	0.25	<0.2				
Boron, total		0.2	0.3	0.1				
Cadmium, total		0.004	0.004	0.002				
Calcium, dissolved		375	58	135				
Chloride		25	1	71				
Sodium, dissolved		200	400	115				
Silver, dissolved		--	0.004	--				
Sulfate, dissolved (as SO_4)		472	333	243				
Vanadium, dissolved		<0.01	0.006	<0.01				
Manganese, dissolved		<0.005	1.1	0.060				
Chromium, total		0.1	0.02	<0.01				
Copper, total		<0.005	0.005	<0.005				
Fluoride, dissolved		0.6	1.0	0.5				
Iron, total		0.05	0.34	0.16				
Iron, dissolved		0.02	0.32	0.11				
Lead, total		<0.05	0.03	<0.05				
Magnesium, dissolved		265	19	28				
Mercury, total		<0.005	0.002	0.001				
Molybdenum, dissolved		--	<0.01	--				
Nitrate (as N)		2.77	0.06	0.26				
Phosphorus, total (as P)		0.06	0.07	0.02				

TABLE 2.6-6 (Continued)

Location	Abandoned Stock Well				
Station No.	G7R				
Collection Date	7/25/77	11/10/77	Future date	Future date	Future date
Field Specific Conductivity (umhos/cm)	UNABLE TO SAMPLE	UNABLE TO SAMPLE			
Field pH					
Dissolved Oxygen					
Temperature (°C)					
Estimated flow, gpm					
Determination (mg/l)					
pH					
TDS (@180°C)					
Redox Potential					
Alkalinity (as $CaCO_3$)					
Hardness, total (as $CaCO_3$)					
Carbonate (as CO_3)					
Aluminum, dissolved					
Ammonia (as N)					
Arsenic, total					
Barium, total					
Boron, total					
Cadmium, total					
Calcium, dissolved					
Chloride					
Sodium, dissolved					
Silver, dissolved					
Sulfate, dissolved (as SO_4)					
Vanadium, dissolved					
Manganese, dissolved					
Chromium, total					
Copper, total					
Fluoride, dissolved					
Iron, total					
Iron, dissolved					
Lead, total					
Magnesium, dissolved					
Mercury, total					
Molybdenum, dissolved					
Nitrate (as N)					
Phosphorus, total (as P)					

More information will be gathered regarding the quality of shallow ground water at the mill site and tailing retention site. These data will be submitted in the Supplemental Report.

The water quality analysis of ground water from the mill site well drilled into the Navajo sandstone is included in Table 2.6-6 for reference and comparison with other ground waters. However, it must be recognized that the ground water in the Navajo sandstone beneath the mill site is isolated from the shallow ground water regime of the Dakota-Morrison rock formations by several hundred feet of less permeable geologic formations. Therefore, because these geologic formations are of different character and physical composition, it is understandable that the ground water compositions are entirely different in each formation.

Specifically, based on analyses of water from the Blanding mill site well (Station No. G2R), the ground water in the Navajo sandstone is a calcium-bicarbonate type water with low total dissolved solids, and a very slightly alkaline pH. The dissolved iron content of 0.57 mg/l, however, would require treatment in order to meet U.S. Public Health Service (1962) recommended standards of 0.3 mg/l for drinking water.

2.6.3.2 Surface Water Quality in Project Vicinity

Surface water samples have been collected at several locations around the project site and analysed as part of the baseline field studies. The locations of these preoperational surface water quality sampling stations are shown on Plate 2.6-10 and the results of the analyses are presented in Table 2.6-7.

Two sets of surface water samples have been collected from the Blanding site area; one in July 1977, another in November 1977. Samples were collected from Westwater Creek, Cottonwood Creek and Corral Creek, intermittent streams which drain the mill site area; and, from a surface stock pond just southeast of the proposed mill site. Attempts have been made to sample Recapture Creek at Station No. S4R and a small wash south

TABLE 2.6-7 (Continued)

Location	Westwater Creek		Corral Creek		Corral Creek		Corral/Recapture Creeks Junction	
Station No.	S1R		S2R		S3R		S4R	
Collection Date	7/25/77	11/10/77	7/25/77	11/10/77	7/25/77	11/10/77	7/25/77	11/10/77
Determination (mg/l)	NOT ENOUGH WATER IN STREAM TO ADEQUATELY SAMPLE		NOT ENOUGH WATER IN STREAM TO ADEQUATELY SAMPLE	NOT ENOUGH WATER IN STREAM TO ADEQUATELY SAMPLE			NO WATER IN STREAM TO SAMPLE	NO WATER IN STREAM TO SAMPLE
Potassium, dissolved		2.8			13	4.8		
Selenium, dissolved		--			0.16	--		
Silica dissolved (as SiO_2)		7			10	2		
Strontium, dissolved		0.44			1.9	2.2		
Uranium, total (as U)		0.006			0.005	0.028		
Uranium, dissolved (as U)		0.002			0.002	0.028		
Zinc, dissolved		0.09			0.06	0.02		
Total Organic Carbon		6				11		
Chemical Oxygen Demand		23				79		
Oil and Grease		1				1		
Total Suspended Solids		12				9		
Determination (pCi/l)								
Gross Alpha±Precision[1]					15±2			
Gross Beta±Precision[1]					180±20			
Radium -226±Precision[1]					0.0±0.3			
Thorium -230±Precision[1]					3.1±6.5			
Lead -210±Precision[1]					1.4±2.1			
Polonium -210±Precision[1]					0.0±0.3			

[1]Variability of the radioactive disintegration process (counting error) at the 95% confidence level. 1.96σ.

Since the half-life of polonium-210 is 138 days, it will be in equilibrium with lead-210 in approximately 1380 days or 3.8 years. There will be equal activities of polonium-210 and lead-210 when in equilibrium.

TABLE 2.6-7 (Continued)

Location	Surface Pond		Unnamed Wash		Cottonwood Creek		Cottonwood Creek	
Station No.	S5R		S6R		S7		S8R	
Collection Date	7/25/77	11/10/77	7/25/77	11/10/77	7/25/77	11/10/77	7/25/77	11/10/77
Determination (mg/l)								
Potassium, dissolved	NOT SAMPLED	14	NO WATER TO SAMPLE	NO WATER TO SAMPLE	UNABLE TO SAMPLE	UNABLE TO SAMPLE	6.9	3.2
Selenium, dissolved		--					0.08	--
Silica dissolved (as SiO_2)		2					10	8
Strontium, dissolved		0.10					0.64	0.60
Uranium, total (as U)		0.004					0.027	0.004
Uranium, dissolved (as U)		0.003					0.015	0.004
Zinc, dissolved		0.02					0.06	0.05
Total Organic Carbon		15						7
Chemical Oxygen Demand		71						61
Oil and Grease		2						2
Total Suspended Solids		268						146
Determination (pCi/l)								
Gross Alpha±Precision[1]							16±3	
Gross Beta±Precision[1]							72±17	
Radium-226±Precision[1]							0.6±1.3	
Thorium-230±Precision[1]							0.9±0.6	
Lead-210±Precision[1]							0.8±1.9	
Polonium-210±Precision[1]							0.0±0.3	

[1]Variability of the radioactive disintegration process (counting erros) at the 95% confidence level, 1.96σ.

Since the half-life of polonium-210 is 138 days, it will be in equilibrium with lead-210 in approximately 1380 days or 3.8 years. There will be equal activities of polonium-210 and lead-210 when in equilibrium.

TABLE 2.6-7 (Concluded)

Location	Westwater Creek			
Station No.	S9			
Collection date	7/25/77	11/10/77	Future dates	Future dates
Determination (mg/l)				
Potassium, dissolved	NO WATER IN STREAM TO SAMPLE	NO WATER IN STREAM TO SAMPLE		
Selenium, dissolved				
Silica, dissolved (as SiO_2)				
Strontium, dissolved				
Uranium, total				
Uranium, dissolved (as U)				
Zinc, dissolved				
Total Organic Carbon				
Chemical Oxygen Demand				
Oil and Grease				
Total Suspended Solids				
Determination (pCi/l)				
Gross Alpha±Precision[1]				
Gross Beta±Precision[1]				
Radium-226±Precision[1]				
Thorium-230±Precision[1]				
Lead-210±Precision[1]				
Polonium-210±Precision[1]				

[1]Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

Since the half-life of polonium-210 is 138 days, it will be in equilibrium with lead-210 in approximately 1380 days or 3.8 years. There will be equal activities of polonium-210 and lead-210 when in equilibrium.

TABLE 2.6-8

WATER QUALITY OF GROUND WATER AND SURFACE WATER IN VICINITY OF HANKSVILLE ORE-BUYING STATION, HANKSVILLE, UTAH

Location	Ore-Buying Station Well in Entrada Sandstone				
Station No.	HG1R				
Collection Date	12/21/76[1]	7/25/77	12/5/77	12/5/77[2]	Future date
Field Specific Conductivity (umhos/cm)		7400	ANALYSIS NOT YET COMPLETED BY COMMERCIAL TESTING LABORATORY	ANALYSIS NOT YET COMPLETED BY COMMERCIAL TESTING LABORATORY	
Field pH		6.6			
Dissolved Oxygen		--			
Temperature (°C)		19.5			
Estimated flow, gpm		20			
Determination (mg/l)					
pH	8.3	6.9			
TDS (@180°C)	7230	6020			
Redox Potential	-	240			
Alkalinity (as $CaCO_3$)	62	60			
Hardness, total (as $CaCO_3$)	1350	1080			
Carbonate (as CO_3)	0.0	0			
Aluminum, dissolved	-	<0.01			
Ammonia (as N)	1.2	0.53			
Arsenic, total	0.002	<0.01			
Barium, total	0.0	0.05			
Boron, total	1.06	1.2			
Cadmium, total	0.0	0.008			
Calcium, dissolved	352	345			
Chloride	132	94			
Sodium, dissolved	2020	1790			
Silver, dissolved	0.070	0.004			
Sulfate, dissolved (as SO_4)	4720	3920			
Vanadium, dissolved	-	<0.002			
Manganese, dissolved	0.160	0.06			
Chromium, total	0.0	0.03			
Copper, total	0.085	0.03			
Fluoride, dissolved	0.40	0.47			
Iron, total	1.28	2.2			
Iron, dissolved	-	1.3			
Lead, total	0.0	0.11			
Magnesium, dissolved	114	115			
Mercury, total	0.0	0.002			
Molybdenum, dissolved	-	0.01			
Nitrate (as N)	0.0	<0.05			
Phosphorus, total (as P) (ortho)	0.5	0.02			

[1]Utah Division of Health, Lab. No. 761461
[2]Replicate sample analysis for Quality Assurance on radioactivity.

2.6.3.4 Surface Water Quality in Vicinity of Hanksville Ore-Buying Station

The Hanksville ore-buying station is located in an area of very low precipitation (see Section 2.7.3). Consequently, there are no perennial streams near the site. Only small ill-defined channels drain the site area during short-duration storm events. Nevertheless, two surface water sampling stations on Halfway Wash (Plate 2.6-11) have been selected in the vicinity of the Hanksville ore-buying station to determine water quality during the few times a year when surface runoff may occur.

However, it has not been possible, from the period of July 1977 to December 1977, to collect water samples in the vicinity as there has been no collectable surface runoff.

2.7 METEOROLOGY AND AIR QUALITY

2.7.1 Regional Climatology

The climate of southeastern Utah is classified as dry to arid continental. Of main importantance in the determination of the climatology of this area are its location between major mountain ranges, its distance from major moisture sources and its proximity relative to major storm tracks. The region including the Blanding vicinity, is typified by warm summer and cold winter temperatures, precipitation averaging less than 35 centimeters (13.8 in) annually, low humidity, clear skies and large annual and diurnal temperature variations.

Total annual precipitation in the region is low as moisture from the Pacific and Gulf of Mexico is largely removed as it passes over the Sierra Nevada and Rocky Mountain chains. The Blanding vicinity, which averages nearly 30 centimeters (11.8 cm) annually, receives considerably more precipitation than areas to the west and northwest. Precipitation occurs throughout the year at Blanding but over one third of annual precipitation occurs in the three-month period of August through October. With the absence of local sources of moisture, thunderstorms (which usually comprise a major portion of the annual precipitation in most areas) are not abundant in this area; this accounts for the relatively

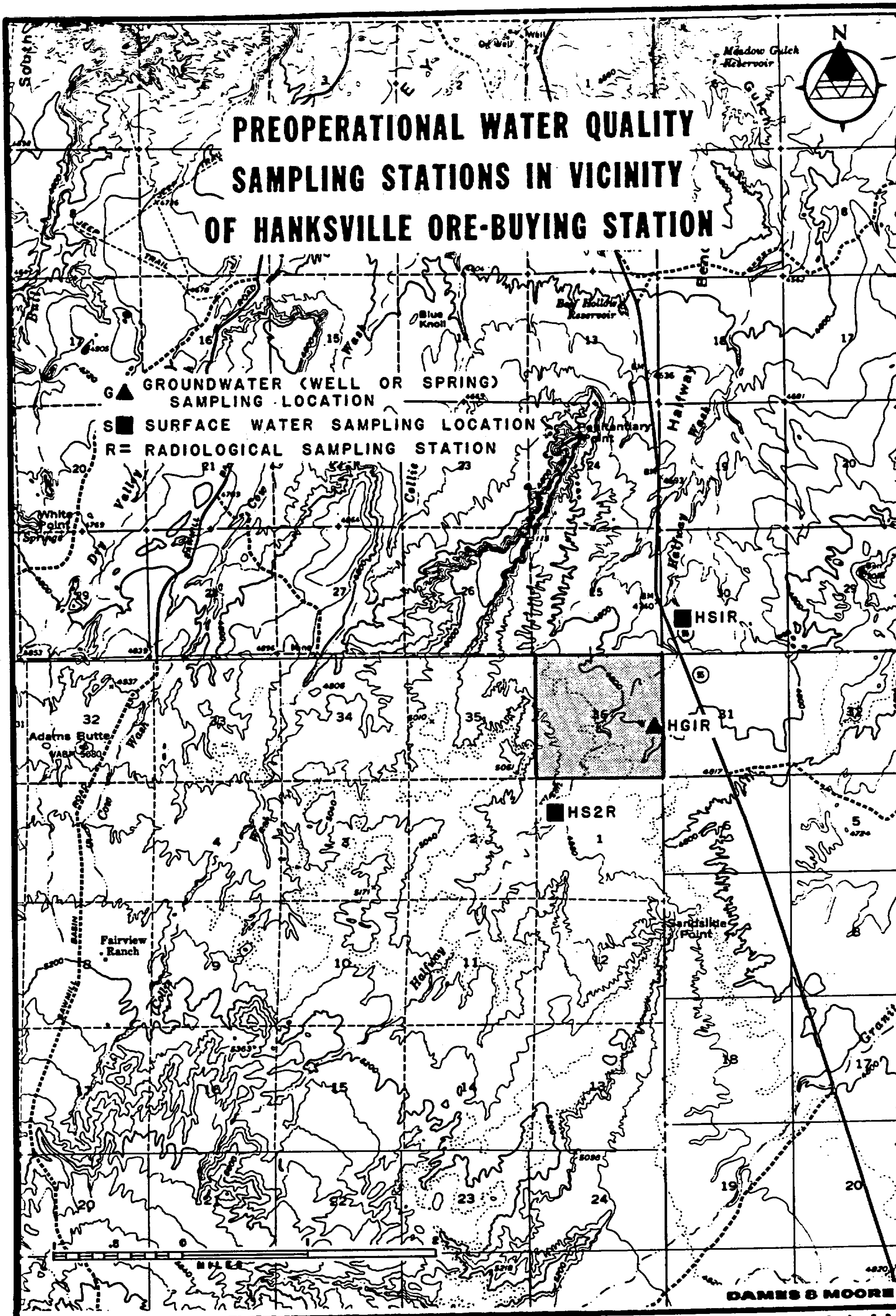

PREOPERATIONAL WATER QUALITY
SAMPLING STATIONS IN VICINITY
OF HANKSVILLE ORE-BUYING STATION
G▲ GROUNDWATER (WELL OR SPRING)
SAMPLING LOCATION
S■ SURFACE WATER SAMPLING LOCATION
R= RADIOLOGICAL SAMPLING STATION
HS1R
HG1R
HS2R
N
Meadow Gulch Reservoir
Blue Knoll
Halfway Wash
White Point Springs
Adams Butte
Fairview Ranch
Sandslide Point
Granite
MILES
DAMES & MOORE

PLATE 2.6-11

sampling was performed by Dames & Moore personnel using the "scintillation flask method" (see Section 6.1.5.6).

2.9.1.3 Ground Water

Quarterly sampling of ground water and radiometric analysis of composite samples was begun in July 1977 as part of the water quality monitoring program described in Section 2.6.3.1. The results of analyses to date are presented in Table 2.6-6.

2.9.1.4 Surface Water

Collection of composite surface water samples from the environs of the project site was begun in July 1977 and is on-going (see Section 2.6.3.2). The results of radiometric analyses of samples collected to date are presented in Table 2.6-7.

2.9.1.5 Soils

Collection of soil samples from the environs of the project site was initiated in June 1977 and will be repeated, on a quarterly basis, for a period of one year. The results of radiometric analyses will be presented in the Supplemental Report.

2.9.1.6 Vegetation

Composite terrestrial vegetation samples were collected May 17, 1977 at two locations on the project site. The results of the radiometric analyses of these samples are presented in Table 2.9-3.

The higher concentration of lead-210 relative to the other nuclides is attributed to the foliar deposition of lead-210 as a result of the decay of atmospheric radon-222. This concentration is normal for radionuclide measurements in vegetation.

2.9.1.7 Wildlife

Collection of terrestrial mammals, primarily Dipodomys ordi, in the vicinity of the project site was begun during May 1977. Samples were composited by station prior to analysis. The results of the

ATTACHMENT 2

final

NUREG-0556

environmental statement

related to operation of

WHITE MESA URANIUM PROJECT

ENERGY FUELS NUCLEAR, INC.

MAY 1979

Docket No. 40-8681

U. S. Nuclear Regulatory Commission • Office of Nuclear Material Safety and Safeguards

NUREG-0556

FINAL ENVIRONMENTAL STATEMENT

related to the
Energy Fuels Nuclear, Inc.,

WHITE MESA URANIUM PROJECT

(San Juan County, Utah)

Docket No. 40-8681

May 1979

prepared by the
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

2.6.2 Groundwater

A generalized section of the stratigraphic and water-bearing units in southeastern Utah is shown in Fig. 2.6. Recharge of these aquifers occurs from seasonally variable rainfall infiltrating along the flanks of the Abajo, Henry, and La Sal mountains and along the flanks of folds. Recharge water also originates from precipitation on the flat-lying beds where it percolates into the groundwater region along joints.

In the White Mesa area, 39 groundwater appropriations (applications for water wells) are on file with the Utah State Engineers Office for wells lying within an 8-km (5-mile) radius of the project site. All but one of these wells produce from the Dakota and Morrison formations. Thirty-five of these are for wells which are actually constructed (ER, Table 2.6-1). Most of these wells produce less than 55 m^3/day (10 gpm) and are used for domestic, irrigation, and stock-watering purposes. The remaining well, which was drilled to a depth of 548 m (1800 ft) by Energy Fuels Nuclear, withdraws water from the Navajo Sandstone. The majority (31) are hydrologically upgradient or cross gradient with respect to the project site. The remaining four wells (three onsite and one offsite, south) are on land owned by the applicant. Two of the onsite wells are located in the area of the proposed tailings impoundment and will be completely plugged with bentonite and/or another suitable clay.[5,6] The well which is offsite and south will be capped or used for monitoring purposes.

As is the case throughout most of the Four Corners region, the Blanding area depends largely on groundwater for its water supply. A porous soil, underlain by the Dakota Sandstone on top of a regional aquiclude (the Brushy Basin Member of the Morrison Formation), provides the Blanding area with a near-surface source of groundwater. This situation is somewhat uncommon in the highly dissected south-central portion of the Colorado Plateau.

The Dakota sandstone on White Mesa has been completely isolated by erosion; consequently, all recharge to this formation comes from precipitation and irrigation on the mesa. No irrigation occurs close to the mill site, and normal precipitation is only 30 cm (12 in.) per year, most of which reenters the atmosphere as evapotranspiration (i.e., it does not penetrate the soils over the Dakota). The Dakota is the underlying bedrock under the proposed tailings impoundment and has a permeability coefficient from 1.5 to 3 m (5 to 10 ft) per year (ER, Sect. 4.2.4.1 and Appendix H). Jointing occurs in the formation but is probably not fully penetrating. An aquiclude, the Brushy Basin member of the Morrison Formation, underlies the Dakota sandstone, which accounts for the groundwater retained in the lower portion of the Dakota.

In the immediate vicinity, only the Dakota Sandstone and the Salt Wash Member (including the Westwater Member) are significant aquifers. The Entrada and Navajo formations contain larger quantities of water, but their depth prohibits common exploitation, in use for domestic water supplies.

Comb Ridge and the Abajo Mountains are significant areas of recharge of the Salt Wash and deeper aquifers. General gradients of groundwater movement in these aquifers follow the regional structure, and the water discharges ultimately in the vicinity of the San Juan River.

Because the Brushy Basin Member acts as an aquiclude to the Salt Wash Member in the uplands, the primary recharge areas for this aquifer are Brushy Basin Wash to the northwest of Blanding, Cottonwood Creek to the west and southwest of the town, and the upper reaches of Montezuma Creek, especially along Dodge and Long canyons.

Several permeability tests were conducted at the mill and tailings retention sites. The results of these tests show a hydraulic conductivity of 1.5 to 3 m (5 to 10 ft) per year (see Fig. 2.7). The shallow groundwater movement at the mill site is estimated to be about 0.3 to 0.6 cm (0.01 to 0.02 ft) per year toward the south-southwest and the shallow groundwater movement at the tailings site is about 0.08 to 0.3 cm (0.0025 to 0.01 ft) per year in the same direction. The values were derived using the following formula based on Darcy's Law:

$$V = Ki/\theta ,$$

where

DRILL HOLE NO.	DATE	LAND SURFACE ELEVATION	DEPTH TO WATER	ELEVATION OF WATER
3	08/19/77	5634.4	56.5'	5577.9
	08/22/77		56.0'	5578.4
	08/27/77		56.5'	5577.9
	11/04/77		56.8'	5577.6
9	08/30/77	5679.3	100.0'	5579.3
	11/04/77		99.8'	5579.5
12	08/30/77	5648.1	75.0'	5573.1
	11/04/77		81.3'	5566.8
19	08/27/77	5600.3	110.0'	5490.3
	11/04/77		110.0'	5490.3
28	08/22/77	5547.6	75.0'	5472.6
	08/27/77		76.0'	5471.6
	11/04/77		75.7'	5471.9
N. E.	11/04/77	5472	34.7'	5637.3
N	08/16/77	5653	93.0'	5560.0
	08/22/77		93.5'	5559.5
	08/27/77		94.0'	5559.0
	09/08/77		94.0'	5559.0
S. E.	08/08/77	5595	96.0'	5499.0
	08/16/77		84.0'	5511.0
	08/22/77		84.5'	5510.5
	08/27/77		84.5'	5510.5
S. W.	08/08/77	5595	91.0'	5504.0
	08/16/77		90.0'	5505.0
	08/22/77		90.5'	5504.5
	08/27/77		90.0'	5505.0
	11/04/77		90.7'	5504.3

KEY

—5520'— ELEVATION OF WATER TABLE (FEET ABOVE MSL)

←—— DIRECTION OF SHALLOW GROUND WATER MOVEMENT

○28 BOREHOLE LOCATION AND NUMBER ENCOUNTERING WATER

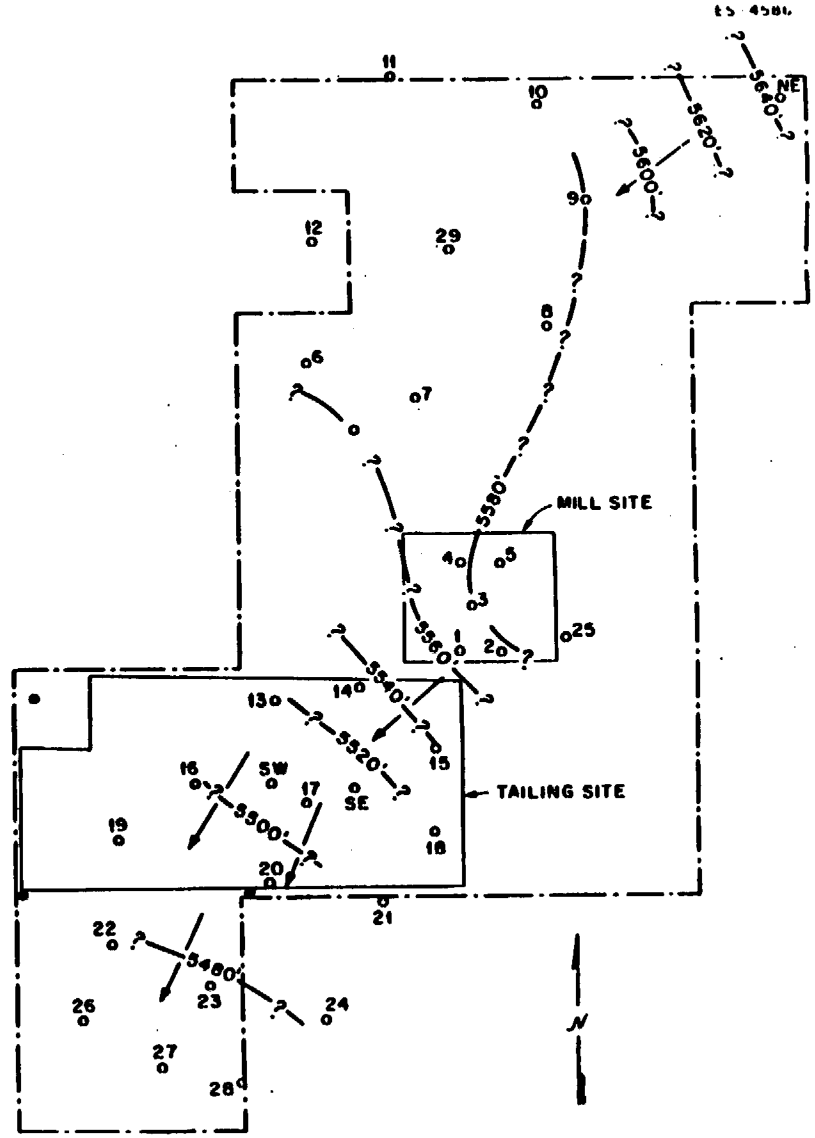


Fig. 2.7. Groundwater-level map of the White Mesa site.
Source: ER, Plate 2.6-2.

Table 4.4. Effects of initial construction stages

Location	Area		Yearly sediment production to local streams		Yearly net change		Yearly change	
	ha	acres	MT/ha	tons/acre	MT/ha	tons/acre	MT	tons
Borrow area	15	36	0	0	−22	−10	−330	−360
Topsoil stockpile slopes	0.2	0.5	1120	500	1098	+490	220	245
Overburden stockpile slopes	0.4	1	1120	500	1098	+490	439	490
Topsoil central stockpile	3.6	9	0	0	−22	−10	−79	−90
Overburden central stockpile	6	15	0	0	−22	−10	−132	−150
Evaporation cells I and E	40	98	0	0	−22	−10	−880	−980
Tailing cells 2 and 3	50	124	0	0	−22	−10	−1100	−1240
Mill site drainage	24	60	0	0	−22	−10	−528	−600
Net							−2390	−2685

Source: Energy Fuels Nuclear, Inc., "Transmittal of Conceptual Review Construction Drawing Set and Synopsis, Tailings Management System, White Mesa Uranium Project, Blanding, Utah," Apr. 2, 1979.

There will be no discharge of mill effluents to local surface waters. In addition, sanitary wastes generated by mill operation will be retained in a sanitary drainage field (Sect. 3.2.3.2) and should not affect surface-water quality.

The construction and operation of the proposed uranium mill should not affect local surface waters to any significant extent.

4.3.2 Groundwater

4.3.2.1 Water usage

The applicant has obtained a permit to utilize up to 1.0×10^6 m^3 (811 acre-ft) although the mill will only use about 5.9×10^5 m^3 (480 acre-ft) of water per year, which will be withdrawn from the Navajo sandstone aquifer. All other wells within 8 km (5 miles) produce from other formations. This usage will have no effect on other users.

4.3.2.2 Potential degradation of groundwater

The mill will discharge about 1.12 m^3/min (310 gpm) of liquid to the proposed tailings impoundment (Fig. 3.4). The chemical and radiological composition of this waste liquid is given in Table 3.1.

The applicant has proposed to line the evaporation cells (1-I and 1-E) and tailings cell 2 with a multicomponent liner (of synthetic and onsite clayey-silt materials) and to line the remaining tailings cells with a 2 foot layer of compacted clay (permeability approximately 3×10^{-8} cm/sec) to essentially eliminate seepage into the underlying Dakota formation; therefore, the possibility of groundwater degradation caused by seepage of tailings liquids is considered to be remote. After reclamation, when deterioration of the liner may have occurred, the staff expects essentially no seepage into the Dakota formation because of the high net evaporation rate in the area. Preoperational and operational monitoring of the groundwater is required (Sect. 6.3), and mitigating measures will be taken if unexpected groundwater contamination is observed.

Table 6.1. Preoperational monitoring program

Type of sample	Sample collection: Number	Sample collection: Location	Sample collection: Type and frequency	Sample measurement: Test frequency	Sample measurement: Type of measurement
Air					
Particulate	3	Locations onsite at or near site boundaries	Continuous; weekly	Quarterly composites of samples	Natural uranium, Ra 226, Th 230, and Pb 210
Particulate	1	Locations offsite including nearest residences	Continuous; weekly	Quarterly composites of samples	Natural uranium, Ra 226, Th 230, and Pb 210
Particulate	1	Background location remote from site	Continuous; weekly	Quarterly composites of samples	Natural uranium, Ra 226, Th 230, and Pb 210
Radon gas	5	At same locations where particulates are sampled	Continuous (one week per month; same period each month); samples collected for 48-hr intervals	Each 48-hr sample	Rn-222
Water					
Groundwater	3	Wells located around tailings disposal area (one downgradient and two crossgradient; deep)	Grab; quarterly	Quarterly	Dissolved natural uranium, Ra-226, Th-230, and chemicals[a]
				Semiannually	Dissolved Pb-210 and Po-210
	1 (from each well)	Wells within 2 km of tailings disposal areas (could be used for potable water or irrigation)	Grab; quarterly	Quarterly	Total and dissolved natural uranium, Ra-226, Th-230, and chemicals[a]
				Semiannually	Total and dissolved Pb-210 and Po-210
	1	Well located up gradient from disposal area for background	Grab; quarterly	Quarterly	Dissolved and natural uranium, Ra 226, Th-230, and chemicals[a]
				Semiannually	Dissolved Pb-210 and Po-210
Surface water	1 (from each body of water)	Onsite or offsite streams (Westwater Creek, Corral Creek, Cottonwood Wash, etc.) which may be potentially contaminated by direct surface drainage or tailings impoundment failure	Grab; quarterly	Quarterly	Suspended and dissolved natural uranium, Ra-226, Th 230
			Grab; semiannually	Semiannually	Suspended and dissolved Pb-210 and Po-210
Vegetation (forage)	3	Grazing areas near the mill site in different sectors having the highest predicted particulate concentrations during milling operations	Grab; three times during grazing season	Three times	Natural uranium, Ra-226, Th-230, Pb-210, and Po-210
Food (crops, livestock)	3 (of each type)	Within 5 km of mill site	Grab; three times during harvest or slaughter	One time	Natural uranium, Ra-226, Th 230, Pb-210, and Po-210
Fish	Each body of water	Collection of game fish (if any) from streams in the site environs which may be contaminated by surface runoff or tailings impoundment failure	Grab; semiannually	Two times	Natural uranium, Ra 226, Th 230, Pb-210, and Po 210

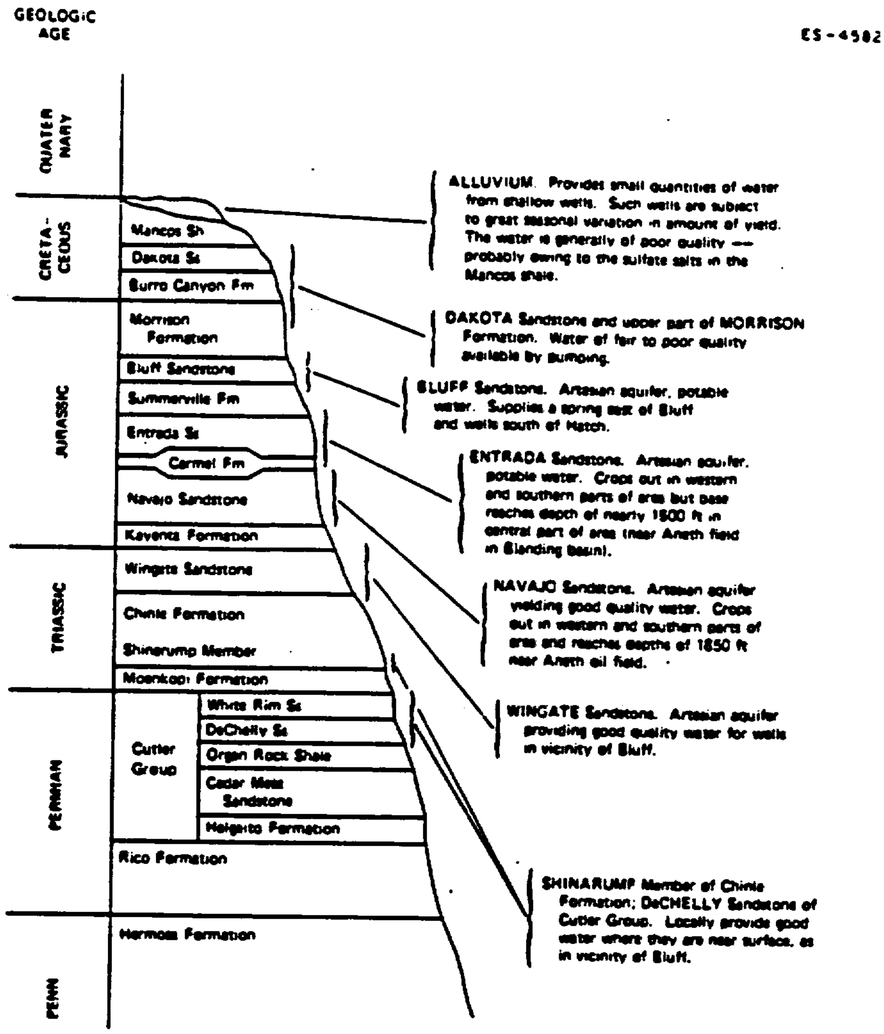


Fig. 2.6. Generalized stratigraphic section showing freshwater-bearing units in southeastern Utah. Source: ER, Plate 2.6-1.

V = the rate of movement of groundwater through the formation,

K = the hydraulic conductivity of formation 1.5 to 3 m/year (5 to 10 ft/year),

i = gradient (calculated as 0.03 at mill site and 0.01 at tailings site),

θ = porosity of formation (assumed as 20%).

Table 2.25 is a tabulation of groundwater quality of the Navajo Sandstone aquifer. The TDS range from 244 to 1110 mg/liter in three samples taken over a period from January 27, 1977, to May 4, 1977. High iron (0.57 mg/liter) concentrations are found in the Navajo Sandstone. The U.S. Environmental Protection Agency recommends 0.3 mg of dissolved iron per liter for drinking water.[13] Feltis[14] noted that the total dissolved solids in the alluvium and at shallow depths in the Dakota Sandstone, the Burro Canyon Formation, and the Morrison Formation range from 300 to 2000 mg/liter.

The applicant has sampled groundwater from local springs and wells at locations shown in Fig. 2.5. Total dissolved solids ranged from about 700 to 3300 mg/liter. Standards for public drinking water were frequently exceeded for sulfate, selenium, iron, and arsenic. The waters are suitable for stock and wildlife use.

Table 2.25. Water quality of groundwater in the project vicinity[a]
Zero values (0.0) are below detection limits

Parameter	Blanding mill site well in Navajo Sandstone, G2R				
	1/27/77[b]	5/4/77[c]	7/25/77	12/05/77	3/23/78
Field specific conductivity, μmhos/cm			400		310
Field pH			6.9		7.6
Dissolved oxygen					—
Temperature °C			22.2		11
Estimated flow, m^3/day (gpm)			109 (20)		—
Determination, mg/liter					
pH	8.0	7.8	7.7	7.8	8.16
TDS (at 180°C)	244	245	1110	446	216
Redox potential			220	220	211
Alkalinity (as $CaCO_3$)	189	180	224	185	187
Hardness, total (as $CaCO_3$)	198		208	195	177
Carbonate (as CO_3)	0.0		0.0	0.0	0.0
Aluminum, dissolved			<0.01	<0.1	<0.1
Ammonia (as N)	0.0		<0.1	<0.1	0.16
Arsenic, total	0.014		<0.01	<0.01	0.007
Barium, total	<0.0		0.13	<0.1	0.15
Boron, total	0.040		<0.1	0.11	<0.1
Cadmium, total	0.0		0.004	<0.02	<0.005
Calcium, dissolved	51	49	61	57	112
Chloride	0.0	50	<1	2	4
Sodium, dissolved	8.0		5.3	23	13
Silver, dissolved	0.0		<0.002	0.010	0.006
Sulfate, dissolved (as SO_4)	24	17	17	83	26.7
Vanadium, dissolved			<0.002	0.16	0.005
Manganese, dissolved	0.020		0.03	0.03	0.03
Chromium, total	0.0		0.02	<0.05	0.02
Copper, total	0.0		0.005	<0.010	0.005
Fluoride, dissolved	0.17	0.1	0.22	0.2	0.2
Iron, total	0.54		0.81	0.35	2.1
Iron, dissolved			0.57	0.30	2.3
Lead, total	0.0		0.02	<0.05	<0.05
Magnesium, dissolved	17	18	18	15	21
Mercury, total	0.0	0.0	0.002	<0.00002	0.00002
Molybdenum, dissolved			<0.01	0.010	0.004
Nitrate (as N)	0.05	0.12	<0.05	<0.05	<0.05
Phosphorus, total (as P)	0.03		<0.01	<0.02	0.03
Potassium, dissolved	3.0		3.2	2.8	2.4
Selenium, dissolved	0.0		0.05	0.014	<0.005
Silica, dissolved (as SiO_2)	12	5.8	12	6	8
Strontium, dissolved			0.67	0.5	0.60
Uranium, total (as U)			<0.002	0.16	<0.002
Uranium, dissolved (as U)			<0.002	0.031	<0.002
Zinc, dissolved	0.0		0.38	0.007	0.12
Total organic carbon				1.1	16
Chemical oxygen demand				<1	66
Oil and grease				1.0	1
Total suspended solids				6	1940
Determination (pCi/liter)					
Gross alpha ± precision		7	10.2 ± 2.8	1.6 ± 1.3	1.8 ± 1.4
Gross beta ± precision		<20	73 ± 19	8 ± 6	9 ± 6
Ra-226 ± precision			0.1 ± 0.3	0.6 ± 0.4	0.3 ± 0.3
Th-230 ± precision			0.7 ± 2.7	0.3 ± 0.6	0.1 ± 0.4
Pb-210 ± precision			1.0 ± 2.0	0.7 ± 2.1	0.0 ± 4.0
Po-210 ± precision			0.0 ± 0.3	0.0 ± 0.8	0.0 ± 0.6

[a]The spring in Corral Creek, Station No. G1R, was tested on July 25, 1977, and again on November 10, 1977. Because of the low flow, the spring could not be located.

[b]Utah State Division of Health Analysis, Lab No. 77081.

[c]Partial analysis by Hazen Research, Inc., Sample No. HRI-11603.

Source: Adapted from ER, Table 2.6-6, and "Supplemental Report, Baseline Water Quality Environmental Report, White Mesa Uranium Project," June 29, 1978.

The staff feels that the applicant's revegetation procedures and monitoring programs are adequate to ensure successful reclamation. Sufficient records must be maintained by the applicant to furnish evidence of compliance with all monitoring. The applicant will file a performance bond with the State of Utah to ensure performance of land reclamation.

6.3 WATER

6.3.1 Surface water

Quarterly monitoring of surface-water quality will continue throughout the life of the project. Sample locations are described in Table 2.21 and Fig. 2.5, and the chemical and physical parameters to be measured are given in Table 2.20. Because of the temporary nature of many of the watercourses in the site vicinity, it is recommended that the applicant take advantage of seasonal rainfall and snowmelt in scheduling the collection of water samples.

6.3.2 Groundwater

The applicant has supplied chemical constituent data for samples from each of two abandoned stock wells on the project site. Water from these wells (G6R and G7R on Fig. 2.5), completed in the Dakota Sandstone, is of poor quality. Total dissolved solids are in excess of 2000 ppm, which would have adverse effects on many crops. Total sulfate is in excess of 1300 ppm compared with an acceptable value of 250 ppm; dissolved iron is in excess of 3 ppm compared with an acceptable value of 0.05 ppm; and lead is in excess of 0.12 ppm compared with an acceptable value of 0.05 ppm.[5] Data from local springs indicate that the water is suitable for stock and wildlife use only.

Additional sampling in accordance with Table 6.1 will be required. During operation, the applicant will be required to monitor the groundwater from wells installed and located as specified in the Source Material License to detect potential groundwater contamination (as discussed in Sect. 4.3.2.2) until reclamation is completed. The applicant is also required to submit a plan to mitigate such contamination if observed.

6.4 SOILS

During September 1977, an existing soil survey of the site was field-verified by a retired USDA Soil Conservation Service scientist, and a soil scientist for the applicant's consultant (ER, Sect. 6.1.4.1). At least one soil profile for each mapping unit was located and sampled. Soil analyses for potential uses in reclamation operations included contents and characteristics such as texture, water-holding capacity, saturation percentage, pH, lime percentage, gypsum, electrical conductivity, exchangeable sodium percentage, sodium adsorption ratio, organic carbon, cation exchange capacity, boron, selenium and available phosphates, potassium, and nitrate/nitrogen (ER, Sect. 6.1.4.1).

6.5 BIOTA

6.5.1 Terrestrial

Plant communities at the project site were mapped by aerial photographs and field verification (ER, Sect. 6.1.4.3). Vegetation on the site was surveyed during the spring and summer of 1977 (Fig. 6.1). Five 1.0-m^2 quadrats were placed every 10 m along 100-m transects. The number of transects varied depending upon the size and homogeneity of the community. The larger and more diverse communities had the greatest number of transects. Species collected were tentatively identified in the field and later verified at the Rocky Mountain Herbarium of the University of Wyoming. The density of each species was determined by counting the number of individual plants in each quadrat. The percentage of cover for each community was estimated visually within each quadrat, and all quadrats were then summed and divided by the total number of quadrats to reach a mean percentage of cover for the entire community. Production studies were also conducted during the 1977 growing season (April through September) and expressed as kilograms per hectare (pounds per acre). The number of 1.0-m^2 samples taken in each community on the site to measure production varied from 5 to 40, depending upon the size and homogeneity of the community.

Table 6.1. (continued)

Type of sample	Sample collection			Sample measurement	
	Number	Location	Type and frequency	Test frequency	Type of measurement
Site survey					
Gamma dose rate	80	150-m intervals to a distance of 1500 m in each of eight directions from a point equidistance between the milling area and tailings pond	Gamma dose rate; once prior to construction	One time	Pressurized ionization chamber or properly calibrated portable survey instrument
	10	150-m intervals in both horizontal and vertical transverses across the milling areas	Gamma dose rate; once following preparation of milling site	One time	Pressurized ionization chamber or properly calibrated portable survey instrument
	5	At same locations as used for collection of particulate samples	Gamma dose rate; quarterly	Quarterly	Pressurized ionization chamber or properly calibrated portable survey instrument
Surface soil	40	300-m intervals to a distance of 1500 m in each of eight directions from a point equidistance from mill and tailings pond sites	Grab; once prior to site construction	One time	All samples for Ra-226, 10% of samples for natural uranium, Th 230, and Pb 210
	6	300-m intervals in both a horizontal and vertical transverse across the milling area	Grab; once following site preparation	One time	All samples for Ra-226, one sample for natural uranium, Th 230, and Pb-210
	5	At same locations as used for collection of air particulate samples	Grab, once prior to site construction	One time	Natural uranium, Ra 226, Th 230, and Pb-210
Subsurface soil profile	5	750-m intervals in each of four directions from a point equidistance from the mill and tailings pond sites	Grab; once prior to site construction	One time	All samples for Ra 226, one set of samples for natural uranium, Th 230, and Pb-210
	1	At center of mill building area	Grab; once following site preparation	One time	Natural uranium, Ra-226, Th 230, and Pb-210
Sediment	2 (from each stream)	Upstream and downstream of waters that may receive surface water runoff from potentially contaminated areas or that could be affected by tailings impoundment failure	Grab; once following spring runoff and once in late summer following period of extended low flow	Two times	Natural uranium, Ra 226, Th-230, and Pb-210
Radon-222 flux	10	At center of mill site and at 750 and 1500 m in each of four directions from the site	Two- to three-day period, one sample during each of three months (normal weather)	Each sample	Rn-222 flux

[a]Nonradiological chemical parameters listed in Table 2.25.

Source. "Branch Position for Preoperational Radiological Environmental Monitoring Program for Uranium Mills," U.S. Nuclear Regulatory Commission, Memorandum from L. C. Rouse, Chief of Fuel Processing and Fabrication Branch, Jan. 9, 1978.

ATTACHMENT 3

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

AUG 0 7 1979

Docket No. 40-8681

Energy Fuels Nuclear, Inc.
ATTN: Mr. R. W. Adams
Chairman of the Board
Three Park Central, Suite 900
1515 Arapahoe
Denver, Colorado 80202

Gentlemen:

Enclosed is Source Material License No. SUA-1358. This license is being issued subsequent to the notice of availability by the Environmental Protection Agency on May 25, 1979, of the Nuclear Regulatory Commission's Final Environmental Statement (FES) related to the operation of your uranium mill. This license does not presently authorize construction of the embankments proposed for the tailings impoundment nor does it authorize construction of tailings impoundment liner system. NRC approval shall be incorporated into this license by amendment and shall be obtained prior to construction of either of these tailings impoundment system components. Please note that this license is conditioned to require that the licensee shall, at least three months prior to the initiation of mill operations, submit the surety arrangements as well as supporting documentation showing a breakdown of the costs associated with mill decommissioning and mill site and tailings area reclamation to the NRC and shall receive approval of the surety arrangements from NRC prior to the initiation of mill operations.

At least ninety (90) days prior to the anticipated start-up of milling operations, you must notify the NRC of such in writing in order that the Commission's staff can conduct an on-site inspection of both the mill and tailings impoundment prior to mill start-up. Please note that all administrative and operating procedures and monitoring programs must be developed and implemented at least 30 days prior to mill start-up. In addition, all staffing and employee training must be completed at least one week prior to mill start-up.

Please note that this license contains conditions which were discussed and agreed upon in conversations between your Mr. C. E. Baker and Mr. E. A. Trager of my staff.

As you are aware, the Commission is preparing a Generic Environmental Impact Statement (GEIS) on uranium milling. Please be advised that the conclusions of this GEIS, and any related rule making, may result in new requirements concerning your mill waste generating processes and tailings management practices.

FOR THE NUCLEAR REGULATORY COMMISSION

John J Linehan

for Ross A. Scarano, Chief
Uranium Recovery Licensing Branch
Division of Waste Management

Enclosure:
Source Material License No. SUA-1358

NRC-374
(9-78)

U. S. NUCLEAR REGULATORY COMMISSION
MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and itle 10, Code of Federal Regulations, Chapter 1, Parts 30, 31, 32, 33, 34, 35, 36, 40 and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the lace(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations f the applicable Part(s); and to import such byproduct and source material. This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regula-tions and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee	
1. Energy Fuels Nuclear, Inc.	3. License number SUA-1358
2. Three Park Central, Suite 900 1515 Arapahoe Denver, Colorado 80202	4. Expiration date August 31, 1984
	5. Docket or Reference No. 40-8681

6. Byproduct, source, and/or special nuclear material	7. Chemical and/or physical form	8. Maximum amount that licensee may possess at any one time under this license
Natural Uranium	Any	Unlimited

9. The licensee is hereby authorized to possess byproduct material in the form of uranium waste tailings generated by the licensee's milling operations authorized under SUA-1358.

10. Authorized place of use: The licensee's uranium ore buying and milling facilities located in San Juan County, near Blanding, Utah.

11. For use in accordance with statements, representations, and conditions contained in Subsection 2.1.1 and Plates 2.1-1 and 2.1-2, Subsections 3.2 and 3.5 through 3.7 and Plates 3.1-1 through 3.1-5, Section 4 and Tables 4.1-1 and 4.1-2, Section 5 (and tables), Subsection 6.3, and Section 7 of the licensee's application dated February 6, 1978, and revisions dated September 26, 1978, and July 6 and 16, 1979 and a supplement dated August 3, 1979. Whenever the word "will," "would" or "should" is used in the above, it shall denote a requirement.

12. The maximum mill throughput shall not exceed 4700 pounds of barreled U_3O_8 per day, averaged over a year.

13. The licensee is hereby exempted from the requirements of Section 20.203(e)(2) of 10 CFR Part 20 for areas within the mill, provided that all entrances to the mill are conspicuously posted in accordance with Section 20.203(e)(2) and with words, "Any area within this mill may contain radioactive material."

14. Any changes in the mill circuit or effluent collection systems, as illustrated and described in Subsections 3.2 and 3.5, Plates 3.1-1, 3.1-2, 3.1-3 and 3.1-5, Section 4, and Tables 4.1-1 and 4.1-2, of the licensee's application, shall require approval by the NRC in the form of a license amendment.

15. Operations shall be immediately suspended in the affected areas of the ore buying station or the mill if any of the emission control equipment, for the ore crushing or feed areas or the yellowcake drying or drumming areas specified in Table 4.1-1 of the licensee's application, is inoperative.

16. The results of sampling, analyses, surveys and monitoring, the results of calibration of equipment, reports on audits and inspections, and all meetings and training courses, committed to in Sections 4.5 and 7 and Subsections 3.2 and 3.5 through 3.7 and 6.3 of the licensee's application and supplements and in the additional conditions to this license, as well as any subsequent reviews, investigations, and corrective actions, shall be documented. Unless otherwise specified in NRC regulations, all such documentation shall be maintained for a period of at least 5 years.

17. The licensee shall maintain a management control program which shall include written operating procedures, reviewed and approved by the Radiation Safety Officer, for all aspects of mill operations, including the radiation safety program and the environmental monitoring and control program. Approval by the RSO will be indicated by the signature of the RSO on the procedure.

18. A formal report of the quarterly review/audit of all audits and inspections as well as employee exposures (including bioassay data), effluent release data, and environmental data shall be prepared by the Internal Audit Committee and along with conclusions and recommendations submitted to the Vice President of Uranium Operations to determine (1) if there are any upward trends developing in personnel exposures for identifiable categories of workers or types of operations or effluent

releases, (2) if exposures and effluents might be lowered under the concept of as low as reasonably achievable, and (3) if equipment for effluent and exposure control is being properly used, maintained, and inspected. This review shall include a review of the radiation safety and environmental monitoring programs data collected during the three previous quarters.

19. Eating and/or smoking shall only be allowed in control rooms, offices, or enclosed lunch areas.

20. In-plant airborne monitoring, committed to in Section 5 of the licensee's application and supplements, shall be performed under conditions typical of employee exposures. Along with results of airborne radioactivity, a record of the state of operation of both process and effluent control equipment and ventilation conditions shall be kept.

21. Release of equipment or packages from the restricted area shall be in accordance with Annex C, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," dated November 1976 (enclosed).

22. The licensee shall conduct at least-biweekly surface contamination surveys (both smear and total contamination) in all eating areas, change rooms, control rooms, and mill administrative offices. Decontamination of these areas shall be in accordance with Annex C, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," dated November 1976 (enclosed).

23. The licensee shall implement a program to minimize dispersal of dust from the ore piles by water sprinkling or other dust suppression techniques, unless a documented weekly inspection indicates that the moisture content of the ore and/or weather conditions are controlling dusting. This program shall include the use of written operating procedures that specify the use of specific control methods for all conditions.

24. The licensee shall construct the tailings disposal facility to incorporate the features described in Alternative 1 of Section 10.3.2 and Section 3.2.4.7 of NUREG-0556, dated May 1979, subject to revisions based on the conclusions of the final Generic Environmental Impact Statement on Uranium Milling and any related rulemaking.

25. Construction of any of the tailings embankments shall not begin until the system design has been reviewed and approved by the NRC in accordance with Regulatory Guide 3.11. NRC approval shall be incorporated into this license by amendment and shall be required prior to embankment construction. Required freeboard and other operating requirements shall be determined during the review.

26. The licensee shall construct the liner system for the tailings area only after the final liner and liner system specifications and the program for installatio maintenance and inspection of the liner system have been reviewed and approved by the NRC staff. NRC approval shall be incorporated into this license by amendment and shall be required prior to liner construction.

27. The licensee shall provide for stabilization and reclamation of the mill site and tailings disposal areas and mill decommissioning as described in Alternative 1 of Section 10.3 and in Section 3.3 of NUREG-0556, dated May 1979, subject to revisions based on the conclusions of the Final Generic Environmental Impact Statement on Uranium Milling and any related rulemaking. Decontamination shall be in accordance with Annex C, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricte Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," dated November 1976 (enclosed). In addition, surety arrangements shall be provided prior to the initiation of mill operations and maintained in order to ensure completion of the mill site and tailings area stabilization, reclamation, and decommissioning plans.

28. Prior to the initiation of mill activities and the associated generation of tailings, the licensee shall submit to the Uranium Recovery Licensing Branch, U.S. Nuclear Regulatory Commission, Washington, DC 20555, documentation that ownership of lands to be used for tailings disposal has been acquired as described in the licensee's application and supplements.

29. At least three months prior to the initiation of mill operations and the associated generation of tailings, the licensee shall submit the proposed suret arrangements as well as supporting documentation showing a breakdown of the costs associated with mill decommissioning and mill site and tailings area reclamation to the Uranium Recovery Licensing Branch, U.S. Nuclear Regulatory Commission, Washington, DC 20555. The licensee is required to receive approval of the surety arrangement held with the Utah Department of Natural Resources, Division of Oil, Gas and Mining, from NRC prior to

the initiation of mill activities and the associated generation of tailings. Within 30 days of each revision thereafter, the licensee shall submit to the Uranium Recovery Licensing Branch a copy of the proposed revision of the surety arrangements covering mill decommissioning and mill site and tailings area reclamation as well as supporting documentation showing a breakdown of the costs associated with these actions and to obtain approval of the NRC.

The NRC will not terminate the license until final reclamation meets applicable NRC regulations..

30. The licensee shall implement an interim stabilization program that minimizes to the maximum extent reasonably achievable dispersal of blowing tailings. This program shall include the use of written operating procedures that specify the use of specific control methods for all conditions. The effectiveness of the control methods used shall be evaluated weekly by means of a documented tailings area inspection.

31. The licensee shall conduct and document at least one inspection of the tailings embankment per day and shall immediately notify Region IV, U.S. Nuclear Regulatory Commission, Office of Inspection and Enforcement, Arlington, TX, by telephone and telegraph of any failure in the dam retention system or tailings discharge system which results in a release of radioactive material and/or of any of any unusual conditions which if not corrected could lead to such a failure. This requirement is in addition to the requirements of 10 CFR Part 20.

32. The licensee shall monitor the use of the tailings impoundment by wildlife in conjunction with the program to conduct and document an inspection of the tailings discharge system once per shift.

33. The licensee shall consult and coordinate with the Utah Division of Wildlife Resources regarding the extent of fencing and other ways to mitigate any adverse impacts that may occur to deer and shall document the results of these actions.

34. Before engaging in any activity not previously assessed by the NRC, the licensee shall prepare and record an environmental evaluation of such activity. When the evaluation indicates that such activity may result in a significant adverse environmental impact that was not assessed, or that is greater than that assessed in the Final Environmental Statement (NUREG-0556), the licensee shall provide a written evaluation of such activities and obtain prior approval of the NRC for the activity.

35. If unexpected harmful effects or evidence of irreversible damage not otherwise identified in NUREG-0556 dated May 1979 are detected during construction or operations, the licensee shall provide to the NRC an acceptable analysis of the problem and a plan of action to eliminate or significantly reduce the harmful effects or damage.

36. Mill tailings other than samples for research shall not be transferred from the site without specific prior approval of the NRC obtained through application for amendment of this license. The licensee shall maintain a permanent record of all transfers made under the provisions of this condition.

37. The results of the effluent and environmental monitoring program required by this license shall be reported in accordance with 10 CFR Part 40, Section 40.65. In addition, a copy of the report shall be sent directly to the Uranium Recovery Licensing Branch, U.S. Nuclear Regulatory Commission, Washington, DC 20555.

38. In addition to conducting the environmental monitoring program summarized in Appendix G of the application, the licensee shall perform air particulate monitoring as described in Appendix G of the application for "ore crusher stack" for all stacks from areas or process circuits in which ore, yellowcake or tailings are handled. Also, the licensee shall conduct a monitoring program to collect onsite meteorological data, e.g., wind speed and direction at 1-hour intervals and to annually reduce this data to a joint frequency distribution by wind speed, direction, and stability class. The results of these additional effluent and meteorological monitoring requirements shall be included in the licensee's semiannual environmental monitoring report to the NRC.

39. The licensee shall conduct an annual survey of land use (grazing, residences, wells, etc.) in the area within five miles of the mill and submit a report of this survey annually to the Uranium Recovery Licensing Branch, U.S. Nuclear Regulatory Commission, Washington, DC 20555. This report shall indicate any differences in land use from that described in the licensee's Environmental Report (January 1978) and supplements or the previous annual report. The first annual report shall be submitted by August 1, 1980, and by August 1 each year thereafter.

40. The licensee shall avoid by project design where feasible the archeological sites designated "Eligible" in the attached Table A, below. Sites that will ultimately be located within 100 feet of the perimeter of the reclaimed tailings impoundment area are considered unavoidable and shall be recovered through archeological excavation.

41. The licensee shall conduct testing as required and shall report the results of the testing to enable the Commission to determine if those archeological sites designated "Undetermined" in Table A are of significance warranting their redesignation as "Eligible." This action by the licensee shall be completed by January 1, 1981. In all cases such testing and a review of the testing results by the Commission shall be completed before any aspect of the undertaking affects a site.

42. The licensee shall conduct archeological and historic surveys and testing on the NE1/4 of Section 33, T37S, R22E to identify such additional sites as may be located there and to enable the Commission to evaluate their significance. The results of surveys and testing shall be reported to the Commission no later than December 1, 1979. The licensee shall avoid any site within this area until the Commission has reviewed the licensee's report and has advised the licensee of its determinations. If the Commission, upon review, amends Table A to include additional sites, the licensee shall take such action with respect to such additional sites as may be required for the sites that have initially been designated.

43. Condition 42, above, will apply to lands associated with the undertaking, but which have not currently been identified, e.g., to borrow areas outside the current project boundaries, with the exception that the results of surveys and testing may be reported to the Commission after December 31, 1979.

44. The licensee shall avoid any archeological site designated "Undetermined" in Table A.

45. When it is not feasible to avoid an archeological site designated "Eligible" in Table A, the licensee shall institute a data recovery program with respect to the site which the Commission determines will satisfactorily mitigate any adverse effect.

46. The licensee must cooperate with the Commission in the development and implementation of a monitoring program with respect to the preservation of cultural resources. The licensee shall have obtained the written approval of the Commission with respect to this program before initiation of ground-disturbing activities. The plan shall, among other things, include provision for (1) the presence during specified operations of an archeological contractor satisfactory to the Commission, and (2) appropriate action, including notice to the Commission and the SHPO and suspension of ground disturbing activities, upon discovery of previously unidentified cultural resources. An archeological contractor acceptable to the SHPO and meeting the minimum standards for a principal investigator as specified by the Secretary of the Interior will be considered satisfactory to the Commission.

47. The licensee shall recover through archeological excavation all "Eligible" archeological sites listed in Table A which are located in borrow areas, stockpile storage areas and construction areas. Recovery of all sites will be completed no later than December 31, 1982, with sites in the area of the first three tailings impoundment cells (the two evaporation cells and the first tailings cell) being recovered first.

48. The licensee shall have the archeological contractor approve the plan for the layout of haul roads, i.e., to best avoid sites, and shall obtain the written approval of the Commission for this plan prior to earth moving activities.

49. The licensee shall provide the additional documentation required to obtain a determination of eligibility for the "Earth Dam," "Range War Site," "Kunen Jones Home," "Posey War Sites," and "White Mesa Community" cultural sites prior to October 1, 1979. If the Earthen Dam is determined to be "Eligible," the licensee shall ensure that the Earthen Dam is recorded prior to its demolition or alteration so that there will be a permanent record of its existence. Energy Fuels Nuclear, Inc., will first contact the Historic American Engineering Record (HAER), Heritage Conservation and Recreation Service (Department of the Interior, Washington, DC 20243; telephone 202-343-4256) to determine the level of documentation required. All documentation must be accepted by the HAER prior to demolition or excavation. Copies of all documentation found acceptable to the HAER shall be provided to the Commission within one month of acceptance by the HAER.

FORM NRC-374A
(5-76)

U. S. NUCLEAR REGULATORY COMMISSION
MATERIALS LICENSE
Supplementary Sheet

License Number SUA-1358

Docket or Reference No. 40-8681

TABLE A

Archeological Sites Related to the White Mesa Project

Eligible Sites			Undetermined Sites				Non-Eligible Sites	
42Sa	6379	6699	42Sa	3766	6436	7685	42Sa	6380
	6385	6739		6381	6437	7686		6384
	6387	6740		6382	6438	7688		6386
	6388	7653		6383	6440	7692		6397
	6392	7655		6389	6442	7694		6404
	6393	7656		6390	6445	7695		6684
	6394	7657		6391	6686	7696		6685
	6395	7658		6398	6697	7699		6754
	6396	7659		6399	6752	7750		7654
	6403	7660		6400	6753	7751		7698
	6405	7661		6401	6757	7752		
	6408	7665		6402	7662	7753		
	6427	7668		6406	7663	7754		
	6429	7675		6407	7664	7875		
	6430	7684		6419	7669	7876		
	6432	7687		6420	7670			
	6435	7689		6421	7671			
	6439	7690		6422	7672			
	6441	7691		6423	7673			
	6443	7693		6424	7674			
	6444	7696		6425	7676			
	6693	7700		6426	7679			
				6428	7680			
				6431	7681			
				6433	7682			
				6434	7683			

Total: 44 Total: 67 Total: 10

For the U. S. Nuclear Regulatory Commissio

by John J. Linehan for R. A. Scarano

Division of Fuel Cycle and Material Safety
Washington, D.C. 20555

Date

ATTACHMENT 4

BKR

D'APPOLONIA

CONSULTING ENGINEERS, INC.

September 9, 1981

Project No. RM78-682-B

Dr. C.E. Baker
Energy Fuels Nuclear, Inc.
Suite 900
Three Park Central
1515 Arapahoe
Denver, CO 80202

RECEIVED
SEP 14 1981

XC: MDV
GWG
BKR
File - WMP, EML, Groundwater

Letter Report
Assessment of Groundwater Quality
White Mesa Project
Blanding, Utah

Dear Dr. Baker:

INTRODUCTION

In response to your request of June 4, 1981, D'Appolonia has reviewed the water quality data from monitor wells installed around the tailings retention area. The purpose of this review and evaluation is to determine if the data indicate any degradation of the groundwater quality which could be attributed to a leak from the tailings facility or any other mill-related operation. Pre-operational baseline data and operational data have been included in the review process. The data have been evaluated with regard to trends in select parameters and general overall water quality variation with time.

This report is divided into two main sections as follows:

- Evaluation of Groundwater Quality: Potential Degradation of Sources - This section contains the water quality evaluation of the existing local groundwater. Data from the pre-operational and operational wells were utilized.

- Evaluation of Well 7-2 Water Source - This section evaluates the possible sources for the water detected in Well 7-2. Data from the pre-operational and operational phase wells and surface water supplies were utilized.

EVALUATION OF GROUNDWATER QUALITY:
POTENTIAL DEGRADATION AND SOURCES

Data Reviewed

Available data reviewed and evaluated consisted of pre-operational water quality analyses from Wells 1, 2, 3, and 4 for October, 1979, and January and April, 1980, and monthly operational phase analyses from May 1980, through February, 1981. The pre-operational sampling and laboratory analyses were performed by D'Appolonia except for the radionuclide parameters which were performed by CDM Acculabs, Denver, Colorado (October, 1979), and Hazen Research, Golden, Colorado (January, April, 1980).

Monthly operational water quality data from May 1980 through February 1981 was provided by Energy Fuels. Wells sampled during this period were deep groundwater monitoring Wells 1, 2, 3, 4, 5, and intermediate depth leak detection Well 7-2. Samples for this period were taken by Energy Fuels personnel and the analyses performed by WAMCO Labs, Casper, Wyoming. During September, 1980, select samples were also analyzed by D'Appolonia for comparison purposes.

Indicator Parameters Selected for Evaluation

The water quality data was reviewed by selecting several parameters and plotting the values for each well against time. The parameters selected for evaluation with explanations of the rational for their selection follow:

- Sulfate, SO_4^{2-}: Sulfate is highly concentrated in the tailings water (35,000 mg/l) and tends to move relatively rapidly and freely through the subsurface at approximately the same rate as the groundwater. As the sulfate from tailings water reacts with calcareous soil, gypsum ($CaSO_4 \cdot 2H_2O$) will precipitate, removing some of the sulfate from the tailings water. However, the increase in sulfate concentration will still be substantially above background levels, thus indicating the probability of a leak.

- Chloride, Cl^-: Chloride is concentrated in the tailings water (2,200 mg/l) and moves through the subsurface at approximately the same rate as the groundwater. Chloride is usually considered a conservative species; that is, it does not react with the soil or groundwater. Thus, elevated chloride levels usually indicate a leak of tailings water. However, the increase over background levels is not as dramatic as observed with sulfate.

- Total Dissolved Solids, TDS: This parameter is an indicator of gross water quality and elevated values indicate an increase in dissolved ions in the water. Typically, 60 percent of the dissolved species in the tailings water are due to sulfate; therefore, an increase observed in TDS should indicate a corresponding increase in sulfate.

- Sodium, Na^{+}: Substantial concentrations of sodium exist in the tailings water (6,400 mg/l). As sodium is not very reactive in the subsoil environment, increased concentrations of sodium in the groundwater may indicate a leaking tailings cell.

- pH: This parameter is an indicator of the possible change in water quality because of acid tailings seepage. As tailings water reacts with calcareous soils, the pH is neutralized. During the neutralization process, many of the radionuclides (thorium, lead uranium, etc.) and the heavy metals are co-precipitated with iron oxyhydroxides. Therefore, decreases in pH indicate severe leakage and increased concentrations of radionuclides and heavy metals. The acid front is substantially attenuated relative to the movement of the groundwater; therefore, increases in sulfate and chloride will be observed much earlier than decreases in pH.

- Radium-226, Ra-226: This parameter is the most mobile radionuclide and therefore is an indicator of quality change. The movement of this element in the subsurface environment is probably controlled by the solubility of radium sulfate.

- Bicarbonate, HCO_3^-: Due to the low pH of the tailings water, no bicarbonate/carbonate ions are present. However, as the acid in the tailings water reacts with the calcareous soil, carbon dioxide and bicarbonate ions are generated. Therefore, elevated concentrations of bicarbonate may indicate acid leakage. Increases depend upon the amount of calcite that reacts; therefore, increases may be difficult to observe.

- Calcium, Ca^{2+}: Like bicarbonate, calcium ions result from reaction of the acid in the tailings water with the calcite in the soil. Some calcium is present already in the tailings water.

Calcium is also removed by the precipitate of gypsum. Overall, trends associated with calcium concentrations are difficult to interpret due to the variety of mechanisms occurring.

In summary, elevated concentrations of sulfate, chloride and TDS in the groundwater are probably the best indicators to evaluate a change in groundwater quality from an acid-type uranium mill and tailings facility.

Evaluation of Indicator Parameters

Values for each of the above parameters were plotted against time for each well as shown in Figures 1 through 8. In general, the data plotted on these figures indicates a change from pre-operational to operational phase values. The trend of this change is almost always an increase in value. This increase may not reflect an actual change in groundwater quality, rather it may be due to the differences in sampling procedures and laboratory techniques.

Specific items of importance observed for each of the indicator parameters are:

- Sulfate, SO_4^{2-}, Figure 1 - The data for this parameter are relatively constant except for Well 3 which shows a gradual, but erratic increasing trend. Wells 2 and 4 also appear to have slighly increasing concentrations. Well 1 consistently has the lowest values for the deep wells. However, Well 7-2 has lower values than Well 1.

- Chloride, Cl^-, Figure 2 - The data for this parameter are relatively variable with no particular trend, except again for Well 3. The chloride concentrations measured in Well 3 show a gradually increasing trend with time. Well 4 also appears to have slightly increasing values. Wells 1 and 2 have similar concentrations which are the lowest observed. Well 7-2 has substantially higher values than the other wells.

- Total dissolved solids, TDS, Figure 3 - This parameter indicates trends similar to that shown for sulfate. Concentrations in Well 3 are gradually increasing with time; concentrations in Well 1 are low, with Well 7-2 having similar, but slightly lower values.

- Sodium, Na^+, Figure 7 - The values for this parameter are constant with a very slight increasing trend noted in Wells 2 and 3. Well 7-2 has the lowest values and Well 1 the next lowest.

- pH, Figure 5 - This parameter is quite variable for all wells but typically fall within a range of pH = 6.5 to 7.75. A slightly decreasing trend was observed from September 1980 through February 1981, with Well 3 having the lowest value by a slight amount.

- Radium-226, Ra-226, Figure 6 - This parameter is variable, but no trends are observed. One very high value for Well 7-2 in July 1980 was reported. However, the concentrations returned to a more typical level the next month; therefore, the July 1980 value is considered erroneous.

- Bicarbonate, HCO_3^-, Figure 7 - This parameter indicates no particular trend with Well 7-2 having the lowest values; Well 1, the next lowest, and the other wells grouped together with higher but similar values. A high value was reported for Wells 2, 3 and 5 in September 1980, but the values went back down in the subsequent months' analysis.

- Calcium, Ca^{2+}, Figure 8 - This parameter shows an increasing trend for Wells 2 and 3. A relatively wide variation in values is observed, with Wells 3 and 4 having the highest concentrations.

The data plotted on the figures for several wells indicate increasing trends for certain parameters. To determine whether the increase was statistically significant, Student's 't' test was used. The hypothesis that the mean of the pre-operational concentrations is equal to the mean of the operational concentrations was tested at the 99 percent level. This level of significance means that the confidence needed to state there was indication of degradation must be high. Such a level is justified because it should help screen out extraneous variability due to sampling methods or fluctuations in other variables. The methodology used is in accordance with the monitoring and evaluation techniques required by the Resource Conservation and Recovery Act (RCRA)(40 C.F.R. 265.9).

The sulfate, chloride and TDS concentrations in Well 1, 2, 3 and 4 were evaluated. In all cases, the means of pre-operational and operational concentrations were <u>not</u> statistically different at the 99 percent confidence level. However, at the 95 percent confidence level, the means of TDS and chloride in Well 3 were statistically different. In fact, chloride concentrations in Well 3 were almost different at the 99 percent level. The main reason the means are not different is due to the large variance (standard deviation) in the means. For example, in Well 4, the sulfate concentrations were as follows:

- o Pre-operational 1,673 ± 441 mg/l
- o Operational 1,921 ± 102 mg/l

These values yielded a 't' of 1.0 while the criteria 't' at 99 percent is 9.9. Therefore, the hypothesis that the means are equal is rejected. In other words, the large variability in the analyses makes it difficult to conclude that the means of the two populations are different. If the variability (as measured by the standard deviation) was smaller, differences in the means between the pre-operational and operational data would be easier to detect.

If the increasing trend is due to tailings water leakage, it should not be observed in the upgradient Well 1. However, the mean of the operational sulfate concentrations in Well 1 increases 47 percent over the mean of the pre-operational concentrations. The mean of the sulfate concentration in Well 3 increased 70 percent. Therefore, most of the apparent increase observed in Well 3 can be attributed to natural increases in background. The increase in Well 3 appears to be more dramatic because the pre-operational concentrations are significantly higher than those in Well 1. However, as shown, the percentage increase is similar in the two wells. In fact, the concentration of such species as calcium and sulfate increased substantially during pre-operational sampling. If this increase was projected into the operational period, the actual values measured during operational sampling would actually be less than or similar to the trend predicted from the pre-operational data. Furthermore, in most instances, the constant increase is no longer observed and concentrations have fairly well stabilized over the past 6 to 8 months. This observation is significant and indicates that the waters in the wells are now in equilibrium with their surrounding rock.

<u>Conclusions</u>

Conclusions from the available data and analyses discussed above are:

- o No trends are present which would indicate a failure of the liner system in Cell 2. The water quality values shown on Figures 1 through 8 do not indicate any contamination occurring from the operation of the tailings cell.

  The changes and trends which have been noted and discussed above are not considered significant enough to indicate a leak from the tailings cell.

- o Statistical analyses also indicates that there are no differences in the means between the operational and pre-operational data. However, the mean of the chloride concentrations in Well 3 during operations may be slightly higher than the pre-operational mean (at the 95 percent confidence level). If increased levels of chloride occur in Well 3, increases in chloride concentrations should also be noted at Well 7-2 and 5. Wells 7-2 and 5 both have higher chloride concentrations than the other wells indicating the possiblity of degradation from some source. However, if the source was Cell 2, increased sulfate concentrations should be observed in Wells 7-2, 5 and 3. As previously stated, the sulfate increase in Well 3 is not statistically significant and Wells 5 and 7-2 have low sulfate concentrations. This indicates that Cell 2 is probably not leaking to any detectable degree and that the increased levels of chloride observed are probably from another source. Possiblities for this source are discussed later.

- o Well 3 is reflecting some change in groundwater quality which is not being reflected by the upgradient baseline Well 1. The groundwater quality change in Well 3 could be the result of several causes other than an actual change in the water quality. One of these causes is reflected in the fact that when Well 3 was drilled and completed in September, 1979 it was dry and required several days before a water level was detected. This is indicative of a low permeability material with low productivity. Lower permeable aquifers typically contain elevated concentrations of dissolved species due to the longer contact time and more surface area of aquifer materials. Water quality parameters could also be increasing in this well if water is being concentrated and formation water is not being introduced. Well 3 could also be reflecting the effect of the different water source detected in Well 7-2; however, the increasing sulfate values in Well 3 are inconsistent with the low sulfate values in Well 7-2. Also, Well 5 (down gradient from Well 7-2) does not reflect a change in water quality with time. Therefore, it is concluded that the water quality parameters being detected in Well 3 may be unrepresentative of the actual groundwater quality and that remedial work on Well 3 should be performed.

- o Defective samples or analyses were probably obtained for the September 1980 period.

The possibility of a different contaminant source detected in Well 7-2 is discussed in detail in the following section.

EVALUATION OF WELL 7-2 WATER SOURCE

Potential Water Sources

Water was reported by Energy Fuels in Well 7-2 in June 1980. Well 7-2 is one of five intermediate depth wells completed at a depth of 50 to 60 feet (30 to 40 feet above the local water table). The purpose of the intermediate depth wells is detection of a leak from the tailings cell. Water should not be detected in these wells unless a change in the groundwater model for the site occurs or a new source of water is developed. To determine if the water detected in Well 7-2 was related to the tailings cell or mill operations, an assessment of the possible sources of this water was made. The results of this assessment are discussed in the following sections.

Two categories of potential water sources for the water were evaluated as follows:

- o Natural Groundwater
  - Local groundwater system
  - New source of groundwater recharge, i.e., irrigation water or construction water ponded on-site
- o Mill or Tailings Related Facilities
  - Tailings Cell 2
  - Mill sedimentation pond (Baker's Lake)
  - Mill process circuit

Natural Groundwater Source Evaluation

The natural groundwater source was evaluated by comparing the measured water level in Well 7-2 with the level predicted in the local groundwater model (discussed in Engineer's Report, Tailings Management System, June 1979). The prediction indicates that the local water table is about 40 feet below the level of water in Well 7-2. Forty feet is greater than a normal fluctuation in the level of the water table due to seasonal variations in precipitation. Therefore, this physical interpretation indicates that the water in Well 7-2 is from another source. A new potential groundwater source is unlikely because of the long-term existence of the water (8 months) which is not consistent with seasonal (irrigation) or intermittent (construction-related) sources. No other new sources were identified.

Water quality comparisons between Well 7-2 and baseline, Well 1, were also made as discussed under the previous section. This comparison indicates that the water in Well 7-2 is different than the local groundwater. In general, the local groundwater has greater concentrations of the major ions (bicarbonate, sulfate, magnesium, sodium and total dissolved solids). However, the concentrations of chloride, nitrate and uranium are greater in Well 7-2.

A comparison of water from Well 7-2 was made with Well 5 which is closest to Well 7-2 geographically and located downgradient from Well 7-2 with respect to the flow of groundwater. This comparison is shown in Table 1 and is based upon calculating the mean value for a population of values from several analyses. The value is reported as the mean with a standard deviation of 2 sigma. This type of statistical evaluation is used to emphasize differences between populations rather than precision of analyses. Although a large value of standard deviation relative to a mean may represent lack of analytical precision, it also reflects variation in the concentration of a parameter with respect to time. Lack of overlap in the range defined by the standard deviations indicator may be interpreted as values which belong to different populations. This hypothesis can be tested using Student's "t" test as previously described. However, the general conclusions can be made without the test.

In Table 1, it is observed that the concentrations of sodium, sulfate, bicarbonate, fluoride, alkalinity, and total dissolved solids, as well as the specific conductance, are greater in Well 5 than in Well 7-2. The concentrations of chloride, fluoride, nitrate, and uranium are greater in Well 7-2. Concentrations of other parameters, such as pH, calcium, potassium, and magnesium are essentially the same in the two wells. Additionally, the concentration of radium-226 was substantially greater in Well 7-2 in July; however, in subsequent analyses, the concentration decreased to background levels.

The differences in concentrations of major constituents from the statistical analysis between Wells 7-2 and 7-5, however, are large enough to suggest that the water in Well 7-2 is from a source other than regional groundwater.

<u>Mill Tailings Related Source Evaluation</u>

The potential of a local source from the tailings or within the mill site was also considered. The potential sources evaluated included tailings Cell 2, the mill sedimentation pond (Baker's Lake), and other mill circuit sources. Determination of the most likely source was made by comparing the water in Well 7-2 with waters from Cell 2 and from the mill sedimentation pond.

Water was collected from Cell 2, the sedimentation pond, and Well 7-2 by Energy Fuels in September 1980 and samples sent to D'Appolonia for analysis. Splits from the sedimentation pond and Well 7-2 samples were also sent to WAMCO by Energy Fuels for analysis. The results of these analyses are presented in Table 2. A discussion of the comparison between the results from the two laboratories is presented later.

The most obvious aspect in the comparison of the water quality from the three sources is that concentrations of most components in Well 7-2 are considerably lower, by one to two orders of magnitude, than corresponding parameters in either Cell 2 or the sedimentation pond.

The water in tailings Cell 2 is a characteristically acidic solution containing very high levels of sulfate from the sulfuric acid used in the leaching process. It contains high levels of sodium and chloride which are derived from sodium chlorate ($NaClO_4$) and sodium chloride (NaCl) in the acid leach process. Nitrate is present in tailings Cell 2 in relatively moderate amounts; however, the source of this nitrate is not readily apparent. Some acid leach processes use ammonium nitrate (NH_4NO_3) in the solvent extraction circuit. Another source for nitrate may be in the oxidation of the ammonium ion during the drying of the yellowcake and subsequent collection in the fly ash. The presence of nitrogen oxidizing bacteria in the tailings cell could produce nitrates, but such a species would need to be extremely tolerant to highly acidic, saline solutions. It is not likely that ammonia can oxidize readily in the tailings cell at the given conditions of pH and Eh.

The mill sedimentation pond (Baker Lake) is an unlined collection pond located in the southwest corner of the mill and facilities area and immediately north of tailings Cell 2. The purpose of this pond is to collect and retain sediment and runoff water from the facilities area. The pond should be dry except after a precipitation event while evaporation of the runoff occurs. Water has been reported in the sedimentation pond since June, 1980. The source of this water is reported to be from runoff, mill processes, and start-up-type operations.

Concentrations of parameters in the sedimentation pond are generally an order of magnitude lower than in tailings Cell 2. The water is basically sulfate-rich with moderate concentrations of chloride, sodium, calcium, and magnesium. (Nitrate concentrations are not elevated above values which are generally considered harmful to plants and animals.) The solution is acidic, although not to the same degree as tailings Cell 2. Neither the sedimentation pond nor tailings Cell 2 contain detectable amounts of bicarbonate ion, and consequently, the waters have no measurable alkalinity.

In evaluating either one of these surface waters as the source of water in Well 7-2, it is apparent that the concentrations of the major components are considerably different so that identification of the likely source should be possible. However, water in Well 7-2 is not as concentrated as either Cell 2 or the sedimentation pond source with respect to some parameters (sulfate, chloride, sodium, magnesium, potassium, ammonia, radionuclides, acidity), and is more concentrated with respect to others (bicarbonate, calcium, nitrate, alkalinity).

As previously discussed, the natural buffering capacity of the soils, which is due to calcium carbonate, can neutralize acid in the leachate and elevate the pH. This neutralization reaction causes an increase in the concentrations of calcium and bicarbonate in the groundwater and a decrease in heavy metal and radionuclide concentrations.

Because Well 7-2 is near both tailings Cell 2 and the sedimentation pond, it was expected that the concentrations of major constituents should be very similar to those in the source. Chemical reactions, such as precipitation and adsorption, act to alter the chemistry of a water as it moves through soil or bedrock, and such a mechanism will influence the differences in compositions between the well and the surface ponds. However, one notable exception to these processes is chloride which forms easily soluble salts. Hence, it is not removed from groundwater by precipitation or adsorbed by most geological materials. Chloride ions are considered to move at the same rate as the groundwater, and therefore, are considered to be a good tracer. Although sulfate is not strongly adsorbed by soils either, it is preferred over chloride in some cases of adsorption, and it can be precipitated as gypsum when the solubility product is exceeded.

Chloride concentrations in Well 7-2 remained relatively constant, varying from 83 to 99 mg/l from July, 1980 through February 1981 (Figure 2). The chloride concentrations in the sedimentation pond and tailings Cell 2 were recorded as 250 mg/l and 2,200 mg/l resepctively (Table 2). Allowing for some dilution, the concentration of chloride in Well 7-2 best reflects that found in the sedimentation pond. Concentrations of all other constituents in Well 7-2 are likewise more similar to the sedimentation pond than tailings Cell 2. If water was seeping from a leak in the tailings cell, greater concentrations would be expected in the well.

Comparison of Laboratories

As previously mentioned, splits of samples from Well 7-2 and the sedimentation pond were taken in September, 1980, and analyzed by D'Appolonia's water quality lab and WAMCO Labs. Table 2 presents the results from D'Appolonia and WAMCO laboratories for Well 7-2 and the mill sedimentation pond for comparison. Overall, the results from the two laboratories are very similar with the following exceptions:

- Ammonia measured by WAMCO in the sedimentation pond is extremely high.
- Concentrations of radionuclides measured by D'Appolonia were substantially higher than the values measured by WAMCO.

These high values reported by the respective laboratories are probably in error and are being checked by the laboratories. Besides these few parameters, the agreement is typically excellent. Therefore, the increasing trend observed between pre-operational and operational data probably cannot be attributed to differences in laboratories. Some differences may be attributed to changes in sampling techniques and personnel. However, these are also probably small.

Other Considerations

Dilution of the groundwater has been mentioned as a reason for lower concentrations in the well. One possible source for mixing of waters could be water from the septic leach field. Other possibilities are water from irrigation of sod at the facilities, and construction-related sources. Both conditions could cause water to intercept the water from the sedimentation pond at a point upgradient from Well 7-2; however, such occurrences are speculative and would be difficult to verify.

One item which has been investigated closely is the trend of nitrate in the well from July to September, 1980. The source of the elevated concentration of nitrate (100 mg/l) in July, 1980, has been difficult to identify because no waters which could be sources were found to contain comparable levels of nitrate. In a conversation with Jim Gallagher of WAMCO Labs in Casper, Wyoming, reasonable doubt was raised concerning the validity of this analysis. Mr. Gallagher suggested that a sample may have been collected for nitrate analysis with a bottle previously acidified with nitric acid. Other possible sources of nitrate could be from septic sludge or fertilizer. However, the existence of such sources is not known.

Conclusions

Based on the preceding discussion, the most likely source of water in Well 7-2 is the sedimentation pond. This conclusion is supported by the following facts:

- o Water in Well 7-2 is not similar to local groundwater quality or elevation.
- o Water in Well 7-2 is closer in chemical composition to water from the sedimentation pond than to water in tailings Cell 2.
- o Chemical concentrations of some key components, such as chloride, should be similar in both Well 7-2 and its source. The concentration of chloride and sulfate is far too small in the well for tailings Cell 2 to be the source.
- o The sedimentaion pond is directly upgradient from Well 7-2. The tailings cell lies between the well and the pond, and it is lined with an impermeable seal. The sedimentation pond is not lined and water can percolate into the subsurface where it could flow beneath the impermeable seal of the tailings and intercept Well 7-2 at depth.
- o Changes in chemical composition between the sedimentation pond and the well water are attributed to chemical interactions between the groundwater and the geological material through which it

- Changes in chemical composition between the sedimentation pond and the well water are attributed to chemical interactions between the groundwater and the geological material through which it flows. Dilution may change the levels of concentrations by mixing of two waters, but another source of water in the immediate subsurface has not been verified.

OVERALL SUMMARY AND CONCLUSIONS

Groundwater water quality data from pre-operational and operational (through February 1981) phases have been reviewed. No indication of local groundwater degradation attributable to the mill or tailings operation is evident from these data. Indications of a change in water quality in Well 3 are considered to possibly be the result of poor water supply to Well 3. However, the consistency of the concentrations measured recently may indicate that static conditions have been achieved.

The possible sources of water in Well 7-2 were also evaluated. Results of the evaluation indicates that the most likely source is the sedimentation pond (Baker Lake). The basis for this conclusion is the comparison of water quality data and the elimination of other known possible sources. The water quality comparison for Well 7-2 and the sedimentation pond as detector and source, respectively, is not exact and other unknown sources may be contributing or causing the detection occurrence of water in Well 7-2.

If you have any questions or wish to discuss any of these items, please contact us.

Very truly yours,

Corwin E. Oldweiler
Project Engineer

Roger L. Olsen
Project Geochemist

CEO:RLO:klg

cc: H.R. Roberts, Energy Fuels
D.K. Sparling, Energy Fuels

TABLE 1

WATER QUALITY PARAMETER COMPARISON
WELL 7-2 and WELL 5[1]

PARAMETER	UNITS	WELL 7-2[2] JULY 1980 - SEPT 1980	WELL 5[3] MAY 1980 - SEPT 1980
pH	Standard Units	7.54±.17	7.60±.14
Specific Conductance	micromhos/cm@25°C	1389±137	2480±126
Alkalinity	mg/l as CaCO3	168±33	376±114
Hardness	mg/l as CaCO3	600±63	601±48
Total Dissolved Solids Solids	mg/l	1112±139	2228±126
Major Ions			
Sodium	mg/l	99±8	468±24
Calcium	mg/l	160±7	162±17
Potassium	mg/l	10±4	18±4
Magnesium	mg/l	49±11	48±5
Chloride	mg/l	89±5	57±4
Sulfate	mg/l	502±48	1140±120
Bicarbonate	mg/l	205±40	460±140
Carbonate	mg/l	0±0	0±0
Fluoride	mg/l	0.51±.21	0.29±.08
Nitrate	mg/l	39±53	.07[4]
Uranium	µg/l	24±19	8.5±1.0[5]

(1) Analyses were performed by WAMCO Lab of Casper, Wyoming.

(2) Values are statistical means with standard deviations for a population of three data sets.

(3) Values are statistical means with standard deviations for a population of five data sets.

(4) Average of two values.

(5) Mean determined for four values.

TABLE 2

WATER QUALITY PARAMETER COMPARISON[1]

PARAMETER	UNITS	WELL 7-2 A[2]	WELL 7-2 B[3]	MILL SITE SEDIMENTATION POND (BAKER'S LAKE) A[2]	MILL SITE SEDIMENTATION POND (BAKER'S LAKE) B[3]	TAILINGS CELL 2[3]
pH	S.U.	7.56	6.60	4.46	4.00	1.10
Specific Conductance	umhos/cm	1454	1400	2650	3700	87000
Acidity	mg/1 $CaCO_3$	—	<2	—	38	3800
Total Alkalinity	mg/1 $CaCO_3$	190	175	14	0	0
Bicarbonate	mg/1 HCO_3	232	214	17	0	0
Carbonate	mg/1 CO_3	0	0	0	0	0
Chloride	mg/1	83	77	270	250	2200
Nitrate	mg/1 NO_3-N	8	12	2	3.5	24
Ammonia	mg/1 NH_3-N	ND	2.2	116	0.16	3.0
Total Phosphate	mg/1 PO_4-P	3.7	5.75	0.72	0.56	160
Sulfate	mg/1	538	250	1108	1300	35000
Total Dissolved Solids	mg/1@180°C	1218	1150	2281	2140	58100
Metals						
Arsenic	mg/1	0.004[4]	0.026	0.002[4]	0.174	35.8
Calcium	mg/1	164	155	212	145	90
Magnesium	mg/1	59	44	100	72	1800
Potassium	mg/1	9	4	33	17	405
Sodium	mg/1	101	94	250	190	1400
Uranium	mg/1	20	28	49	18	87
Radionuclides						
Gross alpha	pCi/1	3.4	57.4	22.0	1,700	114,000
Gross beta	pCi/1	1.8	7.4	55.0	444.0	74.0
Ra-226	pCi/1	0.2	0.23	3.6	2.1	180
Calculated Values						
Cations	meq/1	17.65	15.54	30.52	21.85	223.7
Anions	meq/1	17.33	11.07	30.94	34.15	790.4
$\frac{\text{Cations-Anions}}{\text{Cations+Anions}} \times 100$	Percent	0.91	-16.8	-0.68	21.9	55.9

ND = Not Detected

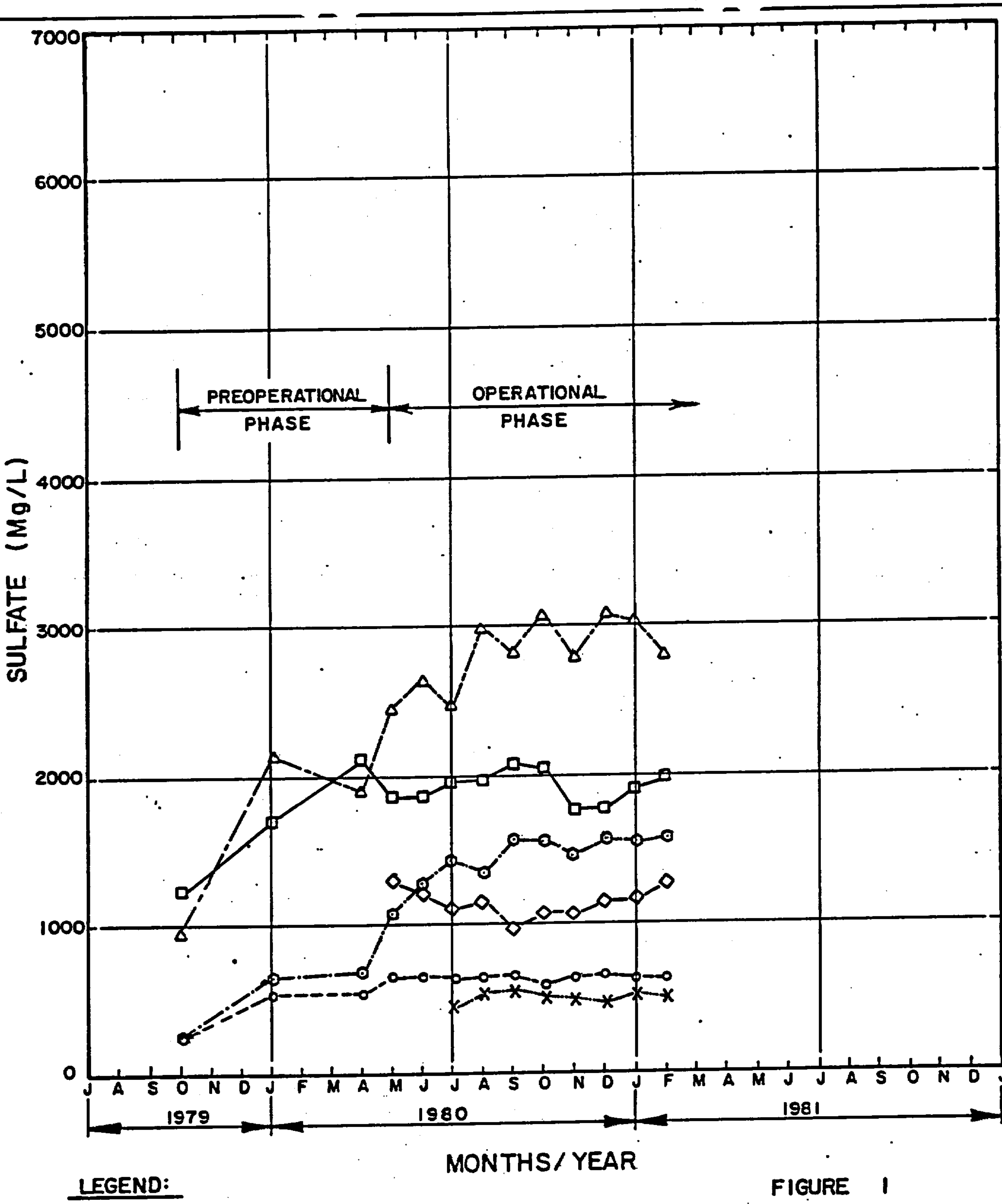
(1) Analysis for samples taken on September 19, 1980; all parameters are dissolved unless otherwise indicated.

(2) Analyses performed by WAMCO Labs; Well 7-2 dated October 21, 1981, WAMCO No. 1903; Baker Lake, dated October 13, 1980, WAMCO No. 1907.

(3) Analyses performed by D'Appolonia water laboratory.

(4) Total analysis.

DRAWN BY | 8/5/81 | CHECKED BY | 9.9.81 | APPROVED BY | DRAWING NUMBER RM78-682-A26



LEGEND:

- WELL 1
- WELL 2
- WELL 3
- WELL 4
- WELL 5
- WELL 7-2

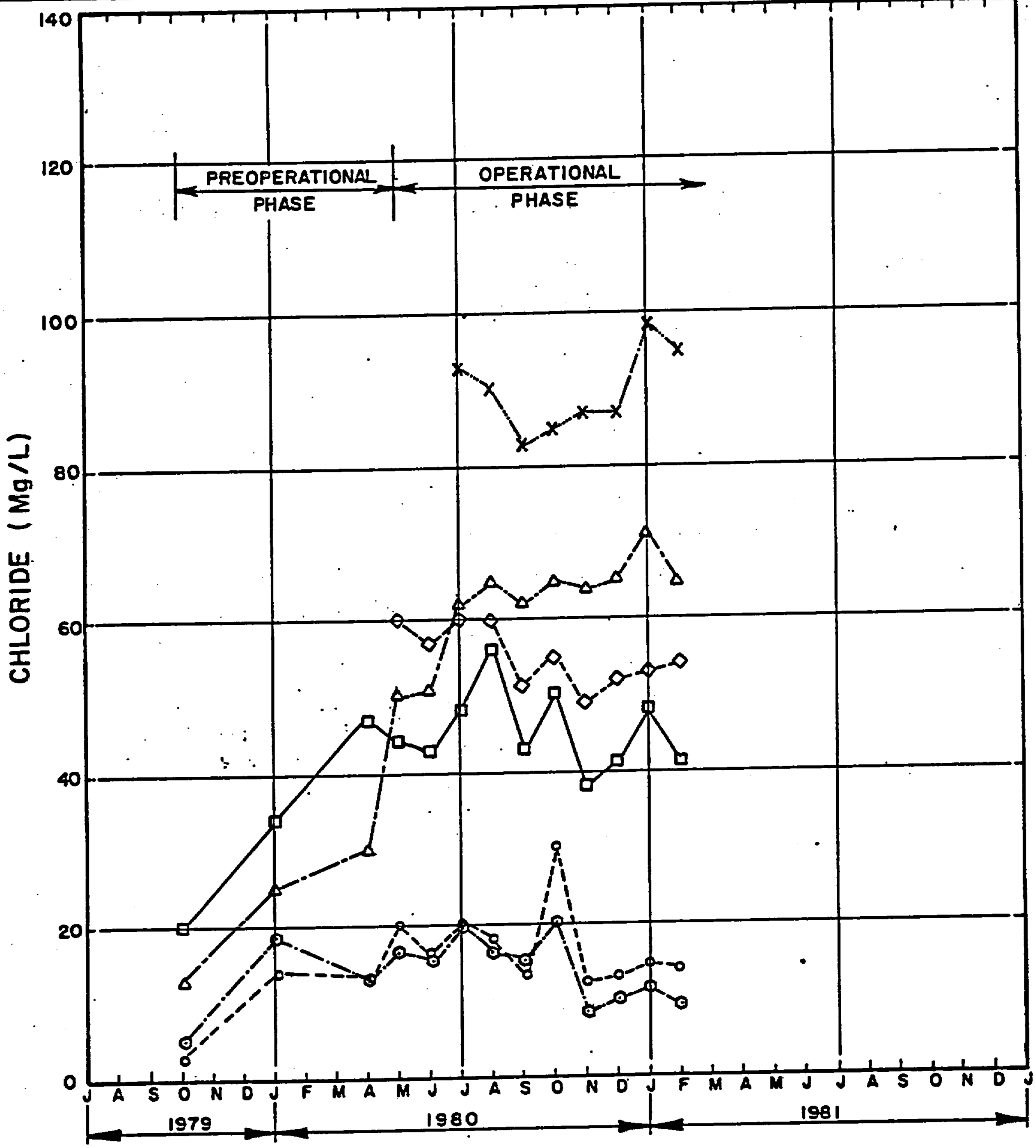
FIGURE 1

CHANGES IN SULFATE CONCENTRATION

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

D'APPOLONIA



LEGEND:

- WELL 1
- WELL 2
- WELL 3
- WELL 4
- WELL 5
- WELL 7-2

FIGURE 2

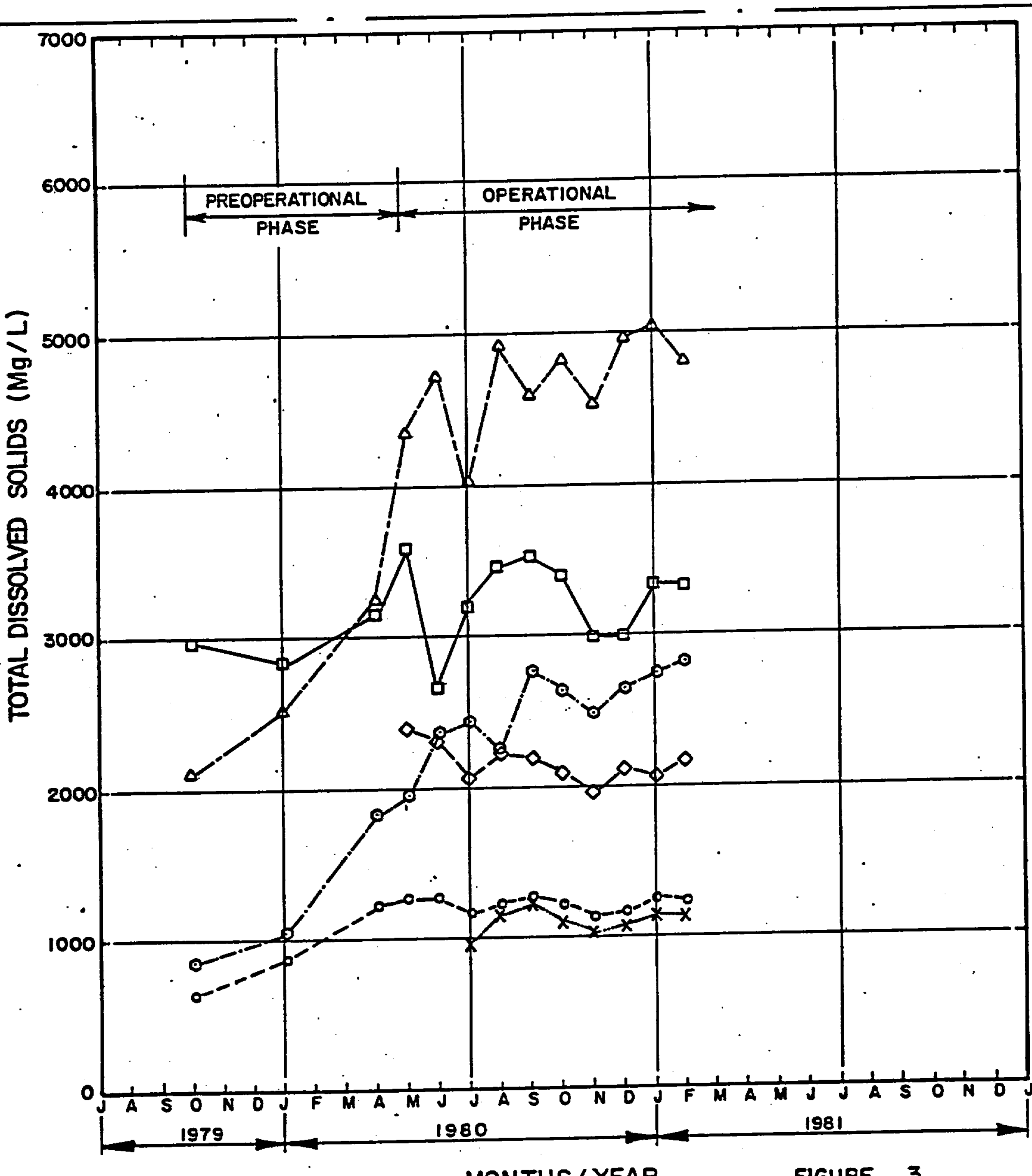
CHANGES IN CHLORIDE CONCENTRATION

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

D'APPOLONIA

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
D.J. Rodriguez 8/5/81	RLG		RM78-682-A31



LEGEND:

- WELL 1
- WELL 2
- WELL 3
- WELL 4
- WELL 5
- WELL 7-2

FIGURE 3

CHANGES IN
TOTAL DISSOLVED SOLIDS

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

D'APPOLONIA

DRAWN BY D. Rodriguez 8/5/81 | CHECKED BY | APPROVED BY | DRAWING NUMBER RM78-682-A30

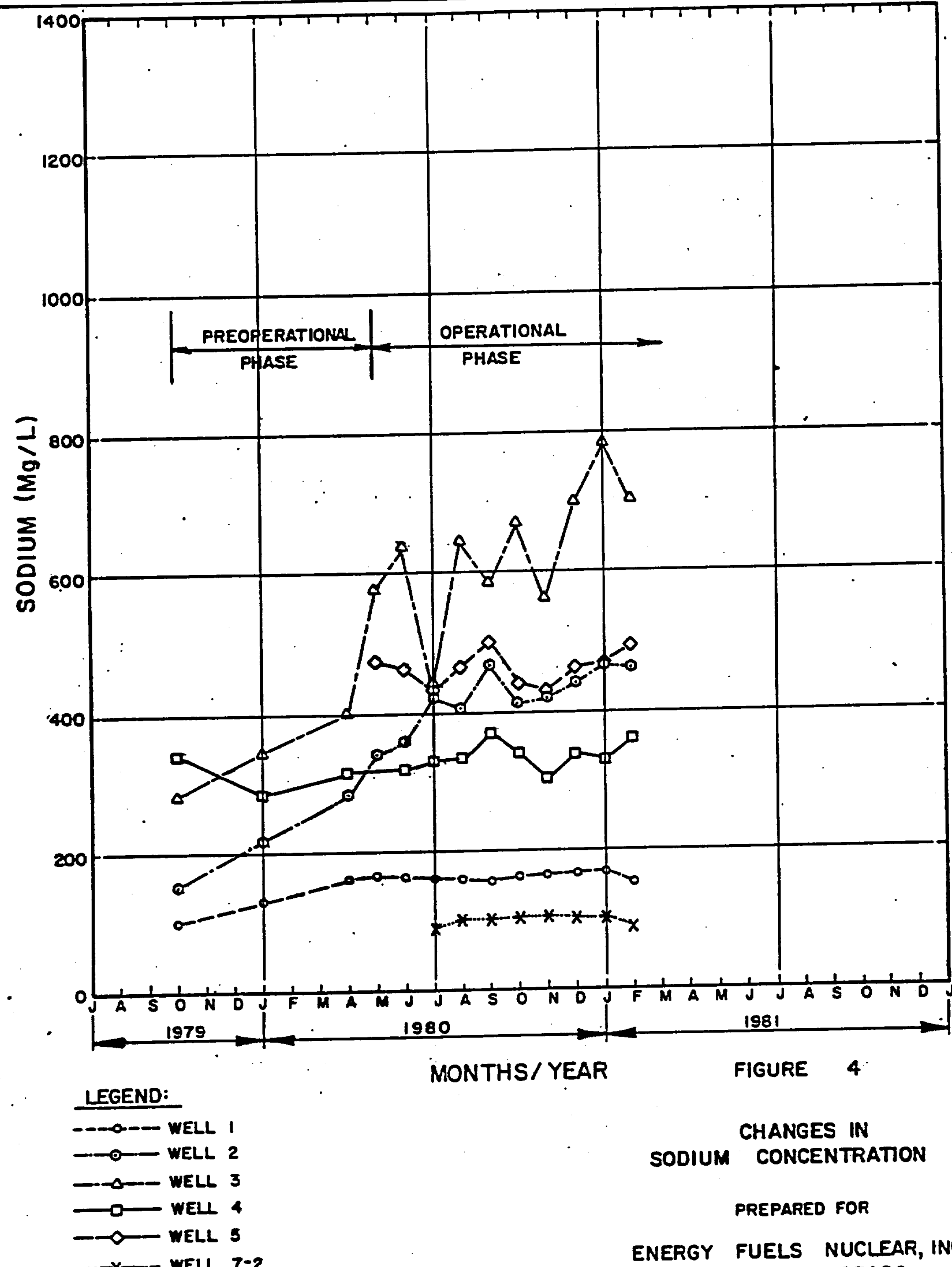


FIGURE 4

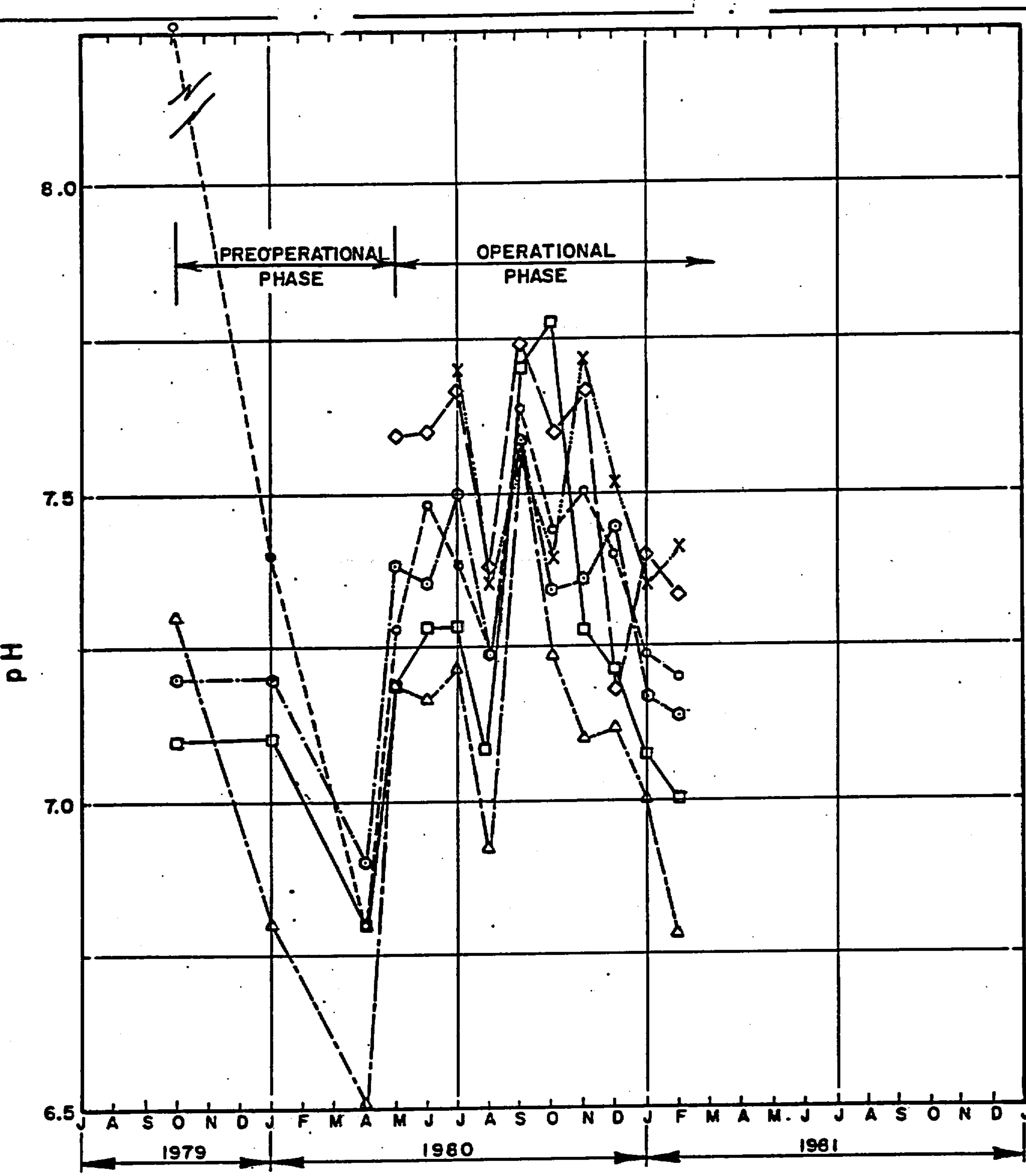
CHANGES IN SODIUM CONCENTRATION

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

D'APPOLONIA

DRAWN BY D.J.Rodriguez 8/5/81 CHECKED BY APPROVED BY DRAWING NUMBER RM78-682-A28



DRAWN BY D.J.Rodriguez 8/5/81 | CHECKED BY RLO 9/9/81 | APPROVED BY 9-9-81 | DRAWING NUMBER RM78-682-A29

LEGEND:

- WELL 1
- WELL 2
- WELL 3
- WELL 4
- WELL 5
- WELL 7-2

FIGURE 5

CHANGES IN pH

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

D'APPOLONIA

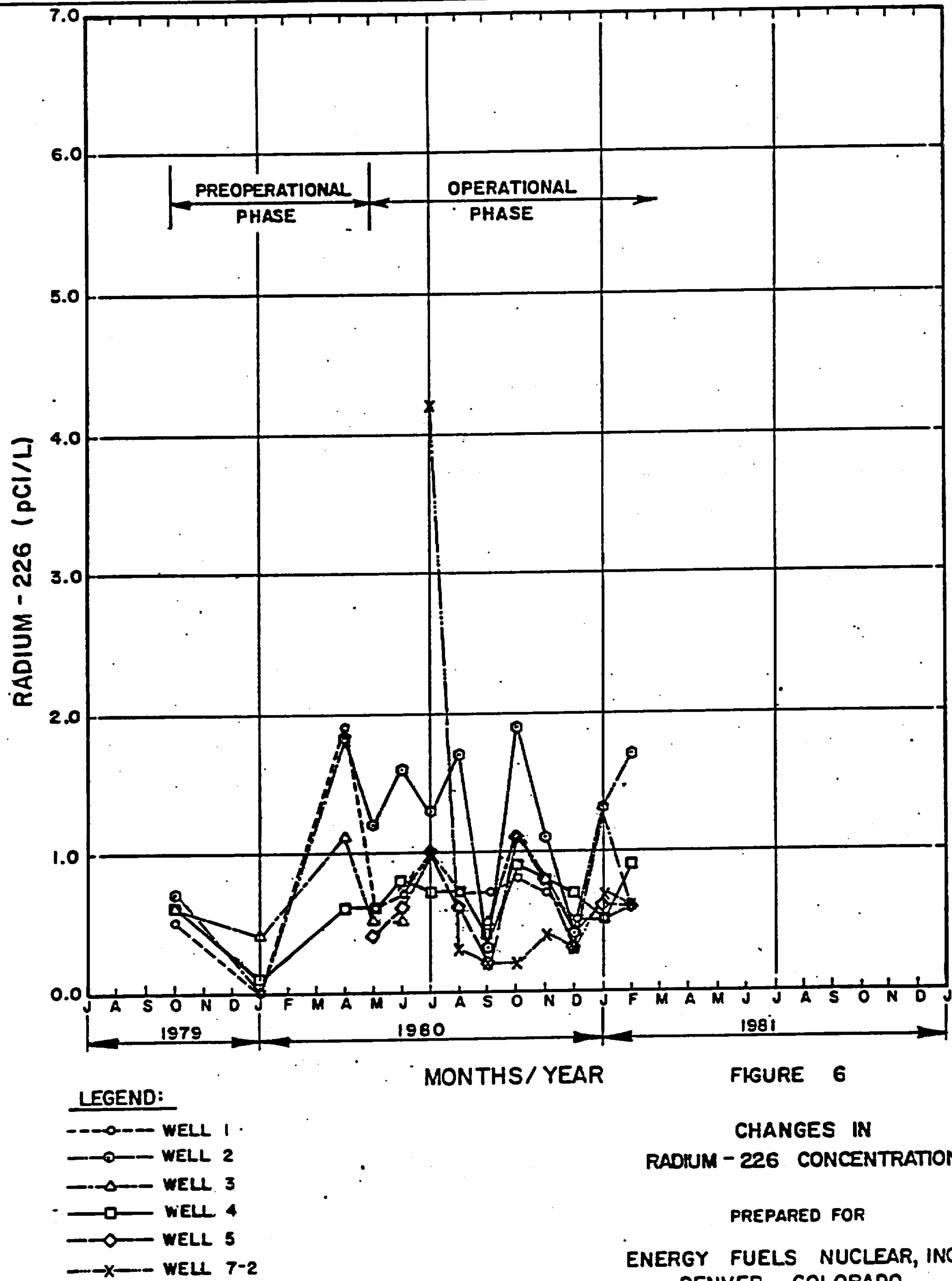


FIGURE 6

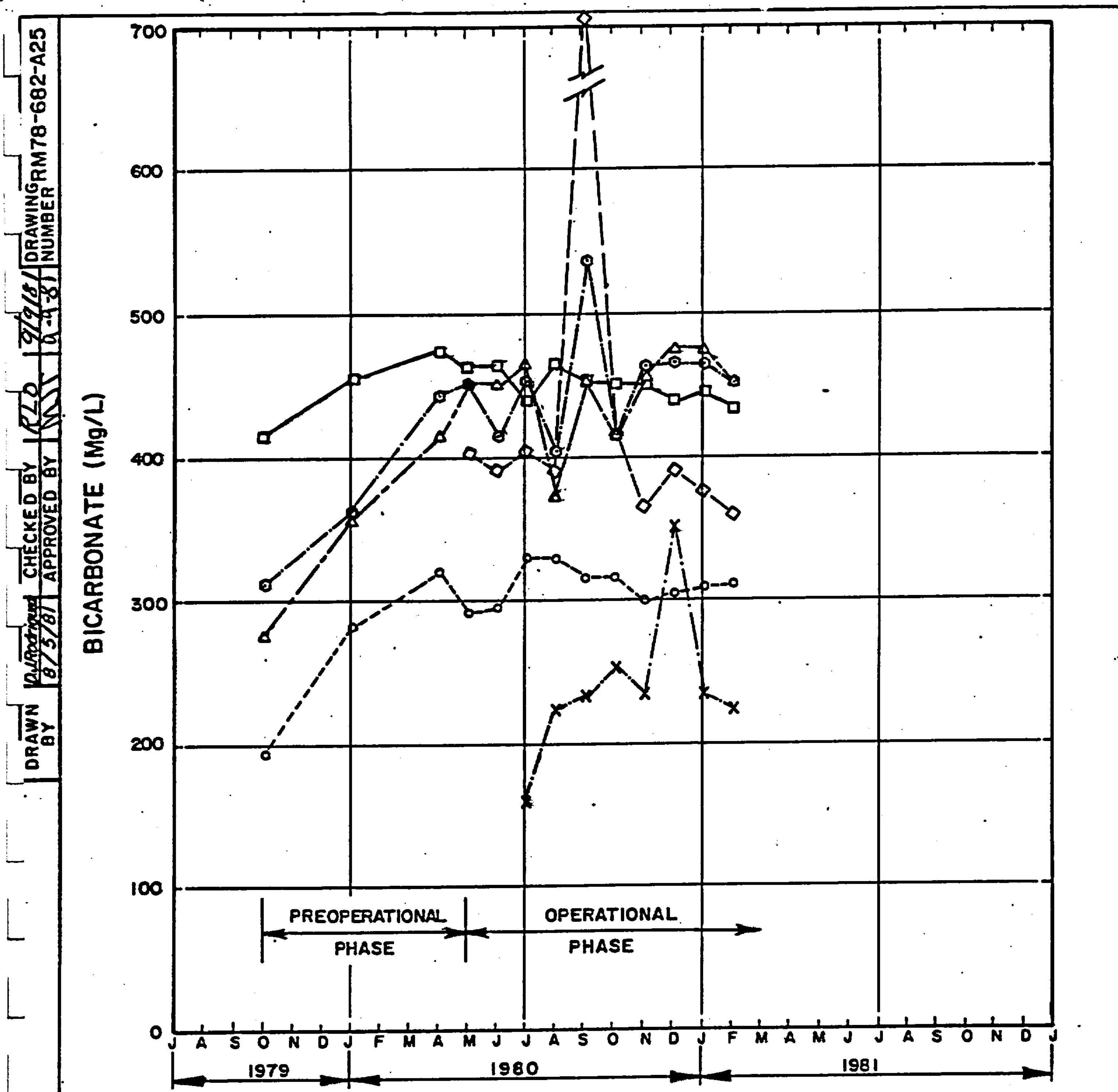
CHANGES IN RADIUM - 226 CONCENTRATION

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

D'APPOLONIA

DRAWN BY D.J. Rodriguez 8/5/81 | CHECKED BY KLO | APPROVED BY | DRAWING NUMBER RM78-682-A24



LEGEND:

- WELL 1
- WELL 2
- WELL 3
- WELL 4
- WELL 5
- WELL 7-2

FIGURE 7

CHANGES IN BICARBONATE CONCENTRATION

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

D'APPOLONIA

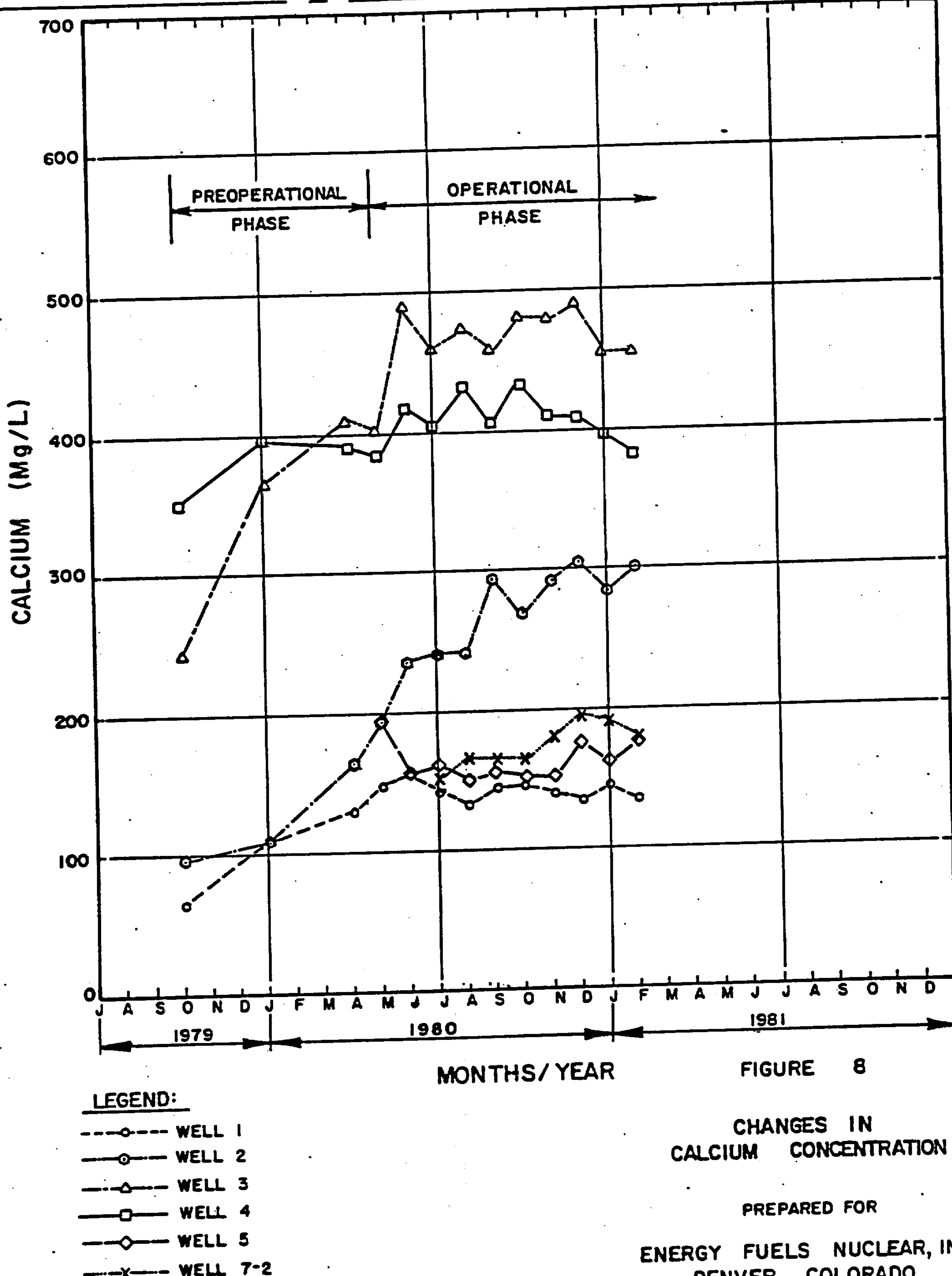


FIGURE 8

CHANGES IN CALCIUM CONCENTRATION

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

D'APPOLONIA

DRAWN BY JRod 8/5/81 | CH | DB | APPROVED BY | RLL | DR | 9/ 9-9-81 | NUMBER GRN 0 681 -7

ATTACHMENT 5

ANALYTICAL REPORT

27-OCT-82

ENVIROLOGIC SYSTEMS, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82289 - 1	W82289 - 2	W82289 - 3	W82289 - 4	W82289 - 5	W82289-6
SAMPLE ID:	WELL #1	WELL #2	WELL #3	WELL #4	WELL #5	Added Well Sample
SAMPLE REMARKS:						
DATE/TIME SAMPLED	08-31-82/ 850	08-31-82/1125	08-31-82/ 950	08-31-82/ 945	08-31-82/1025	
DATE/TIME RECEIVED	08-31-82/1400	08-31-82/1400	08-31-82/1400	08-31-82/1400	08-31-82/1400	10/21/82/850
DATE/TIME ANALYZED	09-01-82/ 900	09-01-82/ 900	09-01-82/ 900	09-01-82/ 900	09-01-82/ 900	10/21/82/130[illegible]

CHEMIST: RIF/DRH
LOCATION: AURORA, CO

---

*FIELD TEMPERATURE (DEG. C)	20.5	23.0	17.5	26.5	24.0	15.0
*FIELD pH	7.8	8.4	8.6	8.1	8.8	4.5
LAB pH (@ 25 DEG. C)	8.05	8.05	8.30	8.00	8.30	4.60
*FIELD COND. (uMHOS @ 25 DEG. C)	140	130	130	130	140	3900
LAB COND. (uMHOS @ 25 DEG. C)	610	383	419	405	401	4450

* VALUES SUPPLIED TO CORE LABORATORIES BY SAMPLE COLLECTION AGENT
--ALL VALUES REPORTED ON A DISSOLVED BASIS (MG./L.) UNLESS INDICATED OTHERWISE

27-OCT-82

ENVIROLOGIC SYSTEMS, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82289 - 1	W82289 - 2	W82289 - 3	W82289 - 4	W82289 - 5	W82289-6
SAMPLE ID:	WELL #1	WELL #2	WELL #3	WELL #4	WELL #5	Added Well
SAMPLE REMARKS:						Sample

GENERAL PARAMETERS

TOTAL DISSOLVED SOLIDS (CALC.)	530 (254)	180 (134)	280 (173)	250 (151)	252 (148)	4890 (3421)
BICARBONATE (HCO3)	303	225	206	239	234	6.14
CARBONATE (CO3)	<1	<1	<1	<1	<1	<1
HYDROXIDE (OH)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SULFATE (SO4)	97.1	22.6	63.8	32.9	30.5	3185
CHLORIDE (Cl)	8.01	0.94	7.06	1.06	3.15	213
TOTAL ALKALINITY (AS CaCO3)	263	192	181	203	201	22
PHOSPHATE-TOTAL (PO4-P)	<0.01	<0.01	<0.01	<0.01	0.02	
NITROGEN-KJELDAHL (TOTAL)	<0.5	<0.5	1.5	<0.5	<0.5	1.1
NITRATE (NO3-N)	<0.1	0.1	0.3	<0.1	0.1	20.4
NITRITE (NO2-N)	0.002	0.003	0.004	0.002	0.005	0.027
SULFIDE (S)	<0.1	<0.1	0.7	<0.1	<0.1	
ORGANIC CARBON, TOTAL (TOC)	<1	<1	16	2	<1	
Inorganic Carbon, Total (TIC)	63.8	48.5	38.3	48.8	47.4	
Phosphate-Total (PO4-P),Total	0.01	0.01	0.02	0.01	0.02	<0.01

*All data reported on a TOTAL basis unless noted otherwise

27-OCT-82

ENVIROLOGIC SYSTEMS, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307- SAMPLE ID: SAMPLE REMARKS:	W82289 - 1 WELL #1	W82289 - 2 WELL #2	W82289 - 3 WELL #3	W82289 - 4 WELL #4	W82289 - 5 WELL #5	W82289-6 Added Well Sample
TOTAL METALS						
TOTAL CALCIUM (Ca)	36.0	49.0	33.0	45.0	13.0	520
TOTAL COPPER (Cu)	<0.01	<0.01	0.02	0.06	0.01	<0.01
TOTAL IRON (Fe)	0.58	0.35	7.80	0.56	0.15	2.38
TOTAL MAGNESIUM (Mg)	28.0	20.0	22.0	18.0	6.1	480
TOTAL MANGANESE (Mn)	<0.01	<0.01	0.14	<0.01	<0.01	3.90
TOTAL POTASSIUM (K)	7.0	3.4	3.3	3.5	1.6	4.5
TOTAL SELENIUM (Se)	<0.01	<0.01	<0.01	<0.01	<0.01	
TOTAL SODIUM (Na)	69.0	7.2	33.0	24.0	82.0	170
TOTAL VANADIUM (V)	<0.5	<0.5	<0.5	<0.5	<0.5	
TOTAL ZINC (Zn)	0.01	0.06	0.79	0.04	0.03	2.00

27-OCT-82

ENVIROLOGIC SYSTEMS, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307- SAMPLE ID: SAMPLE REMARKS:	W82289 - 1 WELL #1	W82289 - 2 WELL #2	W82289 - 3 WELL #3	W82289 - 4 WELL #4	W82289 - 5 WELL #5
RADIOCHEMISTRY					
>Gross Alpha (pCi/l)	1.6 ± 1.4	5.3 ± 2.2	2.0 ± 1.3	3.7 ± 1.9	3.3 ± 1.8
>Gross Beta (pCi/l)	6.2 ± 1.8	3.3 ± 1.7	3.2 ± 1.6	5.1 ± 1.7	1.9 ± 1.6

>--Denotes Parameter Analyzed on a total basis

CORE LABORATORIES, INC.
ANALYTICAL REPORT

CLIENT IDENTIFICATION

JOB NO.:6307-W83484
COMPANY: ENERGY FUELS NUCLEAR, INC.
JOB/GROUP REMARKS:

JAN 3 RECD

IDENTIFICATION	IDENTIFICATION
1) MONITORING WELL 1	2) MONITORING WELL 2
3) MONITORING WELL 3	4) MONITORING WELL 4
5) MONITORING WELL 5	6) MONITORING WELL 11
7) MONITORING WELL 12	8) MONITORING WELL 13
9) MONITORING WELL 20 (duplicate sample of Well #3)	10) CULINARY WELL
11) S. COTTONWOOD CREEK	12) RUIN SPRINGS

JAN 3 RECD
DBS

4th Quarter 1983

29-DEC-83

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83484 - 1	W83484 - 2	W83484 - 3	W83484 - 4	W83484 - 5	W83484 - 6
SAMPLE ID:	MONITORING	MONITORING	MONITORING	MONITORING	MONITORING	MONITORING
SAMPLE REMARKS:	WELL 1	WELL 2	WELL 3	WELL 4	WELL 5	WELL 11
DATE/TIME SAMPLED	10-26-83/	10-27-83/	10-26-83/	10-26-83/	10-27-83/	10-26-83/
DATE/TIME RECEIVED	11-01-83/1000	11-01-83/1000	11-01-83/1000	11-01-83/1000	11-01-83/1000	11-01-83/1000
DATE/TIME ANALYZED	11-02-83/ 800	11-02-83/ 800	11-02-83/ 800	11-02-83/ 800	11-02-83/ 800	11-02-83/ 800
CHEMIST: RIF/DRH						
LOCATION: AURORA, CO						

LAB pH (@ 25 deg. C)	7.89	7.72	7.49	7.71	7.96	8.21
LAB COND. (as umhos/cm @ 25C)	1680	3560	5550	3700	2840	2600

--ALL VALUES REPORTED ON A DISSOLVED BASIS (MG./L.) UNLESS INDICATED OTHERWISE

CORE LABORATORIES, INC.
ANALYTICAL REPORT

29-DEC-83

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83484 - 1		W83484 - 2		W83484 - 3		W83484 - 4		W83484 - 5		W83484 - 6	
SAMPLE ID:	MONITORING		MONITORING		MONITORING		MONITORING		MONITORING		MONITORING	
SAMPLE REMARKS:	WELL 1		WELL 2		WELL 3		WELL 4		WELL 5		WELL 11	
MAJOR CATIONS												
CALCIUM (Ca)	140	(6.99)	310	(15.47)	450	(22.45)	430	(21.46)	150	(7.48)	28	(1.40)
MAGNESIUM (Mg)	54	(4.44)	92	(7.57)	210	(17.28)	160	(13.17)	41	(3.37)	6.7	(0.55)
SODIUM (Na)	170	(7.39)	500	(21.75)	800	(34.80)	320	(13.92)	480	(20.88)	540	(23.49)
POTASSIUM (K)	6.1	(0.16)	6.5	(0.17)	21	(0.54)	9.0	(0.23)	7.0	(0.18)	5.0	(0.13)
SUM OF MAJOR CATIONS (me/l)		(18.99)		(44.96)		(75.08)		(48.78)		(31.91)		(25.57)
SUM OF TOTAL CATIONS (me/l)		(18.99)		(44.96)		(75.08)		(48.78)		(31.91)		(25.57)
MAJOR ANIONS												
BICARBONATE (HCO3)	334.0	(5.47)	451.0	(7.39)	524.0	(8.59)	464.0	(7.60)	396.0	(6.49)	402.0	(6.59)
CARBONATE (CO3)	<1	(0.00)	<1	(0.00)	<1	(0.00)	<1	(0.00)	<1	(0.00)	<1	(0.00)
HYDROXIDE (OH)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)
SULFATE (SO4)	675	(14.05)	1818	(37.85)	3226	(67.17)	2034	(42.35)	1183	(24.63)	922	(19.20)
CHLORIDE (Cl)	12.7	(0.36)	5.1	(0.14)	56.6	(1.60)	35.8	(1.01)	46.8	(1.32)	26.0	(0.73)
SUM OF MAJOR ANIONS (me/l)		(19.88)		(45.38)		(77.36)		(50.96)		(32.44)		(26.52)
SUM OF TOTAL ANIONS (me/l)		(19.88)		(45.38)		(77.36)		(50.96)		(32.44)		(26.52)

29-DEC-83

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83484 - 1	W83484 - 2	W83484 - 3	W83484 - 4	W83484 - 5	W83484 - 6
SAMPLE ID:	MONITORING	MONITORING	MONITORING	MONITORING	MONITORING	MONITORING
SAMPLE REMARKS:	WELL 1	WELL 2	WELL 3	WELL 4	WELL 5	WELL 11
GENERAL PARAMETERS						
TOTAL DISSOLVED SOLIDS (CALC.)	1225 (1225)	2972 (2957)	5127 (5026)	3300 (3221)	2093 (2106)	1697 (1729)
*TOTAL ALK. (pH 3.7 as CaCO3)	289	389	457	401	339	353

*--FILTERABLE

CORE LABORATORIES, INC.
ANALYTICAL REPORT

29-DEC-83

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83484 - 1	W83484 - 2	W83484 - 3	W83484 - 4	W83484 - 5	W83484 - 6
SAMPLE ID:	MONITORING	MONITORING	MONITORING	MONITORING	MONITORING	MONITORING
SAMPLE REMARKS:	WELL 1	WELL 2	WELL 3	WELL 4	WELL 5	WELL 11

DISSOLVED METALS

URANIUM (U3O8)	0.003 2.03 x 10^{-7} uCi/ml	0.009 6.09 x 10^{-7}	0.042 2.8 x 10^{-8}	0.001 6.77 x 10^{-10}	0.001 6.77 x 10^{-10}	0.001 6.77 x 10^{-10}

29-DEC-83

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83484 - 1	W83484 - 2	W83484 - 3	W83484 - 4	W83484 - 5	W83484 - 6
SAMPLE ID:	MONITORING	MONITORING	MONITORING	MONITORING	MONITORING	MONITORING
SAMPLE REMARKS:	WELL 1	WELL 2	WELL 3	WELL 4	WELL 5	WELL 11
DISSOLVED RADIOCHEMISTRY						
GROSS ALPHA (pCi/L)	14 ± 6	0.0 ± 5.2	43 ± 9	2.1 ± 4.7	0.2 ± 3.0	0.0 ± 2.5

CORE LABORATORIES, INC.
ANALYTICAL REPORT

29-DEC-83

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83484 - 7	W83484 - 8	W83484 - 9	W83484 -10
SAMPLE ID:	MONITORING	MONITORING	MONITORING	CULINARY
SAMPLE REMARKS:	WELL 12	WELL 13	WELL 20	WELL
DATE/TIME SAMPLED	10-27-83/	10-27-83/	10-27-83/	10-26-83/
DATE/TIME RECEIVED	11-01-83/1000	11-01-83/1000	11-01-83/1000	11-01-83/1000
DATE/TIME ANALYZED	11-02-83/ 800	11-02-83/ 800	11-02-83/ 800	11-02-83/ 800
CHEMIST: RIF/DRH			duplicate sample from Well #3	
LOCATION: AURORA, CO				

LAB pH (@ 25 deg. C)	7.47	7.87	7.78	8.20
LAB COND. (as umhos/cm @ 25C)	4000	4380	5770	470

--ALL VALUES REPORTED ON A DISSOLVED BASIS (MG./L.) UNLESS INDICATED OTHERWISE

29-DEC-83

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83484 - 7		W83484 - 8		W83484 - 9		W83484 -10	
SAMPLE ID:	MONITORING		MONITORING		MONITORING		CULINARY	
SAMPLE REMARKS:	WELL 12		WELL 13		WELL 20		WELL	
MAJOR CATIONS								
CALCIUM (Ca)	530	(26.45)	350	(17.47)	520	(25.95)	46	(2.30)
MAGNESIUM (Mg)	210	(17.28)	100	(8.23)	210	(17.28)	19	(1.56)
SODIUM (Na)	290	(12.61)	640	(27.84)	790	(34.36)	17	(0.74)
POTASSIUM (K)	13	(0.33)	9.9	(0.25)	21	(0.54)	3.4	(0.09)
SUM OF MAJOR CATIONS (me/l)		(56.68)		(53.79)		(78.13)		(4.69)
SUM OF TOTAL CATIONS (me/l)		(56.68)		(53.79)		(78.13)		(4.69)
MAJOR ANIONS								
BICARBONATE (HCO3)	529.0	(8.67)	430.0	(7.05)	532.0	(8.72)	255.0	(4.18)
CARBONATE (CO3)	<1	(0.00)	<1	(0.00)	<1	(0.00)	<1	(0.00)
HYDROXIDE (OH)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)
SULFATE (SO4)	2338	(48.68)	2265	(47.16)	3250	(67.67)	64	(1.33)
CHLORIDE (Cl)	53.9	(1.52)	41.2	(1.16)	58.3	(1.64)	0.6	(0.02)
SUM OF MAJOR ANIONS (me/l)		(58.87)		(55.37)		(78.03)		(5.53)
SUM OF TOTAL ANIONS (me/l)		(58.87)		(55.37)		(78.03)		(5.53)

CORE LABORATORIES, INC.
ANALYTICAL REPORT

29-DEC-83

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83484 - 7	W83484 - 8	W83484 - 9	W83484 -10
SAMPLE ID:	MONITORING	MONITORING	MONITORING	CULINARY
SAMPLE REMARKS:	WELL 12	WELL 13	WELL 20	WELL

GENERAL PARAMETERS

TOTAL DISSOLVED SOLIDS (CALC.)	3922 (3699)	3689 (3621)	5156 (5115)	293 (278)
*TOTAL ALK. (pH 3.7 as $CaCO_3$)	453	371	461	221

*--FILTERABLE

CORE LABORATORIES, INC.
ANALYTICAL REPORT

29-DEC-83

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83484 - 7	W83484 - 8	W83484 - 9	W83484 -10
SAMPLE ID:	MONITORING	MONITORING	MONITORING	CULINARY
SAMPLE REMARKS:	WELL 12	WELL 13	WELL 20	WELL
DISSOLVED METALS				
URANIUM (U3O8)	0.015 1.01×10^{-8}	0.021 1.42×10^{-8}	0.036 2.4×10^{-8}	0.001 6.77×10^{-10}

CORE LABORATORIES, INC.
ANALYTICAL REPORT

29-DEC-83

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83484 - 7	W83484 - 8	W83484 - 9	W83484 -10
SAMPLE ID:	MONITORING	MONITORING	MONITORING	CULINARY
SAMPLE REMARKS:	WELL 12	WELL 13	WELL 20	WELL
DISSOLVED RADIOCHEMISTRY				
GROSS ALPHA (pCi/L)	10 ± 5	11 ± 5	34 ± 8	0.0 ± 0.8

Received
5/17/82
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CORE LABORATORIES, INC.
ANALYTICAL REPORT

MAR 1 0 1999

CLIENT IDENTIFICATION

JOB NO.:6307-W82096
COMPANY: ENERGY FUELS NUCLEAR, INC.
JOB/GROUP REMARKS:

IDENTIFICATION	IDENTIFICATION
1) WELL NO. 1 CULINARY	2) WELL NO. 2 MONITORING
3) WELL NO. 4 MONITORING	

CORE LABORATORIES, INC.
ANALYTICAL REPORT

26-APR-82

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82096 - 1	W82096 - 2	W82096 - 3
SAMPLE ID:	WELL NO. 1	WELL NO. 2	WELL NO. 4
SAMPLE REMARKS:	CULINARY	MONITORING	MONITORING
DATE/TIME SAMPLED	04-07-82/	04-02-82/	04-07-82/
:E/TIME RECEIVED	04-09-82/1045	04-09-82/1045	04-09-82/1045
DATE/TIME ANALYZED	04-13-82/1050	04-13-82/1050	04-13-82/1050
CHEMIST: RIF/DRH			
LOCATION: AURORA, CO			

LAB pH (@ 25 DEG. C)	7.70	7.50	7.36
LAB COND. (uMHOS @ 25 DEG. C)	459	3402	3630

--ALL VALUES REPORTED ON A DISSOLVED BASIS (MG./L.) UNLESS INDICATED OTHERWISE

CORE LABORATORIES, INC.
ANALYTICAL REPORT

26-APR-82

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82096 - 1	W82096 - 2	W82096 - 3
SAMPLE ID:	WELL NO. 1	WELL NO. 2	WELL NO. 4
SAMPLE REMARKS:	CULINARY	MONITORING	MONITORING

MAJOR CATIONS

	W82096 - 1		W82096 - 2		W82096 - 3	
CALCIUM (Ca)	43.0	(2.15)	310	(15.47)	420	(20.96)
MAGNESIUM (Mg)	22.0	(1.81)	88.0	(7.24)	160	(13.16)
SODIUM (Na)	22.0	(0.96)	460	(20.01)	330	(14.36)
SUM OF MAJOR CATIONS (meq)		(4.92)		(42.72)		(48.48)
SUM OF TOTAL CATIONS (meq)		(4.92)		(42.72)		(48.48)

MAJOR ANIONS

	W82096 - 1		W82096 - 2		W82096 - 3	
...ARBONATE (HCO3)	249	(4.08)	451	(7.39)	451	(7.39)
CARBONATE (CO3)	<1	(0.00)	<1	(0.00)	<1	(0.00)
HYDROXIDE (OH)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)
SULFATE (SO4)	40.7	(0.85)	1766	(36.77)	2056	(42.81)
CHLORIDE (Cl)	2.46	(0.07)	6.94	(0.20)	39.7	(1.12)
SUM OF MAJOR ANIONS (meq)		(5.00)		(44.36)		(51.32)
SUM OF TOTAL ANIONS (meq)		(5.00)		(44.36)		(51.32)

CORE LABORATORIES, INC.
ANALYTICAL REPORT

26-APR-82

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82096 - 1	W82096 - 2	W82096 - 3
SAMPLE ID:	WELL NO. 1	WELL NO. 2	WELL NO. 4
SAMPLE REMARKS:	CULINARY	MONITORING	MONITORING

IERAL PARAMETERS

TOTAL DISSOLVED SOLIDS (CALC.)	390 (252)	2860 (2852)	3260 (3227)
TOTAL ALKALINITY (AS CaCO3)	222	404	404

CORE LABORATORIES, INC.
ANALYTICAL REPORT

26-APR-82

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82096 - 1	W82096 - 2	W82096 - 3
SAMPLE ID:	WELL NO. 1	WELL NO. 2	WELL NO. 4
SAMPLE REMARKS:	CULINARY	MONITORING	MONITORING

BIOCHEMISTRY

LEAD 210 (pCi/)		**	**
POLONIUM 210 (pCi/L)		3.9 ± 2.4	0.6 ± 0.7
RADIUM 226 (pCi/L)		**	**
THORIUM 230 (pCi/L)		**	**
URANIUM (U308)-(ug/L)		7	2

**--PRELIMINARY REPORT, RESULTS TO FOLLOW

CORE LABORATORIES, INC.
ANALYTICAL REPORT

26-APR-82

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82096 - 1	W82096 - 2	W82096 - 3
SAMPLE ID:	WELL NO. 1	WELL NO. 2	WELL NO. 4
SAMPLE REMARKS:	CULINARY	MONITORING	MONITORING

'AL RADIOCHEMISTRY

TOTAL LEAD 210 (pCi/L)	**		
TOTAL POLONIUM 210 (pCi/L)	0.5 ± 0.5		
TOTAL RADIUM 226 (pCi/L)	**		
TOTAL THORIUM 230 (pCi/L)	**		
TOTAL URANIUM (U3O8)-(ug/L)	<1		

**--PRELIMINARY REPORT, RESULTS TO FOLLOW

Received
5/17/82
DES

CORE LABORATORIES, INC.
ANALYTICAL REPORT

CLIENT IDENTIFICATION

JOB NO.:6307-W82094
COMPANY: ENERGY FUELS NUCLEAR, INC.
JOB/GROUP REMARKS:

IDENTIFICATION	IDENTIFICATION
1) WELL NO. 7-2	2) SOUTH COTTONWOOD
3) WESTWATER	

CORE LABORATORIES, INC.
ANALYTICAL REPORT

22-APR-82

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82094 - 1	W82094 - 2	W82094 - 3
SAMPLE ID:	WELL NO. 7-2	SOUTH	WESTWATER
SAMPLE REMARKS:		COTTONWOOD	
DATE/TIME SAMPLED	04-01-82/	04-01-82/	04-01-2 /
E/TIME RECEIVED	04-07-82/1100	04-07-82/1100	04-07-2 /1100
DATE/TIME ANALYZED	04-08-82/1030	04-08-82/1030	04-08-2 /1030
CHEMIST: RIF/DRH			
LOCATION: AURORA, CO			
LAB pH (@ 25 DEG. C)	7.50	8.35	8.20
LAB COND. (uMHOS @ 25 DEG. C)	1352	686	1155

--ALL VALUES REPORTED ON A DISSOLVED BASIS (MG./L.) UNLESS INDICATED OTHERWISE

CORE LABORATORIES, INC.
ANALYTICAL REPORT

22-APR-82

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82094 - 1	W82094 - 2	W82094 - 3
SAMPLE ID:	WELL NO. 7-2	SOUTH	WESTWATER
SAMPLE REMARKS:		COTTONWOOD	

IERAL PARAMETERS

TOTAL DISSOLVED SOLIDS (CALC.)	850 (875)	410 (413)	710 (758)
TOTAL SUSPENDED SOLIDS		<4	5
BICARBONATE (HCO3)	235	296	348
CARBONATE (CO3)	<1	<1	<1
HYDROXIDE (OH)	<0.5	<0.5	<0.5
SULFATE (SO4)	380	114	258
CHLORIDE (Cl)	86.1	19.5	67.7
TOTAL ALKALINITY (AS CaCO3)	210	270	303

CORE LABORATORIES, INC.
ANALYTICAL REPORT

22-APR-82

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82094 - 1	W82094 - 2	W82094 - 3
SAMPLE ID:	WELL NO. 7-2	SOUTH	WESTWATER
SAMPLE REMARKS:		COTTONWOOD	
'ALS			

CALCIUM (Ca)	160	55.0	88.0
MAGNESIUM (Mg)	40.0	36.0	24.0
SODIUM (Na)	93.0	44.0	150

CORE LABORATORIES, INC.
ANALYTICAL REPORT

22-APR-82

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82094 - 1	W82094 - 2	W82094 - 3
SAMPLE ID:	WELL NO. 7-2	SOUTH	WESTWATER
SAMPLE REMARKS:		COTTONWOOD	
IOCHEMISTRY			
LEAD 210 (pCi/)	**		
POLONIUM 210 (pCi/L)	**		
RADIUM 226 (pCi/L)	**		
THORIUM 230 (pCi/L)	**		
URANIUM (U3O8)-(ug/L)	25		

**--PRELIMINARY REPORT, RESULTS TO FOLLOW

CORE LABORATORIES, INC.
ANALYTICAL REPORT

22-APR-82

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82094 - 1	W82094 - 2	W82094 - 3
SAMPLE ID:	WELL NO. 7-2	SOUTH	WESTWATER
SAMPLE REMARKS:		COTTONWOOD	

ʳAL RADIOCHEMISTRY

TOTAL LEAD 210 (pCi/L)		**	**
TOTAL POLONIUM 210 (pCi/L)		**	**
TOTAL RADIUM 226 (pCi/L)		**	**
TOTAL THORIUM 230 (pCi/L)		**	**
TOTAL URANIUM (U3O8)-(ug/L)		18	2

**--PRELIMINARY REPORT, RESULTS TO FOLLOW

WAMCO LAB

P. O. Box 2953 - Casper, WY 82602

ANALYSIS REPORT

COMPANY: Energy Fuels Nuclear, Inc. DATE: March 30, 1982

Sample type Water W. O. No. 3028

Analysis in Milligrams per Liter except where Noted

Sample No. (Well No.)	1	2	3	4	5
Total Dissolved Solids	1199	2769	4990	3228	2273
Sodium (Na)	170	483	757	340	490
Potassium (K)	14	26	58	32	22
Calcium (Ca)	142	325	481	417	200
Magnesium (Mg)	55	244	229	177	83
Sulfate (SO4)	613	1590	3100	1920	1260
Chloride (Cl)	13	8	64	42	51
Carbonate (CO3)	0	0	0	0	0
Bicarbonate (HCO3)	325	447	464	433	354
Hydroxide (OH)					
pH, Units	7.25	7.17	6.73	7.07	7.32
Conductivity uMhos/cm 25 C	1450	3450	5100	3704	3050
Major Cations, Milliequiv.	19.37	42.07	76.79	50.97	35.15
Major Anions, Milliequiv.	19.12	42.71	75.57	49.97	34.48
Absolute Value, Charged Bal.	0.65	-.75	0.80	0.99	0.96
Ammonia (NH3 as N)	0.45	<.10	1.16	0.92	<.10
Nitrate (NO3 as N)	<.05	0.43	0.20	0.22	0.93
Nitrite (NO2 as N)	<.001	<.001	<.001	<.001	0.05
Floride (F)	0.51	0.40	0.57	0.45	0.74
Total Alkalinity as CaCO3	267	367	382	354	290
Total Hardness as CaCO3	581	1028	2141	1768	718
Boron (B)	0.25	0.25	0.12	0.28	0.11
Aluminum (Al)	<.10	<.10	<.10	<.10	<.10
Arsenic (As)	<.001	<.001	<.001	<.001	<.001
Barium (Ba)	<.10	<.10	<.10	<.10	<.10
Cadmium (Cd)	<.022	<.002	0.004	<.002	<.002
Chromium (Cr)	<.01	<.01	<.01	<.01	<.01
Copper (Cu)	<.01	<.01	<.01	<.01	<.01
Iron (Fe)	1.67	0.22	0.04	0.07	<.01
Lead (Pb)	<.05	<.05	<.05	<.05	<.05
Manganese (Mn)	0.22	2.16	2.07	0.83	0.29
Mercury (Hg)	<.0002	<.0002	<.0002	<.0002	<.0002
Nickel (Ni)	<.02	<.02	<.02	<.02	<.02
Selenium (Se)	<.001	0.009	0.003	0.003	<.001
Zinc (Zn)	0.020	0.087	0.058	0.049	0.015
Molybdenum (Mo)	<.10	<.10	<.10	<.10	<.10
Uranium (U3O8) PPB	<1	3	6	2	1
Vanadium (V2O5)	<.10	<.10	<.10	<.10	<.10

WAMCO LAB

P. O. Box 2953 - Casper, WY 82602

ANALYSIS REPORT

COMPANY: Energy Fuels Nuclear Inc. DATE: March 31, 1982

Sample type Water W. O. No. 3028

Analysis in Milligrams per Liter except where Noted

Sample No. (well No.)	1	2	3	4	5
Redox Potential	143	140	126	126	127
Phosphorus as P	<.01	<.01	<.01	<.01	<.01
Silica (SiO2)	4.40	6.10	5.90	6.00	4.90
Strontium (Sr)	10.7	21.20	8.80	11.90	11.70
Uranium (U308),Dissolved	1	3	4	1	<1
Total Organic Carbon (TOC)	1	3	4	1	3
Chemical Oxygen Demand BOD	<1	5	1	3	7
Oil and Grease	.1	0.2	0.1	03.	01.
Total Suspended Solids	36	42	30	25	53
Gross Alpha pCi/L +- Prec	1.5+-1.5	3.0+-2.3	4.5+-2.5	1.5+-1.5	7.5+-2.3
Gross Beta pCi/L +- Prec	6.3+-3.1	14+-3.5	22+-3.9	5.4+-3.1	12+-3.4
Radium-226 pCi/L +- Prec	0.8+-.5	1.6+-.6	1.1+-.5	1.0+-.5	0.9+-.5
Thorium-230 pCi/L +- Prec	0.8+-.5	0.9+-.6	1.5+-.9	0.8+-.5	1.7+-.9
Lead 210 pCi/L +- Prec	1.3+-1.2	1.2+-1.1	1.8+-1.3	0.9+-1.1	1.0+-1.1
Polonium 210 pCi/L +- Prec	0.9+-.7	1.1+-.8	1.3+-.8	0.8+-.6	1.3+-.8

Sample Description:

3028-1 #1 1-28-82
3028-2 #2 1-28-82
3028-3 #3 1-27-82
3028-4 #4 1-26-82
3028-5 #5 1-26-82

WAMCO LAB

P. O. Box 2953 – Casper, WY 82602

ANALYSIS REPORT

COMPANY: Energy Fuels Nuclear, Inc. DATE: March 30, 1982

W. O. No. 3028

Sample type Water

Analysis in Milligrams per Liter except where Noted

Sample No. *(Well No.)*	6 *(7-2)*
Total Dissolved Solids	951
Sodium (Na)	97
Potassium (K)	11
Calcium (Ca)	160
Magnesium (Mg)	39
Sulfate (SO4)	435
Chloride (Cl)	92
Carbonate (CO3)	0
Bicarbonate (HCO3)	232
Hydroxide (OH)	
pH, Units	7.39
Conductivity uMhos/cm 25 C	1275
Major Cations, Milliequiv.	15.69
Major Anions, Milliequiv.	15.44
Absolute Value, Charged Bal.	0.80
Ammonia (NH3 as N)	<.10
Nitrate (NO3 as N)	<.05
Nitrite (NO2 as N)	<.001
Floride (F)	0.51
Total Alkalinity as CaCO3	190
Total Hardness as CaCO3	559
Boron (B)	0.28
Aluminum (Al)	<.10
Arsenic (As)	<.001
Barium (Ba)	<.10
Cadmium (Cd)	<.002
Chromium (Cr)	<.01
Copper (Cu)	<.01
Iron (Fe)	<.01
Lead (Pb)	<.05
Manganese (Mn)	<.01
Mercury (Hg)	<.0002
Nickel (Ni)	<.02
Selenium (Se)	<.001
Zinc (Zn)	0.017
Molydenum (Mo)	<.10
Uranium (U3O8) PPB	6
Vanadium (V2O5)	<.10
Radium-226 pCi/L +- Prec	0.5+-.4

WAMCO LAB

P. O. Box 2953 – Casper, WY 82602

ANALYSIS REPORT

COMPANY: Energy Fuels Nuclear, Inc. DATE: March 31, 1982

Sample type Water W. O. No. 3028

Analysis in Milligrams per Liter except where Noted

Sample No.	6 (7-2)
Redox Potential	127
Phopsphorus as P	<.01
Silica (SiO2)	6.40
Strontium (Sr)	2.62
Uranium (U3O8),Dissolved	5
Total Organic Carbon (TOC)	6
Chemical Oxygen Demand BOD	9
Oil and Grease	02.
Total Suspended Solids	16
Gross Alpha pCi/L. +- Prec	1.5+-1.5
Gross Beta pCi/L +- Prec	3.6+-3.0
Radium-226 pCi/L +- Prec	0.5+-.4
Thorium-230 pCi/L +- Prec	0.9+-.6
Lead-210 pCi/L +- Prec	1.2+-1.1
Polonium 210 pCi/L +- Prec	0.6+-.5

Sample Description:

3028-6 #7 1-27-82

Received April 7 1982
DES

WAMCO LAB

P. O. Box 2953 - Casper, WY 82602

ANALYSIS REPORT

COMPANY: Energy Fuels Nuclear, Inc.

DATE: March 30, 1982

Sample type Water

W. O. No. 3028

Analysis in Milligrams per Liter except where Noted

Sample No.	1 (monitoring well)	2	3	4	5
Total Dissolved Solids	1199	2769	4990	3228	2273
Sodium (Na)	170	483	757	340	490
Potassium (K)	14	26	58	32	22
Calcium (Ca)	142	325	481	417	200
Magnesium (Mg)	55	244	229	177	83
Sulfate (SO4)	613	1590	3100	1920	1260
Chloride (Cl)	13	8	64	42	51
Carbonate (CO3)	0	0	0	0	0
Bicarbonate (HCO3)	325	447	464	433	354
Hydroxide (OH)					
pH, Units	7.25	7.17	6.73	7.07	7.32
Conductivity uMhos/cm 25 C	1450	3450	5100	3700	3050
Major Cations, Milliequiv.	19.37	42.07	76.79	50.97	35.15
Major Anions, Milliequiv.	19.12	42.71	75.57	49.97	34.48
Absolute Value, Charged Bal.	0.65	-.75	0.80	0.99	0.96
Ammonia (NH3 as N)	0.45	<.10	1.16	0.92	<.10
Nitrate (NO3 as N)	<.05	0.43	0.20	0.22	0.93
Nitrite (NO2 as N)	<.001	<.001	<.001	<.001	0.05
Floride (F)	0.51	0.40	0.57	0.45	0.74
Total Alkalinity as CaCO3	267	367	382	354	290
Total Hardness as CaCO3	581	1028	2141	1768	718
Boron (B)	0.25	0.25	0.12	0.28	0.11
Aluminum (Al)	<.10	<.10	<.10	<.10	<.10
Arsenic (As)	<.001	<.001	<.001	<.001	<.001
Barium (Ba)	<.10	<.10	<.10	<.10	<.10
Cadmium (Cd)	<.002	<.002	0.004	<.002	<.002
Chromium (Cr)	<.01	<.01	<.01	<.01	<.01
Copper (Cu)	<.01	<.01	<.01	<.01	<.01
Iron (Fe)	1.67	0.02	0.04	0.07	<.01
Lead (Pb)	<.05	<.05	<.05	<.05	<.05
Manganese (Mn)	0.22	0.16	2.07	0.83	0.29
Mercury (Hg)	<.0002	<.0002	<.0002	<.0002	<.0002
Nickel (Ni)	<.02	<.02	<.02	<.02	<.02
Selenium (Se)	<.001	0.009	0.003	0.003	<.001
Zinc (Zn)	0.020	0.087	0.059	0.049	0.015
Molydenum (Mo)	<.10	<.10	<.10	<.10	<.10
Uranium (U3O8) PPB	<1	3	6	2	1
Vanadium (V2O5)	<.10	<.10	<.10	<.10	<.10

WAMCO LAB

P. O. Box 2953 - Casper, WY 82602

ANALYSIS REPORT

COMPANY: Energy Fuels Nuclear, Inc. DATE: March 31, 1982

Sample type Water W. O. No. 3028

Analysis in Milligrams per Liter except where Noted

Sample No.	1	2	3	4	5
Redox Potential	143	140	126	126	127
Phopsphorus as P	<.01	<.01	<.01	<.01	<.01
Silica (SiO2)	4.40	6.10	5.90	6.00	4.90
Strontium (Sr)	10.7	21.20	8.80	11.90	11.70
Uranium (U3O8), Dissolved	1	3	4	1	<1
Total Organic Carbon (TOC)	1	3	4	1	3
Chemical Oxygen Demand BOD	<1	5	1	3	7
Oil and Grease	.1	0.2	0.1	03.	01.
Total Suspended Solids	36	42	30	25	53
Gross Alpha pCi/L +- Prec	1.5+-1.5	3.0+-2.3	4.5+-2.5	1.5+-1.5	7.5+-2.3
Gross Beta pCi/L +- Prec	6.3+-3.1	14+-3.5	22+-3.9	5.4+-3.1	12+-3.4
Radium-226 pCi/L +- Prec	0.8+-.5	1.6+-.6	1.1+-.5	1.0+-.5	0.9+-.5
Thorium-230 pCi/L +- Prec	0.8+-.5	0.9+-.6	1.5+-.9	0.8+-.5	1.7+-.9
Lead 210 pCi/L +- Prec	1.3+-1.2	1.2+-1.1	1.8+-1.3	0.9+-1.1	1.0+-1.1
Polonium 210 pCi/L +- Prec	0.9+-.7	1.1+-.8	1.3+-.8	0.8+-.6	1.3+-.6

Sample Description:

3028-1 #1 1-28-82
3028-2 #2 1-28-82
3028-3 #3 1-27-82
3028-4 #4 1-26-82
3028-5 #5 1-26-82

Received
9/7/87
DK

3rd Qtr

CORE LABORATORIES, INC.
ANALYTICAL REPORT

CLIENT IDENTIFICATION

JOB NO.:6307-W82268
COMPANY: ENERGY FUELS NUCLEAR, INC.
JOB/GROUP REMARKS:

IDENTIFICATION	IDENTIFICATION
1) MONITORING WELL #1	2) MONITORING WELL #2
3) MONITORING WELL #3	4) MONITORING WELL #4
5) MONITORING WELL #5	6) MONITORING WELL SOUTH

CORE LABORATORIES, INC.
ANALYTICAL REPORT

03-SEP-82

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82268 - 1	W82268 - 2	W82268 - 3	W82268 - 4	W82268 - 5	W82268 - 6
SAMPLE ID:	MONITORING	MONITORING	MONITORING	MONITORING	MONITORING	MONITORING
SAMPLE REMARKS:	WELL #1	WELL #2	WELL #3	WELL #4	WELL #5	WELL SOUTH
DATE/TIME SAMPLED	08-04-82/	08-03-82/	08-05-82/	08-05-82/	08-03-82/	08-05-82/
DATE/TIME RECEIVED	08-09-82/1000	08-09-82/1000	08-10-82/1000	08-10-82/1000	08-09-82/1000	08-10-82/1000
DATE/TIME ANALYZED	08-10-82/1000	08-10-82/1000	08-10-82/1000	08-10-82/1000	08-10-82/1000	08-10-82/1000
CHEMIST: RIF/DRH						
LOCATION: AURORA, CO						
LAB pH (@ 25 DEG. C)	7.82	7.70	7.50	7.80	8.01	7.30
LAB COND. (uMHOS @ 25 DEG. C)	1570	3340	5170	3380	2790	5190

--ALL VALUES REPORTED ON A DISSOLVED BASIS (MG./L.) UNLESS INDICATED OTHERWISE

CORE LABORATORIES, INC.
ANALYTICAL REPORT

03-SEP-82

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82268 - 1		W82268 - 2		W82268 - 3		W82268 - 4		W82268 - 5		W82268 - 6	
SAMPLE ID:	MONITORING		MONITORING		MONITORING		MONITORING		MONITORING		MONITORING	
SAMPLE REMARKS:	WELL #1		WELL #2		WELL #3		WELL #4		WELL #5		WELL SOUTH	
MAJOR CATIONS												
CALCIUM (Ca)	130	(6.49)	320	(15.97)	480	(23.95)	420	(20.96)	170	(8.48)	480	(23.95)
MAGNESIUM (Mg)	51.0	(4.20)	91.0	(7.49)	210	(17.27)	170	(13.98)	48.0	(3.95)	210	(17.27)
SODIUM (Na)	160	(6.96)	470	(20.45)	750	(32.63)	340	(14.79)	470	(20.45)	750	(32.63)
SUM OF MAJOR CATIONS (meq)		(17.65)		(43.91)		(73.85)		(49.73)		(32.88)		(73.85)
SUM OF TOTAL CATIONS (meq)		(17.65)		(43.91)		(73.85)		(49.73)		(32.88)		(73.85)
JOR ANIONS												
BICARBONATE (HCO3)	319	(5.23)	450	(7.38)	426	(6.98)	450	(7.38)	372	(6.10)	426	(6.98)
CARBONATE (CO3)	<1	(0.00)	<1	(0.00)	<1	(0.00)	<1	(0.00)	<1	(0.00)	<1	(0.00)
HYDROXIDE (OH)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)
SULFATE (SO4)	662	(13.78)	1788	(37.22)	3185	(66.31)	2047	(42.62)	1295	(26.97)	3185	(66.31)
CHLORIDE (Cl)	12.4	(0.35)	6.27	(0.18)	66.7	(1.88)	43.1	(1.22)	55.0	(1.55)	66.3	(1.87)
SUM OF MAJOR ANIONS (meq)		(19.36)		(44.78)		(75.17)		(51.22)		(34.62)		(75.16)
SUM OF TOTAL ANIONS (meq)		(19.36)		(44.78)		(75.17)		(51.22)		(34.62)		(75.16)

CORE LABORATORIES, INC.
ANALYTICAL REPORT

03-SEP-82

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82268 - 1	W82268 - 2	W82268 - 3	W82268 - 4	W82268 - 5	W82268 - 6
SAMPLE ID:	MONITORING	MONITORING	MONITORING	MONITORING	MONITORING	MONITORING
SAMPLE REMARKS:	WELL #1	WELL #2	WELL #3	WELL #4	WELL #5	WELL SOUTH
GENERAL PARAMETERS						
TOTAL DISSOLVED SOLIDS (CALC.)	1238 (1171)	2996 (2895)	5388 (4900)	3546 (3241)	2264 (2221)	5276 (4900)
TOTAL ALKALINITY (AS CaCO3)	276	389	371	389	324	376

CORE LABORATORIES, INC.
ANALYTICAL REPORT

03-SEP-82

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82268 - 1	W82268 - 2	W82268 - 3	W82268 - 4	W82268 - 5	W82268 - 6
SAMPLE ID:	MONITORING	MONITORING	MONITORING	MONITORING	MONITORING	MONITORING
SAMPLE REMARKS:	WELL #1	WELL #2	WELL #3	WELL #4	WELL #5	WELL SOUTH
RADIOCHEMISTRY						
LEAD 210 (pCi/)	0.0 ± 3.5	0.0 ± 3.5	0.0 ± 3.5	0.0 ± 3.5	0.0 ± 3.7	0.0 ± 3.6
POLONIUM 210 (pCi/L)	0.3 ± 0.5	0.0 ± 0.0	0.3 ± 0.3	0.3 ± 0.3	0.3 ± 0.3	0.5 ± 0.5
RADIUM 226 (pCi/L)	0.7 ± 0.2	1.5 ± 0.2	1.2 ± 0.2	1.0 ± 0.2	0.4 ± 0.1	0.9 ± 0.2
THORIUM 230 (pCi/L)	0.2 ± 0.8	2.0 ± 1.2	0.2 ± 0.9	0.3 ± 0.9	0.2 ± 0.8	1.7 ± 1.2
URANIUM (U3O8)-(ug/L)	<1	4	13	<1	<1	29

Received
5/17/82
DRS

CORE LABORATORIES, INC.
ANALYTICAL REPORT

CLIENT IDENTIFICATION

JOB NO.:6307-W82096
COMPANY: ENERGY FUELS NUCLEAR, INC.
JOB/GROUP REMARKS:

IDENTIFICATION

1) WELL NO. 1
CULINARY

3) WELL NO. 4
MONITORING

IDENTIFICATION

2) WELL NO. 2
MONITORING

CORE LABORATORIES, INC.
ANALYTICAL REPORT

7-MAY-82

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82096 - 1	W82096 - 2	W82096 - 3
SAMPLE ID:	WELL NO. 1	WELL NO. 2	WELL NO. 4
SAMPLE REMARKS:	CULINARY	MONITORING	MONITORING
DATE/TIME SAMPLED	04-07-82/	04-02-82/	04-07-82/
TE/TIME RECEIVED	04-09-82/1045	04-09-82/1045	04-09-82/1045
DATE/TIME ANALYZED	04-13-82/1050	04-13-82/1050	04-13-82/1050
CHEMIST: RIF/DRH			
LOCATION: AURORA, CO			
LAB pH (@ 25 DEG. C)	7.70	7.50	7.36
LAB COND. (uMHOS @ 25 DEG. C)	459	3402	3630

--ALL VALUES REPORTED ON A DISSOLVED BASIS (MG./L.) UNLESS INDICATED OTHERWISE

CORE LABORATORIES, INC.
ANALYTICAL REPORT

7-MAY-82

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82096 - 1		W82096 - 2		W82096 - 3	
SAMPLE ID:	WELL NO. 1		WELL NO. 2		WELL NO. 4	
SAMPLE REMARKS:	CULINARY		MONITORING		MONITORING	
...JOR CATIONS						
CALCIUM (Ca)	43.0	(2.15)	310	(15.47)	420	(20.96)
MAGNESIUM (Mg)	22.0	(1.81)	88.0	(7.24)	160	(13.16)
SODIUM (Na)	22.0	(0.96)	460	(20.01)	330	(14.36)
SUM OF MAJOR CATIONS (meq)		(4.92)		(42.72)		(48.48)
SUM OF TOTAL CATIONS (meq)		(4.92)		(42.72)		(48.48)
MAJOR ANIONS						
ARBONATE (HCO3)	249	(4.08)	451	(7.39)	451	(7.39)
CARBONATE (CO3)	<1	(0.00)	<1	(0.00)	<1	(0.00)
HYDROXIDE (OH)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)
SULFATE (SO4)	40.7	(0.85)	1766	(36.77)	2056	(42.81)
CHLORIDE (Cl)	2.46	(0.07)	6.94	(0.20)	39.7	(1.12)
SUM OF MAJOR ANIONS (meq)		(5.00)		(44.36)		(51.32)
SUM OF TOTAL ANIONS (meq)		(5.00)		(44.36)		(51.32)

CORE LABORATORIES, INC.
ANALYTICAL REPORT

7-MAY-82

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82096 - 1	W82096 - 2	W82096 - 3
SAMPLE ID:	WELL NO. 1	WELL NO. 2	WELL NO. 4
SAMPLE REMARKS:	CULINARY	MONITORING	MONITORING

ιERAL PARAMETERS

TOTAL DISSOLVED SOLIDS (CALC.)	390 (252)	2860 (2852)	3260 (3227)
TOTAL ALKALINITY (AS CaCO3)	222	404	404

ANALYTICAL REPORT

7-MAY-82

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82096 - 1	W82096 - 2	W82096 - 3
SAMPLE ID:	WELL NO. 1	WELL NO. 2	WELL NO. 4
SAMPLE REMARKS:	CULINARY	MONITORING	MONITORING

)IOCHEMISTRY

LEAD 210 (pCi/)		0.5 ± 1.2	0.9 ± 1.0
POLONIUM 210 (pCi/L)		2.0 ± 1.0	0.6 ± 0.7
RADIUM 226 (pCi/L)		0.6 ± 0.2	1.0 ± 0.2
THORIUM 230 (pCi/L)		0.0 ± 0.5	0.0 ± 0.3
URANIUM (U3O8)-(ug/L)		7	2

CORE LABORATORIES, INC.
ANALYTICAL REPORT

7-MAY-82

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82096 - 1	W82096 - 2	W82096 - 3
SAMPLE ID:	WELL NO. 1	WELL NO. 2	WELL NO. 4
SAMPLE REMARKS:	CULINARY	MONITORING	MONITORING

'AL RADIOCHEMISTRY

TOTAL LEAD 210 (pCi/L)	1.0 ± 1.0
TOTAL POLONIUM 210 (pCi/L)	0.5 ± 0.5
TOTAL RADIUM 226 (pCi/L)	0.2 ± 0.2
TOTAL THORIUM 230 (pCi/L)	0.6 ± 1.4
TOTAL URANIUM (U3O8)-(ug/L)	<1

Received
5/17/8?

CORE LABORATORIES, INC.
ANALYTICAL REPORT

CLIENT IDENTIFICATION

JOB NO.:6307-W82100
COMPANY: ENERGY FUELS NUCLEAR, INC.
JOB/GROUP REMARKS: MONITORING WELLS

IDENTIFICATION	IDENTIFICATION
1) WELL NO. 1	2) WELL NO. 3
3) WELL NO. 5	

CORE LABORATORIES, INC.
ANALYTICAL REPORT

6-MAY-82

ENERGY FUELS NUCLEAR, INC.
MONITORING WELLS

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82100 - 1	W82100 - 2	W82100 - 3
SAMPLE ID:	WELL NO. 1	WELL NO. 3	WELL NO. 5
SAMPLE REMARKS:			
DATE/TIME SAMPLED	04-13-82/	04-13-82/	04-13-82/
DATE/TIME RECEIVED	04-16-82/1100	04-16-82/1100	04-16-82/1100
DATE/TIME ANALYZED	04-19-82/ 900	04-19-82/ 900	04-19-82/ 900
CHEMIST: RIF/DRH			
LOCATION: AURORA, CO			

LAB pH (@ 25 DEG. C)	7.70	7.20	7.80
LAB COND. (uMHOS @ 25 DEG. C)	1635	5489	3275

--ALL VALUES REPORTED ON A DISSOLVED BASIS (MG./L.) UNLESS INDICATED OTHERWISE

CORE LABORATORIES, INC.
ANALYTICAL REPORT

6-MAY-82

ENERGY FUELS NUCLEAR, INC.
MONITORING WELLS

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82100 - 1		W82100 - 2		W82100 - 3	
SAMPLE ID:	WELL NO. 1		WELL NO. 3		WELL NO. 5	
SAMPLE REMARKS:						
MAJOR CATIONS						
CALCIUM (Ca)	140	(6.99)	470	(23.45)	220	(10.98)
MAGNESIUM (Mg)	50.0	(4.11)	250	(20.56)	55.0	(4.52)
SODIUM (Na)	190	(8.26)	790	(34.36)	510	(22.19)
SUM OF MAJOR CATIONS (meq)		(19.36)		(78.37)		(37.69)
SUM OF TOTAL CATIONS (meq)		(19.36)		(78.37)		(37.69)
MAJOR ANIONS						
BICARBONATE (HCO3)	325	(5.33)	472	(7.74)	358	(5.87)
CARBONATE (CO3)	<1	(0.00)	<1	(0.00)	<1	(0.00)
HYDROXIDE (OH)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)
SULFATE (SO4)	697	(14.51)	3239	(67.44)	1518	(31.60)
CHLORIDE (Cl)	11.7	(0.33)	64.3	(1.81)	50.0	(1.41)
SUM OF MAJOR ANIONS (meq)		(20.17)		(76.99)		(38.88)
SUM OF TOTAL ANIONS (meq)		(20.17)		(76.99)		(38.88)

CORE LABORATORIES, INC.
ANALYTICAL REPORT

6-MAY-82

ENERGY FUELS NUCLEAR, INC.
MONITORING WELLS

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82100 - 1		W82100 - 2		W82100 - 3	
SAMPLE ID:	WELL NO. 1		WELL NO. 3		WELL NO. 5	
SAMPLE REMARKS:						
GENERAL PARAMETERS						
TOTAL DISSOLVED SOLIDS (CALC.)	1269	(1248)	5193	(5045)	2575	(2528)
TOTAL ALKALINITY (AS CaCO3)	286		416		323	

CORE LABORATORIES, INC.
ANALYTICAL REPORT

6-MAY-82

ENERGY FUELS NUCLEAR, INC.
MONITORING WELLS

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82100 - 1	W82100 - 2	W82100 - 3
SAMPLE ID:	WELL NO. 1	WELL NO. 3	WELL NO. 5
SAMPLE REMARKS:			

...DIOCHEMISTRY

LEAD 210 (pCi/)	0.0 ± 1.1	1.3 ± 1.2	0.0 ± 1.1
POLONIUM 210 (pCi/L)	0.2 ± 0.6	0.8 ± 1.0	0.4 ± 0.7
RADIUM 226 (pCi/L)	0.3 ± 0.1	0.5 ± 0.1	0.3 ± 0.1
THORIUM 230 (pCi/L)	0.2 ± 1.0	0.0 ± 0.2	0.0 ± 0.4
URANIUM (U308)-(ug/L)	2	35	4

CORE LABORATORIES, INC.
ANALYTICAL REPORT

Receivd 1/20/83 [illegible]

CLIENT IDENTIFICATION

JOB NO.:6307-W82438
COMPANY: ENERGY FUELS NUCLEAR INC.
JOB/GROUP REMARKS:

IDENTIFICATION	IDENTIFICATION
1) MONITORING WELL #4	2) MONITORING WELL #5

CORE LABORATORIES, INC.
ANALYTICAL REPORT

01-17-83

ENERGY FUELS NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82438 - 1	W82438 - 2
SAMPLE ID:	MONITORING	MONITORING
SAMPLE REMARKS:	WELL #4	WELL #5
DATE/TIME SAMPLED	12-10-82/	12-13-82/
DATE/TIME RECEIVED	12-16-82/1427	12-16-82/1427
DATE/TIME ANALYZED	12-17-82/ 830	12-17-82/ 830
CHEMIST: RIF/DRH		
LOCATION: AURORA, CO		
LAB pH (@ 25 deg. C)	7.60	8.02
LAB COND. (as umhos/cm @ 25C)	3320	2610

--ALL VALUES REPORTED ON A DISSOLVED BASIS (MG./L.) UNLESS INDICATED OTHERWISE

01-17-83

ENERGY FUELS NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82438 - 1		W82438 - 2	
SAMPLE ID:	MONITORING		MONITORING	
SAMPLE REMARKS:	WELL #4		WELL #5	
MAJOR CATIONS				
CALCIUM (Ca)	420	(20.96)	143	(7.14)
MAGNESIUM (Mg)	190	(15.64)	40	(3.29)
SODIUM (Na)	334	(14.53)	431	(18.75)
POTASSIUM (K)	9.2	(0.24)	7.4	(0.19)
SUM OF MAJOR CATIONS (me/l)		(51.37)		(29.37)
SUM OF TOTAL CATIONS (me/l)		(51.37)		(29.37)
MAJOR ANIONS				
BICARBONATE (HCO3)	453.0	(7.42)	377.0	(6.18)
CARBONATE (CO3)	<1	(0.00)	<1	(0.00)
HYDROXIDE (OH)	<0.5	(0.00)	<0.5	(0.00)
SULFATE (SO4)	1979	(41.20)	1182	(24.61)
CHLORIDE (Cl)	36.0	(1.02)	47.1	(1.33)
SUM OF MAJOR ANIONS (me/l)		(49.64)		(32.12)
SUM OF TOTAL ANIONS (me/l)		(49.64)		(32.12)

CORE LABORATORIES, INC.
ANALYTICAL REPORT

01-17-83

ENERGY FUELS NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82438 - 1	W82438 - 2
SAMPLE ID:	MONITORING	MONITORING
SAMPLE REMARKS:	WELL #4	WELL #5

ENERAL PARAMETERS

OTAL DISSOLVED SOLIDS (CALC.)	3470 (3195)	2180 (2039)
TOTAL ALK. (pH 3.7 as CaCO3)	389	323

--FILTERABLE

CORE LABORATORIES, INC.
ANALYTICAL REPORT

01-17-83

ENERGY FUELS NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82438 - 1	W82438 - 2
SAMPLE ID:	MONITORING	MONITORING
SAMPLE REMARKS:	WELL #4	WELL #5

ISSOLVED METALS

RANIUM (U3O8)	<0.001	<0.001

CORE LABORATORIES, INC
ANALYTICAL REPORT

01-17-83

NERGY FUELS NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

OB NO. 6307-	W82438 - 1	W82438 - 2
AMPLE ID:	MONITORING	MONITORING
AMPLE REMARKS:	WELL #4	WELL #5
SSOLVED RADIOCHEMISTRY		
ROSS ALPHA (pCi/L)	0.3 ± 1.5	2.2 ± 1.5

CLIENT IDENTIFICATION

Received 1/28/83

OB NO.:6307-W82436
OMPANY: ENERGY FUEL NUCLEAR INC.
OB/GROUP REMARKS:

IDENTIFICATION	IDENTIFICATION
1) MONITORING WELL #1	2) MONITORING WELL #2

CORE LABORATORIES, INC
ANALYTICAL REPORT

01-17-83

ENERGY FUEL NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82436 - 1	W82436 - 2
SAMPLE ID:	MONITORING	MONITORING
SAMPLE REMARKS:	WELL #1	WELL #2
DATE/TIME SAMPLED	12-10-82/	12-10-82/
DATE/TIME RECEIVED	12-14-82/1000	12-14-82/1000
DATE/TIME ANALYZED	12-14-82/1300	12-14-82/1300

CHEMIST: RIF/DRH
LOCATION: AURORA, CO

AB pH (@ 25 deg. C)	7.80	7.71
AB COND. (as umhos/cm @ 25C)	1525	3190

--ALL VALUES REPORTED ON A DISSOLVED BASIS (MG./L.) UNLESS INDICATED OTHERWISE

CORE LABORATORIES INC
ANALYTICAL REPORT

01-17-83

ENERGY FUEL NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82436 - 1		W82436 - 2	
SAMPLE ID:	MONITORING		MONITORING	
SAMPLE REMARKS:	WELL #1		WELL #2	

AJOR CATIONS

ALCIUM (Ca)	143	(7.14)	300	(14.97)
AGNESIUM (Mg)	51	(4.20)	90	(7.41)
ODIUM (Na)	170	(7.39)	480	(20.88)
OTASSIUM (K)	6.4	(0.16)	10.2	(0.26)
UM OF MAJOR CATIONS (me/l)		(18.90)		(43.52)
UM OF TOTAL CATIONS (me/l)		(18.90)		(43.52)

AJOR ANIONS

ICARBONATE (HCO3)	326.0	(5.34)	451.0	(7.39)
ARBONATE (CO3)	<1	(0.00)	<1	(0.00)
YDROXIDE (OH)	<0.5	(0.00)	<0.5	(0.00)
ULFATE (SO4)	653	(13.60)	1749	(36.41)
HLORIDE (Cl)	10.9	(0.31)	5.5	(0.16)
UM OF MAJOR ANIONS (me/l)		(19.25)		(43.96)
UM OF TOTAL ANIONS (me/l)		(19.25)		(43.96)

01-17-83

ENERGY FUEL NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82436 - 1	W82436 - 2
SAMPLE ID:	MONITORING	MONITORING
SAMPLE REMARKS:	WELL #1	WELL #2

ENERAL PARAMETERS

OTAL DISSOLVED SOLIDS (CALC.)	1326 (1197)	3056 (2860)
TOTAL ALK. (pH 3.7 as CaCO3)	277	388

--FILTERABLE

CORE LABORATORIES, INC.
ANALYTICAL REPORT

01-17-83

:NERGY FUEL NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82436 - 1	W82436 - 2
SAMPLE ID:	MONITORING	MONITORING
SAMPLE REMARKS:	WELL #1	WELL #2
ISSOLVED METALS		
RANIUM (U3O8)	<0.001	<0.001

CORE LABORATORIES, INC.
ANALYTICAL REPORT

01-17-83

ENERGY FUEL NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82436 - 1	W82436 - 2
SAMPLE ID:	MONITORING	MONITORING
SAMPLE REMARKS:	WELL #1	WELL #2

DISSOLVED RADIOCHEMISTRY

GROSS ALPHA (pCi/L)	37.3 ± 11.1	1.6 ± 1.6

CORE LABORATORIES, INC.
ANALYTICAL REPORT

CLIENT IDENTIFICATION

OB NO.:6307-W82451
OMPANY: ENERGY FUELS NUCLEAR, INC.
OB/GROUP REMARKS:

IDENTIFICATION	IDENTIFICATION
1) MONITOR WELL #3	2) MONITOR WELL #11
3) MONITOR WELL #12	4) MONITOR WELL #13

1/21/82

17-JAN-83

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82451 - 1	W82451 - 2	W82451 - 3	W82451 - 4
SAMPLE ID:	MONITOR WELL	MONITOR WELL	MONITOR WELL	MONITOR WELL
SAMPLE REMARKS:	#3	#11	#12	#13
DATE/TIME SAMPLED	12-13-82/	12-16-82/	12-17-82/	12-17-82/
DATE/TIME RECEIVED	12-21-82/1000	12-21-82/1000	12-21-82/1000	12-21-82/1000
DATE/TIME ANALYZED	12-21-82/1300	12-21-82/1300	12-21-82/1300	12-21-82/1300
CHEMIST: RIF/DRH				
LOCATION: AURORA, CO				
LAB pH (@ 25 deg. C)	7.55	8.19	7.8	7.85
LAB COND. (as umhos/cm @ 25C)	5450	2600	3840	4200

--ALL VALUES REPORTED ON A DISSOLVED BASIS (MG./L.) UNLESS INDICATED OTHERWISE

17-JAN-83

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82451 - 1		W82451 - 2		W82451 - 3		W82451 - 4	
SAMPLE ID:	MONITOR WELL		MONITOR WELL		MONITOR WELL		MONITOR WELL	
SAMPLE REMARKS:	#3		#11		#12		#13	
MAJOR CATIONS								
CALCIUM (Ca)	480	(23.95)	36	(1.80)	500	(24.95)	390	(19.46)
MAGNESIUM (Mg)	185	(15.22)	8.8	(0.72)	214	(17.61)	109	(8.97)
SODIUM (Na)	810	(35.24)	550	(23.92)	310	(13.48)	630	(27.40)
POTASSIUM (K)	16	(0.41)	5.7	(0.15)	16	(0.41)	8.1	(0.21)
SUM OF MAJOR CATIONS (me/l)		(74.82)		(26.60)		(56.46)		(56.05)
SUM OF TOTAL CATIONS (me/l)		(74.82)		(26.60)		(56.46)		(56.05)
MAJOR ANIONS								
BICARBONATE (HCO3)	463.0	(7.58)	399	(6.53)	416.0	(6.82)	419.0	(6.87)
CARBONATE (CO3)	<1	(0.00)	<1	(0.00)	<1	(0.00)	<1	(0.00)
HYDROXIDE (OH)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)
SULFATE (SO4)	3259	(67.85)	926	(19.28)	2395	(49.86)	2288	(47.64)
CHLORIDE (Cl)	53.0	(1.50)	24.4	(0.69)	57.4	(1.62)	40.5	(1.14)
SUM OF MAJOR ANIONS (me/l)		(76.93)		(26.50)		(58.30)		(55.65)
SUM OF TOTAL ANIONS (me/l)		(76.93)		(26.50)		(58.30)		(55.65)

17-JAN-83

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82451 - 1	W82451 - 2	W82451 - 3	W82451 - 4
SAMPLE ID:	MONITOR WELL	MONITOR WELL	MONITOR WELL	MONITOR WELL
SAMPLE REMARKS:	#3	#11	#12	#13

GENERAL PARAMETERS

TOTAL DISSOLVED SOLIDS (CALC.)	5366 (5034)	1812 (1750)	4116 (3700)	3780 (3675)
*TOTAL ALK. (pH 3.7 as CaCO3)	399	340	366	360

*--FILTERABLE

CORE LABORATORIES, INC
ANALYTICAL REPORT

17-JAN-83

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82451 - 1	W82451 - 2	W82451 - 3	W82451 - 4
SAMPLE ID:	MONITOR WELL	MONITOR WELL	MONITOR WELL	MONITOR WELL
SAMPLE REMARKS:	#3	#11	#12	#13
DISSOLVED METALS				
URANIUM (U308)	0.037	<0.001	0.024	0.033

CORE LABORATORIES, INC.
ANALYTICAL REPORT

17-JAN-83

ENERGY FUELS NUCLEAR, INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W82451 - 1	W82451 - 2	W82451 - 3	W82451 - 4
SAMPLE ID:	MONITOR WELL	MONITOR WELL	MONITOR WELL	MONITOR WELL
SAMPLE REMARKS:	#3	#11	#12	#13
ISSOLVED RADIOCHEMISTRY				
ROSS ALPHA (pCi/L)	12.0 ± 22.5	33.2 ± 18.1	33.2 ± 22.6	10.7 ± 17.1

2nd (Qtr?) 1982

CLIENT IDENTIFICATION

JOB NO.:6307-W83176
COMPANY: ENERGY FUELS NUCLEAR INC.
JOB/GROUP REMARKS:

IDENTIFICATION	IDENTIFICATION
1) WELL #4	2) WELL #5
3) WELL #11	4) WELL #12
5) WELL DIKE 4 (duplicate sample of well #13)	6) WELL #13
7) WELL #2	

26-JULY-83

ENERGY FUELS NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83176 - 1	W83176 - 2	W83176 - 3	W83176 - 4	W83176 - 5	W83176 - 6
SAMPLE ID:	WELL #4	WELL #5	WELL #11	WELL #12	WELL DIKE 4	WELL #13
SAMPLE REMARKS:						
DATE/TIME SAMPLED	05-25-83/	05-24-83/	05-24-83/	05-04-83/	05-04-83/	05-26-83/
DATE/TIME RECEIVED	05-27-83/1000	05-27-83/1000	05-27-83/ 100	05-27-83/1000	05-27-83/1000	05-27-83/1000
DATE/TIME ANALYZED	05-27-83/1300	05-27-83/1300	05-27-83/1300	05-27-83/1300	05-27-83/1300	05-27-83/1300
CHEMIST: RIF/DRH						
LOCATION: AURORA, CO						
LAB pH (@ 25 deg. C)	7.82	8.11	8.09	7.39	7.96	8.02
LAB COND. (as umhos/cm @ 25C)	3580	2730	2500	3700	4200	4100

--ALL VALUES REPORTED ON A DISSOLVED BASIS (MG./L.) UNLESS INDICATED OTHERWISE

CORE LABORATORIES, INC.
ANALYTICAL REPORT

26-JULY-83

ENERGY FUELS NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83176 - 1		W83176 - 2		W83176 - 3		W83176 - 4		W83176 - 5		W83176 - 6	
SAMPLE ID:	WELL #4		WELL #5		WELL #11		WELL #12		WELL DIKE 4		WELL #13	
SAMPLE REMARKS:												
MAJOR CATIONS												
CALCIUM (Ca)	420	(20.96)	150	(7.48)	31	(1.55)	530	(26.45)	360	(17.96)	360	(17.96)
MAGNESIUM (Mg)	190	(15.64)	42	(3.46)	7.7	(0.63)	270	(22.22)	94	(7.74)	94	(7.74)
SODIUM (Na)	330	(14.35)	460	(20.01)	530	(23.05)	310	(13.48)	640	(27.84)	640	(27.84)
POTASSIUM (K)	8.0	(0.20)	6.5	(0.17)	4.7	(0.12)	12	(0.31)	8.5	(0.22)	8.5	(0.22)
SUM OF MAJOR CATIONS (me/l)		(51.16)		(31.12)		(25.35)		(62.47)		(53.76)		(53.76)
SUM OF TOTAL CATIONS (me/l)		(51.71)		(31.37)		(25.46)		(62.59)		(54.24)		(54.24)
MAJOR ANIONS												
BICARBONATE (HCO3)	430.0	(7.05)	372.0	(6.10)	363.0	(5.95)	507.0	(8.31)	411.0	(6.74)	396.0	(6.49)
CARBONATE (CO3)	<1	(0.00)	<1	(0.00)	<1	(0.00)	<1	(0.00)	<1	(0.00)	<1	(0.00)
HYDROXIDE (OH)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)
SULFATE (SO4)	2109	(43.91)	1228	(25.57)	943	(19.63)	2420	(50.38)	2315	(48.20)	2324	(48.39)
CHLORIDE (Cl)	37.3	(1.05)	48.1	(1.36)	26.8	(0.76)	80.5	(2.27)	42.2	(1.19)	43.8	(1.24)
SUM OF MAJOR ANIONS (me/l)		(52.01)		(33.03)		(26.34)		(60.96)		(56.13)		(56.12)
SUM OF TOTAL ANIONS (me/l)		(52.03)		(33.08)		(26.37)		(60.98)		(56.15)		(56.14)

CORE LABORATORIES, INC.
ANALYTICAL REPORT

26-JULY-83

ENERGY FUELS NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83176 - 1	W83176 - 2	W83176 - 3	W83176 - 4	W83176 - 5	W83176 - 6
SAMPLE ID:	WELL #4	WELL #5	WELL #11	WELL #12	WELL DIKE 4	WELL #13
SAMPLE REMARKS:						

GENERAL PARAMETERS

TOTAL DISSOLVED SOLIDS (CALC.)	3532 (3340)	2236 (2140)	1728 (1739)	4026 (3879)	3824 (3694)	3808 (3697)
TOTAL SUSPENDED SOLIDS	8	92	6	93	10	14
OIL & GREASE, TOTAL	<5	<5	<5	<5	<5	<5
*PHOSPHATE, TOTAL (PO4-P)	<0.01	<0.01	<0.01	<0.01	0.02	<0.01
*NITROGEN, AMMONIA (NH3-N)	0.58	0.39	0.48	0.81	0.97	0.94
*NITROGEN, NITRATE (NO3-N)	0.2	0.6	<0.1		0.2	0.2
*FLUORIDE (F)	0.3	0.8	0.5	0.3	0.3	0.3
ORGANIC CARBON, TOTAL (TOC)	<2	<2	4	5	3	2
*REDOX POTENTIAL, eH (mV)	193	182	200	180	182	181
OXYGEN DEMAND, CHEMICAL (COD)	<5	6	<5	106	16	17

*--FILTERABLE

CORE LABORATORIES INC
ANALYTICAL REPORT

26-JULY-83

ENERGY FUELS NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83176 - 1	W83176 - 2	W83176 - 3	W83176 - 4	W83176 - 5	W83176 - 6
SAMPLE ID:	WELL #4	WELL #5	WELL #11	WELL #12	WELL DIKE 4	WELL #13
SAMPLE REMARKS:						
DISSOLVED METALS						
ALUMINUM (Al)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
IRON (Fe)	4.15	0.91	0.85		2.42	2.44
MANGANESE (Mn)	1.22	0.29	0.04	2.03	3.1	3.1
MOLYBDENUM (Mo)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
SELENIUM (Se)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SILICA (SiO2)	13	9	11		14	14
SILVER (Ag)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
STRONTIUM (Sr)	11	7.5	1.79		8.0	7.9
URANIUM (U)	<0.001	<0.001	<0.001	0.003	0.006	0.006
VANADIUM (V)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
ZINC (Zn)	<0.01	<0.01	<0.01	0.04	<0.01	<0.01

26-JULY-83

ENERGY FUELS NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83176 - 1	W83176 - 2	W83176 - 3	W83176 - 4	W83176 - 5	W83176 - 6
SAMPLE ID:	WELL #4	WELL #5	WELL #11	WELL #12	WELL DIKE 4	WELL #13
SAMPLE REMARKS:						
TOTAL METALS						
ARSENIC (As), total	<0.01	<0.01	<0.01		<0.01	<0.01
BARIUM (Ba), total	<0.1	<0.1	<0.1		<0.1	<0.1
BORON (B), total	0.28	0.28	0.28		0.24	0.23
CADMIUM (Cd), total	<0.01	<0.01	<0.01		<0.01	<0.01
CHROMIUM (Cr), total	<0.01	<0.01	<0.01		<0.01	<0.01
COPPER (Cu), total	<0.01	<0.01	<0.01		<0.01	<0.01
IRON (Fe), total	4.18	1.51	1.09		2.47	2.45
LEAD (Pb), total	<0.01	<0.01	0.02		<0.01	<0.01
MERCURY (Hg), total	<.0003	<.0003	<.0003		<.0003	<.0003

26-JULY-83

ENERGY FUELS NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83176 - 1	W83176 - 2	W83176 - 3	W83176 - 4	W83176 - 5	W83176 - 6
SAMPLE ID:	WELL #4	WELL #5	WELL #11	WELL #12	WELL DIKE 4	WELL #13
SAMPLE REMARKS:						
DISSOLVED RADIOCHEMISTRY						
GROSS ALPHA (pCi/L)	0.0 ± 10.9	0.0 ± 10.3	0.0 ± 15.5	0.0 ± 17.3	0.0 ± 20.9	0.0 ± 18.7
GROSS BETA (pCi/L)	1.5 ± 28.9	2.9 ± 13.3	7.1 ± 12.4	0.0 ± 22.6	0.0 ± 28.9	0.0 ± 27.7
LEAD 210 (pCi/L)	0.0 ± 0.8	0.0 ± 0.8	0.0 ± 0.8	0.0 ± 0.8	0.0 ± 0.8	0.0 ± 0.8
POLONIUM 210 (pCi/L)	0.0 ± 0.6	0.0 ± 0.8	0.0 ± 0.8	0.0 ± 1.0	0.0 ± 0.7	0.0 ± 1.0
RADIUM 226 (pCi/L)	1.0 ± 0.2	1.2 ± 0.2	0.4 ± 0.2	0.6 ± 0.2	0.7 ± 0.2	0.6 ± 0.2
THORIUM 230 (pCi/L)	0.1 ± 0.4	0.2 ± 0.6	0.0 ± 0.6	0.1 ± 0.8	0.1 ± 0.3	0.1 ± 0.6

0.8

ANALYTICAL REPORT

26-JULY-83

ENERGY FUELS NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83176 - 7
SAMPLE ID:	WELL #2
SAMPLE REMARKS:	
DATE/TIME SAMPLED	05-04-83/
DATE/TIME RECEIVED	05-27-83/1000
DATE/TIME ANALYZED	05-27-83/1300
CHEMIST: RIF/DRH	
LOCATION: AURORA, CO	

LAB pH (@ 25 deg. C)	7.80
LAB COND. (as umhos/cm @ 25C)	3170

--ALL VALUES REPORTED ON A DISSOLVED BASIS (MG./L.) UNLESS INDICATED OTHERWISE

CORE LABORATORIES, INC.
ANALYTICAL REPORT

26-JULY-83

ENERGY FUELS NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307- W83176 - 7
SAMPLE ID: WELL #2
SAMPLE REMARKS:

MAJOR CATIONS

CALCIUM (Ca)	320	(15.97)
MAGNESIUM (Mg)	87	(7.16)
SODIUM (Na)	470	(20.44)
POTASSIUM (K)	9.5	(0.24)
SUM OF MAJOR CATIONS (me/l)		(43.82)
SUM OF TOTAL CATIONS (me/l)		(43.84)

MAJOR ANIONS

BICARBONATE (HCO3)	442.0	(7.24)
CARBONATE (CO3)	<1	(0.00)
HYDROXIDE (OH)	<0.5	(0.00)
SULFATE (SO4)	1801	(37.50)
CHLORIDE (Cl)	25.0	(0.71)
SUM OF MAJOR ANIONS (me/l)		(45.45)
SUM OF TOTAL ANIONS (me/l)		(45.47)

ANALYTICAL REPORT

26-JULY-83

ENERGY FUELS NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83176 - 7
SAMPLE ID:	WELL #2
SAMPLE REMARKS:	

GENERAL PARAMETERS

TOTAL DISSOLVED SOLIDS (CALC.)	2820 (2934)
TOTAL SUSPENDED SOLIDS	26
OIL & GREASE, TOTAL	<5
*PHOSPHATE, TOTAL (PO4-P)	<0.01
*NITROGEN, AMMONIA (NH3-N)	0.14
*FLUORIDE (F)	0.3
ORGANIC CARBON, TOTAL (TOC)	4
*REDOX POTENTIAL, eH (mV)	231
OXYGEN DEMAND, CHEMICAL (COD)	<5

*--FILTERABLE

CORE LABORATORIES, INC.
ANALYTICAL REPORT

26-JULY-83

ENERGY FUELS NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83176 - 7
SAMPLE ID:	WELL #2
SAMPLE REMARKS:	

DISSOLVED METALS

ALUMINUM (Al)	<0.1
CHROMIUM (Cr)	<0.01
MANGANESE (Mn)	0.22
MOLYBDENUM (Mo)	<0.1
SELENIUM (Se)	0.01
SILVER (Ag)	<0.01
URANIUM (U)	0.005
VANADIUM (V)	<0.1
ZINC (Zn)	0.08

CORE LABORATORIES, INC
ANALYTICAL REPORT

26-JULY-83

ENERGY FUELS NUCLEAR INC.

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307- W83176 - 7
SAMPLE ID: WELL #2
SAMPLE REMARKS:

DISSOLVED RADIOCHEMISTRY

GROSS ALPHA (pCi/L)	0.0 ± 13.1
GROSS BETA (pCi/L)	0.0 ± 28.3
LEAD 210 (pCi/L)	0.0 ± 0.8
POLONIUM 210 (pCi/L)	0.0 ± 1.0
RADIUM 226 (pCi/L)	1.7 ± 0.2
THORIUM 230 (pCi/L)	0.4 ± 0.6

CORE LABORATORIES, INC.
ANALYTICAL REPORT

CLIENT IDENTIFICATION

JUL 8 REC'D

DES

JOB NO.:6307-W83121
COMPANY: ENERGY FUELS NUCLEAR
JOB/GROUP REMARKS:

IDENTIFICATION	IDENTIFICATION
1) CULLINARY WELL	2) SO. COTTONWOOD SURFACE WATER
3) WEST WATER SURFACE WATER	4) WELL #1 TAILINGS MONITOR
5) WELL #3 TAILINGS MONITOR	

28-JUNE-83

ENERGY FUELS NUCLEAR

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83121 - 1	W83121 - 2	W83121 - 3	W83121 - 4	W83121 - 5
SAMPLE ID:	CULLINARY WEL	SO. COTTONWOO	WEST WATER	WELL #1	WELL #3
SAMPLE REMARKS:		SURFACE WATER	SURFACE WATER	TAILINGS MONI	TAILINGS MONI
DATE/TIME SAMPLED	04-19-83/	04-19-83/	04-19-83/	04-22-83/	04-21-83/
DATE/TIME RECEIVED	04-22-83/1000	04-22-83/1000	04-22-83/1000	04-26-83/1000	04-26-83/1000
DATE/TIME ANALYZED	04-23-83/1300	04-23-83/1300	04-23-83/1300	04-27-83/1300	04-27-83/1300
CHEMIST: RIF/DRH					
LOCATION: AURORA, CO					
LAB pH (@ 25 deg. C)	7.83	7.89	8.10	7.75	7.52
LAB COND. (as umhos/cm @ 25C)	478	435	1300	1625	4900

--ALL VALUES REPORTED ON A DISSOLVED BASIS (MG./L.) UNLESS INDICATED OTHERWISE

CORE LABORATORIES, INC
ANALYTICAL REPORT

28-JUNE-83

ENERGY FUELS NUCLEAR

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83121 - 1		W83121 - 2		W83121 - 3		W83121 - 4		W83121 - 5	
SAMPLE ID:	CULLINARY WEL		SO. COTTONWOO		WEST WATER		WELL #1		WELL #3	
SAMPLE REMARKS:			SURFACE WATER		SURFACE WATER		TAILINGS MONI		TAILINGS MONI	
MAJOR CATIONS										
CALCIUM (Ca)	44	(2.20)	43	(2.15)	100	(4.99)	150	(7.48)	470	(23.45)
MAGNESIUM (Mg)	20	(1.65)	17	(1.40)	25	(2.06)	51	(4.20)	260	(21.40)
SODIUM (Na)	27	(1.17)	23	(1.00)	170	(7.39)	170	(7.39)	770	(33.49)
POTASSIUM (K)	4.2	(0.11)	2.5	(0.06)	2.3	(0.06)	6.0	(0.15)	22	(0.56)
SUM OF MAJOR CATIONS (me/l)		(5.13)		(4.61)		(14.51)		(19.23)		(78.91)
SUM OF TOTAL CATIONS (me/l)		(5.14)		(4.61)		(14.51)		(19.27)		(79.04)
MAJOR ANIONS										
BICARBONATE (HCO3)	251.0	(4.11)	201.0	(3.29)	352.0	(5.77)	322.0	(5.28)	444.0	(7.28)
CARBONATE (CO3)	<1	(0.00)	<1	(0.00)	<1	(0.00)	<1	(0.00)	<1	(0.00)
HYDROXIDE (OH)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)	<0.5	(0.00)
SULFATE (SO4)	41	(0.85)	48	(1.00)	305	(6.35)	658	(13.70)	3226	(67.17)
CHLORIDE (Cl)	2.8	(0.08)	7.7	(0.22)	86.0	(2.43)	16.5	(0.47)	66.5	(1.88)
SUM OF MAJOR ANIONS (me/l)		(5.04)		(4.51)		(14.55)		(19.45)		(76.33)
SUM OF TOTAL ANIONS (me/l)		(5.04)		(4.51)		(14.55)		(19.45)		(76.33)

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RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83121 - 1	W83121 - 2	W83121 - 3	W83121 - 4	W83121 - 5
SAMPLE ID:	CULLINARY WEL	SO. COTTONWOO	WEST WATER	WELL #1	WELL #3
SAMPLE REMARKS:		SURFACE WATER	SURFACE WATER	TAILINGS MONI	TAILINGS MONI

GENERAL PARAMETERS

TOTAL DISSOLVED SOLIDS (CALC.)	278 (265)	266 (242)	790 (864)	1160 (1213)	4880 (5040)
TOTAL SUSPENDED SOLIDS	<4	2758	14		
*TOTAL ALK. (pH 3.7 as CaCO3)	219	177	307	283	393
*P-ALK. (pH 8.3 as CaCO3)	<1	<1	<1	<1	<1
*PHOSPHATE, TOTAL (PO4-P)	<0.01	0.01	0.01	<0.01	<0.01
*NITROGEN, AMMONIA (NH3-N)	0.15	0.09	<0.05	0.53	0.57

*--FILTERABLE

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ENERGY FUELS NUCLEAR

RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307- SAMPLE ID: SAMPLE REMARKS:	W83121 - 1 CULLINARY WEL	W83121 - 2 SO. COTTONWOO SURFACE WATER	W83121 - 3 WEST WATER SURFACE WATER	W83121 - 4 WELL #1 TAILINGS MONI	W83121 - 5 WELL #3 TAILINGS MONI
DISSOLVED METALS					
ALUMINUM (Al)	<0.1	<0.1	<0.1	<0.1	<0.1
ARSENIC (As)	<0.01	<0.01	<0.01	<0.01	<0.01
CADMIUM (Cd)	<0.01	<0.01	<0.01	<0.01	<0.01
CHROMIUM (Cr)	<0.01	<0.01	<0.01	<0.01	<0.01
COPPER (Cu)	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (Pb)	<0.01	<0.01	<0.01	<0.01	<0.01
MANGANESE (Mn)	0.01	<0.01	0.08	0.24	2.57
MERCURY (Hg)	<.0003	<.0003	<.0003	<.0003	<.0003
MOLYBDENUM (Mo)	<0.1	<0.1	<0.1	<0.1	<0.1
SELENIUM (Se)	<0.01	<0.01	<0.01	<0.01	0.01
URANIUM (U308)				<0.001	0.030
VANADIUM (V)	<0.1	<0.1	<0.1	<0.1	<0.1
ZINC (Zn)	<0.01	<0.01	0.01	<0.01	0.10

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RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83121 - 1	W83121 - 2	W83121 - 3	W83121 - 4	W83121 - 5
SAMPLE ID:	CULLINARY WEL	SO. COTTONWOO	WEST WATER	WELL #1	WELL #3
SAMPLE REMARKS:		SURFACE WATER	SURFACE WATER	TAILINGS MONI	TAILINGS MONI
TOTAL METALS					
URANIUM (U3O8), total	<0.001	0.005	<0.001		

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RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83121 - 1	W83121 - 2	W83121 - 3	W83121 - 4	W83121 - 5
SAMPLE ID:	CULLINARY WEL	SO. COTTONWOO	WEST WATER	WELL #1	WELL #3
SAMPLE REMARKS:		SURFACE WATER	SURFACE WATER	TAILINGS MONI	TAILINGS MONI
DISSOLVED RADIOCHEMISTRY					
GROSS ALPHA (pCi/L)				7.9 ± 10.2	27.0 ± 29.3
GROSS BETA (pCi/L)				9.3 ± 9.8	133 ± 41.5
LEAD 210 (pCi/L)				0.0 ± 0.7	0.5 ± 0.7
POLONIUM 210 (pCi/L)				0.0 ± 0.1	0.7 ± 0.8
RADIUM 226 (pCi/L)				0.4 ± 0.1	1.4 ± 0.2
THORIUM 230 (pCi/L)				0.0 ± 0.5	0.5 ± 1.0

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RESULTS OF WATER QUALITY ANALYSIS
ON SAMPLES COLLECTED AT LOCATION:

JOB NO. 6307-	W83121 - 1	W83121 - 2	W83121 - 3	W83121 - 4	W83121 - 5
SAMPLE ID:	CULLINARY WEL	SO. COTTONWOO	WEST WATER	WELL #1	WELL #3
SAMPLE REMARKS:		SURFACE WATER	SURFACE WATER	TAILINGS MONI	TAILINGS MONI

TOTAL RADIOCHEMISTRY

	W83121 - 1	W83121 - 2	W83121 - 3	W83121 - 4	W83121 - 5
GROSS ALPHA (pCi/L), total	0.2 ± 2.0	43.9 ± 19.6	0.0 ± 4.4		
GROSS BETA (pCi/L), total	18.2 ± 5.1	31.7 ± 23.4	0.0 ± 8.4		
LEAD 210 (pCi/L), total	0.0 ± 0.7	3.9 ± 1.0	0.0 ± 0.7		
POLONIUM 210 (pCi/L), total	0.0 ± 0.1	3.1 ± 1.8	0.0 ± 0.1		
RADIUM 226 (pCi/L), total	0.4 ± 0.1	1.7 ± 0.3	0.1 ± 0.1		
THORIUM 230 (pCi/L), total	0.0 ± 0.5	2.1 ± 0.8	0.0 ± 0.6		

ATTACHMENT 6

U.S. NUCLEAR REGULATORY COMMISSION

MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 40 and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee	
1. Umetco Minerals Corporation	3. License number SUA-1358, as renewed
2. Post Office Box 787 Blanding, Utah 84511	4. Expiration date September 23, 1991
	5. Docket or Reference No. 40-8681

6. Byproduct, source, and/or special nuclear material	7. Chemical and/or physical form	8. Maximum amount that licensee may possess at any one time under this license
Natural Uranium	Any	Unlimited

9. Authorized place of use: The licensee's uranium milling facilities located in San Juan County, Utah.

10. The licensee is hereby authorized to possess byproduct material in the form of uranium waste tailings and other uranium byproduct waste generated by the licensee's milling operations authorized by this license.

11. For use in accordance with statements, representations and conditions contained in Sections 3.6.6, 5.1, 5.2, 5.3, 5.4, 6.2 and 6.3 and Appendix E, Section 5, of the license renewal application dated January, 1985 as revised May, 1985, except where superceded by license condition below.

    Whenever the word "will" is used in the above referenced sections, it shall denote a requirement.

12. The mill production per calendar year shall not exceed 4,380 tons of U_3O_8.

13. Any changes in the mill circuit as illustrated and described in Plate 3.1-3 of the renewal application shall require approval by the U.S. Nuclear Regulatory Commission in the form of a license amendment.

14. Release of equipment or packages from the restricted area shall be in accordance with Attachment No. 1 to SUA-1358, "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.

15. The licensee shall avoid by project design, where feasible, the archeological sites designated "contributing" in Attachment No. 2 to SUA-1358. When it is not feasible

NRC Form 374A
(5-84)

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to avoid a site designated "contributing" in Attachment No. 2, the licensee shall institute a data recovery program for that site based on the research design submitted by letter from C. E. Baker of Energy Fuels Nuclear to Mr. Melvin T. Smith, Utah State Historic Preservation Officer, dated April 13, 1981.

The licensee shall recover through archeological excavation all "contributing" sites listed in Attachment No. 2 which are located in or within 100 feet of borrow areas, stockpile areas, construction areas, or the perimeter of the reclaimed tailings impoundment. Data recovery fieldwork at each site meeting these criteria shall be completed prior to the start of any project related disturbance within 100 feet of the site, but analysis and report preparation need not be complete.

Additionally, the licensee shall conduct such testing as is required to enable the Commission to determine if those sites designated as "Undetermined" in Attachment No. 2 and located within 100 feet of present or known future construction areas are of such significance to warrant their redesignation as "contributing." In all cases, such testing shall be completed before any aspect of the undertaking affects a site.

16. Archeological contractors shall be approved in writing by the Commission. The Commission will consult with the SHPO regarding the qualifications of all archeological contractors and the quality of the laboratory facilities they will use. The Commission will approve an archeological contractor who meets the minimum standards for a principal investigator set forth in 36 CFR Part 66, Appendix C, and whose qualifications are found acceptable by the SHPO.

17. The licensee shall conduct an annual survey of land use (private residences, grazing areas, private and public potable water and agricultural wells, and non-residential structures and uses) in the area within five miles (8 km) of any portion of the restricted area boundary and submit a report of this survey to the USNRC, Uranium Recovery Field Office. This report shall indicate any differences in land use from that described in the last report.

18. The results of all effluent and environmental monitoring required by this license shall be reported in accordance with 10 CFR 40, Section 40.65 with copies of the report sent to the USNRC, Uranium Recovery Field Office. Monitoring data shall be reported in the format shown in the Attachment No. 3 to SUA-1358, "Sample Format for Reporting Monitoring Data."

19. Before engaging in any activity not previously assessed by the USNRC, the licensee shall prepare and record an environmental evaluation of such activity. When the evaluation indicates that such activity may result in a significant adverse environmental impact that was not previously assessed or that is greater than that previously assessed, the licensee shall provide a written evaluation of such activities and obtain prior approval of the USNRC in the form of a license amendment.

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20. The licensee shall maintain a USNRC approved surety arrangement adequate to cover tailings stabilization and reclamation, mill decommissioning, mill site reclamation, long term maintenance and monitoring, and ground water restoration as warranted. The licensee shall submit for USNRC review and approval a proposed revision to the surety arrangement within six (6) months of USNRC approval of a revised tailings area reclamation plan or approval of or revision to any ground water protection program. The revised surety shall be in effect within three (3) months of written USNRC approval. Furthermore, the licensee shall submit for USNRC review any proposed revision or update to the surety arrangement at least two (2) months prior to the proposed effective date. Along with each proposed revision or update and at least annually, the licensee shall submit documentation showing a breakdown of the costs and the cost basis for tailings stabilization and reclamation, mill decommissioning, mill site reclamation, long term maintenance and monitoring, and ground water restoration as warranted.

    If the licensee chooses to retain a corporate guarantee as the surety arrangement, the licensee shall provide for USNRC review and approval in the form of a license amendment the financial data listed in Items (a) - (d) of Attachment No. 4 to SUA-1358, NRC Self-Bonding Criteria, within four (4) months of the date of this license and annually thereafter.

21. Prior to termination of this license, the licensee shall provide for transfer of title to byproduct material and land, including any interests therein (other than land owned by the United States or the State of Utah), which is used for the disposal of such byproduct material or is essential to ensure the long term stability of such disposal site to the United States or the State of Utah, at the State's option.

22. The licensee shall not make any changes to the present tailings retention system without specific prior approval of the USNRC, Uranium Recovery Field Office, in the form of a license amendment.

23. The license shall implement an interim stabilization program for all tailings not covered by standing water. This program shall include written operating procedures and shall minimize dispersal of blowing tailings. The effectiveness of the control method used shall be evaluated weekly by means of a documented tailings area inspection. The operating procedure shall be submitted for USNRC review and approval within three (3) months of the issuance of this license.

24. The licensee shall implement the effluent and environmental monitoring program specified in Section 5.5 of the renewal application as revised with the following modifications or additions:

    A. Stack sampling shall include a determination of flow rate.

    B. TLD chips used for radon monitoring shall be exchanged and read quarterly.

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C. Surface water samples shall also be analyzed semiannually for total and dissolved U-nat, Ra-226, and Th-230.

D. Ground water samples from Monitor Wells 1, 2, 3, 4, 5, 11, 12, 13 and the culinary water well shall be analyzed quarterly for pH, specific conductance, chlorides, sulfates, TDS, and U-nat. Quarterly water level measurements shall also be made. Ground water samples shall be analyzed semiannually for arsenic, selenium, sodium, Ra-226, Th-230, and Pb-210.

E. Data for the quarterly ground water parameters shall be maintained in graphical form and copies of the graphs included with the environmental monitoring reports submitted in accordance with 10 CFR 40.65.

F. The licensee shall utilize lower limits of detection in accordance with Section 5 of Regulatory Guide 4.14, Revision 1 dated April 1980, for analysis of effluent and environmental samples.

25. The licensee shall submit to the USNRC, Uranium Recovery Field Office, by March 15, 1986 for review and approval in the form of a license amendment a detailed reclamation plan for the authorized tailings disposal area which includes the following:

A. A post operations interim stabilization plan which details methods to prevent wind and water erosion and recharge of the tailings area.

B. A plan to determine the best methodology to dewater and/or consolidate the tailings cells prior to placement of the final reclamation cover.

C. Plan and cross-sectional views of a final reclamation cover which details the location and elevation of tailings. The plan shall include details on cover thickness, physical characteristics of cover materials, proposed testing of cover materials (specifications and QA), the estimated volumes of cover materials and their availability and location.

D. Detailed plans for placement of rock or vegetative cover on the final reclaimed tailings pile and mill site area.

E. A proposed implementation schedule for items A through D above which defines the sequence of events and expected time ranges.

F. An analysis to show that the proposed type and thickness of soil cover is adequate to provide attenuation of radon and is adequate to assure long term stability as well as an analysis and proposal on methodology and time required to restore ground water in conformance to regulatory requirements.

G. The licensee shall include a detailed cost analysis of each phase of the reclamation plan to include contractor costs, projected costs of inflation

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based upon the schedule proposed in item E, a proposed contingency cost, and the costs of long term maintenance and monitoring.

26. The licensee shall conduct a tailings retention system and liner inspection program in accordance with Section 5.5.7 and Appendix D, Section 3.0, of the renewal application. Notwithstanding any statements to the contrary, changes in inspection frequency shall require the approval of the USNRC in the form of a license amendment. Further, copies of the report documenting the annual technical evaluation shall be submitted to the Uranium Recovery Field Office, USNRC, within one month of completion of the report.

27. The licensee is hereby exempted from the requirements of Section 20.203(e)(2) of 10 CFR 20 for areas within the mill, provided that all entrances to the mill are conspicuously posted in accordance with Section 20.203(e)(2) and with the words, "Any area within this mill may contain radioactive material."

28. The results of sampling, analyses, surveys and monitoring, the results of calibration of equipment, reports on audits and inspections, all meetings and training courses required by this license and any subsequent reviews, investigations, and corrective actions, shall be documented. Unless otherwise specified in the USNRC regulations all such documentation shall be maintained for a period of at least five (5) years.

29. Standard operating procedures (SOPs) shall be established for all operational process activities involving radioactive materials that are handled, processed, or stored. Standard operating procedures for operational activities shall enumerate pertinent radiation safety practices to be followed. Additionally, written procedures shall be established for nonoperational activities to include in-plant and environmental monitoring, bioassay analyses, and instrument calibrations. An up-to-date copy of each written procedure shall be kept in the mill area to which it applies.

    All written procedures for both operational and nonoperational activities shall be reviewed and approved in writing by the RPO before implementation and whenever a change in procedure is proposed to ensure that proper radiation protection principles are being applied. In addition, the RPO shall perform a documented review of all existing operating procedures at least annually.

30. The Radiation Protection Officer (RPO) shall have the following education, training and experience:

    A. Education: A bachelor's degree in the physical sciences, industrial hygience, or engineering from an accredited college or university or an equivalent combination of training and relevant experience in uranium mill radiation protection. Two (2) years of relevant experience are generally considered equivalent to one (1) year of academic study.

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B. Health physics experience: At least 1 year of work experience relevant to uranium mill operation in applied health physics, radiation protection, industrial hygience, or similar work. This experience should involve actually working with radiation detection and measurement equipment, not strictly administrative or "desk" work.

C. Specialized training: At least 4 weeks of specialized classroom training in health physics specifically applicable to uranium milling. In addition, the RSO should attend refresher training on uranium mill health physics every two (2) years.

D. Specialized knowledge: A thorough knowledge of the proper application and use of all health physics equipment used in the mill, the chemical and analytical procedures used for radiological sampling and monitoring, methodologies used to calculate personnel exposure to uranium and its daughters, and a thorough understanding of the uranium milling process and equipment used in the mill and how the hazards are generated and controlled during the milling process.

31. The license shall be required to use a Radiation Work Permit (RWP) for all work or nonroutine maintenance jobs where the potential for significant exposure to radioactive material exists and for which no standard written operating procedure already exists. The RWP shall be issued by the RPO or his designate, qualified by way of specialized radiation protection training, and shall at least describe the following:

A. The scope of the work to be performed.

B. Any precautions necessary to reduce exposure to uranium and its daughters.

C. The supplemental radiological monitoring and sampling necessary prior to, during, and following completion of the work.

In addition, the RPO's review of all non-routine activities, committed to in Section 5.3.1 of the renewal application, shall be documented.

32. The licensee shall assure that both the RPO and mill foreman, or qualified designees during their absence, perform weekly inspections of all mill areas to observe general radiation control practices and that a member of the radiation protection staff perform the daily walkthrough inspection during weekdays, with qualified supervisory personnel performing the walkthrough on weekends. In addition, the RPO shall prepare a monthly report which includes a review of daily and weekly inspections, and a summary of all monitoring and exposure data for the month. A copy of the monthly report shall be submitted to the Operations Manager.

33. A copy of the semiannual ALARA report described in Section 5.3.2.2 of the renewal application shall be submitted to the Uranium Recovery Field Office, USNRC, by March 1 and October 1, 1986, and every year thereafter.

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34. The licensee shall maintain effluent control systems as specified in Table 4.1-1 of the licensee's renewal application with the following additions:

    A. Operations shall be immediately suspended in the affected area of the mill if any of the emission control equipment for the yellowcake drying or packaging areas is not operating within specifications for design performance.

    B. The licensee shall, during all period of yellowcake drying operations, assure that the scrubber is operating within the manufacturer's recommended ranges for water flow and air pressure differential necessary to achieve design performance. This shall be accomplished by either (1) performing and documenting checks of water flow and air pressure differential approximately every four hours during operation or (2) installing instrumentation which will signal an audible alarm if either water flow or air pressure differential fall below the manufacturer's recommended levels. If any audible alarm is used, its operation shall be check and documented daily.

    C. Air pressure differential gauges for other emission control equipment shall be read and the readings documented once per shift during operations.

35. Sample volume and analysis for all in-plant air monitoring shall be adequate to achieve an LLD of 10% of the MPC listed in Table 1, Appendix B of 10 CFR 20.

36. The licensee shall utilize the results of lapel sampling in calculating employee exposures when the lapel samplers are used.

37. Occupational exposure calculations shall be performed and documented within one week of the end of each regulatory compliance period as specified in 10 CFR 20.103(a)(2) and 10 CFR 20.103(b)(2). Routine airborne ore dust and yellowcake samples shall be analyzed in a timely manner to allow exposure calculations to be performed in accordance with this condition. Non-routine ore dust and yellowcake samples shall be analyzed and the results reviewed by the RSO within two working days after sample collection.

38. The licensee shall conduct a bioassay program in accordance with Section 5.4.2.4 of the renewal application with the following addition:

    A. A urinalysis program shall be conducted for mill personnel as specified in Section 1.4.1 of the "Radiation Protection Procedures Manual" as revised June, 1985.

    B. In-vivo counting of mill personnel shall be conducted at least once every two years.

    C. Laboratory surfaces used for bioassay analyses shall be decontaminated to less than 25 dpm alpha (removable)/100 cm^2 prior to analysis of samples.

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D. Anytime an action level of 15 ug/l uranium for urinalysis or 9 nCi uranium or an in-vivo measurement is reached or exceeded, the licensee shall provide documentation to the USNRC, Uranium Recovery Field Office, indicating what corrective actions have been performed to satisfy the requirements of Regulatory Guide 8.22. This documentation shall be included and submitted with th semiannual 10 CFR 40.65 report.

E. Anytime an action level of 30 ug/l uranium for four consecutive specimens or 130 ug/l uranium for one specimen for urinalysis or 16 nCi uranium for an in-vivo measurement is reached or exceeded, the licensee shall provide documentation within 30 days to the USNRC, Uranium Recovery Field Office, indicating what corrective actions have been performed to satisfy the requirements of Regulatory Guide 8.22.

39. Surveys for fixed and removable alpha contamination shall be conducted in accordance with Section 2.3.2.2 of the "Radiation Protection Procedures Manual" as revised June, 1985. Action levels shall be as specified in Section 2.3.4 of the procedures manual.

40. Calibration of in-plant air and radiation monitoring equipment shall be as specified in Section 3.0 of the "Radiation Protection Procedures Manual" as revised June, 1985, with the exception that in-plant air sampling equipment shall be calibrated at least quarterly. Air sampling equipment shall be checked prior to each use, and the checks documented.

41. The licensee shall submit a detailed decommissioning plan to the USNRC at least twelve (12) months prior to planned final shutdown of mill operations.

42. Within six (6) months of issuance of this license, the licensee shall submit to the Uranium Recovery Field Office a detailed proposal for the disposal of contaminated material and equipment generated at the mill site. The proposal shall include a description of the materials to be disposed of, location(s) of disposal, method(s) of disposal, estimated annual volumes of materials, and an estimate of the impact of the disposal on the tailings management plan.

43. Mill tailings other than samples for research shall not be transferred from the site without specific prior approval of the USNRC in the form of a license amendment. The licensee shall maintain a permanent record of all transfers made under the provisions of this condition.

44. All liquid effluents from mill process buildings, with the exception of sanitary wastes, shall be returned to the mill circuit or discharged to the tailings impoundment.

45. A decontamination and survey program for barrels containing yellowcake shall be conducted in accordance with Section 1.8 of Regulatory Guide 8.30, "Health Physics Programs in Uranium Mills," prior to shipment.

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46. The licensee shall implement a program to minimize dispersal of dust from the ore stockpile area(s). This program shall include written operating procedures. The effectiveness of the control method used shall be evaluated weekly by means of a documented inspection. The operating procedure shall be submitted for USNRC review and approval within three (3) months of the issuance of this license.

47. The licensee shall, by January 1, 1986, submit to the Uranium Recovery Field Office, USNRC, for review and approval in the form of a license amendment a plan for instrumentation which shall detect ruptures of the tailings discharge and solution return lines when these lines are being utilized. Indications of a possible rupture of these lines shall result in activation of an alarm in an occupied area of the mill. The instrumentation shall be tested daily, and testing documented, to ensure proper operation. The instrumentation shall be operational within sixty (60) days of USNRC approval.

48. The licensee shall implement a ground water detection monitoring program to ensure compliance to 40 CFR 192.32(a)(2) which includes the following elements:

   A. The licensee shall monitor at the point of compliance and background wells for the following indicator parameters; Arsenic, Selenium and pH. The licensee shall utilize analytical techniques capable of providing lower limits of detection of 0.005 mg/l and 0.001 mg/l for arsenic and selenium, respectively. Measurements of pH shall be reported to the nearest 1/10 standard unit.

   B. The determination of compliance shall be based on sampling Well Nos. 2 and 3.

   C. The determination of background levels for the parameters specified in subsection (A) shall be defined by sampling Well No. 1.

   D. The licensee shall sample for those parameters specified in subsection (A) above at those wells designated in subsections (B) and (C) on a monthly basis for a period of one (1) year and at least twice annually thereafter. The first monthly sample shall be taken within 30 days of the date of this Order. All semiannual samples shall be taken at least four months apart.

   E. The licensee shall, within 60 days of collection of the last of the twelve monthly samples, propose for USNRC review and approval in the form of a license amendment background levels for indicator parameters and a statistical procedure for identifying significant changes (95% confidence level) between data from the wells specified in subsections (B) and (C).

   F. The licensee shall report the data required by subsection (D) semiannually along with those data required by License Condition No. 18 in accordance to the reporting format, Attachment No. 5 to SUA-1358, "Sample Format for Reporting Detection Monitoring Data." These monitoring requirements are in addition to the requirements specified in License Condition No. 24.

NRC Form 374A
(5-84)

U.S. NUCLEAR REGULATORY COMMISSION

License number: SUA-1358, as renewed

Docket or Reference number: 40-8681

MATERIALS LICENSE
SUPPLEMENTARY SHEET

G. The licensee shall report at least annually in accordance to reporting requirements specified in subsection (F) the rate and direction of ground water flow under the tailings impoundment.

FOR THE NUCLEAR REGULATORY COMMISSION

Date September 26, 1985 BY Edward F. Hawkins
for R. Dale Smith, Director
Uranium Recovery Field Office
Region IV

UNITED STATES NUCLEAR REGULATORY COMMISSION

ATTACHMENT 7

APPLICATION FOR SOURCE MATERIAL LICENSE RENEWAL

JANUARY 1985

(Revision 1 - May 1985)

UMETCO MINERALS CORPORATION

5.0 OPERATIONS (continued)

5.4.3 Contamination Control Program

5.4.3.1 Personnel

All personnel working within the mill area are provided with change room, shower, and laundry facilities. Employees working in the yellow cake product areas or performing maintenance on equipment from these areas are provided coveralls and are required to change and shower prior to leaving the mill. All employees are also required to monitor themselves with an alpha survey meter prior to leaving the mill. Alpha contamination on skin or clothes greater than 1,000 dpm/100 cm^2 shall be cause for additional showering or decontamination and an investigation by radiation protection staff. Spot checks with a survey meter also are made at least quarterly. Coveralls and contaminated clothing are laundered on site. A respiratory protection program includes written procedures and personnel training in the use, care and selection of respirators as outlined in ANSI-Z88.2-1980.

5.5 Environmental Surveillance Program

The environmental monitoring program is designed to assess the effect of mill process and disposal operations on the unrestricted environment. Delination of specific equipment and procedures is presented in the Environmental Surveillance Procedure Manual, Appendix D.

5.5.1 Ambient Air Monitoring

5.5.1.1 Ambient Particulate

Radionuclide particulate sampling will continue at the five locations currently monitored. The present sampling system is to be replaced. The proposed system consists of high volume particulate samplers utilizing mass flow controllers to maintain an air flow rate of forty standard cubic feet per minute. Samplers will be operated continuously with an expected on-stream operating period exceeding ninety percent. Filter rotation will be weekly with quarterly site composition for particulate radionuclide analysis. Analysis will be done for U-natural, Thorium-230, Radium-226, and Lead-210.

5.0 OPERATIONS (continued)

5.5.1.2 Ambient Radon

Radon-222 monitoring will continue at the five air particulate monitoring locations currently utilized. System quality assurance will be determined by placing a duplicate monitor at one site continuously. Monitoring methodology consists of a Passive TLD monitoring system. Integration duration is continuous for one month with monthly exchange of TLD chips for analysis.

5.5.2 External Radiation

TLD badges, as supplied by Eberline, Inc., or equivalent, will be utilized at the five existing ambient particulate monitoring sites to determine ambient external gamma exposures. Exchange of TLD badges will be on a quarterly basis. Badges consist of a minimum of five TLD chips.

5.5.3 Soil and Vegetation

5.5.3.1 Ambient Soil Monitoring

Soil samples from the top one centimeter of surface soils are collected annually at each air particulate monitoring site. A minimum of two kilograms of soil is collected per site and analyzed for U-natural and Radium-226.

5.5.3.2 Ambient Vegetation Monitoring

Forage vegetation samples are collected three times per year from animal grazing areas near the mill site which have the highest predicted concentrations of emissions from the mill. The samples are collected near air particulate station one: by the meteorological station, to the immediate west of this site, and by air particulate station four. Samples are obtained during the grazing season, in the late fall, early spring, and in late spring. One to two kilograms of grass are submitted from each site for analysis of Radium-226 and Lead-210.

5.5.4 Meteorological

Meteorological monitoring will continue at the current site near air particulate sampling station one. The

5.0 OPERATIONS (continued)

sensor and recording equipment will be replaced with sensors to monitor wind velocity and direction along with stability classification. Data integration duration is one-hour with hourly recording of mean speed, total wind run, mean wind direction, and mean wind stability (as degrees sigma theta). The recording system will consist of a backup power supply, a backup paper tape printout and a primary ASCII tape recording system.

Monitoring for precipitation consists of a daily log of precipitation using a standard NOAA rain gauge installed near the administrative office, consistent with NOAA specifications.

Windrose data will be summarized in a format compatible with MILDOS and UDAD specifications for 40 CFR 190 compliance.

5.5.5 Point Emission

Stack emission monitoring from yellow cake facilities follow EPA Method 5 procedure and occur on a quarterly basis, during operating of the facility. Particulate sampling is analyzed for Uranium-natural on a quarterly basis and for Thorium-230, Radium-226, and Lead-210 on a semi-annual basis. Ore stack emission monitoring follows EPA Method 5 procedure on a semi-annual basis, during operation of the facility. Particulate samples are analyzed for Uranium-natural, Thorium-230, Radium-226, and Lead-210. Monitored data includes ventilation system operation levels, process fed levels, particulate emission concentrations, isoKinetic conditions, and radionuclide emission concentrations.

5.5.6 Water

5.5.6.1 Surface Water Monitoring

Stream monitoring of Westwater and Cottonwood Creeks is on a quarterly basis at locations hydrologically above and below the White Mesa Mill and tailing disposal site. Field monitored parameters include pH, specific conductivity, and temperature. Laboratory monitored parameters include total dissolved solids, total suspended solids, and gross alpha concentrations.

5.0 OPERATIONS (continued)

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Groundwater monitoring of the existing monitor and culinary water wells at the White Mesa facility is on a quarterly basis. Wells are pumped and monitored prior to sample recovery. Well water quality is monitored for pH, specific conductance and temperature during pumping with sample recovery occurring when these parameters stabilize.

Sample analysis, for dissolved constituents, occurs on the schedule and for the parameters listed in Table 5.5-1.

5.5.7 Solid Waste

The tailing management system monitoring plan will follow the guidelines developed in the report:

"Initial Phase-Tailings Management System; Monitoring Plan"
February 1982, D'Appolonia

The monitoring program includes daily, monthly, quarterly and annual inspection criteria. The site inspector will be the Environmental Coordinator. UMETCO MINERALS CORPORATION policy on tailing management includes an external consultant review of the site program on a five-year interval to insure stability and integrity of the tailing site.

6.0 MILL ACCIDENTS

6.1 Spectrum of Potential Mill Accidents

A spectrum of potential mill accidents ranging from trivial to serious has been established by classes of occurrence and each class of accident evaluated (Table 6.1-1). Emergency plans for coping with the accidents are also described.

The severity of accidents is based on their potential impact on the environment and is not a measure of dollar loss or employee injury. The categories in Table 6.1-1 are:

1 Trivial - no impact. Necessary repairs made

2 Insignificant - no impact. Corrective action taken

APPLICATION FOR SOURCE MATERIAL
LICENSE RENEWAL

JANUARY 1985

UMETCO MINERALS CORPORATION

product areas or performing maintenance on equipment from these areas are provided coveralls and are required to change and shower prior to leaving the mill. All employees are also required to monitor themselves with an alpha survey meter prior to leaving the mill. Alpha contamination on skin or clothes greater than 1,000 dpm/100 cm^2 shall be cause for additional showering or decontamination and an investigation by radiation protection staff. Spot checks with a survey meter also are made at least quarterly. Coveralls and contaminated clothing are laundered on site. A respiratory protection program includes written procedures and personnel training in the use, care and selection of respirators as outlined in ANSI-Z88.2-1980.

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5.0 OPERATIONS (continued)

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6.1 Spectrum of Potential Mill Accidents

A spectrum of potential mill accidents ranging from trivial to serious has been established by classes of occurrence and each class of accident evaluated (Table 6.1-1). Emergency plans for coping with the accidents are also described.

The severity of accidents is based on their potential impact on the environment and is not a measure of dollar loss or employee injury. The categories in Table 6.1-1 are:

1 Trivial - no impact. Necessary repairs made

2 Insignificant - no impact. Corrective action taken

3 Significant - Slight impact. Corrective action taken

4 Serious - Corrective action necessary. Major local and/or regional impact

5 Very Serious - Corrective action necessary. Major local and/or regional impact

The probability categories in Table 6.1-1 are defined as follows:

1 Probably - expected to occur during operating life of plant

2 Improbable - possible one or two of these events can be expected to occur during the life of the plant

3 Highly Improbable - not expected to occur during the life of the project.

TABLE 5.5-1

CHEMICAL PARAMETER MONITORING SCHEDULE

OPERATIONAL PHASE GROUNDWATER PROGRAM

Second Quarter, Fourth Quarter, Quarterly Sampling	Third Quarter, Semi-Annual Sampling	First Quarter, Annual Sampling
pH (F)	Indicator Parameters	pH (F, L)
Specific Conductance (F)		Specific Conductance (F, L)
Temperature (F)	pH (F, L)	Temperature (F)
Chloride (L)	Specific Conductance (F, L)	Total Dissolved Solids (L)
Uranium (L)	Temperature (F)	Alkalinity (F, L)
	Sulfate (L)	Sulfate (L)
	Chloride (L)	Chloride (L)
	Gross Alpha (L)	Ammonia (L)
	Uranium (L)	Phosphate (L)
		Aluminum (L)
	Accuracy Assessment Parameters	Arsenic (L)
		Cadmium (L)
	Calcium (L)	Calcium (L)
	Magnesium (L)	Chromium (L)
	Potassium (L)	Copper (L)
	Alkalinity (F, L)	Lead (L)
	Sodium (L)	Magnesium (L)
	Total Dissolved Solids (L)	Manganese (L)
		Mercury (L)
		Molybdenum (L)
		Potassium (L)
		Selenium (L)
		Sodium (L)
		Vanadium (L)
		Zinc (L)
		Gross Alpha (L)
		Gross Beta (L)
		Uranium (L)
		Radium-226 (L)
		Thorium-230 (L)
		Lead-210 (L)
		Polonium-210 (L)

Note: F = Parameter measured in field
L = Parameter measured in laboratory
All radionuclides, metals, cations, anions are analyzed for dissolved concentrations only.

ATTACHMENT 8

UNITED STATES NUCLEAR REGULATORY COMMISSION

ENVIRONMENTAL ASSESSMENT

PREPARED BY THE

URANIUM RECOVERY FIELD OFFICE

IN CONSIDERATION OF THE RENEWAL OF

SOURCE MATERIAL LICENSE SUA-1358

FOR

THE UMETCO MINERALS CORPORATION

WHITE MESA URANIUM MILL

Dated: SEP 2 6 1985

2.2.2 Stack Effluent Sampling

Stack sampling has been performed at least semiannually since the mill began operation. The FES (Section 3.2) predicted a product loss from the yellowcake drying and packaging stack of 115 kg per year of which 104 kg would be U_3O_8. This resulted in a calculated release rate of 0.029 Ci/y for U-238. Actual stack sampling measurements performed in 1982 indicated releases of 97.5 kg of U-nat from the yellowcake stack, which corresponds to 0.027 Ci of U-238. The measured values compare favorably with the release values predicted in the FES.

The FES also estimated that 0.0016 Ci/y of Th-230, 6.2E-5 Ci/y of Ra-226, and 6.2E-5 Ci/y of Pb-210 would be released. Based on effluent monitoring data, the average releases during 1982 were 3.2E-5 Ci/qtr of Th-230 (1.3E-4 Ci/y), 1.0E-5 Ci/qtr of Ra-226 (4.1E-5 Ci/y), and 7.9E-5 Ci/qtr of Pb-210 (3.17E-4 Ci/y). All of the measured values were less than the predicted releases except for Pb-210. The calculated concentration of Pb-210 in the yellowcake stack, when flow rate was considered, did not exceed 17.5% of the maximum permissible concentration (MPC) for restricted areas in any quarter.

2.2.3 Radon Gas Monitoring

Radon gas monitoring was performed one week each month at the five stations utilized to collect airborne particulate samples. During 1982, measured radon gas concentrations did not exceed 11% of the MPC for unrestricted areas. The background during this same collection period measured 7.3% of the MPC.

2.2.4 Ground Water and Surface Water Sampling

Umetco previously performed quarterly sampling of nine monitoring wells, one control well upgradient of the tailings system, one drinking water well and two surface water sources. Samples were analyzed for five radionuclides and various chemical and physical parameters.

A staff review of the ground water quality indicated that downgradient monitor wells Nos. 2, 3, 4, 5, 11, 12 and 13 show a higher concentration of dissolved constituents than does the background well (No. 1). Because this has been observed since the time of the preoperational monitoring program, it probably represents normal variance in the ground water. Based on 1982 ground water monitoring data, the highest radionuclide concentrations measured were 0.08, 10, 0.09, 1.8 and 0.3 percent of the applicable MPC for U-nat, Ra-226, Th-230, Pb-210 and Po-210, respectively. No ground water anomalies have been observed. This situation is not unusual since the tailings retention system consists of synthetically lined cells.

Surface water radionuclide concentrations have not varied appreciably. The U-nat concentrations are higher than any other radionuclide and did not exceed 1.1E-8 uCi/ml (0.004 % of the MPC for unrestricted areas).

2.2.5 Direct Gamma Exposure

Direct radiation exposure measurements were made quarterly at the five air particulate monitoring stations. The highest exposure rate measured during 1982 was 37.3 mR/qtr including background and 11.7 mR/qtr above background.

2.3 Radiological Assessment

2.3.1 Introduction

This assessment addresses the radiological impacts from milling operations at the White Mesa site. The licensee desires to process 2000 tons/day of ore with an average ore grade of 0.6%, for a yellowcake production rate of 4,380 tons/year. This assessment presents a state-of-the-art evaluation of impacts from the White Mesa mill at a production rate of 4,380 tons of yellowcake per year.

Components of the radiological analysis presented in this section include estimates of the following: (1) annual releases of radioactive materials from the mill and tailings retention system, (2) resulting dose commitments to nearby individuals and the population within 80 km (50 miles) of the site, and (3) concentrations of radionuclides at the restricted area boundary. The calculated results are compared to measured background radiation and applicable regulatory limits. Tables and figures referenced in the text are provided in Appendix A.

2.3.2 Estimated Releases

A summary of the information and data assumptions used to calculate the annual releases of radioactive materials from the mill and tailings retention system is presented in Table 1. The estimated annual releases are presented in Table 2. More detailed descriptions of release estimates from the tailings cells and ore pad as well as descriptions of the models and assumptions used by the staff to perform the radiological impact assessment are provided in Appendix B. Release rates from the tailings retention system are based on the tailings management plan discussed in Section 4.0.

with each reading. The staff will therefore require that the TLDs be exchanged and read quarterly.

TLD badges supplied by Eberline, Inc., or equivalent, will be utilized at the five existing ambient particulate monitoring sites to determine ambient external gamma exposures. Each badge consists of a minimum of five TLD chips. Exchange of TLD badges will be on a quarterly basis.

3.4. Soil and Vegetation Sampling

Umetco's proposed programs for vegetation and soil sampling are discussed below. Forage vegetation samples will be collected three times per year from animal grazing areas near the mill site. The samples will be collected near the meteorological station, to the immediate west of this site, and by the south tailings area in the late fall, early spring and late spring. One to two kilograms of grass are to be collected from each site and analyzed for Ra-226 and Pb-210.

Soil Samples from the top one centimeter of surface soils will be collected annually at each airborne particulate monitoring site. A minimum of two kilograms of soil is to be collected per site and analyzed for U-nat and Ra-226.

3.5 Ground Water and Surface Water Sampling

3.5.1 Surface Water

Umetco proposes to sample Westwater and Cottonwood Creeks on a quarterly basis at locations upstream and downstream of the White Mesa Mill and tailings disposal site. Field monitored parameters include pH, specific conductivity and temperature. Laboratory monitored parameters include total dissolved solids, total suspended solids, and gross alpha concentrations.

In addition to the surface water monitoring program proposed by the licensee, the staff will require by license condition that analyses be performed semiannually on surface water samples for total and dissolved concentrations of U-nat, Th-230, and Ra-226.

3.5.2 Ground Water

Umetco proposes that ground water sampling of Monitor Wells 1, 2, 3, 4, 5, 11, 12, 13 and the culinary water well at the White Mesa facility continue on a quarterly basis. Wells will be pumped and the water quality monitored for pH, specific conductance and temperature during

ATTACHMENT 9

Umetco Minerals Corporation

WHITE MESA MILL • P.O. BOX 669 • BLANDING, UTAH 84511
☎ (801) 678-2221

40-8681

40-8681
8/23/91

RETURN ORIGINAL TO PDR, HQ.

WHITE MESA MILL

LICENSE SUA–1358
DOCKET NO. 40–8681

AUGUST 1991

CONTENTS: LICENSE APPLICATION
BOOK 1 OF 3

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5.0 ADMINISTRATION (continued)

5.5.5 Point Emission

Stack emission monitoring from yellow cake facilities follow EPA Method 5 procedure and occur on a quarterly basis, during operating of the facility. Particulate sampling is analyzed for Uranium-natural on a quarterly basis and for Thorium-230, Radium-226, and Lead-210 on a semi-annual basis. Demister and ore stack emission monitoring follows EPA Method 5 procedure on a semi-annual basis, during operation of the facility. Particulate samples are analyzed for Uranium-natural, Thorium-230, Radium-226, and Lead-210. Monitored data includes scrubber system operation levels, process feed levels, particulate emission concentrations, isokinetic conditions, and radionuclide emission concentrations. For further procedure information see Section 1.4 of Appendix E in White Mesa Mill Procedures Manual.

5.5.6 Water

5.5.6.1 Surface Water Monitoring

Surface water monitoring is conducted at two locations adjacent to the White Mesa Mill facility known as Westwater Canyon and Cottonwood Creek. Samples are obtained annually from Westwater and quarterly from Cottonwood using grab sampling. Field monitored parameters and laboratory monitored parameters are listed in Table 5.5-1. For further procedure information see Section 2.1 of Appendix E in the White Mesa Mill Procedures Manual.

5.5.6.2 Groundwater Monitoring

Groundwater monitoring of the culinary water and monitor wells are obtained on a quarterly basis by pumping a minimum of two casing volumes, five gallons, or until three successive samples show stabilized readings on pH to ± 0.50, temperature to ± 2 °C, and conductivity to ± 500 umhos at °C.

Upon return to the office, samples are stored in a refrigerator at 4 °C until transferred to the Analytical Laboratory.

Field monitored parameters and laboratory monitored parameters are listed in Table 5.5-2. For further procedure information see Section 2.2 of Appendix E in the White Mesa Mill Procedures Manual.

Table 5.5-1

Operational Phase Surface Water Monitoring Program

Monitoring Sites
Westwater and Cottonwood Creeks.

Field Requirements

1. temperature C;
2. Specific Condictivity umhos at 25 C;
3. pH at 25 C;
4. Sample date;
5. Sample ID. Code;

Vendor Laboratory Requirements

Semiannual*

One gallon Unfiltered and Raw.
One gallon Unfiltered, Raw and preserved to pH <2 with HNO_3.

Total dissolved solids
Total suspended solids
Gross Alpha
Suspended U-nat
Dissolved U-nat
Suspended Ra-226
Dissolved Ra-226
Suspended Th-230
Dissolved Th-230

Quarterly

One gallon Unfiltered and Raw.
One Filtered and Preserved to pH <2 with HNO_3.

Total dissolved solids
Total suspended solids

* Semiannual sample must be taken four months apart.
** Annual Westwater Creek sample is done with semi-annual parameters.
Radionuclides and LLDs reported in uCi/ml

Table 5.5-2

OPERATIONAL PHASE GROUND WATER MONITORING PROGRAM

Monitor Sites
#1, 2, 3, 4, 5, 11, 12, 14, 15, culinary, 2 duplicates

FIELD REQUIREMENTS

Depth of well in feet to nearest half inch.
Temperature in degrees celcius ^{o}C.
pH to two decimal places.
Specific conductance in umhos @ temp.

VENDOR LAB REQUIREMENTS

Semiannual

*	Beryllium (mg/l)
*	Cadmium (mg/l)
*	Molybdenum (mg/l)
*	Nickel (mg/l)
*	TDS mg/l
*	Chlorides (mg/l)
*	Sulfates (mg/l)
**	Selenium (mg/l)
**	Arsenic (mg/l)
**	Ra-226 (uCi/ml)
	Ra-226 LLD(uCi/ml)
**	Ra-228 (uCi/ml)
	Ra-228 LLD (uCi/ml)
**	Th-230 (uCi/ml)
	Th-230 LLD(uCi/ml)
**	Pb-210 (uCi/ml)
	Pb-210 LLD(uCi/ml)
**	U-nat (uCi/ml)
	U-nat LLD(uCi/ml)
**	Gross Alpha (mg/l)

* 1 liter unfiltered, raw, $4^{o}C$

** 1 gal. filtered, preserved with HNO_3 to pH < 2.

Quarterly

*	TDS (mg/l)
*	Chlorides (mg/l)
*	Sulfates (mg/l)
**	U-nat (uCi/ml)
	U-nat LLD(uCi/ml)
*	Sodium (mg/l)

* 1 liter unfiltered, raw, cool $4^{o}C$.

** 1 liter filtered preserved with HNO_3 to pH < 2.

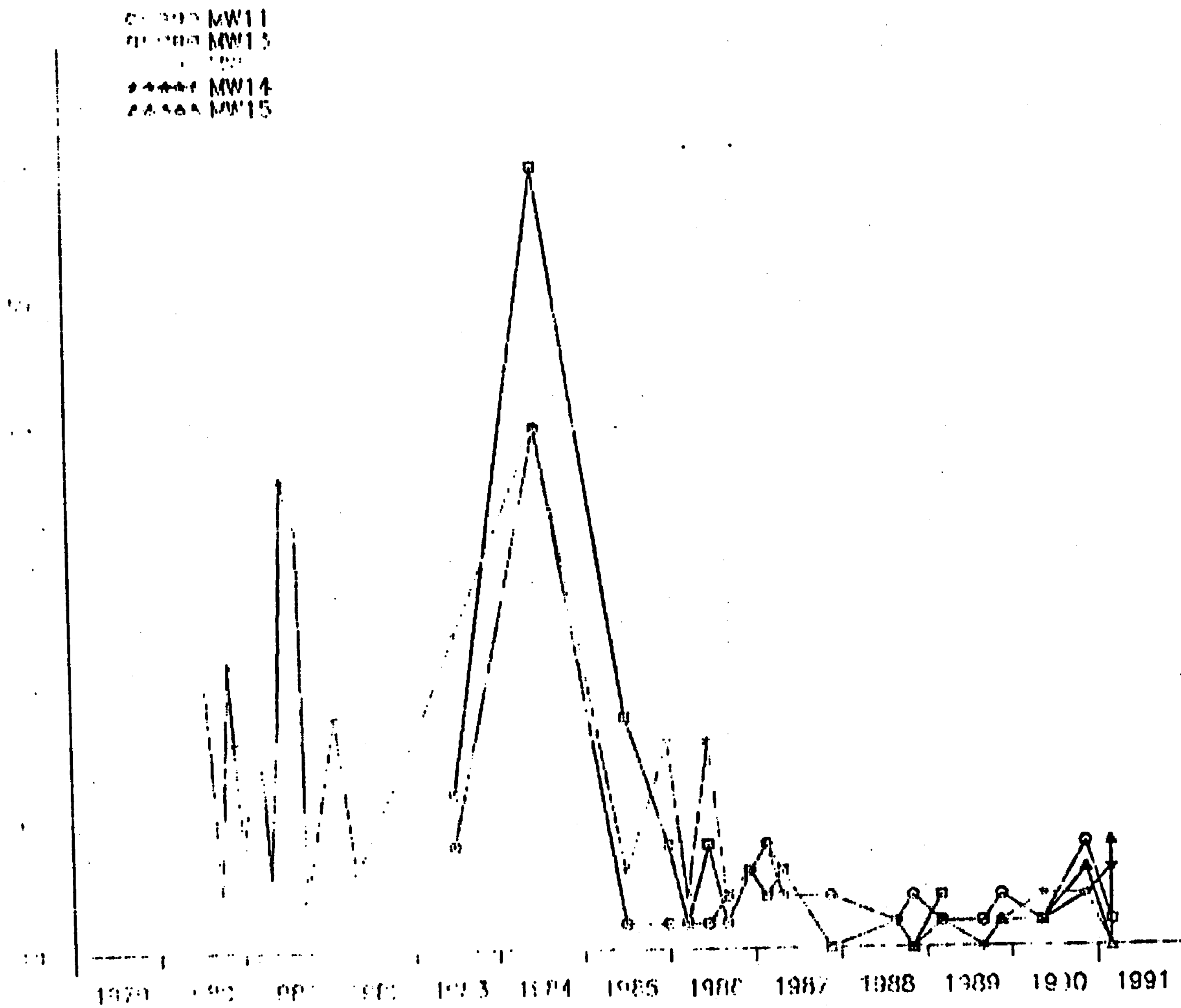

FIGURE 6-14. RADIUM-226 DATA FOR WELLS MW5, MW11, MW13, MW14 AND MW15.

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS.

WELL	DATE	Na	Cl	SO4	TDS	COND	pH	As	Se	U	Ra226	Pb210	Th230
MW1	--	--	--	--	--	--	--	--	--	--	--	--	
	791030	186	2.5	220	625	948	8.6	--	--	--	--	--	--
	800130	140	14.0	520	670	--	7.4	--	--	--	--	--	--
	800530	165	20	635	1250	1500	7.3	--	--	--	--	--	--
	800630	166	16.0	632	1250	1367	7.5	--	--	--	--	--	--
	800731	160	20	610	1182	1469	7.4	0.001	0.001	--	1.0	3.0	0.40
	800831	150	10.0	612	1220	1565	7.2	0.004	0.002	--	0.70	3.0	0.40
	800930	156	13.0	640	1285	1547	7.6	0.002	0.001	--	0.70	3.0	0.80
	801031	162	30	570	1220	1578	7.4	0.001	0.001	--	0.80	3.0	0.50
	801130	166	12.0	613	1166	1589	7.5	0.002	0.001	--	0.70	3.0	0.80
	801231	168	13.0	620	1194	1568	7.4	0.001	0.001	--	0.50	5.0	0.50
	810131	170	15.0	638	1273	1682	7.2	0.001	0.001	--	0.50	3.0	0.50
	810228	148	14.0	600	1254	1723	7.2	0.001	0.001	--	0.60	4.0	0.50
	810331	175	14.0	658	1317	1472	7.5	0.001	0.001	--	2.0	4.0	0.80
	810430	161	13.0	620	1330	1425	7.5	0.001	0.001	--	2.2	4.0	0.50
	810530	160	14.0	650	1386	1543	7.0	0.001	0.001	--	3.5	4.0	1.1
	810630	162	12.0	626	1188	1303	7.3	0.001	0.001	--	1.5	3.0	1.7
	810814	--	--	--	--	1716	--	--	--	--	--	--	--
	810831	161	14.0	630	1197	--	7.4	0.001	0.001	--	0.80	2.0	0.70
	810930	--	--	--	--	--	--	--	--	--	0.40	--	--
	811231	170	15.0	--	1199	--	7.5	--	--	--	--	--	--
	820127	--	--	--	--	1450	--	--	--	--	--	--	--
	820131	170	13.0	613	1200	--	7.3	0.001	0.001	--	0.80	0.00	1.1
	820407	--	--	--	--	1635	--	--	--	--	--	--	--
	820430	190	12.0	697	1200	--	7.7	--	--	--	0.30	1.3	0.80
	820707	--	--	--	--	1570	--	--	--	--	--	--	--
	820831	160	12.0	662	1200	--	7.8	--	--	--	--	0.0	0.20
	821210	--	--	--	--	1320	--	--	--	--	--	--	--
	821231	170	10.9	653	1326	--	7.8	--	--	--	--	--	--
	830125	--	16.0	--	--	1310	--	--	--	--	--	--	--
	830331	--	--	--	--	--	7.6	--	--	--	--	--	--
	830430	--	--	--	--	1320	--	--	--	--	--	--	--
	830629	170	16.5	656	1150	--	7.8	--	--	--	0.40	0.00	0.00
	830906	--	--	--	--	1390	--	--	--	--	--	--	--
	831025	--	--	--	--	1680	--	--	--	--	--	--	--
	831231	170	13.0	660	1200	--	7.6	--	--	--	--	--	--
	840226	--	--	637	--	--	--	--	--	--	--	--	--
	840320	--	--	--	--	1200	--	--	--	--	--	--	--
	840331	--	14.3	--	--	--	7.7	--	--	--	--	--	--
	840614	--	--	--	--	1200	--	--	--	--	--	--	--
	840630	170	12.0	680	1400	--	7.6	--	0.005	--	3.0	1.2	2.0
	840930	--	15.4	--	--	--	7.5	--	--	--	--	--	--

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS(continued).

WELL	DATE	Na	Cl	SO4	TDS	COND	pH	As	Se	U	Ra226	Pb210	Th230
MW1	841205	--	--	--	--	1100	--	--	--	--	--	--	--
	841231	182	14.2	637	693	--	7.7	--	--	--	--	--	--
	850221	--	--	--	--	1300	--	--	--	--	--	--	--
	850331	--	14.0	--	--	--	7.0	--	--	--	--	--	--
	850505	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	850625	--	--	--	--	1100	--	--	--	--	--	--	--
	850628	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	850630	19.9	17.0	816	1560	--	7.6	--	--	--	1.0	2.7	1.2
	850723	--	--	--	--	--	--	0.001	0.04	--	--	--	--
	850806	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	850930	--	10.0	--	--	1500	6.0	0.001	0.001	--	--	--	--
	851030	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	851127	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	851215	--	--	--	--	3000	--	0.001	0.001	--	--	--	--
	851231	320	53	1000	4000	--	7.3	--	--	--	0.50	0.00	0.10
	860124	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	860228	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	860321	--	--	--	--	--	--	--	--	--	0.50	0.00	0.10
	860327	--	--	--	--	1350	--	0.001	0.001	--	--	--	--
	860331	--	--	--	--	--	7.0	--	--	--	--	--	--
	860408	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	860502	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	860619	262	25	703	1200	--	--	--	--	--	0.50	0.00	0.10
	860626	--	--	--	--	1900	--	--	--	--	--	--	--
	860630	--	25	691	1330	--	7.5	--	--	--	--	--	--
	860904	175	2.0	707	1250	1000	7.3	0.001	0.001	--	1.5	0.30	0.40
	861210	210	6.0	680	1270	2200	7.7	0.001	0.002	--	0.40	2.2	0.0
	870220	116	11.0	657	1270	1000	7.3	0.001	0.001	--	0.20	2.2	0.20
	870429	134	12.1	664	1270	1000	7.6	0.002	0.001	--	0.60	3.1	0.10
	870610	--	11.0	691	1280	1500	7.6	--	--	--	--	--	--
	871119	212	9.3	697	1330	1600	7.8	0.003	0.005	--	0.30	0.70	0.00
	880126	185	10.0	690	1310	1300	8.0	0.003	0.009	--	0.60	0.00	0.10
	880601	--	9.9	661	1250	1350	8.1	--	--	--	--	--	--
	880623	157	13.2	640	1220	1550	7.6	0.01	0.01	--	0.50	0.00	0.90
	881103	172	11.0	680	1250	1250	7.5	0.001	0.025	--	0.10	0.00	0.70
	890309	169	12.0	694	1200	1300	7.4	0.01	0.004	--	0.10	0.20	0.00
	890621	--	11.3	710	1200	1694	8.0	--	--	--	--	--	--
	890622	--	--	--	--	--	--	0.004	0.001	--	--	--	--
	890901	163	10.0	352	1210	1670	7.3	0.001	0.001	--	0.000	0.000	0.002
	891115	194	11.0	697	1200	1600	7.5	0.001	0.005	--	0.20	--	--
	891120	--	--	--	--	--	--	--	--	0.20	--	0.40	0.02
	900216	--	--	--	--	--	--	--	--	2.4	--	--	--

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS(continued).

WELL	DATE	Na	Cl	SO4	TDS	COND	pH	As	Se	U	Ra226	Pb210	Th230
MW1	900220	--	11.0	692	1200	1695	7.6	--	--	--	--	--	--
	900508	--	12.0	684	1160	1694	7.4	0.002	0.001	0.70	0.20	0.40	0.10
	900509	160	--	--	--	--	--	--	--	--	--	--	--
	900807	--	11.0	685	1210	1667	7.4	--	--	--	--	--	--
	900816	--	--	--	--	--	--	--	--	0.47	--	--	--
	901113	165	12.0	687	1170	1040	7.9	0.001	0.001	0.54	0.20	0.70	0.20
	910227	171	12.0	662	1272	1700	7.9	0.001	0.002	0.22	0.10	0.00	0.02
MW2	2	--	--	--	--	--	--	--	--	--	--	--	--
	791030	154	5.0	240	790	1270	7.2	--	--	--	--	--	--
	800130	213	10.0	630	1080	--	7.2	--	--	--	--	--	--
	800530	346	10.0	1075	1950	2413	7.4	--	--	--	--	--	--
	800630	361	15.0	1290	2300	3031	7.4	--	--	--	--	--	--
	800731	410	20	1400	2449	2500	7.5	0.02	0.03	--	1.3	3.0	0.30
	800831	410	16.0	1345	2270	2712	7.2	0.004	0.03	--	1.7	3.0	0.40
	800930	460	15.0	1550	2769	2791	7.6	0.002	0.01	--	0.30	3.0	0.50
	801031	415	20	1535	2652	2930	7.3	0.001	0.02	--	1.9	3.0	0.90
	801130	419	8.0	1425	2492	2660	7.4	0.004	0.01	--	1.1	2.0	0.60
	801231	442	10.0	1520	2640	2730	7.4	0.001	0.001	--	0.40	3.0	0.40
	810131	467	11.0	1530	2760	3190	7.2	0.001	0.02	--	1.3	3.0	1.3
	810228	462	9.0	1550	2835	3089	7.1	0.001	0.001	--	1.7	5.0	0.00
	810331	470	10.0	--	--	--	7.2	0.001	--	--	1.6	--	0.40
	810430	476	11.0	1660	3020	3097	7.2	0.001	0.001	--	1.3	5.0	0.60
	810530	472	13.0	1730	2990	2985	7.0	0.001	0.002	--	2.3	3.0	0.70
	810630	450	10.0	1690	2983	2806	7.2	0.001	0.010	--	2.0	5.0	1.1
	810814	--	--	--	--	3702	--	--	--	--	--	--	--
	810831	460	7.0	1750	2932	--	7.4	0.001	0.004	--	7.5	3.0	1.2
	810930	--	--	--	--	--	--	--	--	--	1.1	--	--
	811231	469	14.0	--	2981	--	7.7	--	--	--	--	--	--
	820127	--	--	--	--	3450	--	--	--	--	--	--	--
	820131	483	6.0	1590	2800	--	7.2	0.001	0.009	--	1.6	5.0	0.0
	820407	--	--	--	--	3402	--	--	--	--	--	--	--
	820430	460	7.0	1766	2800	--	7.5	--	--	--	0.60	1.2	0.90
	820707	--	--	--	--	3340	--	--	--	--	--	--	--
	820831	470	6.0	1780	2950	--	7.7	--	--	--	--	0.50	0.00
	821210	--	--	--	--	2720	--	--	--	--	--	--	--
	821231	480	5.5	1749	3056	--	7.7	--	--	--	--	--	--
	830125	--	11.0	--	--	2600	--	--	--	--	--	--	--
	830331	--	--	--	--	--	7.5	--	--	--	--	--	--
	830430	--	--	--	--	2800	--	--	--	--	--	--	--
	830629	470	25	1001	3500	--	7.7	--	--	--	0.17	0.06	0.40

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS(continued).

WELL	DATE	Na	Cl	SO4	TDS	COND	pH	As	Se	U	Ra226	Pb210	Th230
MW2	830906	--	--	--	--	2810	--	--	--	--	--	--	--
	831025	--	--	--	--	3560	--	--	--	--	--	--	--
	831231	500	8.0	1820	2950	--	7.6	--	--	--	--	--	--
	840228	--	--	1835	--	--	--	--	--	--	--	--	--
	840328	--	--	--	--	2380	--	--	--	--	--	--	--
	840331	--	9.4	--	--	--	7.0	--	--	--	--	--	--
	840614	--	--	--	--	2400	--	--	--	--	--	--	--
	840630	500	7.0	1900	3200	--	7.2	--	0.01	--	6.0	9.0	4.0
	840930	--	10.9	--	--	--	7.1	--	--	--	--	--	--
	841205	--	--	--	--	2275	--	--	--	--	--	--	--
	841231	443	7.1	1835	1479	--	7.1	--	--	--	--	--	--
	850221	--	--	--	--	2800	--	--	--	--	--	--	--
	850331	--	13.0	--	--	--	7.6	--	--	--	--	--	--
	850505	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	850625	--	--	--	--	2600	--	--	--	--	--	--	--
	850628	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	850630	540	7.0	1890	3130	--	7.0	--	--	--	1.3	6.3	0.58
	850723	--	--	--	--	--	--	0.02	0.001	--	--	--	--
	850806	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	850930	--	17.0	--	--	2500	7.1	0.001	0.001	--	--	--	--
	851030	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	851127	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	851215	--	--	--	--	3200	--	0.001	0.001	--	--	--	--
	851231	490	71	1270	3700	--	7.3	--	--	--	0.90	1.0	0.0
	860124	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	860228	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	860321	--	--	--	--	--	--	--	--	--	1.0	1.0	0.0
	860327	--	--	--	--	2650	--	0.001	0.001	--	--	--	--
	860331	--	--	--	--	--	7.0	--	--	--	--	--	--
	860400	--	--	--	--	--	--	0.001	0.003	--	--	--	--
	860502	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	860619	543	15.0	2010	3200	--	--	--	--	--	0.90	1.0	0.0
	860626	--	--	--	--	3800	--	--	--	--	--	--	--
	860630	--	17.0	2040	3250	--	7.0	--	--	--	--	--	--
	860904	456	9.5	2020	3240	3700	6.9	0.001	0.001	--	0.00	0.00	0.70
	861210	529	2.7	1660	3140	3200	6.9	0.003	0.002	--	0.50	3.0	0.6
	870220	333	6.6	1910	3230	3900	7.1	0.002	0.021	--	0.50	2.3	1.5
	870429	362	7.7	1920	3180	5000	6.7	0.002	0.001	--	0.000	0.20	0.10
	870810	--	6.0	2000	3190	3300	6.7	--	--	--	--	--	--
	871119	610	4.6	2040	3260	3400	7.4	0.005	0.02	--	0.20	0.08	0.00
	880126	507	3.7	1930	3270	2600	7.4	0.001	0.010	--	2.20	0.08	0.10
	880601	--	4.6	1900	3140	2800	7.2	--	--	--	--	--	--

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS(continued).

WELL	DATE	Na	Cl	SO4	TDS	COND	pH	As	Se	U	Ra226	Pb210	Th230
MW2	880823	495	6.4	1970	3080	3400	7.1	0.02	0.05	1.1	0.20	0.40	0.00
	881103	460	6.6	1980	3150	2850	7.2	0.004	0.02	4.9	0.20	0.00	0.20
	890309	464	7.6	1990	3140	2600	7.1	0.03	0.02	6.0	0.20	0.00	0.00
	890621	--	6.4	2040	3210	3660	7.1	--	--	6.0	--	--	--
	890622	--	--	--	--	--	--	0.01	0.002	--	--	--	--
	890901	466	6.0	2000	3040	3670	7.4	0.005	0.001	0.0	0.50	0.10	0.00
	891115	515	5.0	1990	3060	3620	7.0	0.008	0.01	--	0.20	--	--
	891120	--	--	--	--	--	--	--	--	9.5	--	1.3	0.0
	900216	--	--	--	--	--	--	--	--	7.4	--	--	--
	900220	--	5.0	2020	3190	3630	7.5	--	--	--	--	--	--
	900508	--	7.0	2020	3050	3630	7.1	0.001	0.001	0.0	0.30	0.00	0.00
	900509	504	--	--	--	--	--	--	--	--	--	--	--
	900807	--	6.0	1970	3080	3560	7.0	--	--	--	--	--	--
	900816	--	--	--	--	--	--	--	--	5.9	--	--	--
	901113	470	6.0	1980	3150	2060	7.5	0.001	0.004	7.2	0.40	1.3	0.10
	910227	477	10.0	1849	3154	3720	7.5	-0.001	-0.002	3.5	0.30	0.40	0.00
MW3	3	--	--	--	--	--	--	--	--	--	--	--	--
	791030	202	12.6	930	2100	3260	7.3	--	--	--	--	--	--
	800130	334	25	2100	2450	--	6.6	--	--	--	--	--	--
	800530	575	50	2430	4400	3915	7.2	--	--	--	--	--	--
	800630	642	51	2625	4750	4276	7.2	--	--	--	--	--	--
	800731	442	62	2450	4024	4386	7.2	0.01	0.001	--	1.0	3.0	0.30
	800831	653	65	2975	4900	4537	6.9	0.001	0.005	--	0.60	5.0	0.50
	800930	586	62	2600	4593	4760	7.6	0.002	0.001	--	0.50	2.0	0.40
	801031	677	65	3050	4820	4846	7.2	0.001	0.001	--	1.1	3.0	0.40
	801130	567	64	2750	4522	4702	7.1	0.004	0.003	--	0.00	4.0	0.50
	801231	699	65	3060	4982	4620	7.1	0.001	0.001	--	0.30	3.0	0.00
	810131	756	71	3012	5053	5390	7.0	0.001	0.001	--	1.3	4.0	1.3
	810229	704	65	2700	4804	5054	6.0	0.001	0.001	--	0.60	4.0	0.60
	810331	745	66	3150	5122	5153	7.0	0.001	0.001	--	0.80	5.0	0.60
	810430	703	66	3030	5130	4093	7.1	0.001	0.001	--	1.0	5.0	0.60
	810530	716	110	3100	5190	4910	6.5	0.001	0.001	--	1.5	5.0	0.50
	810630	685	69	3040	5367	4433	6.0	0.001	0.001	--	2.3	6.0	0.80
	810814	--	--	--	--	5632	--	--	--	--	--	--	--
	810831	680	67	3050	5124	--	6.9	0.001	0.001	--	15.5	6.0	1.1
	810930	--	--	--	--	--	--	--	--	--	0.50	--	--
	811231	730	66	--	5167	--	7.3	--	--	--	--	--	--
	820127	--	--	--	--	5100	--	--	--	--	--	--	--
	820131	757	64	3100	4950	--	6.7	0.001	0.003	--	1.1	0.0	0.6
	820407	--	--	--	--	5489	--	--	--	--	--	--	--

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS(continued).

WELL	DATE	Na	Cl	SO4	TDS	COND	pH	As	Se	U	Ra226	Pb210	Th230
MW3	820430	790	64	3239	5125	--	7.2	--	--	--	0.50	1.0	1.5
	820707	--	--	--	--	5170	--	--	--	--	--	--	--
	820831	750	67	3185	5300	--	7.5	--	--	--	--	1.0	0.0
	821210	--	--	--	--	4390	--	--	--	--	--	--	--
	821231	610	53	3259	5366	--	7.5	--	--	--	--	--	--
	830125	--	71	--	--	4260	--	--	--	--	--	--	--
	830331	--	--	--	--	--	7.2	--	--	--	--	--	--
	830430	--	--	--	--	4820	--	--	--	--	--	--	--
	830629	770	66	3226	4980	--	7.5	--	--	--	1.4	0.50	0.50
	830906	--	--	--	--	4490	--	--	--	--	--	--	--
	831025	--	--	--	--	5550	--	--	--	--	--	--	--
	831231	800	63	3200	5150	--	7.4	--	--	--	--	--	--
	840228	--	--	3235	--	--	--	--	--	--	--	--	--
	840320	--	--	--	--	4200	--	--	--	--	--	--	--
	840331	--	67	--	--	--	6.8	--	--	--	--	--	--
	840614	--	--	--	--	4500	--	--	--	--	--	--	--
	840630	700	63	3300	5300	--	7.4	--	0.03	--	6.0	7.0	1.0
	840930	--	57	--	--	--	6.6	--	--	--	--	--	--
	841205	--	--	--	--	3975	--	--	--	--	--	--	--
	841231	489	67	3235	2733	--	6.8	--	--	--	--	--	--
	850221	--	--	--	--	4000	--	--	--	--	--	--	--
	850331	--	68	--	--	--	6.9	--	--	--	--	--	--
	850505	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	850625	--	--	--	--	4200	--	--	--	--	--	--	--
	850628	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	850630	790	73	--	--	--	6.0	--	--	--	1.0	1.2	0.50
	850723	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	850806	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	850930	--	70	--	--	5000	6.4	0.001	0.001	--	--	--	--
	851030	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	851127	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	851215	--	--	--	--	4700	--	0.001	0.001	--	--	--	--
	851231	760	35	2670	5000	--	6.8	--	--	--	5.3	0.40	0.70
	860124	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	860228	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	860321	--	--	--	--	--	--	--	--	--	0.80	0.40	0.70
	860327	--	--	--	--	4000	--	0.001	0.001	--	--	--	--
	860331	--	--	--	--	--	6.6	--	--	--	--	--	--
	860408	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	860502	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	860619	937	140	3450	5500	--	--	--	--	--	5.3	0.40	0.70
	860626	--	--	--	--	5600	--	--	--	--	--	--	--

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS(continued).

WELL	DATE	Na	Cl	SO4	TDS	COND	pH	As	Se	U	Ra226	Pb210	Th230
MW3	860630	--	140	3400	5500	--	6.7	--	--	--	--	--	--
	860904	746	64	3410	5320	6000	6.7	0.001	0.001	--	0.90	0.00	0.90
	861210	764	68	2620	5290	4600	6.5	0.005	0.002	--	1.1	0.0	0.0
	870220	513	66	2640	5330	5600	6.5	0.002	0.002	--	1.1	1.6	0.0
	870429	516	65	3200	5400	5600	6.5	0.001	0.001	--	0.30	0.50	0.20
	870610	--	65	3400	5320	5400	6.6	--	--	--	--	--	--
	871119	950	63	3520	5520	5000	7.2	0.006	0.04	--	0.30	0.00	0.00
	880126	776	64	3020	5100	4500	6.8	0.003	0.02	--	0.00	0.00	0.30
	880601	--	66	3360	5240	4500	6.9	--	--	--	--	--	--
	880823	760	66	3330	5230	4500	6.7	0.03	0.09	--	0.70	0.00	0.70
	881103	659	68	3410	5430	4400	6.7	0.01	0.04	--	0.30	0.00	0.30
	890309	713	64	3410	5270	4200	6.7	0.05	0.03	--	0.30	0.10	0.00
	890621	--	67	3500	5450	5660	6.7	--	--	23	--	--	--
	890622	--	--	--	--	--	--	0.03	0.003	--	--	--	--
	890901	713	65	3500	5290	5550	6.9	0.006	0.004	22	0.20	0.00	0.00
	891115	637	66	2670	5250	5590	6.5	0.010	0.02	--	0.40	--	--
	891120	--	--	--	--	--	--	--	--	19.0	--	1.3	10.0
	900216	--	--	--	--	--	--	--	--	14.0	--	--	--
	900220	--	65	3330	5300	5550	6.0	--	--	--	--	--	--
	900508	--	67	3400	5060	5650	6.6	0.005	0.001	23	0.60	1.0	0.10
	900509	756	--	--	--	--	--	--	--	--	--	--	--
	900807	--	65	3400	5220	5400	6.0	--	--	--	--	--	--
	900816	--	--	--	--	--	--	--	--	16.7	--	--	--
	901113	690	60	3460	5290	4010	6.6	0.001	0.003	15.9	0.20	0.40	0.00
	910227	700	60	2712	5260	5530	6.6	-0.001	-0.002	0.0	0.20	0.10	0.10
MW4	4	--	--	--	--	--	--	--	--	--	--	--	--
	791030	342	20	1220	2950	3360	7.1	--	--	--	--	--	--
	800130	274	35	1700	2000	--	7.1	--	--	--	--	--	--
	800530	346	44	1060	3600	3205	7.2	--	--	--	--	--	--
	800630	322	43	1850	2500	3196	7.3	--	--	--	--	--	--
	800731	335	48	1900	3190	3264	7.3	0.006	0.001	--	0.70	3.0	0.40
	800631	336	56	1900	3400	3233	7.1	0.002	0.002	--	0.70	2.0	0.30
	800930	371	43	2075	3525	2791	7.7	0.001	0.001	--	0.40	3.0	0.70
	801031	341	50	2020	3482	3260	7.6	0.001	0.001	--	0.90	2.0	0.90
	801130	309	38	1700	2990	3289	7.3	638	0.001	--	0.00	5.0	0.60
	801231	330	41	1760	2990	3254	7.2	0.001	0.001	--	0.70	4.0	0.90
	810131	335	48	1900	3330	3435	7.1	0.001	0.001	--	0.50	2.0	0.50
	810228	304	41	1960	3322	3370	7.0	0.001	0.001	--	0.90	3.0	0.70
	810331	330	40	1890	3320	3391	7.7	0.001	0.001	--	0.90	3.0	0.00
	810430	314	41	1800	3310	3363	7.5	0.001	0.001	--	0.50	3.0	0.50

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS(continued).

WELL	DATE	Na	Cl	SO4	TDS	COND	pH	As	Se	U	Ra226	Pb210	Th230
MW4	810530	350	41	1910	3296	3064	6.8	0.001	0.001	--	1.3	3.0	1.2
	810630	351	43	2070	3600	3100	7.3	0.001	0.001	--	1.2	3.0	1.3
	810814	--	--	--	--	3963	--	--	--	--	--	--	--
	810831	323	32	1910	3337	--	7.2	0.001	0.001	--	1.1	5.0	1.4
	810930	--	--	--	--	--	--	--	--	--	0.80	--	--
	811231	330	41	--	3377	--	7.7	--	--	2.0	--	--	--
	820127	--	--	--	--	3370	--	--	--	--	--	--	--
	820131	340	42	1920	3200	--	7.1	0.001	0.003	--	1.0	0.0	1.0
	820331	--	--	--	--	--	--	--	--	0.69	--	--	--
	820407	--	--	--	--	3630	--	--	--	--	--	--	--
	820430	330	40	2056	3200	--	7.3	--	--	--	1.0	0.90	0.80
	820630	--	--	--	--	--	--	--	--	1.3	--	--	--
	820707	--	--	--	--	3380	--	--	--	--	--	--	--
	820831	340	43	2047	3500	--	7.8	--	--	--	--	0.90	0.80
	820930	--	--	--	--	--	--	--	--	0.68	--	--	--
	821210	--	--	--	--	3030	--	--	--	--	--	--	--
	821231	334	36	1979	3470	--	7.6	--	--	0.67	--	--	--
	830125	--	46	--	--	2910	--	--	--	--	--	--	--
	830331	--	--	--	--	--	7.3	--	--	5.5	--	--	--
	830430	--	--	--	--	3420	--	--	--	--	--	--	--
	830629	330	37	2109	3500	--	7.7	--	--	0.68	1.0	0.0	0.10
	830906	--	--	--	--	2970	--	--	--	--	--	--	--
	830929	--	--	--	--	--	--	--	--	2.3	--	--	--
	831025	--	--	--	--	3700	--	--	--	--	--	--	--
	831231	320	36	2075	3250	--	7.6	--	--	0.67	--	--	--
	840228	--	--	2056	--	--	--	--	--	--	--	--	--
	840320	--	--	--	--	2340	--	--	--	--	--	--	--
	840331	--	43	--	--	--	7.8	--	--	1.4	--	--	--
	840614	--	--	--	--	2500	--	--	--	--	--	--	--
	840630	316	43	2075	3500	--	7.0	--	0.009	2.7	7.0	1.0	0.0
	840930	--	45	--	--	--	7.0	--	--	0.41	--	--	--
	841205	--	--	--	--	2325	--	--	--	--	--	--	--
	841231	340	42	2056	1591	--	6.0	--	--	0.61	--	--	--
	850221	--	--	--	--	2700	--	--	--	--	--	--	--
	850331	--	46	--	--	--	7.1	--	--	4.2	--	--	--
	850625	--	--	--	--	2000	--	--	--	--	--	--	--
	850626	--	--	--	--	--	--	0.001	0.021	--	--	--	--
	850630	370	42	2040	3010	--	6.7	--	--	0.90	1.4	0.0	0.90
	850930	--	47	--	--	3300	6.3	--	--	1.4	--	--	--
	851215	--	--	--	--	3000	--	0.001	0.001	--	--	--	--
	851231	340	53	2020	4600	--	6.9	--	--	1.6	0.90	0.22	0.10
	860321	--	--	--	--	--	--	--	--	--	0.60	0.20	0.10

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS(continued).

WELL	DATE	Na	Cl	SO4	TDS	COND	pH	As	Se	U	Ra226	Pb210	Th230
MW4	860327	--	--	--	--	2800	--	0.001	0.001	--	--	--	--
	860331	--	--	--	--	--	6.9	--	--	2.2	--	--	--
	860619	326	98	2120	3450	--	--	--	--	--	0.90	0.20	0.10
	860626	--	--	--	--	3600	--	--	--	--	--	--	--
	860630	--	95	2150	3610	--	6.9	--	--	1.0	--	--	--
	860904	289	42	2160	3450	4100	6.8	0.001	0.001	1.0	0.60	0.00	2.4
	861210	335	45	2000	3530	3400	7.0	--	--	0.19	0.70	0.00	0.50
	870220	289	44	2030	3480	3200	7.0	0.002	0.001	0.19	0.50	1.5	0.0
	870429	232	42	1930	3340	2600	6.9	0.001	0.001	1.3	0.40	6.6	0.60
	870818	--	46	2130	3530	3800	7.6	--	--	1.5	--	--	--
	871119	395	45	2170	3570	3700	7.2	0.002	0.010	0.90	0.10	1.7	0.10
	880125	--	--	--	--	--	--	--	--	1.6	--	--	--
	880126	--	45	2060	3460	--	--	--	--	--	--	--	--
	880601	--	45	2120	3430	2850	7.1	--	--	1.4	--	--	--
	880823	286	48	2100	3320	3100	6.8	0.02	0.006	0.54	0.30	0.00	0.00
	881103	289	48	2120	3450	--	--	0.001	0.005	0.004	0.10	0.00	0.40
	890309	275	45	2070	3530	2700	7.3	0.03	0.02	1.4	0.10	0.00	0.10
	890621	--	46	2100	3500	3690	6.9	--	--	1.2	--	--	--
	890622	--	--	--	--	--	--	0.02	0.003	--	--	--	--
	890901	287	46	2140	3430	3670	7.0	0.003	0.003	2.6	0.20	0.50	0.00
	891115	270	45	2150	3370	3640	6.8	0.002	0.01	--	0.20	--	--
	891120	--	--	--	--	--	--	--	--	0.90	--	0.10	0.10
	900216	--	--	--	--	--	--	--	--	1.6	--	--	--
	900220	--	47	2140	3540	3630	7.0	--	--	--	--	--	--
	900508	--	46	2000	3240	3650	7.0	0.001	0.001	1.6	0.40	0.40	0.00
	900509	291	--	--	--	--	--	--	--	--	--	--	--
	900807	--	48	2080	3320	3550	7.7	--	--	--	--	--	--
	900816	--	--	--	--	--	--	--	--	1.3	--	--	--
	901113	285	50	2130	3280	2070	7.7	0.001	0.001	1.2	0.10	0.90	0.10
	910227	264	50	1946	3424	3730	7.7	0.002	-0.002	1.3	0.30	2.6	0.0
MW5	880530	470	60	1290	2300	2660	7.6	--	--	--	--	--	--
	880630	462	57	1200	2260	2372	7.6	--	--	--	--	--	--
	880731	435	60	1100	2060	2371	7.7	0.006	0.001	--	1.0	5.0	0.50
	880831	465	60	1150	2216	2440	7.4	0.001	0.003	--	0.60	3.0	0.30
	880930	500	51	960	2162	2559	7.7	0.001	0.001	--	0.20	5.0	0.90
	881031	443	55	1060	2096	2479	7.6	0.001	0.001	--	1.1	3.0	1.1
	881130	426	49	1050	1960	2566	7.7	0.002	0.001	--	0.80	4.0	0.90
	881231	460	52	1150	2105	·2412	7.2	0.001	0.001	--	0.40	2.0	0.60
	810131	467	53	1140	2072	2262	7.4	0.001	0.001	--	0.60	4.0	0.60
	810228	467	54	1260	2192	2268	7.3	0.001	0.001	--	0.60	5.0	0.50

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS(continued).

WELL	DATE	Na	Cl	SO4	TDS	COND	pH	As	Se	U	Ra226	Pb210	Th230
MW5	810331	473	55	1210	2256	2630	7.7	0.001	0.001	--	0.70	5.0	0.50
	810430	467	53	1220	2309	2589	7.5	0.001	0.001	--	0.30	5.0	0.90
	810530	459	53	1190	2297	2422	7.2	0.001	0.001	--	0.80	4.0	0.80
	810630	437	53	1105	2114	2699	7.3	0.001	0.001	--	1.8	5.0	0.70
	810814	--	--	--	--	3077	--	--	--	--	--	--	--
	810831	426	52	1115	2119	--	7.0	0.001	0.001	--	1.6	3.0	0.90
	810930	--	--	--	--	--	--	--	--	13.5	0.20	--	--
	811231	460	20	--	2190	--	7.7	--	--	3.0	--	--	--
	820127	--	--	--	--	3050	--	--	--	--	--	--	--
	820131	490	51	1260	2250	--	7.3	0.001	0.001	--	0.90	6.0	2.9
	820331	--	--	--	--	--	--	--	--	0.60	--	--	--
	820407	--	--	--	--	3275	--	--	--	--	--	--	--
	820430	510	50	1510	2500	--	7.6	--	--	--	0.30	1.1	1.7
	820630	--	--	--	--	--	--	--	--	2.7	--	--	--
	820707	--	--	--	--	2790	--	--	--	--	--	--	--
	820831	470	43	1295	2250	--	8.0	--	--	--	--	0.0	0.0
	820930	--	--	--	--	--	--	--	--	0.67	--	--	--
	821210	--	--	--	--	2220	--	--	--	--	--	--	--
	821231	431	47	1162	2100	--	6.0	--	--	0.67	--	--	--
	830125	--	57	--	--	2150	--	--	--	--	--	--	--
	830331	--	--	--	--	--	8.1	--	--	0.80	--	--	--
	830430	--	--	--	--	2490	--	--	--	--	--	--	--
	830629	458	48	1220	2200	--	8.1	--	--	0.67	1.2	0.0	0.20
	830906	--	--	--	--	2130	--	--	--	--	--	--	--
	830929	--	--	--	--	--	--	--	--	5.6	--	--	--
	831025	--	--	--	--	2840	--	--	--	--	--	--	--
	831231	480	54	1200	2100	--	7.7	--	--	0.66	--	--	--
	840228	--	--	1175	--	--	--	--	--	--	--	--	--
	840328	--	--	--	--	2150	--	--	--	--	--	--	--
	840331	--	58	--	--	--	7.9	--	--	1.4	--	--	--
	840614	--	--	--	--	2300	--	--	--	--	--	--	--
	840630	470	54	1200	2200	--	7.8	--	0.005	2.7	2.0	3.0	0.10
	840930	--	57	--	--	--	7.5	--	--	0.41	--	--	--
	841205	--	--	--	--	2000	--	--	--	--	--	--	--
	841231	426	53	1175	1300	--	7.6	--	--	--	--	--	--
	850221	--	--	--	--	2100	--	--	--	--	--	--	--
	850331	--	59	--	--	--	7.6	--	--	0.61	--	--	--
	850625	--	--	--	--	2200	--	--	--	--	--	--	--
	850626	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	850630	540	53	1210	2200	--	7.9	--	--	0.60	0.30	0.30	0.10
	850930	--	62	--	--	2000	7.0	--	--	3.4	--	--	--
	851215	--	--	--	--	2200	--	0.001	0.001	--	--	--	--

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS(continued).

WELL	DATE	Na	Cl	SO4	TDS	COND	pH	As	Se	U	Ra226	Pb210	Th230
MW5	851231	530	71	7620	6600	--	8.1	--	--	0.50	0.00	0.30	0.10
	860321	--	--	--	--	--	--	--	--	--	0.20	0.30	0.10
	860327	--	--	--	--	2300	--	0.001	0.001	--	--	--	--
	860331	--	--	--	--	--	7.0	--	--	1.1	--	--	--
	860619	514	130	1240	2130	--	--	--	--	--	0.00	0.30	0.10
	860626	--	--	--	--	3000	--	--	--	--	--	--	--
	860630	--	130	1890	3210	--	7.5	--	--	5.0	--	--	--
	860904	436	53	1230	2040	3250	7.6	0.001	0.001	0.70	0.20	3.6	1.0
	861210	501	54	1140	2100	2400	7.1	--	--	1.6	0.30	0.00	0.10
	870220	387	54	1120	2050	2800	7.6	0.002	0.001	0.19	0.40	2.7	0.90
	870429	360	54	1310	2300	3700	7.6	0.001	0.001	0.90	0.30	2.4	0.30
	870810	--	54	1140	1990	2700	7.4	--	--	2.1	--	--	--
	871119	564	53	1120	1970	2600	8.0	0.001	0.02	0.30	0.00	0.60	0.00
	880125	--	--	--	--	--	--	--	--	1.0	--	--	--
	880126	--	54	1130	2030	1900	7.7	--	--	--	--	--	--
	880601	--	53	.1030	1890	2100	7.6	--	--	0.90	--	--	--
	880823	432	54	1050	1930	2200	7.8	0.02	0.06	0.12	0.10	0.00	0.40
	881103	410	55	1090	1890	2000	7.5	0.001	0.03	1.1	0.0	0.0	0.0
	890309	321	53	1100	2010	2100	7.6	0.02	0.005	1.5	0.10	0.10	0.00
	890621	--	55	1100	2020	2710	7.4	--	--	0.60	--	--	--
	890622	--	--	--	--	--	--	0.010	0.004	--	--	--	--
	890901	411	54	1140	1940	2740	7.7	0.001	--	1.1	0.0	0.0	0.10
	891115	500	54	1100	2090	2750	7.6	0.007	0.006	--	0.10	--	--
	891120	--	--	--	--	--	--	--	--	0.40	--	1.0	0.0
	900216	--	--	--	--	--	--	--	--	0.70	--	--	--
	900220	--	55	1210	2110	2700	6.0	--	--	--	--	--	--
	900508	--	56	1100	1950	2750	7.6	0.001	0.001	0.70	0.20	1.1	0.0
	900509	456	--	--	--	--	--	--	--	--	--	--	--
	900807	--	53	1140	1970	2660	7.7	--	--	--	--	--	--
	900816	--	--	--	--	--	--	--	--	0.60	--	--	--
	901113	410	54	1100	1800	2000	7.9	0.001	0.001	0.34	0.20	0.00	0.00
	910227	430	50	1020	1850	2640	7.9	-0.001	-0.002	0.27	0.00	0.90	0.00
	910227	427	50	950	1000	--	--	-0.001	-0.002	0.34	--	--	--
MW11	821210	--	--	--	--	2102	--	--	--	--	--	--	--
	821231	550	24	926	1612	--	8.2	--	--	--	--	--	--
	830125	--	32	--	--	1630	--	--	--	--	--	--	--
	830331	--	--	--	--	--	7.4	--	--	0.34	--	--	--
	830430	--	--	--	--	2330	--	--	--	--	--	--	--
	830629	480	27	943	1650	--	8.0	--	--	0.66	0.40	0.00	0.00
	830906	--	--	--	--	2260	--	--	--	--	--	--	--

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS(continued).

WELL	DATE	Na	Cl	SO4	TDS	COND	pH	As	Se	U	Ra226	Pb210	Th230
MW11	830929	--	--	--	--	--	--	--	--	6.5	--	--	--
	831025	--	--	--	--	2600	--	--	--	--	--	--	--
	831231	540	32	900	1550	--	7.2	--	--	0.69	--	--	--
	840228	--	--	937	--	--	--	--	--	--	--	--	--
	840328	--	--	--	--	1500	--	--	--	--	--	--	--
	840331	--	31	--	--	--	7.0	--	--	7.4	--	--	--
	840614	--	--	--	--	1000	--	--	--	--	--	--	--
	840630	530	32	920	1700	--	7.2	--	0.005	2.7	2.0	1.0	2.0
	840930	--	34	--	--	--	7.9	--	--	0.41	--	--	--
	841205	--	--	--	--	1900	--	--	--	--	--	--	--
	841231	446	32	937	--	--	7.9	--	--	1.0	--	--	--
	850221	--	--	--	--	1900	--	--	--	--	--	--	--
	850331	--	34	--	--	--	7.9	--	--	0.27	--	--	--
	850625	--	--	--	--	1850	--	--	--	--	--	--	--
	850628	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	850630	610	31	909	1700	--	8.0	--	--	0.30	0.10	0.00	1.2
	850930	--	38	--	--	2350	7.9	--	--	6.0	--	--	--
	851215	--	--	--	--	3100	--	0.001	0.001	--	--	--	--
	851231	550	71	79	5100	--	7.1	--	--	0.50	0.10	0.90	0.10
	860321	--	--	--	--	--	--	--	--	--	0.10	0.90	0.10
	860327	--	--	--	--	1900	--	0.001	0.001	--	--	--	--
	860331	--	--	--	--	--	7.0	--	--	1.7	--	--	--
	860619	500	77	943	1700	--	--	--	--	--	0.10	0.90	0.10
	860626	--	--	--	--	3400	--	--	--	--	--	--	--
	860630	--	70	949	1700	--	7.9	--	--	1.5	--	--	--
	860904	477	32	956	1710	2700	7.9	0.001	0.001	0.40	0.20	0.10	1.2
	861210	250	33	911	1710	1500	7.9	--	--	0.19	0.30	0.00	0.00
	870220	366	32	895	1710	3400	7.6	0.001	0.003	0.19	0.40	1.5	0.0
	870429	370	43	1020	1800	3250	7.8	0.002	0.001	0.30	0.20	4.0	1.9
	870616	--	33	951	1690	2800	7.4	--	--	0.70	--	--	--
	871119	760	32	961	1720	2300	7.8	0.001	0.02	0.50	0.20	6.7	0.10
	880125	--	--	--	--	--	--	--	--	0.19	--	--	--
	880126	--	31	919	1640	1800	7.0	--	--	--	--	--	--
	880601	--	32	947	1660	2000	7.9	--	--	0.50	--	--	--
	880623	535	34	915	1620	1800	7.7	0.02	0.07	0.05	0.10	0.40	0.00
	881103	486	35	974	1710	1950	8.0	0.001	0.03	0.27	0.20	0.40	0.00
	890309	375	32	975	1730	2000	7.9	0.01	0.002	0.90	0.10	0.70	0.20
	890621	--	32	1020	1750	2520	7.6	--	--	0.00	--	--	--
	890622	--	--	--	--	--	--	0.005	0.004	--	--	--	--
	890901	489	34	1020	1760	2560	7.6	--	--	1.6	0.10	0.10	0.00
	891115	567	34	993	1660	2510	7.6	0.002	0.02	--	0.20	--	--
	891120	--	--	--	--	--	--	--	--	0.60	--	0.10	0.00

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS(continued).

WELL	DATE	Na	Cl	SO4	TDS	COND	pH	As	Se	U	Ra226	Pb210	Th230
MW11	900216	--	--	--	--	--	--	--	--	0.70	--	--	--
	900220	--	33	1010	1700	2750	8.1	--	--	--	--	--	--
	900508	--	33	1000	1660	2550	7.8	0.001	0.001	0.80	0.10	0.70	0.06
	900509	517	--	--	--	--	--	--	--	--	--	--	--
	900607	--	33	973	1700	2530	7.4	--	--	--	--	--	--
	900816	--	--	--	--	--	--	--	--	0.47	--	--	--
	901113	475	34	975	1720	1090	8.0	0.001	0.001	0.61	0.40	1.1	0.20
	910227	522	31	967	1686	2600	6.0	0.002	-0.002	-0.20	0.10	0.60	0.00
MW12	821210	--	--	--	--	3200	--	--	--	--	--	--	--
	821231	310	57	2395	4116	--	7.8	--	--	--	--	--	--
	830125	--	70	--	--	3130	--	--	--	--	--	--	--
	830331	--	--	--	--	--	6.7	--	--	5.0	--	--	--
	830430	--	--	--	--	3400	--	--	--	--	--	--	--
	830629	310	80	2420	4050	--	7.4	--	--	2.0	0.60	0.00	0.10
	830906	--	--	--	--	3250	--	--	--	--	--	--	--
	830929	--	--	--	--	--	--	--	--	11.0	--	--	--
	831025	--	--	--	--	4000	--	--	--	--	--	--	--
	831231	290	65	2330	3950	--	7.2	--	--	10.0	--	--	--
	840228	--	--	2400	--	--	--	--	--	--	--	--	--
	840320	--	--	--	--	3050	--	--	--	--	--	--	--
	840331	--	64	--	--	--	7.2	--	--	29	--	--	--
	840614	--	--	--	--	3200	--	--	--	--	--	--	--
	840630	320	65	2400	4100	--	7.6	--	0.005	10.3	6.0	8.0	0.0
	840930	--	65	--	--	--	6.0	--	--	0.41	--	--	--
	841205	--	--	--	--	3000	--	--	--	--	--	--	--
	841231	320	67	2400	2000	--	6.7	--	--	1.6	--	--	--
	850221	--	--	--	--	4000	--	--	--	--	--	--	--
	850331	--	67	--	--	--	7.1	--	--	0.47	--	--	--
	850625	--	--	--	--	3300	--	--	--	--	--	--	--
	850628	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	850630	330	62	2440	4300	--	6.8	--	--	6.6	1.1	0.0	0.60
	850930	--	71	--	--	3800	6.9	--	--	3.4	--	--	--
	851215	--	--	--	--	2600	--	0.001	0.001	--	--	--	--
	851231	360	53	7020	5100	--	7.7	--	--	6.6	0.70	0.10	0.50
	860321	--	--	--	--	--	--	--	--	--	0.60	0.10	0.50
	860327	--	--	--	--	3100	--	0.001	0.001	--	--	--	--
	860331	--	--	--	--	--	6.7	--	--	9.6	--	--	--
	860619	430	170	2500	4140	--	--	--	--	--	0.70	0.10	0.50
	860626	--	--	--	--	5400	--	--	--	--	--	--	--
	860630	--	150	2520	4210	--	6.7	--	--	9.6	--	--	--

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS(continued).

WELL	DATE	Na	Cl	SO4	TDS	COND	pH	As	Se	U	Ra226	Pb210	Th230
MW12	860904	296	56	2470	4040	5500	6.6	0.001	0.001	9.0	0.90	0.30	0.00
	861210	324	64	2370	4110	3300	7.1	--	--	12.9	0.70	0.00	0.00
	870220	197	63	2100	4120	5500	6.9	0.002	0.001	9.1	0.70	2.1	0.0
	870429	235	63	2300	4120	4400	6.9	0.003	0.001	10.5	0.60	0.00	5.4
	870810	--	61	2430	3990	3300	7.0	--	--	9.0	--	--	--
	871119	334	61	2560	4130	3900	7.3	0.009	0.004	9.4	0.30	2.3	0.0
	880125	--	--	--	--	--	--	--	--	8.9	--	--	--
	880126	--	61	2380	3960	3000	7.1	--	--	--	--	--	--
	880601	--	64	2450	4060	3250	7.1	--	--	12.3	--	--	--
	880823	244	65	2290	3010	3400	6.7	0.02	0.01	1.0	0.50	0.00	0.00
	881103	200	65	2500	4060	3000	6.6	0.001	0.003	120	0.70	0.00	0.50
	890309	186	62	2530	3960	3200	6.9	0.04	0.02	10.0	0.20	0.30	0.20
	890621	--	61	2500	4030	4000	6.8	--	--	11.0	--	--	--
	890622	--	--	--	--	--	--	0.02	0.001	--	--	--	--
	890901	269	59	2250	3630	4010	6.8	0.003	--	11.0	0.50	0.00	0.40
	891115	321	63	2250	3900	4020	7.1	0.003	0.02	--	0.10	--	--
	891120	--	--	--	--	--	--	--	--	5.6	--	0.20	0.00
	900216	--	--	--	--	--	--	--	--	8.8	--	--	--
	900220	--	63	2460	4030	3900	7.2	--	--	--	--	--	--
	900508	--	62	2070	3700	4000	6.6	0.001	0.001	10.0	0.40	0.00	0.00
	900509	264	--	--	--	--	--	--	--	--	--	--	--
	900807	--	63	2450	3750	3800	7.0	--	--	--	--	--	--
	900816	--	--	--	--	--	--	--	--	10.7	--	--	--
	901113	277	63	2460	3760	3000	7.5	0.001	0.001	10.0	0.10	0.30	0.20
	910227	213	61	1850	3260	4120	7.5	0.001	-0.002	0.0	0.30	0.30	0.00
MW13	821210	--	--	--	--	3360	--	--	--	--	--	--	--
	821231	630	40	2200	3700	--	7.0	--	--	--	--	--	--
	830125	--	53	--	--	3290	--	--	--	--	--	--	--
	830331	--	--	--	--	--	7.4	--	--	4.1	--	--	--
	830430	--	--	--	--	3970	--	--	--	--	--	--	--
	830629	640	44	2324	3850	--	8.0	--	--	4.0	0.60	0.00	0.10
	830906	--	--	--	--	3160	--	--	--	--	--	--	--
	830929	--	--	--	--	--	--	--	--	6.6	--	--	--
	831025	--	--	--	--	4360	--	--	--	--	--	--	--
	831231	640	--	2265	3750	--	7.6	--	--	14.0	--	--	--
	840228	--	--	2250	--	--	--	--	--	--	--	--	--
	840326	--	--	--	--	3200	--	--	--	--	--	--	--
	840331	--	50	--	--	--	7.0	--	--	5.2	--	--	--
	840614	--	--	--	--	3200	--	--	--	--	--	--	--
	840630	650	45	2200	3700	--	7.5	--	0.005	10.3	3.0	1.2	5.0

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS(continued).

WELL	DATE	Na	Cl	SO4	TDS	COND	pH	As	Se	U	Ra226	Pb210	Th230
MW13	840930	--	51	--	--	--	7.0	--	--	0.41	--	--	--
	841205	--	--	--	--	3050	--	--	--	--	--	--	--
	841231	459	50	2250	2033	--	7.1	--	--	1.5	--	--	--
	850221	--	--	--	--	3200	--	--	--	--	--	--	--
	850331	--	50	--	--	--	7.4	--	--	2.3	--	--	--
	850625	--	--	--	--	3150	--	--	--	--	--	--	--
	850626	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	850630	660	46	2300	3900	--	7.2	--	--	2.5	0.90	0.20	0.50
	850930	--	47	--	--	3800	6.5	--	--	2.0	--	--	--
	851215	--	--	--	--	3600	--	0.001	0.001	--	--	--	--
	851231	600	71	2120	6000	--	7.1	--	--	13.5	0.40	0.20	0.10
	860321	--	--	--	--	--	--	--	--	--	0.10	0.20	0.10
	860327	--	--	--	--	3000	--	0.002	0.001	--	--	--	--
	860331	--	--	--	--	--	6.9	--	--	14.0	--	--	--
	860619	659	120	2420	3870	--	--	--	--	--	0.40	0.20	0.10
	860626	--	--	--	--	4400	--	--	--	--	--	--	--
	860630	--	100	2420	3850	--	6.9	--	--	11.0	--	--	--
	860904	541	48	2400	3770	5000	7.0	0.001	0.001	11.7	0.10	0.00	0.50
	861210	562	50	2240	3820	3600	7.1	--	--	11.7	0.30	0.00	0.00
	870220	360	48	1990	3700	4400	7.0	0.002	0.007	7.0	0.20	1.1	0.0
	870429	389	49	2270	3810	3900	7.0	0.002	0.001	9.5	0.30	1.0	4.3
	870818	--	51	2300	3750	4200	7.1	--	--	12.0	--	--	--
	871119	677	49	2450	3840	4000	7.4	0.000	0.03	12.0	0.0	1.2	0.10
	880125	--	--	--	--	--	--	--	--	12.0	--	--	--
	880126	--	48	2300	3740	3050	7.1	--	--	--	--	--	--
	880601	--	50	2370	3720	3400	7.3	--	--	14.3	--	--	--
	880823	445	51	2330	3720	3350	6.9	0.02	0.06	1.2	0.10	0.00	0.00
	881103	510	52	2240	3670	3300	7.0	0.003	0.03	123	0	0	0.50
	890309	564	49	2400	3700	3150	6.8	0.03	0.03	--	0.26	0.00	0.20
MW14	890901	--	--	--	--	3660	--	--	--	--	--	--	--
	891115	71	25	2230	3430	3880	6.9	0.003	0.01	--	0.10	--	--
	891120	--	--	--	--	--	--	--	--	27	--	1.0	0.0
	900216	--	--	--	--	--	--	--	--	32	--	--	--
	900220	--	20	2250	3710	3630	6.9	--	--	--	--	--	--
	900503	--	23	1160	3000	3800	6.6	0.001	0.001	33	0.10	0.70	0.00
	900509	380	--	--	--	--	--	--	--	--	--	--	--
	900807	--	21	2240	3500	3710	6.9	--	--	--	--	--	--
	900816	--	--	--	--	--	--	--	--	33	--	--	--
	901113	340	23	2230	3440	2080	6.5	0.001	0.001	33	0.26	0.60	0.00
	910227	265	23	1512	2684	3960	6.5	-0.001	-0.002	24	0.30	0.60	0.00

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS(continued).

WELL	DATE	Na	Cl	SO4	TDS	COND	pH	As	Se	U	Ra226	Pb210	Th230
MW15	890901	--	--	--	--	4560	--	--	--	--	--	--	--
	891115	73	49	2560	3990	4450	6.9	0.006	0.02	--	0.10	--	--
	891120	--	--	--	--	--	--	--	--	44	--	0	4.7
	900216	--	--	--	--	--	--	--	--	30	--	--	--
	900228	--	44	2490	3970	4300	7.5	--	--	--	--	--	--
	900508	--	44	1260	3740	4360	7.1	0.002	0.001	30	0.10	1.3	0.0
	900509	566	--	--	--	--	--	--	--	--	--	--	--
	900807	--	44	2445	3770	4240	7.2	--	--	--	--	--	--
	900816	--	--	--	--	--	--	--	--	25	--	--	--
	901113	540	44	2470	3700	3030	7.1	0.001	0.004	24	0.30	0.10	0.20
	910227	466	41	1676	3356	4360	7.1	-0.001	-0.002	20	0	0.70	0.10
	910227	--	--	--	--	--	--	--	--	--	0.40	0.00	0.00
CULIN	810930	--	--	--	--	--	--	--	--	0.65	--	--	--
	811231	--	--	--	--	--	--	--	--	0.69	--	--	--
	820331	--	--	--	--	--	--	--	--	0.69	--	--	--
	820407	--	--	--	--	459	--	--	--	--	--	--	--
	820630	--	--	--	--	--	--	--	--	0.70	--	--	--
	820707	--	--	--	--	573	--	--	--	--	--	--	--
	820930	--	--	--	--	--	--	--	--	4.5	--	--	--
	821210	--	--	--	--	530	--	--	--	--	--	--	--
	821231	67	4.6	39	334	--	--	--	--	0.66	--	--	--
	830125	--	6.4	--	--	439	--	--	--	--	--	--	--
	830430	--	--	--	--	450	--	--	--	--	--	--	--
	830629	27	2.8	41	--	--	--	--	--	--	0.40	0.00	0.00
	830906	--	--	--	--	412	--	--	--	--	--	--	--
	831025	--	--	--	--	470	--	--	--	--	--	--	--
	831231	--	--	64	--	--	--	--	--	--	--	--	--
	840228	--	--	77	--	--	--	--	--	--	--	--	--
	840328	--	--	--	--	312	--	--	--	--	--	--	--
	840331	--	2.4	--	--	--	7.6	--	--	32	--	--	--
	840614	--	--	--	--	370	--	--	--	--	--	--	--
	840630	5.6	3.0	32	280	--	6.2	--	0.005	2.7	7.0	6.6	2.0
	840930	--	1.9	--	--	--	7.0	--	--	0.41	--	--	--
	841205	--	--	--	--	230	--	--	--	--	--	--	--
	841231	7.2	3.5	--	139	--	8.3	--	--	1.4	--	--	--
	850221	--	--	--	--	300	--	--	--	--	--	--	--
	850331	--	10.0	--	--	--	8.0	--	--	0.20	--	--	--
	850625	--	--	--	--	300	--	--	--	--	--	--	--
	850626	--	--	--	--	--	--	0.006	0.001	--	--	--	--
	850630	7.3	1.0	17.7	221	--	7.0	--	--	1.5	2.6	1.0	0.30

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS(continued).

WELL	DATE	Na	Cl	SO4	TDS	COND	pH	As	Se	U	Ra226	Pb210	Th230
CULIN	850930	--	47	--	--	470	7.3	--	--	1.7	--	--	--
	851215	--	--	--	--	--	--	0.001	0.001	--	--	--	--
	851231	5.5	62	79	--	--	--	--	--	2.2	0.55	0.20	0.05
	860321	--	--	--	--	--	--	--	--	--	0.40	0.20	0.05
	860327	--	--	--	--	500	--	0.001	0.001	--	--	--	--
	860331	--	--	--	--	--	7.0	--	--	--	--	--	--
	860619	24	7.7	45	277	--	--	--	--	--	0.05	0.20	0.05
	860626	--	--	--	--	700	--	--	--	--	--	--	--
	860630	--	9.1	43	292	--	--	--	--	1.0	--	--	--
	860904	30	8.1	49	263	550	7.0	0.001	0.001	2.0	1.3	0.0	0.50
	861210	68	3.3	77	403	800	7.6	--	--	2.2	0.30	0.00	0.00
	870220	54	32	62	311	460	8.5	0.001	0.001	0.19	0.30	1.3	0.10
	870429	7.0	1.7	22	249	500	7.6	0.01	--	0.70	0.50	0.90	1.2
	870818	--	0.40	26	234	500	7.4	--	--	0.50	--	--	--
	871119	11.6	0.09	25	236	600	7.4	0.01	0.001	0.30	0.60	0.90	0.00
	880125	--	--	--	--	--	--	--	--	0.30	--	--	--
	880126	--	0.90	22	22	265	7.7	--	--	--	--	--	--
	880601	--	0.09	25	25	340	6.1	--	--	0.00	--	--	--
	880823	15.2	0.90	7.0	207	310	7.8	0.007	0.001	0.22	0.50	0.00	0.40
	881103	17.4	2.7	34	170	--	7.0	0.001	0.001	1.6	0.50	0.00	0.20
	890309	22	5.7	41	--	--	--	0.007	0.001	1.9	0.90	0.90	0.00
	890621	--	5.2	65	316	550	7.7	--	--	0.60	--	--	--
	890622	--	--	--	--	--	--	0.01	0.001	--	--	--	--
	890901	--	0.0	60	296	575	7.7	0.006	0.001	0.90	0.20	0.30	0.00
	891115	70	7.0	105	544	693	7.6	0.01	0.001	--	0.10	--	--
	891120	--	--	--	--	--	--	--	--	--	--	1.2	3.2
	900216	--	--	--	--	--	--	--	--	0.30	--	--	--
	900220	--	4.0	98	202	604	8.0	--	--	--	--	--	--
	900508	--	6.0	51	338	700	7.6	0.01	0.001	0.30	0.30	0.00	0.00
	900509	71	--	--	--	--	--	--	--	--	--	--	--
	900807	--	7.0	86	344	686	7.8	--	--	--	--	--	--
	900816	--	--	--	--	--	--	--	--	0.40	--	--	--
	901113	49	4.0	89	308	550	6.2	0.01	0.001	0.47	0.40	0.00	0.00
	910227	19.0	-1.0	45	252	449	6.2	0.01	-0.002	-0.20	0.30	0.00	0.10

NOTES:

"-" sign before a value indicates that the value is less than the detection limit. Value shown is lower detection limit.

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS(continued).

NOTES:(continued)

All values are in MG/L except as otherwise noted and the following:

- COND = conductivity, in micromhos/cm @ 25 DEG C.
- pH = pH, in standard units.
- Ra226 = Radium-226, in pCi/l.
- Th230 = Thorium-230, in pCi/l.
- Pb210 = Lead-210, in pCi/l.

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS.

WELL	DATE	Ca	Mg	K	NH3	CNWAD	ALK	Be	Cd
MW1	891120	--	--	--	0.50	0.009	260	--	0.005
	910227	123	52	6.0	--	--	271	0.001	--
MW2	891120	--	--	--	0.009	0.009	344	--	0.005
	910227	298	91	11.0	--	--	349	0.004	--
MW3	891120	--	--	--	0.009	0.009	277	--	0.005
	910227	407	234	25	--	--	204	0.006	--
MW4	891120	--	--	--	0.70	0.009	347	--	0.005
	910227	375	174	10.6	--	--	304	0.004	--
MW5	891101	--	--	--	0.70	0.009	326	--	0.005
	891120	--	--	--	0.70	0.009	322	--	0.005
	891215	--	--	--	0.70	0.009	314	--	0.005
	900124	--	--	--	0.50	0.009	300	--	0.005
	910227	118	34	7.4	--	--	303	0.003	--
	910227	116	34	7.5	--	--	209	0.003	--
MW11	891101	--	--	--	0.60	0.009	316	--	0.005
	891120	--	--	--	0.60	0.009	301	--	0.005
	891215	--	--	--	0.60	0.009	304	--	0.007
	900124	--	--	--	0.50	0.009	300	--	0.007
	910227	33	8.7	6.0	--	--	301	0.002	--
MW12	891101	--	--	--	0.20	0.009	346	--	0.005
	891120	--	--	--	0.10	0.009	342	--	0.005
	891215	--	--	--	0.10	0.009	324	--	0.005
	900124	--	--	--	0.09	0.009	319	--	0.007
	910227	313	81	9.6	--	--	296	0.004	--
MW13	891101	--	--	--	--	--	--	--	--
MW14	891101	--	--	--	0.10	0.009	420	--	0.025

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS(continued).

WELL	DATE	Ca	Mg	K	NH3	CNWAD	ALK	Be	Cd
MW14	891120	--	--	--	0.009	0.009	379	--	0.005
	891215	--	--	--	0.10	0.009	392	--	0.005
	900124	--	--	--	0.09	0.009	382	--	0.005
	910227	306	41	7.9	--	--	361	0.003	--
MW15	891101	--	--	--	0.10	0.009	374	--	0.005
	891120	--	--	--	0.20	0.009	353	--	0.005
	891215	--	--	--	0.10	0.009	355	--	0.005
	900124	--	--	--	0.09	0.009	353	--	0.005
	910227	365	120	9.4	--	--	356	0.004	--
CULIN	891101	--	--	--	--	--	0.000	--	--
	891120	--	--	--	0.20	0.009	240	--	0.005
	910227	30	20	4.8	--	--	201	-0.001	--

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS(continued).

WELL	DATE	Cr	ALPHA	BETA	CHLFM	MTHCL	ACETN	C2S	2-BUT
MW1	891128	0.009	6.3	11.0	4.9	4.9	99	4.9	99
	910227	--	0	7.1	--	--	--	--	--
MW2	891128	0.009	39	31	4.9	4.9	99	4.9	99
	910227	--	4.0	21	--	--	--	--	--
MW3	891128	0.009	65	58	4.9	4.9	99	4.9	99
	910227	--	0	31	--	--	--	--	--
MW4	891128	0.009	4.0	15.0	4.9	4.9	99	4.9	99
	910227	--	10.0	13.0	--	--	--	--	--
MW5	891101	0.005	7.0	12.0	4.9	4.9	99	4.9	99
	891128	0.009	8.0	10.0	4.9	4.9	99	4.9	99
	891215	0.009	7.0	19.0	4.9	4.9	9.9	4.9	9.9
	900124	0.009	0.000	13.0	4.9	4.9	9.9	4.9	9.9
	910227	--	15.0	6.3	--	--	--	--	--
MW11	891101	0.009	42	21	4.9	4.9	99	4.9	99
	891128	0.009	17.0	7.0	4.9	4.9	99	4.9	99
	891215	0.009	13.0	16.0	4.9	4.9	9.9	4.9	9.9
	900124	0.009	0.000	10.0	4.9	4.9	9.9	4.9	9.9
	910227	--	17.0	5.3	--	--	--	--	--
MW12	891101	0.009	47	38	4.9	4.9	99	4.9	99
	891128	0.009	27	34	4.9	4.9	99	4.9	99
	891215	0.009	62	44	4.9	4.9	9.9	4.9	9.9
	900124	0.005	16.0	29	4.9	4.9	9.9	4.9	9.9
	910227	--	24	26	--	--	--	--	--
MW13	891101	--	--	--	--	--	--	--	--
MW14	891101	0.009	53	43	4.9	4.9	99	4.9	99
	891128	0.009	66	48	4.9	4.9	99	4.9	99

TABLE 6-1. GROUND-WATER QUALITY FOR THE WHITE MESA WELLS(continued).

WELL	DATE	Cr	ALPHA	BETA	CHLFM	MTHCL	ACETN	C2S	2-BUT
MW14	891215	0.009	67	37	4.9	4.9	9.9	4.9	9.9
	900124	0.009	40	37	4.9	4.9	9.9	4.9	9.9
	910227	--	48	25	--	--	--	--	--
MW15	891101	0.009	89	55	4.9	4.9	99	4.9	99
	891120	0.009	81	29	4.9	4.9	99	4.9	99
	891215	0.009	98	51	4.9	4.9	9.9	4.9	9.9
	900124	0.009	66	41	4.9	4.9	9.9	4.9	9.9
	910227	--	19.0	18.0	--	--	--	--	--
	910227	--	0.0	5.7	--	--	--	--	--
CULIN	891120	0.009	1.9	6.7	4.9	130	99	4.9	99
	910227	--	0.10	3.7	--	--	--	--	--

NOTES:

"-" sign before a value indicates that the value is less than the detection limit. Value shown is lower detection limit.

ALK = Alkalinity, in mg/l of $CaCO_3$.

CNWAD = Cyanide WAD, in mg/l.

METHCL = Methylene Chloride, in ug/l.

C2S = Carbon Disulfide, in ug/l.

ACETN = Acetone, in ug/l.

CHLFM = Chloroform, in ug/l.

2-BUT = 2-Butanone, in ug/l.

All values are in MG/L except as otherwise noted and the following:
ALPHA = Gross Alpha, in pCi/l.
BETA = Gross Beta, in pCi/l.

TABLE 6-2. GROUND-WATER QUALITY FOR THE REGIONAL WELLS.

WELL	DATE	Ca	Mg	K	Na	HCO3	CO3	Cl	TDS	TSS	NH3	NO2	NO3
037	910417	10.7	3.2	2.6	372	346	0.0	15.0	1020	13.0	0.50	0.10	-0.10
	910417	10.7	3.2	2.4	369	336	12.0	15.0	1030	6.0	0.40	-0.10	0.10
036	910416	453	523	5.6	167	241	12.0	286	2500	5.0	3.0	0.10	2.3
	910416	443	589	5.3	162	234	12.0	219	2510	-4.0	3.1	0.10	2.1
039	910416	500	107	5.4	96	228	12.0	85	2580	9.0	-0.10	0.10	0.20
	910416	520	113	5.7	102	237	12.0	84	2650	5.0	-0.10	0.20	0.10
01	910416	215	224	11.7	48	192	12.0	24	2140	53	0.20	0.10	0.50
	910416	229	238	12.3	43	189	12.0	22	2070	98	0.30	0.10	0.50

TABLE 6-2. GROUND-WATER QUALITY FOR THE REGIONAL WELLS(continued).

WELL	DATE	CN	PO4	Al	As	Ba	B	Be	Cd	Cr	Co	Cu	Cu
#37	910417	0.02	-0.10	-0.05	-0.001	-0.010	0.51	-0.010	-0.005	-0.001	-0.010	-0.010	-0.05
	910417	0.02	-0.10	-0.05	-0.001	-0.010	0.50	-0.010	-0.005	-0.010	-0.010	-0.010	-0.05
#38	910416	0.02	-0.010	53	-0.001	0.02	0.23	0.05	0.02	-0.010	0.42	-0.010	0.07
	910416	0.02	-0.10	52	-0.001	0.010	0.22	0.05	0.03	-0.010	0.41	-0.010	0.08
#39	910416	0.02	-0.10	-0.05	-0.001	-0.010	0.04	-0.010	-0.005	-0.010	0.010	-0.010	0.05
	910416	0.02	-0.10	-0.05	-0.001	-0.010	0.03	-0.010	-0.005	-0.010	-0.010	-0.010	-0.05
#1	910416	0.02	-0.10	-0.05	-0.001	0.04	0.09	-0.010	0.006	-0.010	-0.010	-0.010	0.09
	910416	-0.02	-0.10	-0.05	-0.001	0.05	0.09	-0.010	0.006	-0.010	-0.010	-0.010	0.08

TABLE 6-2. GROUND-WATER QUALITY FOR THE REGIONAL WELLS(continued).

WELL	DATE	Fe	Pb	Li	Mn	Hg	Mo	Ni	Ni	Se	Se	Se	Tl
#37	910417	-0.010	-0.02	0.20	0.04	-0.0002	0.02	-0.010	-0.003	0.002	0.58	-0.005	-0.010
	910417	0.010	-0.02	0.20	0.04	0.04	0.02	-0.010	-0.003	0.002	0.57	-0.005	-0.010
#38	910416	0.93	0.04	1.9	7.7	-0.0002	-0.010	0.41	-0.003	0.05	0.9	-0.005	-0.010
	910416	0.91	0.04	1.9	7.2	-0.0002	-0.010	0.38	-0.003	0.05	0.6	-0.005	-0.010
#39	910416	6.4	-0.02	0.10	2.4	-0.0002	0.010	-0.010	-0.003	-0.002	2.7	-0.005	-0.010
	910416	6.6	-0.02	0.10	2.5	-0.0002	0.010	-0.010	-0.003	-0.002	2.0	-0.005	-0.010
#1	910416	0.32	-0.02	0.10	1.2	-0.0002	-0.010	-0.010	-0.003	-0.002	3.7	-0.005	-0.010
	910416	0.33	-0.02	0.10	1.3	-0.0002	-0.010	0.010	-0.003	-0.002	4.0	-0.005	-0.010

TABLE 6-2. GROUND-WATER QUALITY FOR THE REGIONAL WELLS(continued).

WELL	DATE	Tl	Ag	V	Zn	U	Ra226	Ra228	Ra6+8	Th230	ALPHA	BETA
037	910417	-0.05	-0.010	-0.010	0.01	3.8	0.30	0.40	0.70	0.10	2.6	7.2
	910417	-0.05	-0.010	-0.010	0.006	2.7	0.70	0.70	1.4	6.8	0.0	7.4
038	910416	-0.05	-0.010	0.010	2.2	7.7	6.9	17.0	26	0	208	108
	910416	-0.05	-0.010	0.010	2.1	7.8	6.9	15.0	22	0	89	58
039	910416	-0.05	-0.010	0.010	0.37	33	1.3	1.2	2.5	0.0	38	26
	910416	-0.05	-0.010	0.010	0.38	32	1.6	1.0	2.6	0.0	84	26
01	910416	-0.05	-0.010	0.02	0.10	4.5	0.70	1.6	2.3	0.0	10.0	18.0
	910416	-0.05	-0.010	0.02	0.005	4.9	0.70	1.7	2.4	0.0	11.0	21

NOTES:

"-" sign before a value indicates that the value is less than the detection limit. Value shown is lower detection limit.

RA228 = Radium-228, in pCi/l.

RA6+8 = Radium-226 + Radium-228, in pCi/l.

All values are in MG/L except as otherwise noted and the following:
Ra226 = Radium-226, in pCi/l.
Th230 = Thorium-230, in pCi/l.
ALPHA = Gross Alpha, in pCi/l.
BETA = Gross Beta, in pCi/l.

7.0 BACKGROUND CONCENTRATIONS

Table 7-1 presents the latest water-quality data from each of the upgradient wells (MW1, #1, #38 and #39) and sidegradient wells (MW2, MW4 and MW37). Maximum natural concentrations that were recently measured at this site are 0.002, 0.05, 0.03, 0.02, 0.38, 0.05, 31.8, 2.6, 22, 6.8 and 89 for arsenic, beryllium, cadmium, molybdenum, nickel, selenium, uranium, lead-210, radium 226+228, thorium-230 and gross alpha, respectively. All the units are mg/l, except for the radionuclides (U-nat, Pb 210, Ra 226+228, Th 230 and gross alpha), which are in pCi/l.

TABLE 7-1. BACKGROUND CONCENTRATIONS OF HAZARDOUS CONSTITUENTS.

	WELLS						
	MW1	MW2	MW4	1	37	38	39
CONSTITUENT							
ARSENIC	0.001	<.001	0.002	<.001	<.001	<.001	<.001
BERYLLIUM	0.001	0.004	0.004	<.01	<.01	0.05	<.01
CADMIUM	0.005	0.005	0.005	0.006	<.005	0.03	<.005
MOLYBDENUM	0.01	0.02	0.02	<.01	0.02	<.01	0.01
NICKEL	0.02	0.06	0.07	<.01	<.01	0.38	<.01
SELENIUM	0.002	<.002	<.002	<.002	0.002	0.05	<.002
U-NAT	0.22	3.5	1.3	4.9	2.7	7.8	31.8
LEAD-210	0	0.4	2.6	----	----	----	----
RADIUM 226+228	1.8	2.8	2.4	2.4	1.4	22	2.6
THORIUM-230	0	0	0	0	6.8	0	0
GROSS ALPHA	0	4	10	11	0	89	84

8.0 REFERENCES

Dames and Moore, 1978, Environmental Report, White Mesa Uranium Project, San Juan County Utah, Consulting Report for Energy Fuels Nuclear, Inc.

Haynes, D.D., J.D. Vogel and D.G. Wyant, 1972, Geology, Structure and Uranium Deposits of the Cortez Quadrangle, Colorado and Utah. U.S. Geological Survey, Miscellaneous Investigation Series, May I-629.

ATTACHMENT 10

Hydrogeologic Evaluation of White Mesa Uranium Mill

Prepared For:

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July 1994

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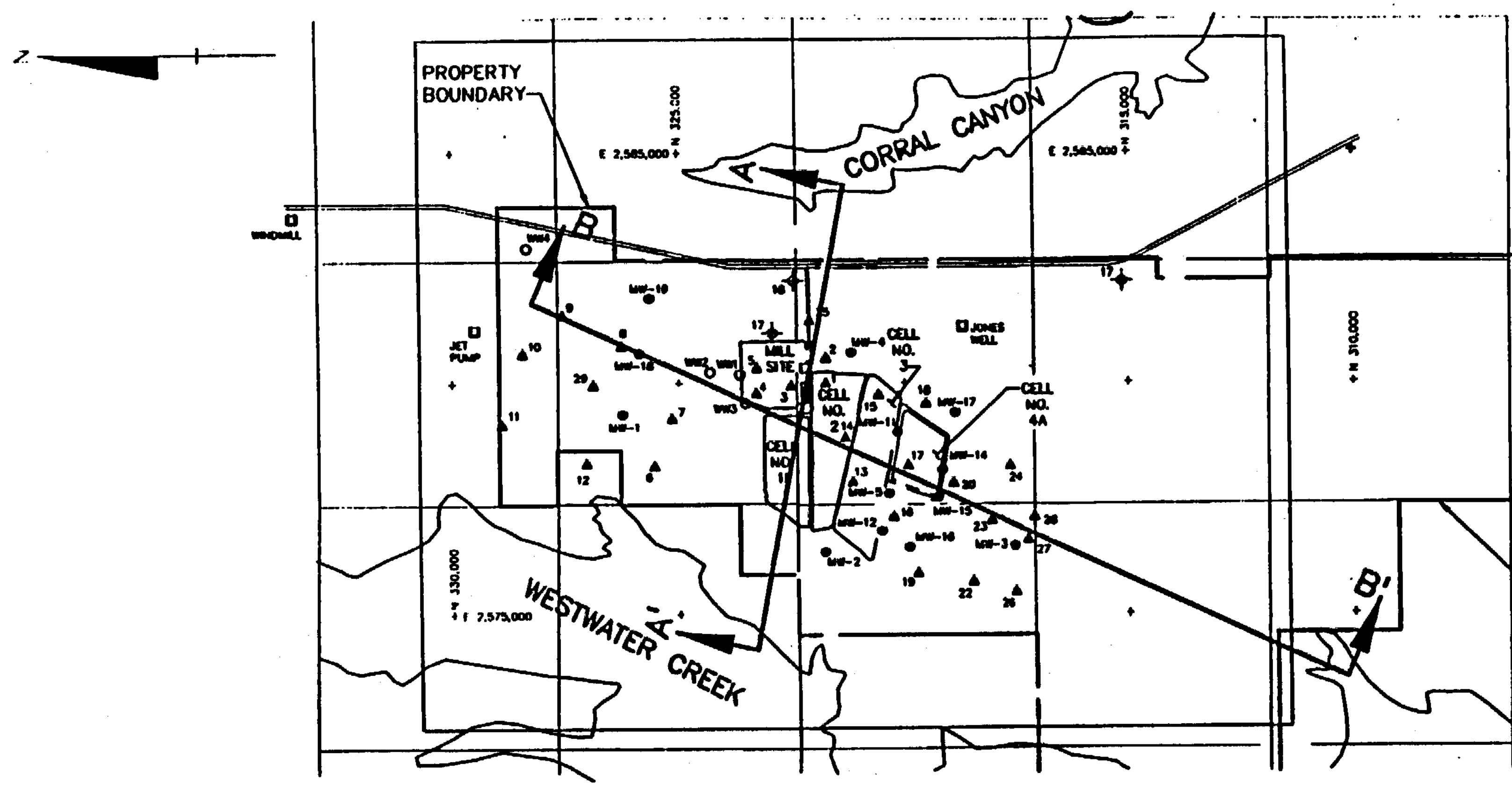
of 900 feet of water or 390 pounds per square inch (psi) within the Entrada/Navajo Aquifer. The positioning of this aquifer and its hydraulic head versus other strata is shown on Figures 2.2 and 2.3. In-situ hydraulic pressure of ground water in the Entrada/Navajo Aquifer is strong evidence of the "aquitard" 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:

- ▲12 DAMES AND MOORE 1978 BORINGS
- ○WW4 WATER SUPPLY WELLS D'APPOLONIA (1981)
- ●MW-2 EXISTING MONITORING WELLS
- ✣17 EXISTING WATER SUPPLY WELLS
- ◘ STOCK WELLS
- B 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

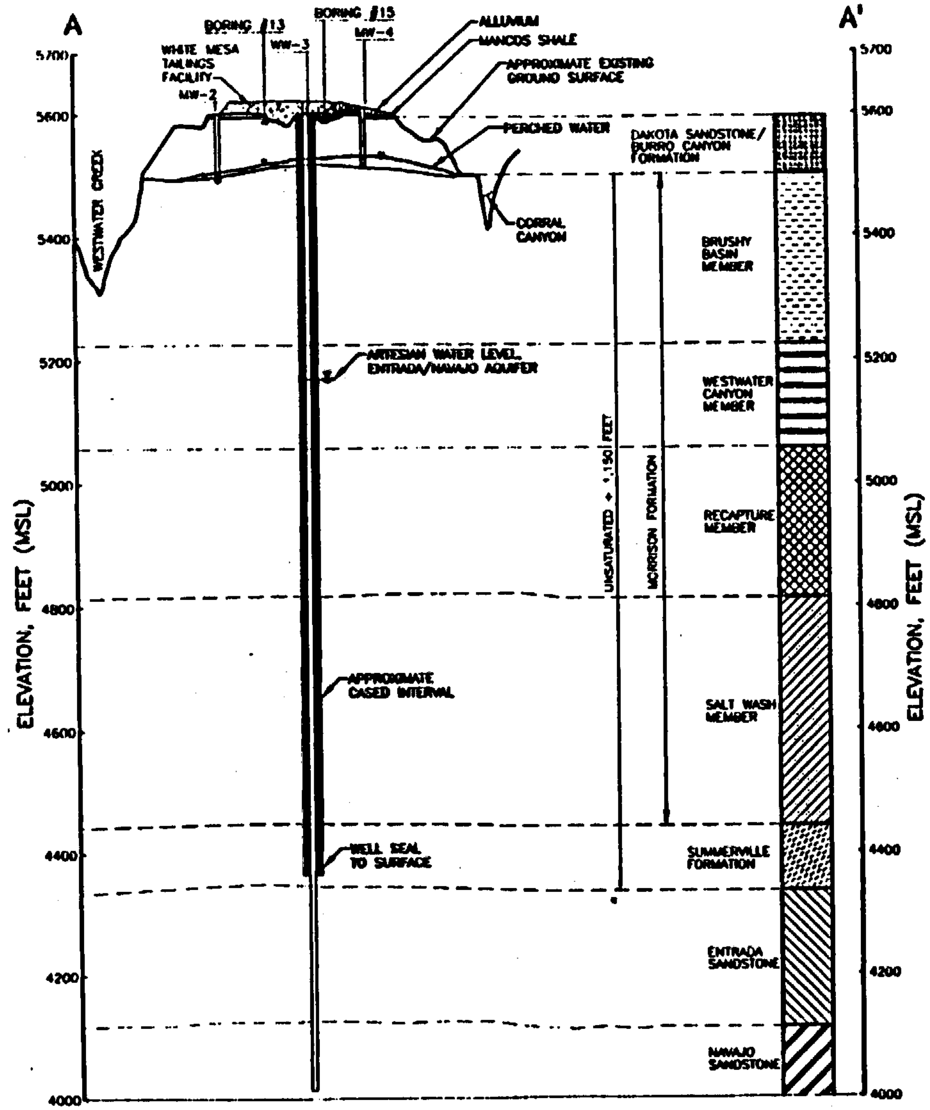
TITAN Environmental

No.	DATE	ISSUE / REVISION	DWN	CH'KD	APP'D

DATE: 7-18-94
SCALE: AS SHOWN

FIGURE 2.1

DRAWING NUMBER 4111-85



VERTICAL SCALE

200 0 200 FEET

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

PREPARED FOR

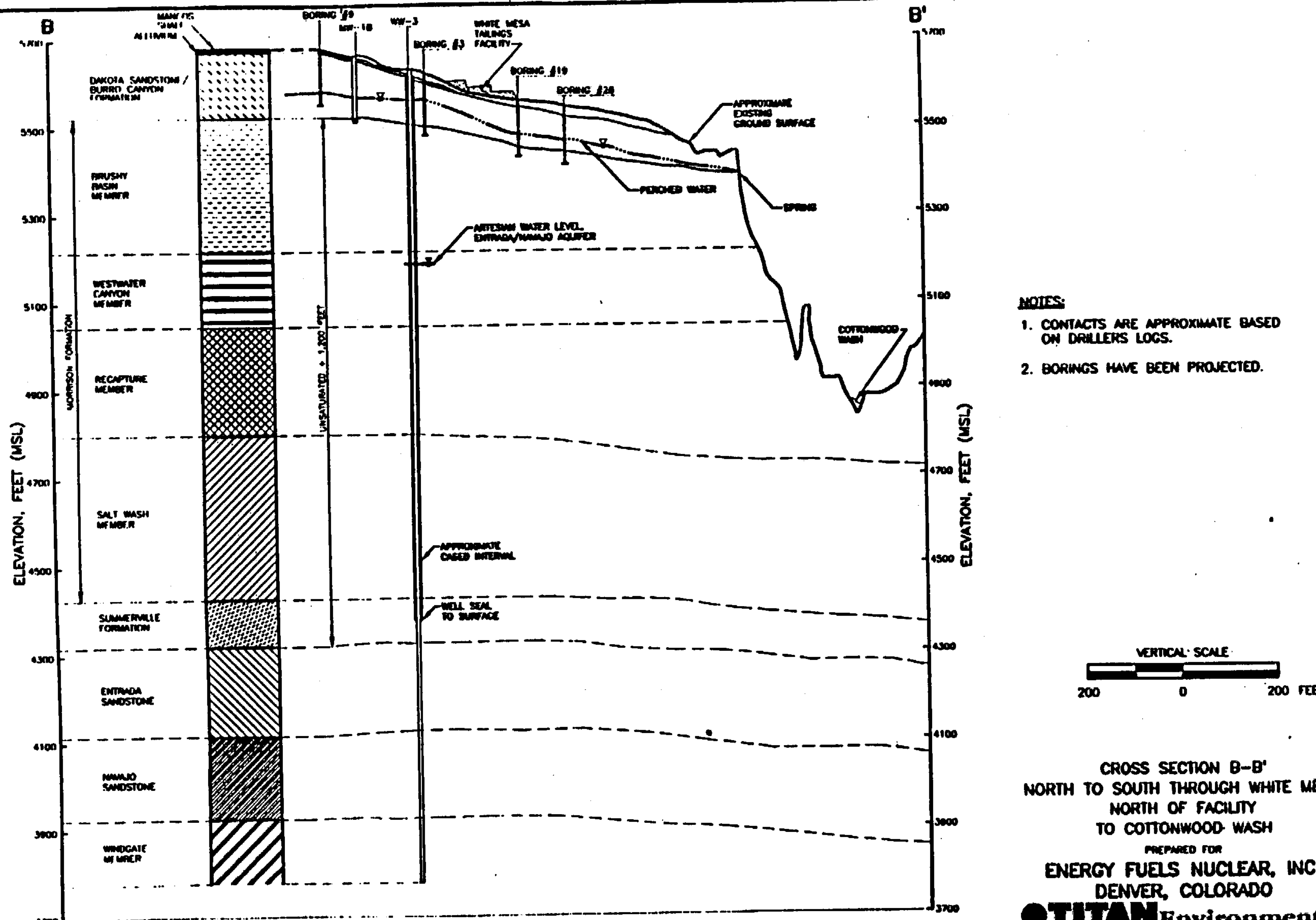
ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

TITAN Environmental

DATE: 7-18-94
SCALE: AS SHOWN

FIGURE 2.2

DRAWING NUMBER 4111-B2



NOTES:

1. CONTACTS ARE APPROXIMATE BASED ON DRILLERS LOGS.
2. BORINGS HAVE BEEN PROJECTED.

CROSS SECTION B–B'
NORTH TO SOUTH THROUGH WHITE MESA
NORTH OF FACILITY
TO COTTONWOOD WASH

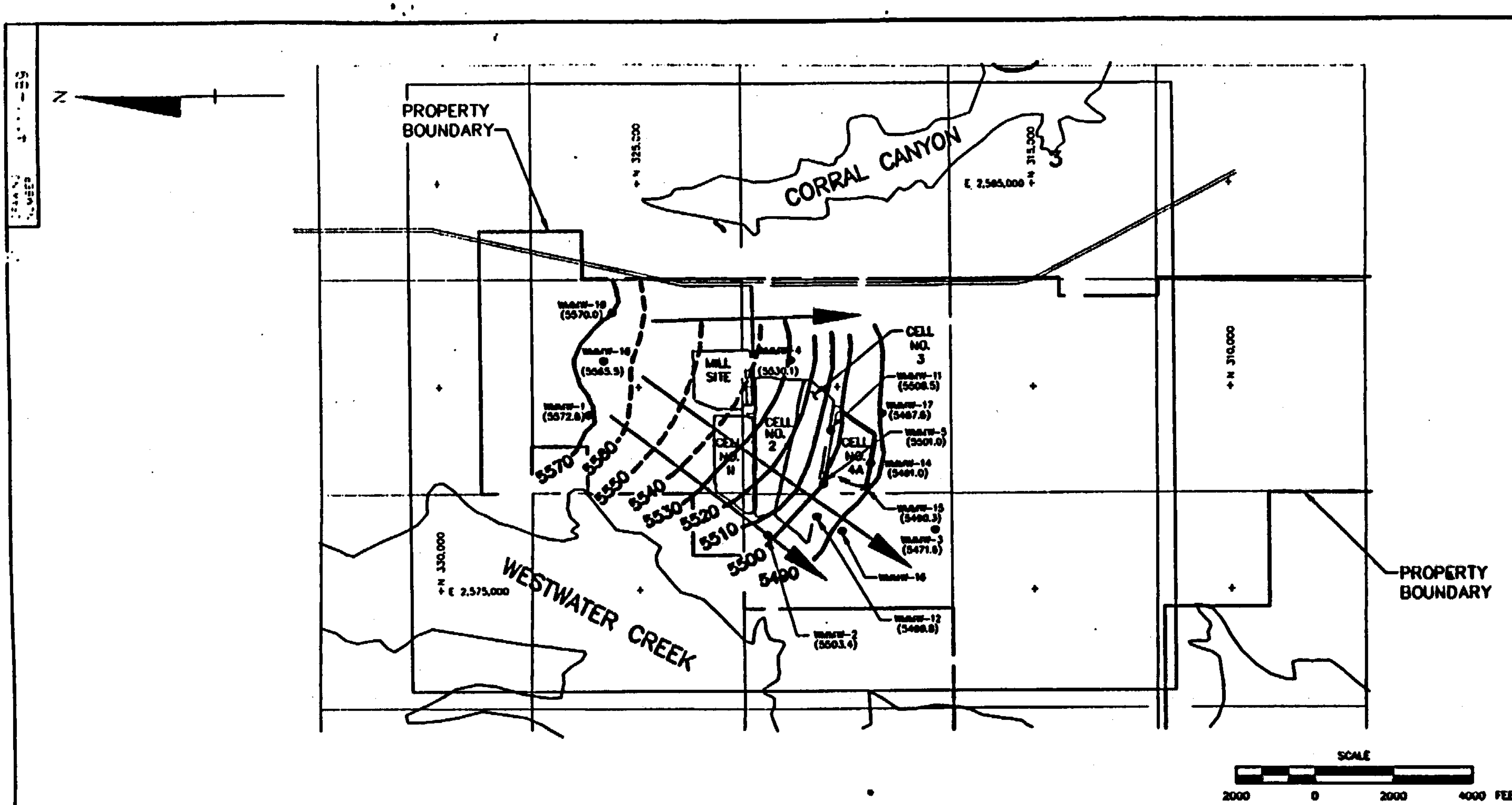
PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

TITAN Environmental

DATE: 7-18-94 SCALE: AS SHOWN	FIGURE 2.3	DRAWING NUMBER 4111-B1

No.	DATE	ISSUE / REVISION



LEGEND:

5550 CONTOUR IN FEET ABOVE MEAN SEA LEVEL

GROUND WATER FLOW DIRECTION

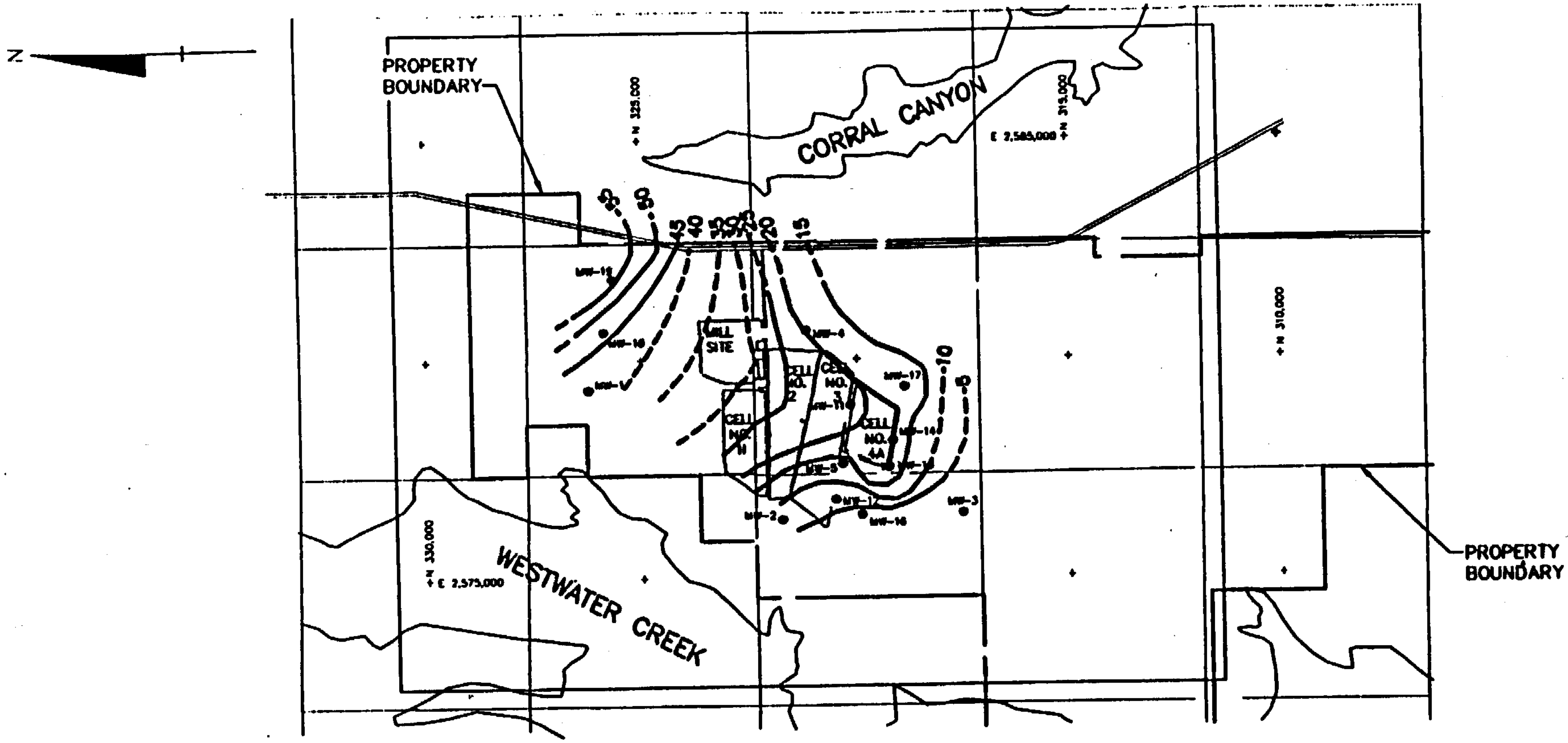
PERCHED GROUND WATER LEVELS
FALL 1992
WHITE MESA MILL
BLANDING, UTAH

PREPARED FOR
ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

TITAN Environmental

DATE: 7-18-94	FIGURE 2.4	DRAWING NUMBER 4111-B9
SCALE: AS SHOWN		

No	DATE	ISSUE / REVISION



LEGEND:

—5 SATURATED THICKNESS IN FEET

SCALE

2000 0 2000 4000 FEET

SATURATED THICKNESS FALL 1992
BURRO CANYON FORMATION
WHITE MESA MILL
BLANDING, UTAH

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

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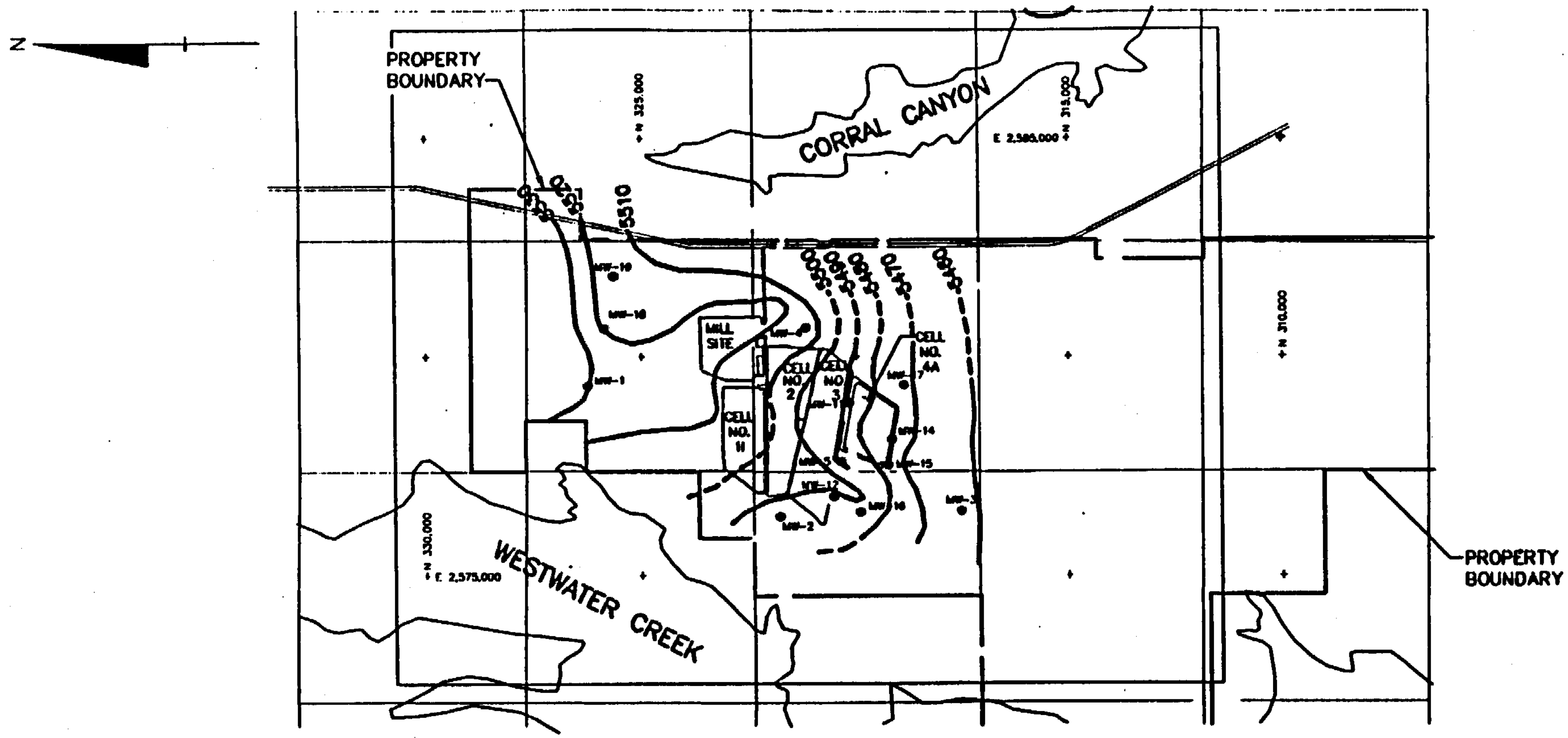
DATE: 7-18-94	FIGURE 2.5	DRAWING NUMBER 4111-B8
SCALE: AS SHOWN		

No.	DATE	ISSUE / REVISION				
		ISSUED FOR DRAFT SUBMITTAL				



LEGEND:

5520 CONTOUR IN FEET ABOVE MEAN SEA LEVEL

SCALE

2000 0 2000 4000 FEET

ELEVATION OF
TOP OF BRUSHY BASIN
WHITE MESA MILL
BLANDING, UTAH

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

TITAN Environmental

DATE: 7-18-94 SCALE: AS SHOWN	FIGURE 2.6	DRAWING NUMBER 4111-B7

No	DATE	ISSUE / REVISION			

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 quality 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

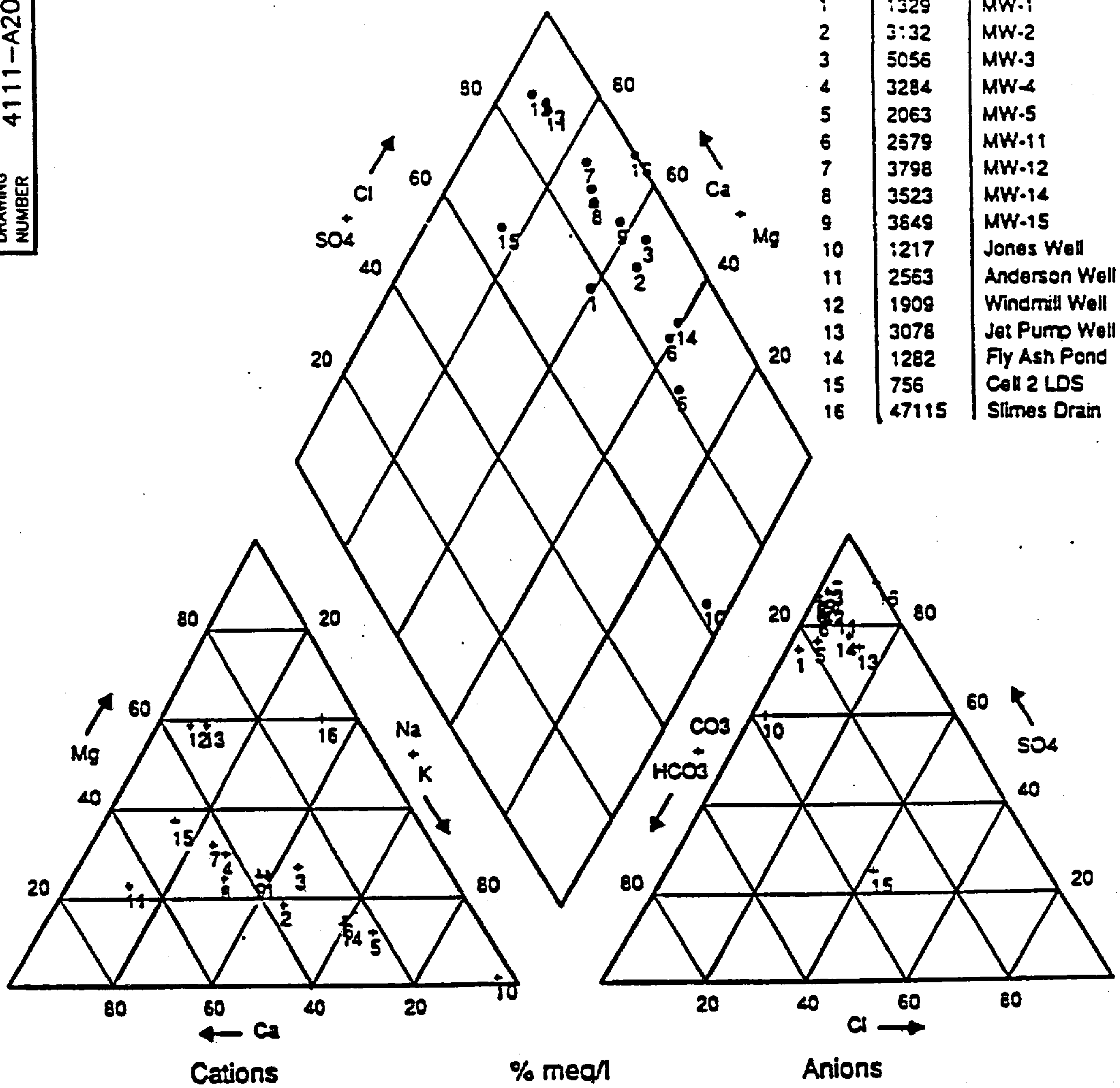
Monitoring Well and Ground Water Elevation Data
White Mesa Uranium Mill

Well Name	Date Installed	Total Depth	Perforations	Water Level			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 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

DRAWING NUMBER 4111-A20

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	2579	MW-11
7	3798	MW-12
8	3523	MW-14
9	3649	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

PREPARED FOR

ENERGY FUELS NUCLEAR DENVER, COLORADO

REFERENCE:
Umetco 1992

TITAN Environmental

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1		ISSUED FOR DRAFT SUBMITTAL	T.M.G.		

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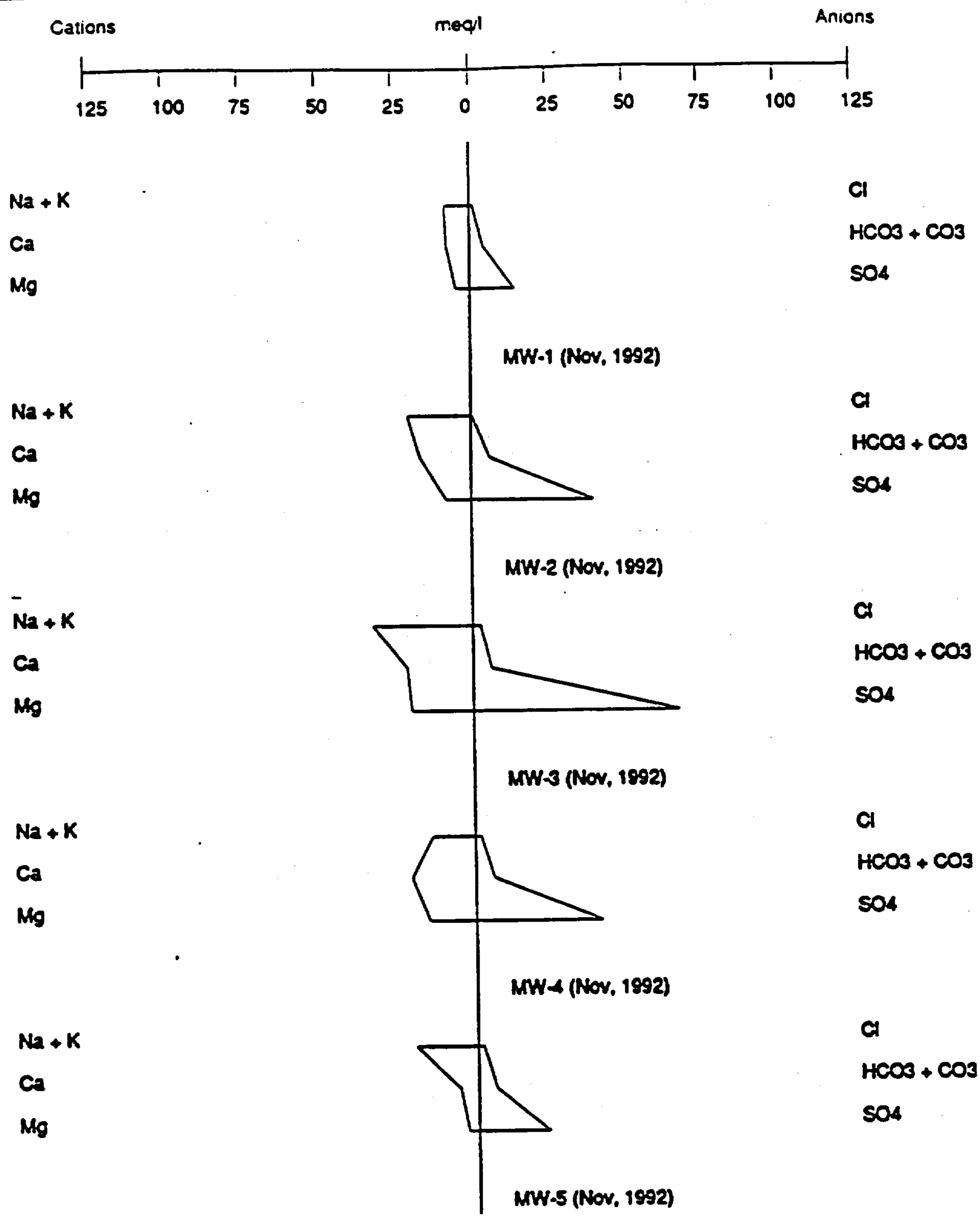
SCALE: N.T.S.

FIGURE 2.7

DRAWING NUMBER 4111-A20



REFERENCE:
Umetco 1992

STIFF DIAGRAMS OF WATER FROM MONITOR WELLS

PREPARED FOR

ENERGY FUELS NUCLEAR
DENVER, COLORADO

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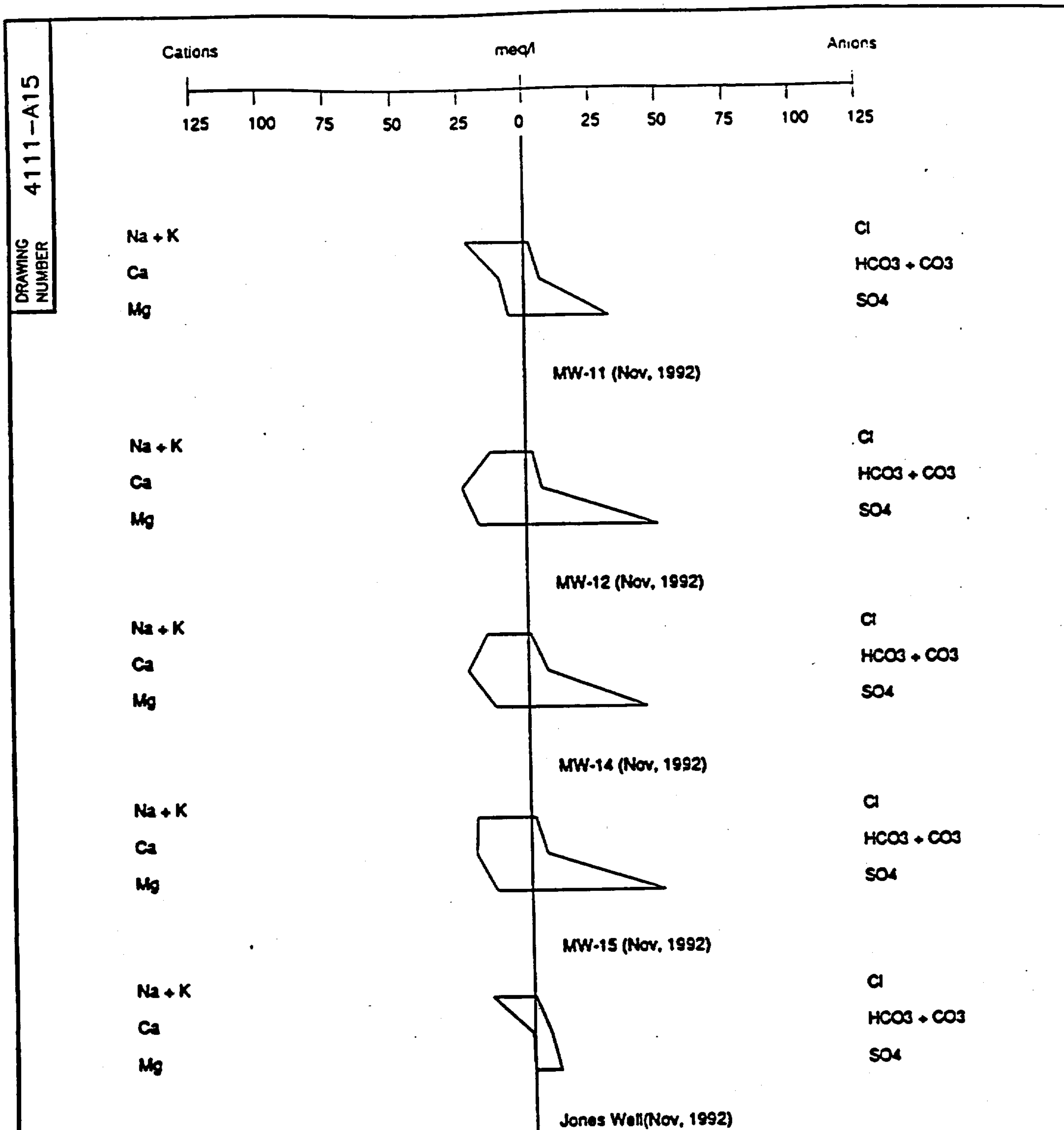
FIGURE 2.8

DRAWING NUMBER 4111-A14



STIFF DIAGRAMS OF WATER FROM MONITOR WELLS AND STOCK WELL

PREPARED FOR

ENERGY FUELS NUCLEAR DENVER, COLORADO

REFERENCE:
Umetco 1992

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DATE: 7-19-94
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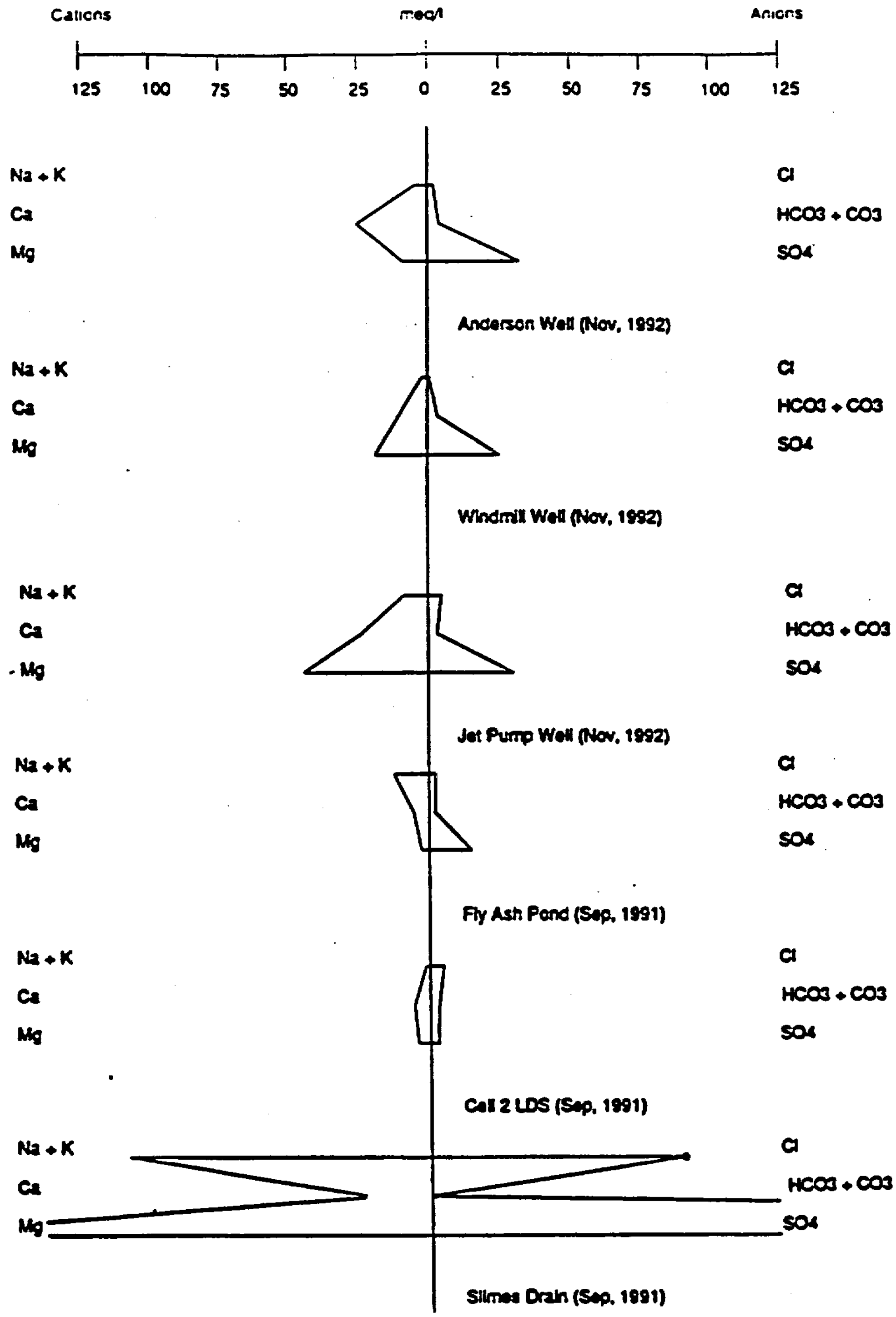
FIGURE 2.9

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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DATE: 7-19-94
SCALE: N.T.S.

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.

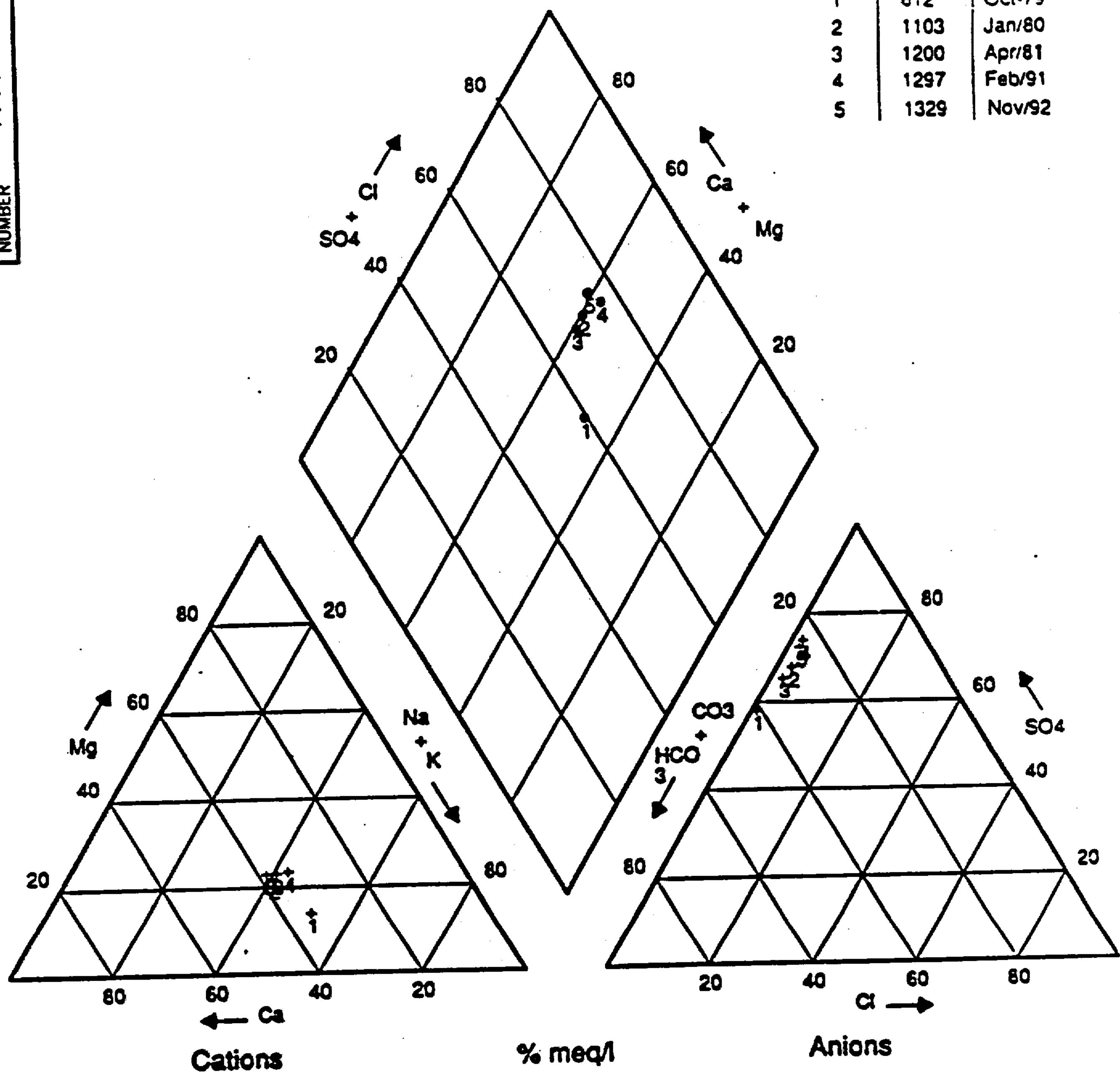
Variability of water within the Burro Canyon Formation is the result of slow moving to nearly stagnant ground water flow beneath the site. These conditions are likely leading to dissolution of minerals from the Brushy Basin Member and the formation of sulfate-dominated waters.

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

DRAWING NUMBER 4111-A17

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
PREPARED FOR
ENERGY FUELS NUCLEAR
DENVER, COLORADO

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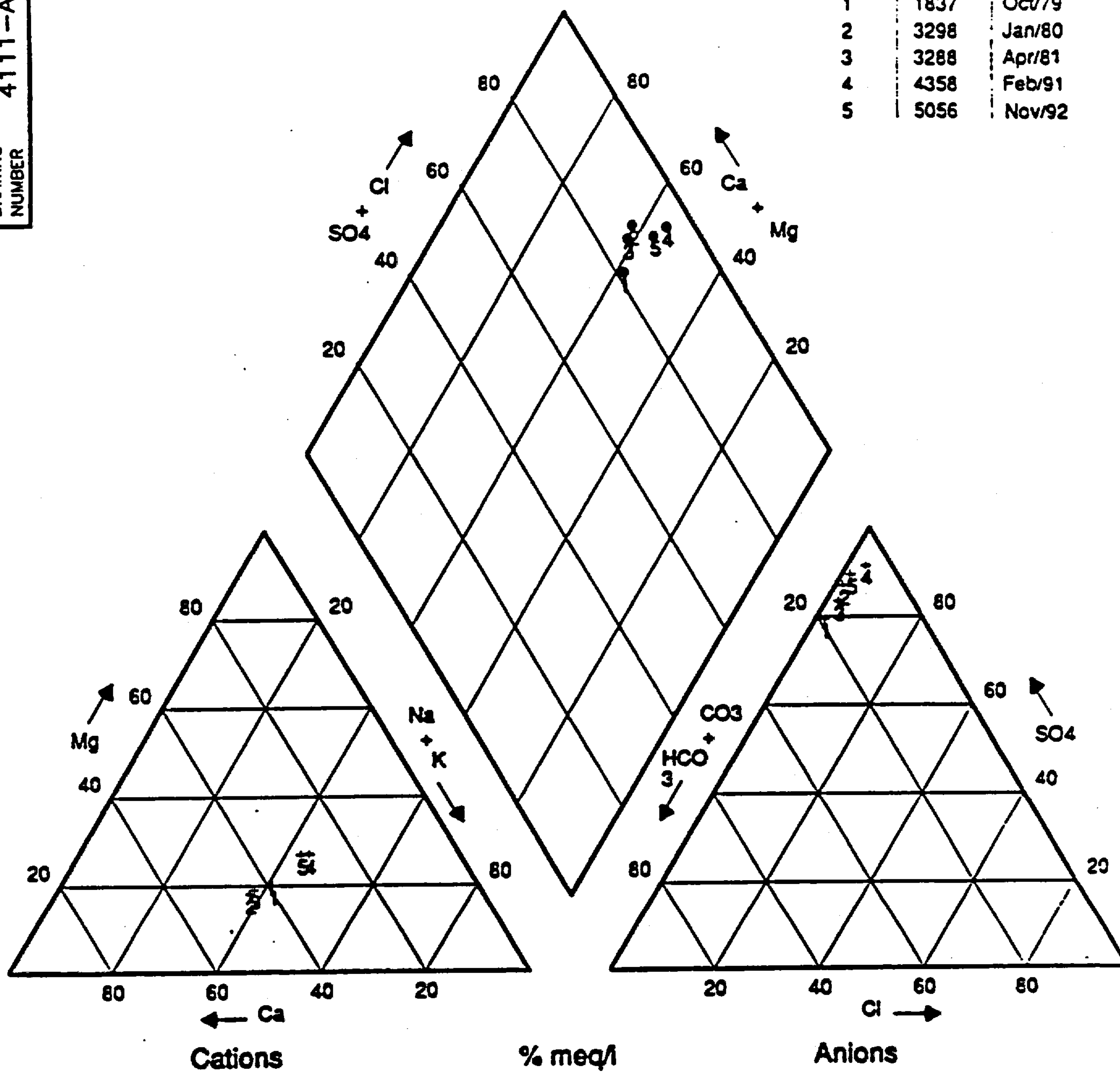
DATE: 7–19–94
SCALE: N.T.S.

FIGURE 2.11

DRAWING NUMBER 4111–A17

DRAWING NUMBER 4111-A18

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
PREPARED FOR
ENERGY FUELS NUCLEAR
DENVER, COLORADO

REFERENCE:
Umetco 1992

TITAN Environmental

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⚠		ISSUED FOR DRAFT SUBMITTAL	T.M.G.		

DATE: 7-19-94
SCALE: N.T.S.

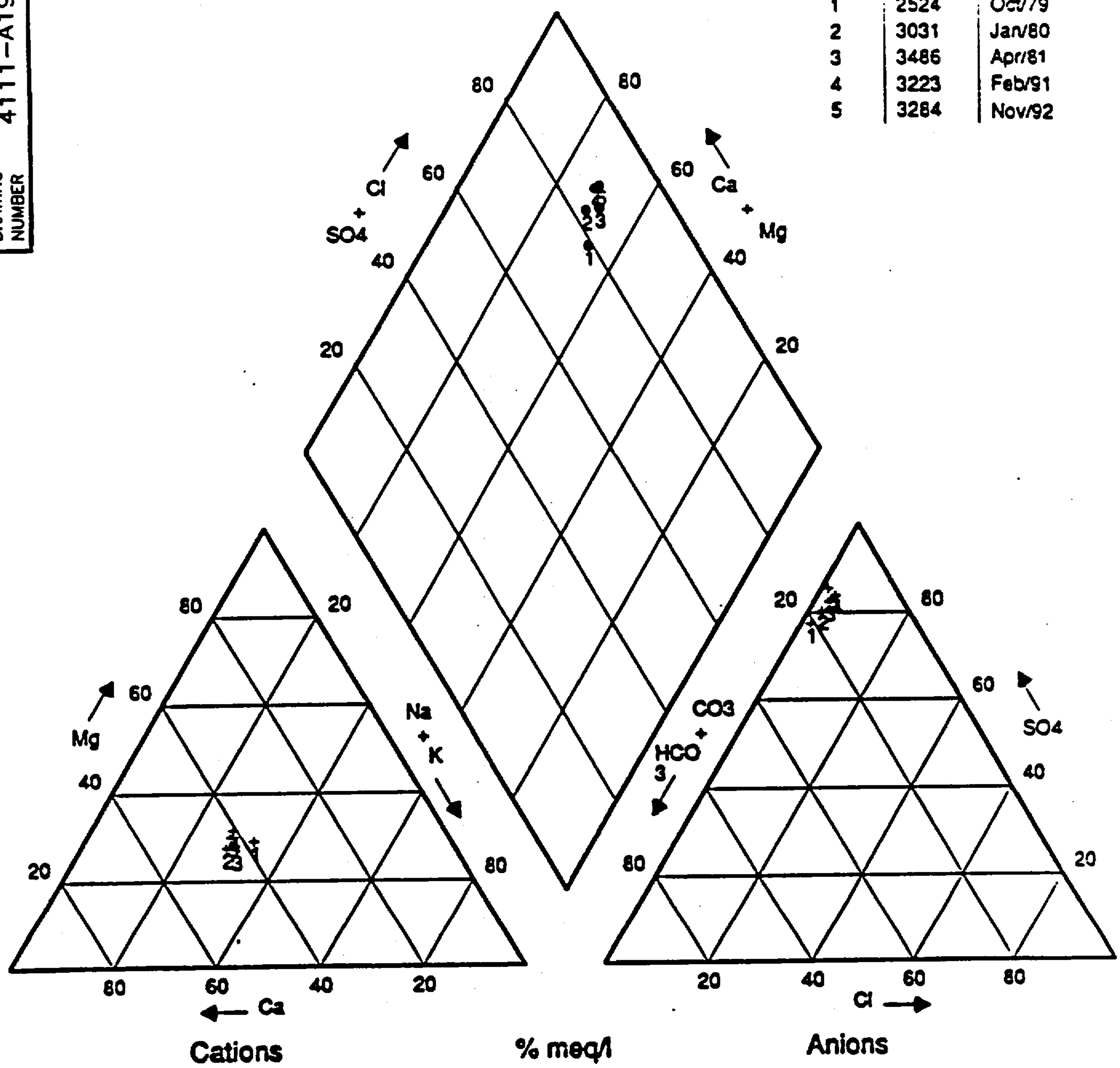
FIGURE 2.12

DRAWING NUMBER 4111-A18

⚠1

DRAWING NUMBER 4111-A19

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

1		ISSUED FOR DRAFT SUBMITTAL	T.M.G.		
No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY

TITAN Environmental

DATE: 7-19-94
SCALE: N.T.S.

FIGURE 2.13

DRAWING NUMBER 4111-A19

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.

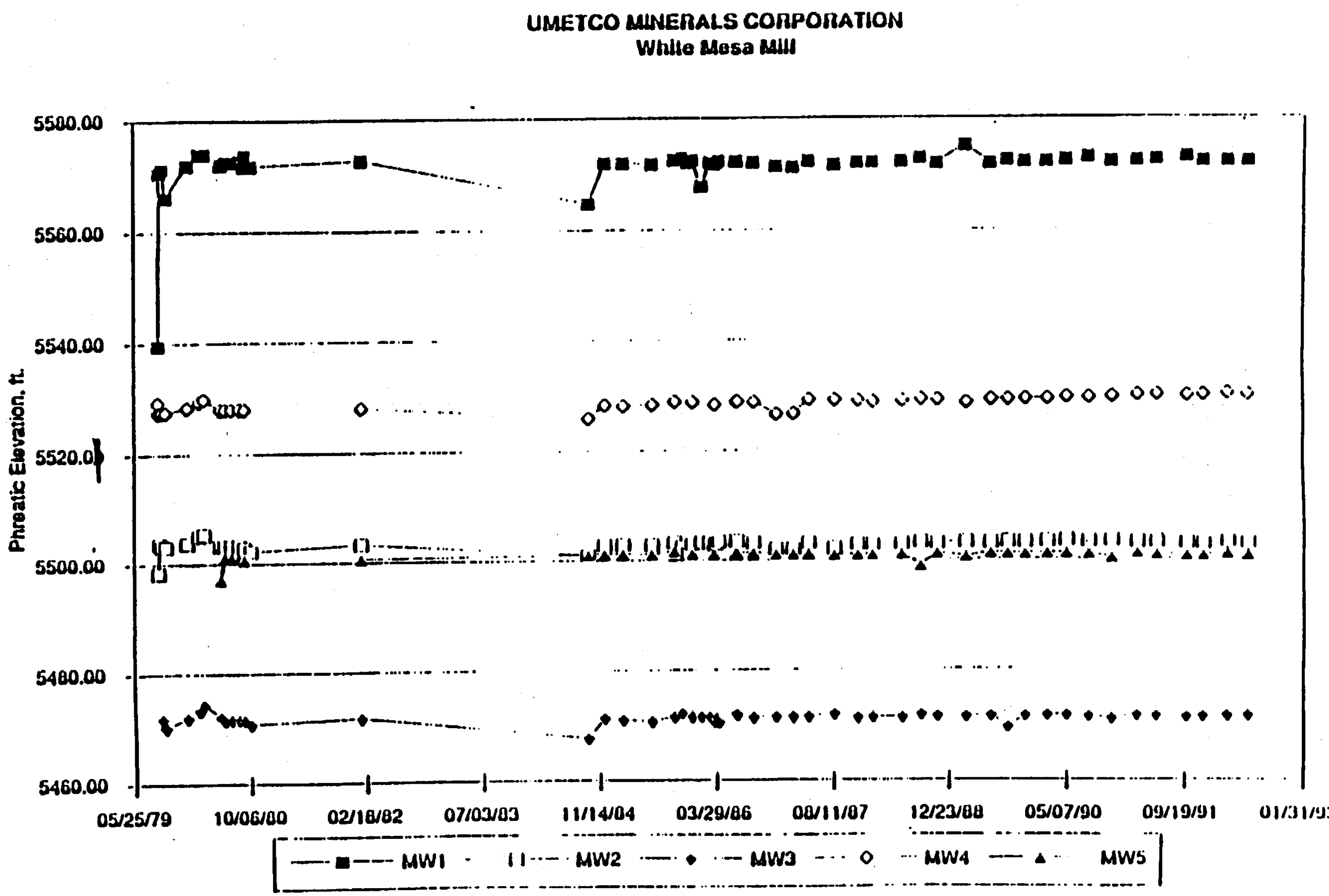
Well WMMW-3 (installed September 1979) was originally constructed to serve as the point of compliance well. Statistical testing ("t" test) on a chloride population from 1980-81 compared to a chloride population from 1990-92 shows that there is no significant difference in the two chloride populations. 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.

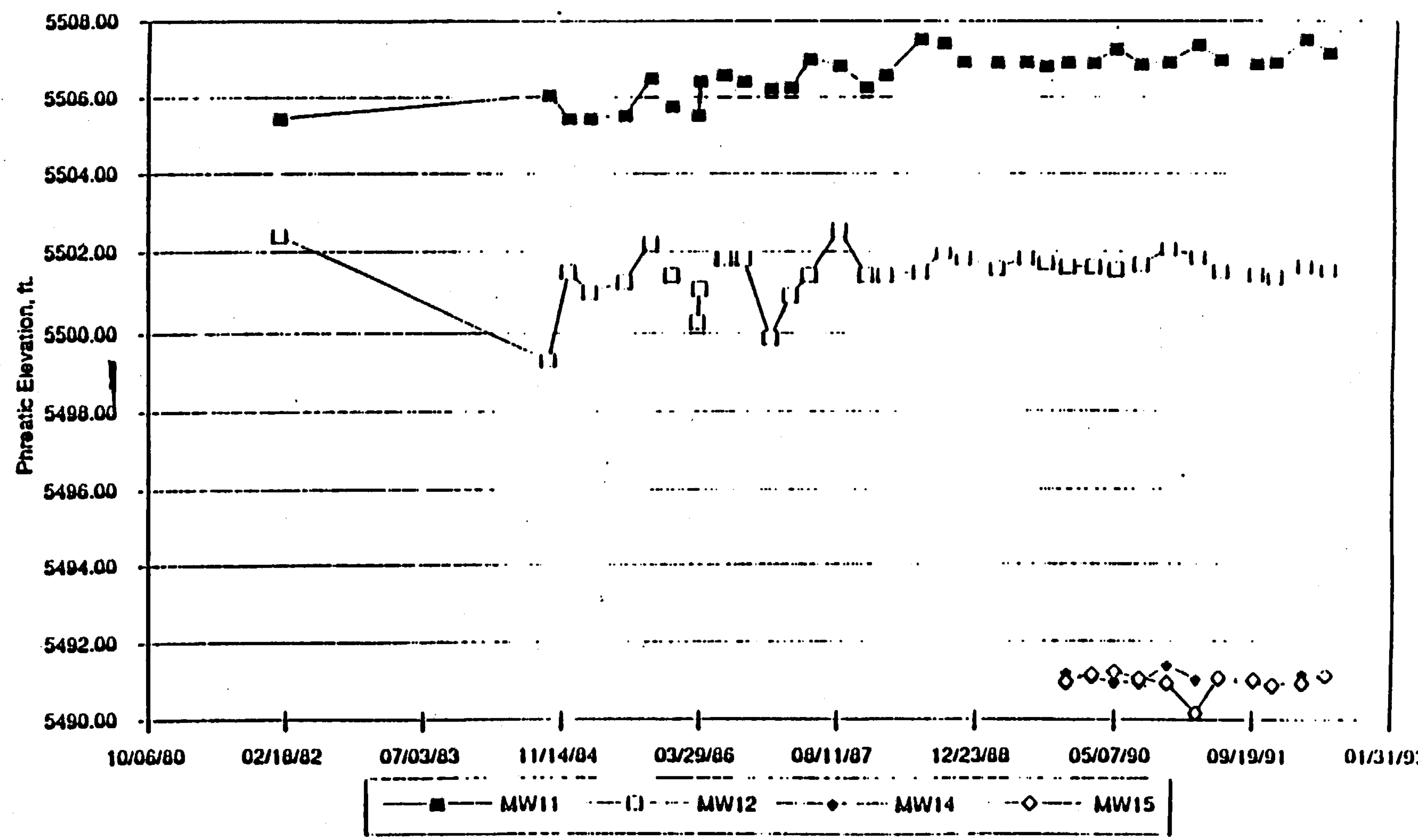
Wells WMMW-14 and 15 (installed September 1989) were installed in the south embankment of Disposal Cell No. 4A in 1989. Wells WMMW-14 and 15 have a similar water chemistry to Monitor Well WMMW-12 which was installed in 1982. A statistical "t" test chloride value indicates the mean chloride value in Well 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.

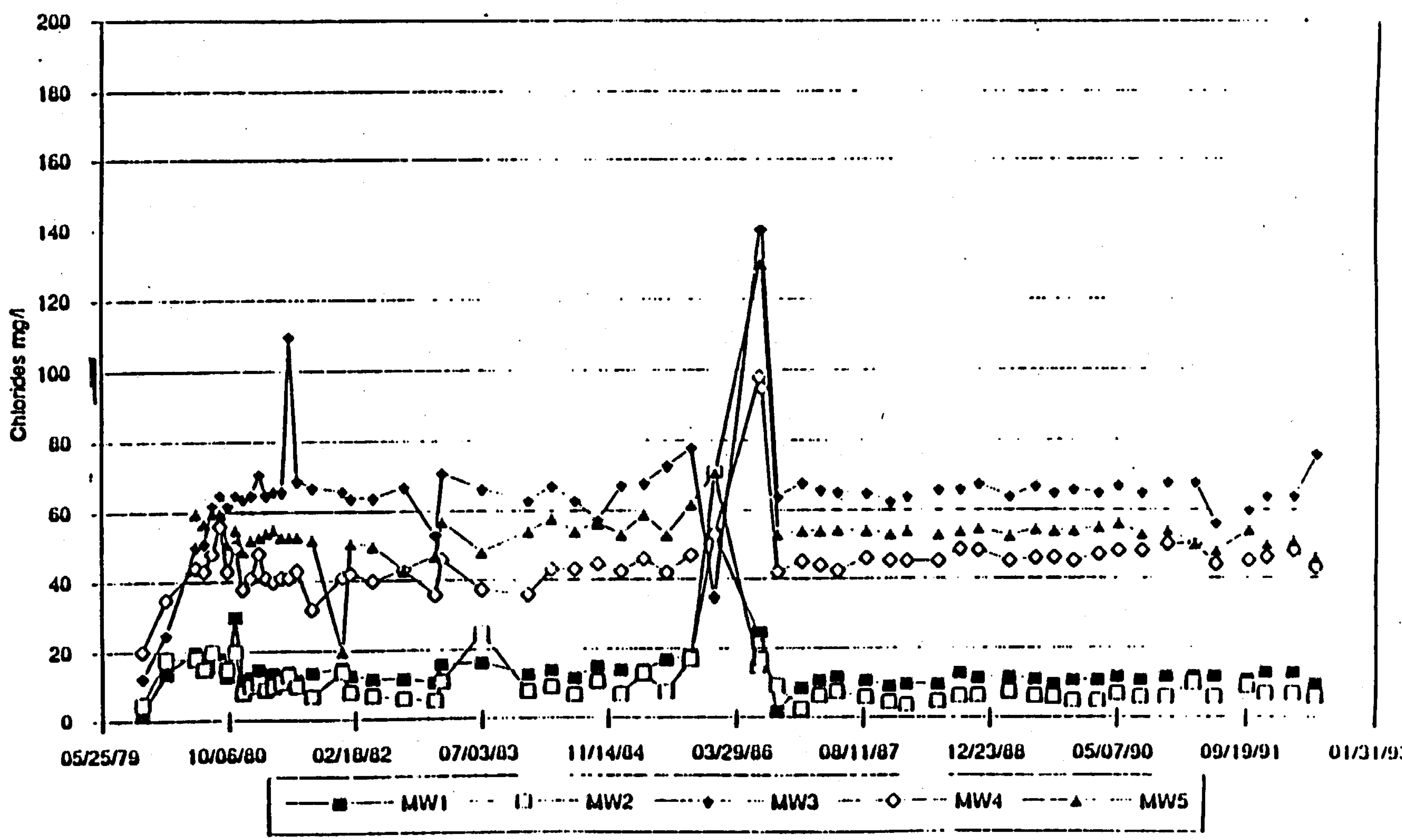


UMETCO MINERALS CORPORATION
White Mesa Mill
5580.00
5560.00
5540.00
5520.00
5500.00
5480.00
5460.00
Phreatic Elevation, ft.
05/25/79
10/06/80
02/18/82
07/03/83
11/14/84
03/29/86
08/11/87
12/23/88
05/07/90
09/19/91
01/31/93
MW1
MW2
MW3
MW4
MW5

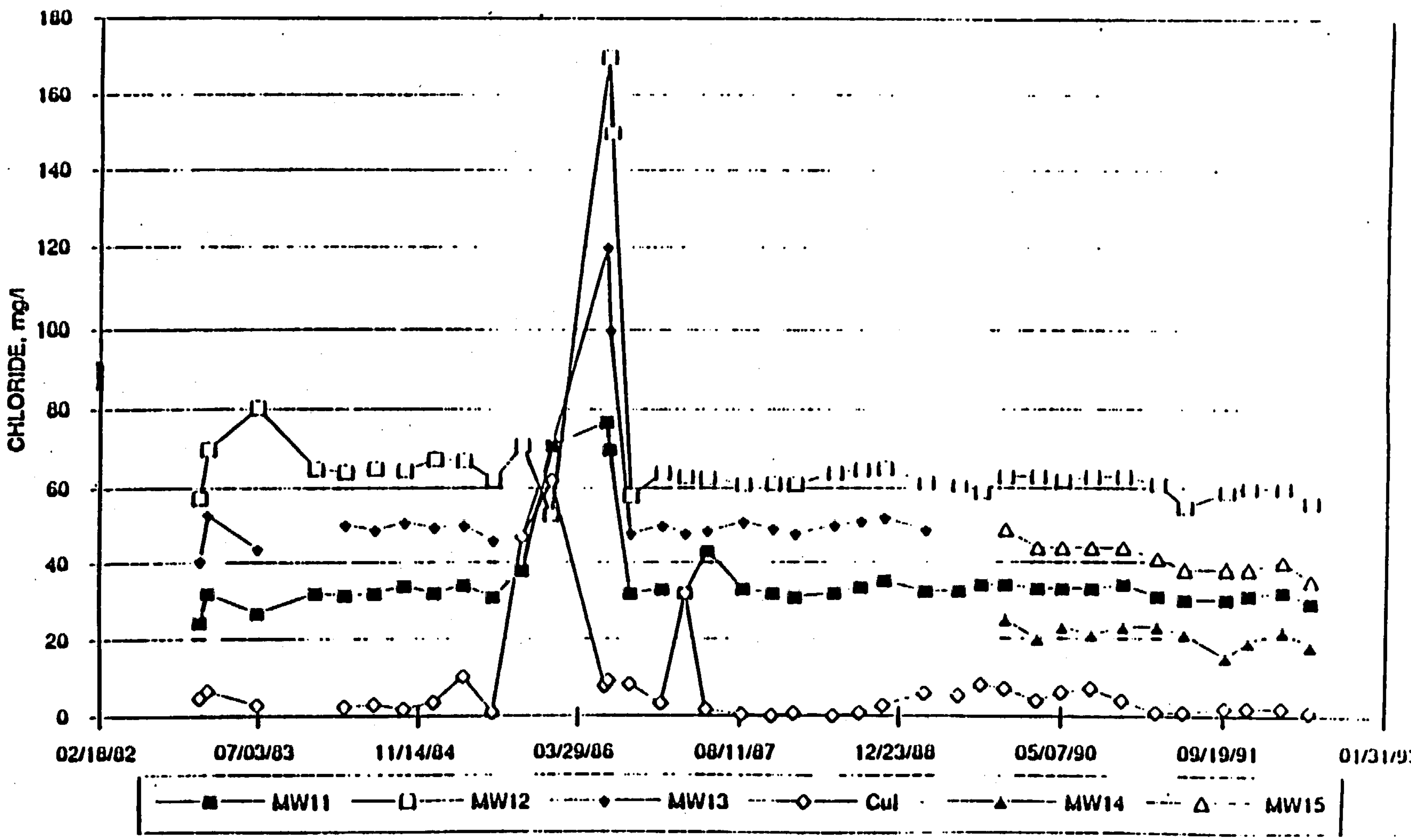
UMETCO MINERALS CORPORATION
WHITE MESA MILL



UMETCO MINERALS CORPORATION
White Mesa Mill



UMETCO MINERALS CORPORATION
Wite Mesa Mill



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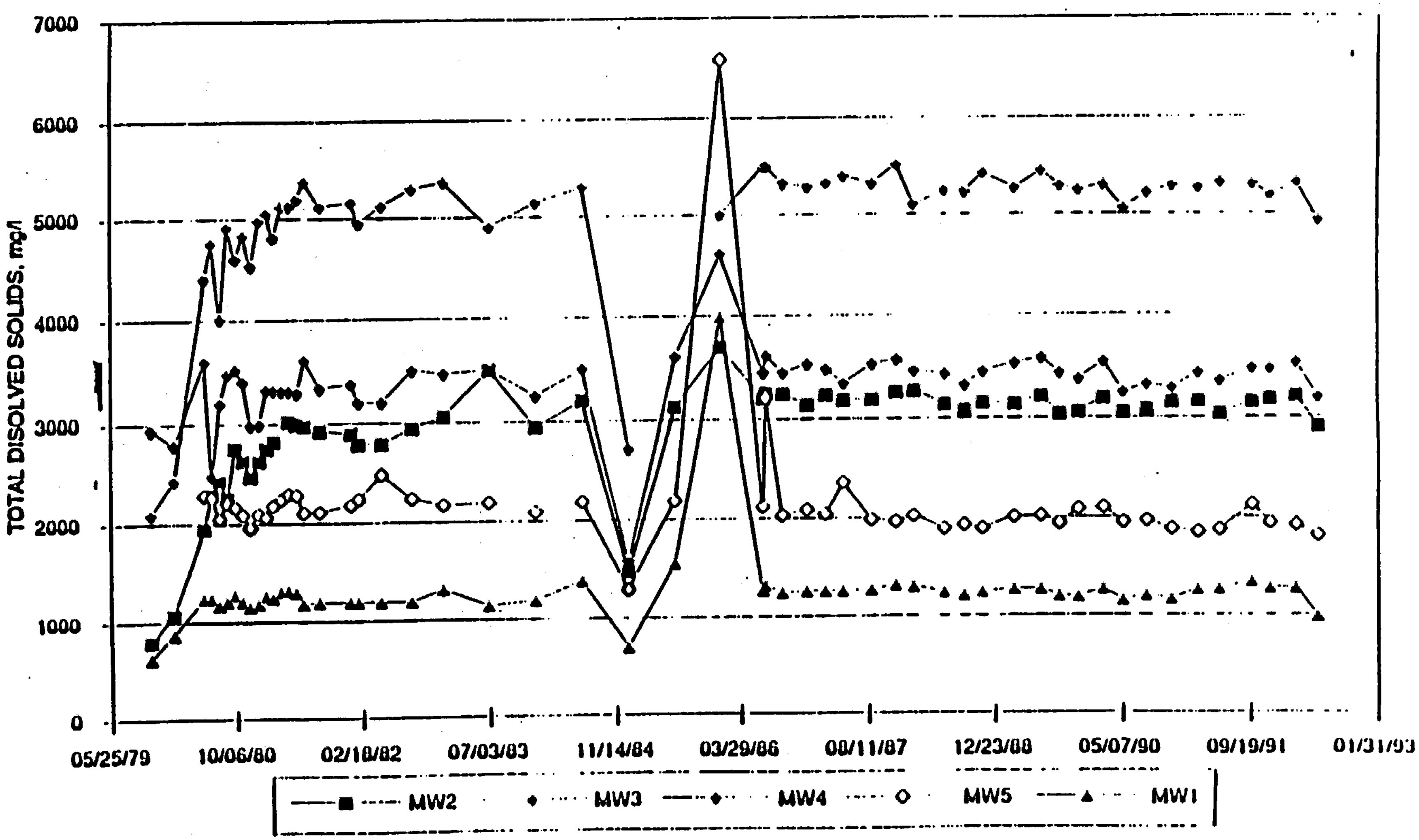
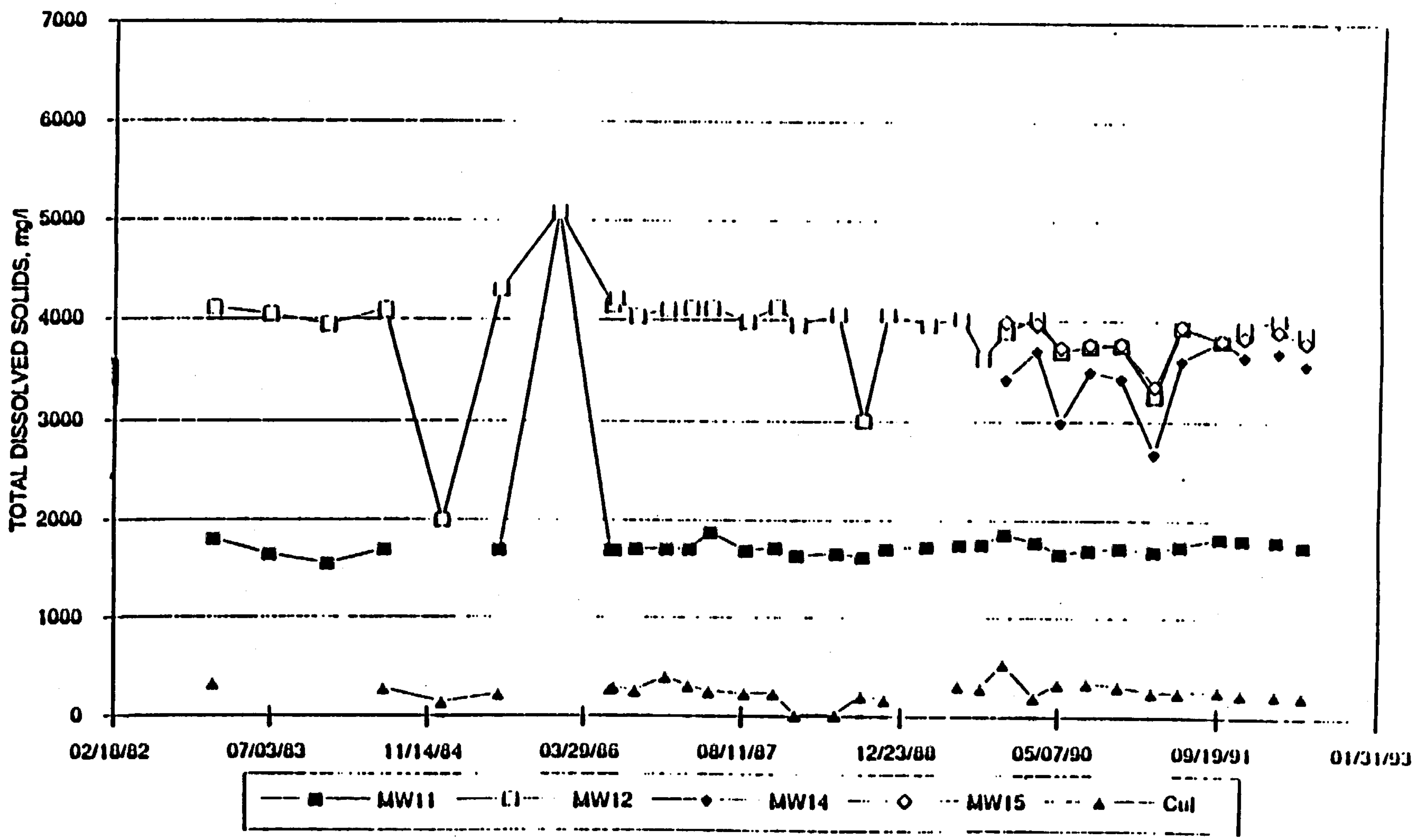
WHITE MESA MILL



UMETCO MINERALS CORPORATION
WHITE MESA MILL



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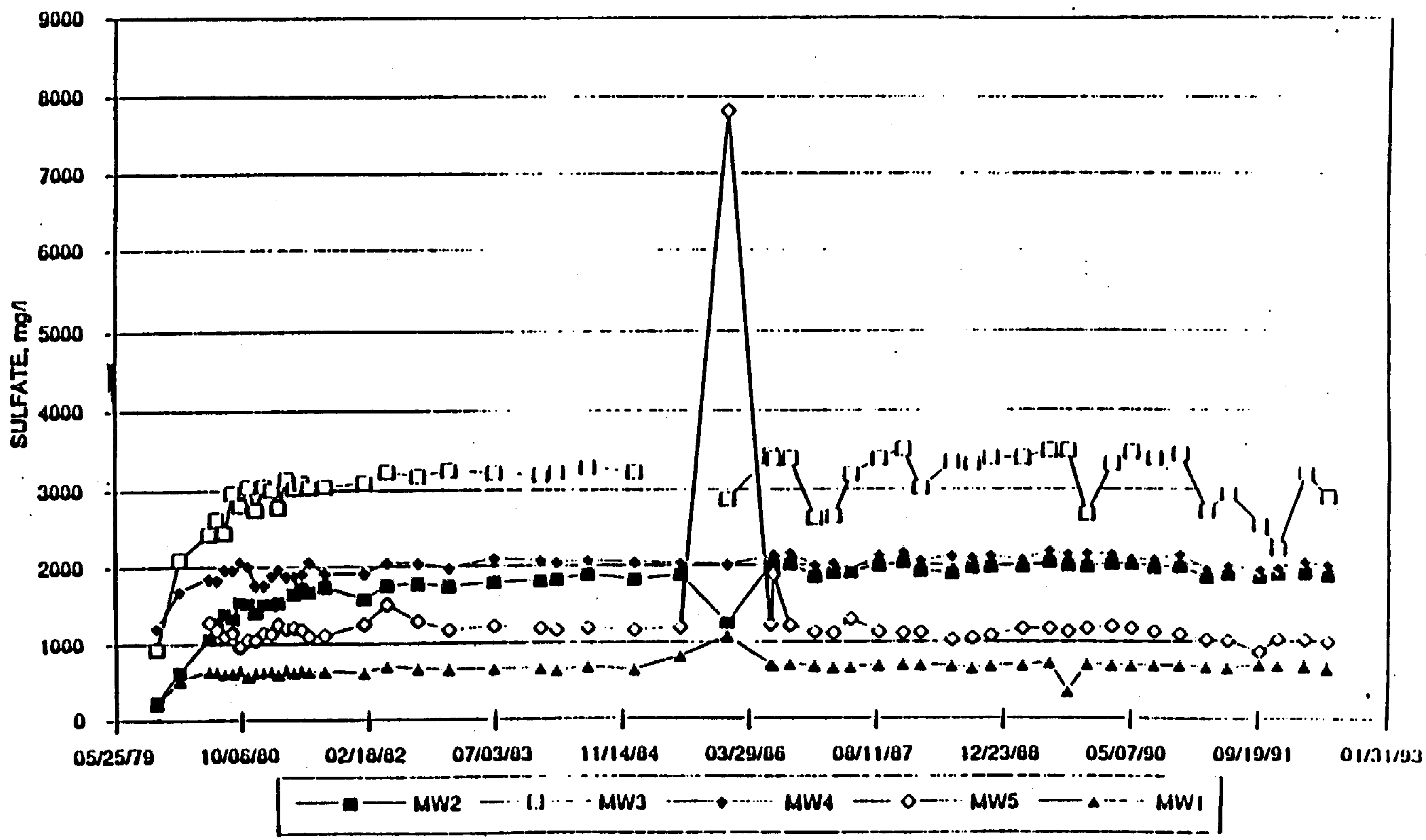
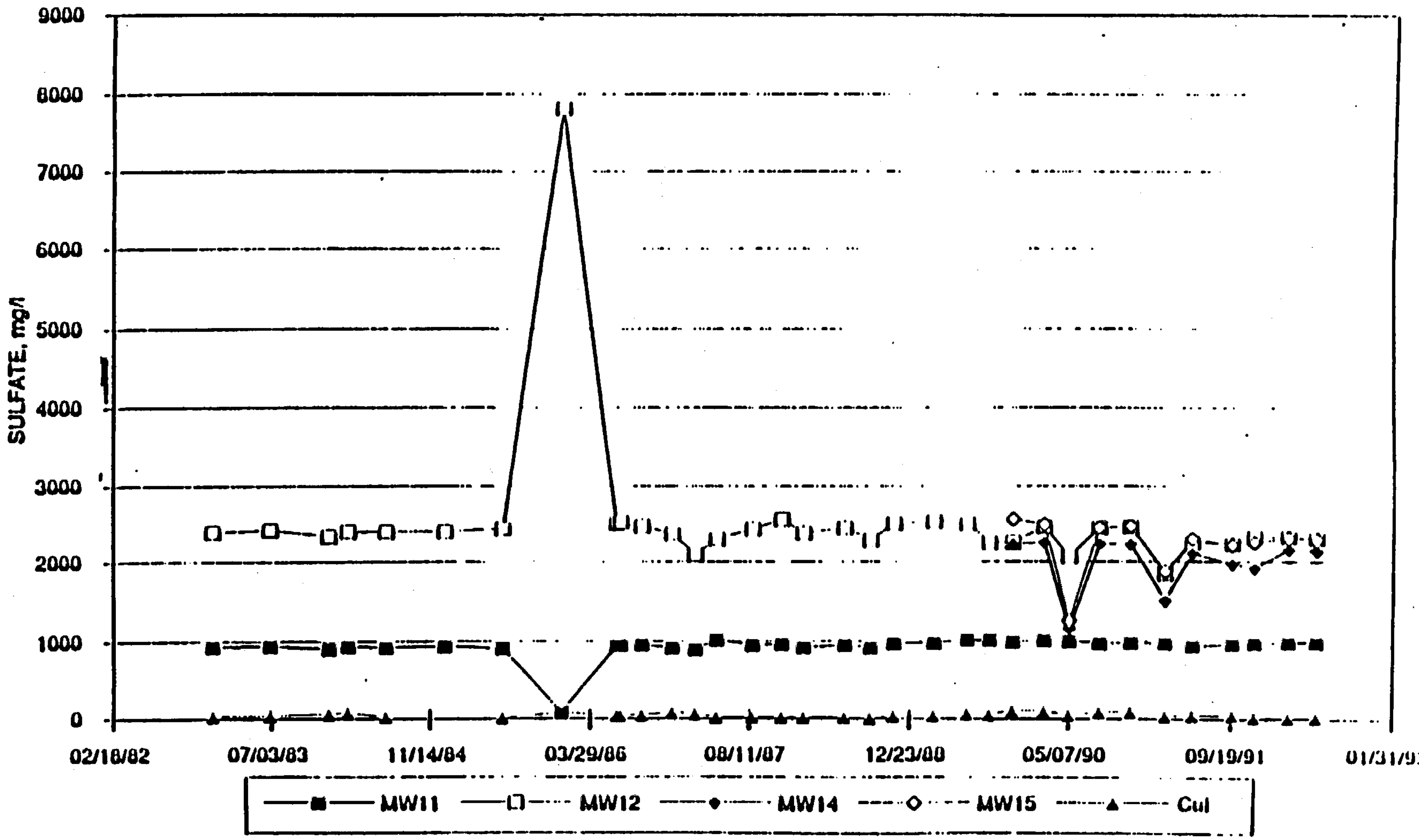
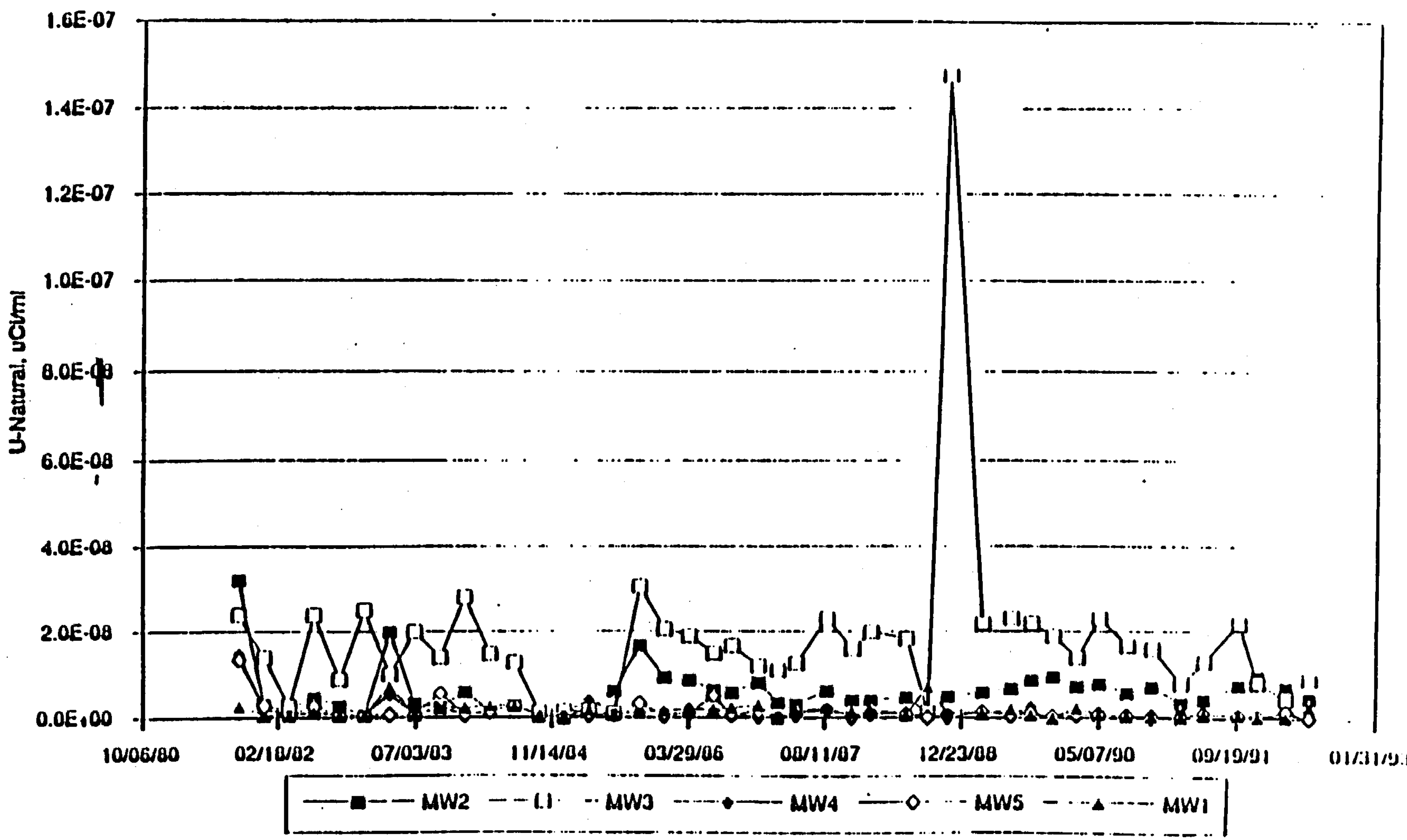
WHITE MESA MILL



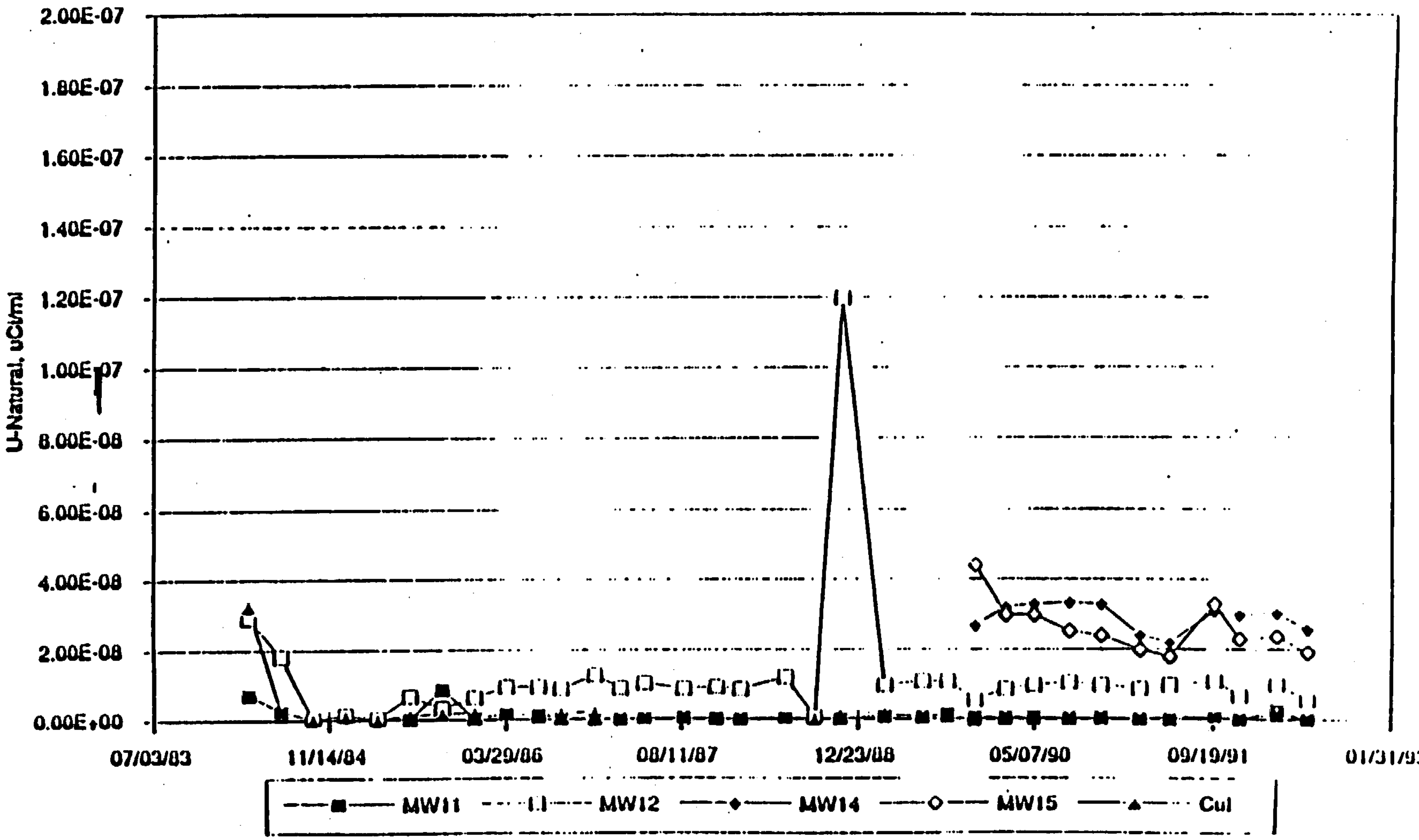
UMETCO MINERALS CORPORATION
WHITE MESA MILL

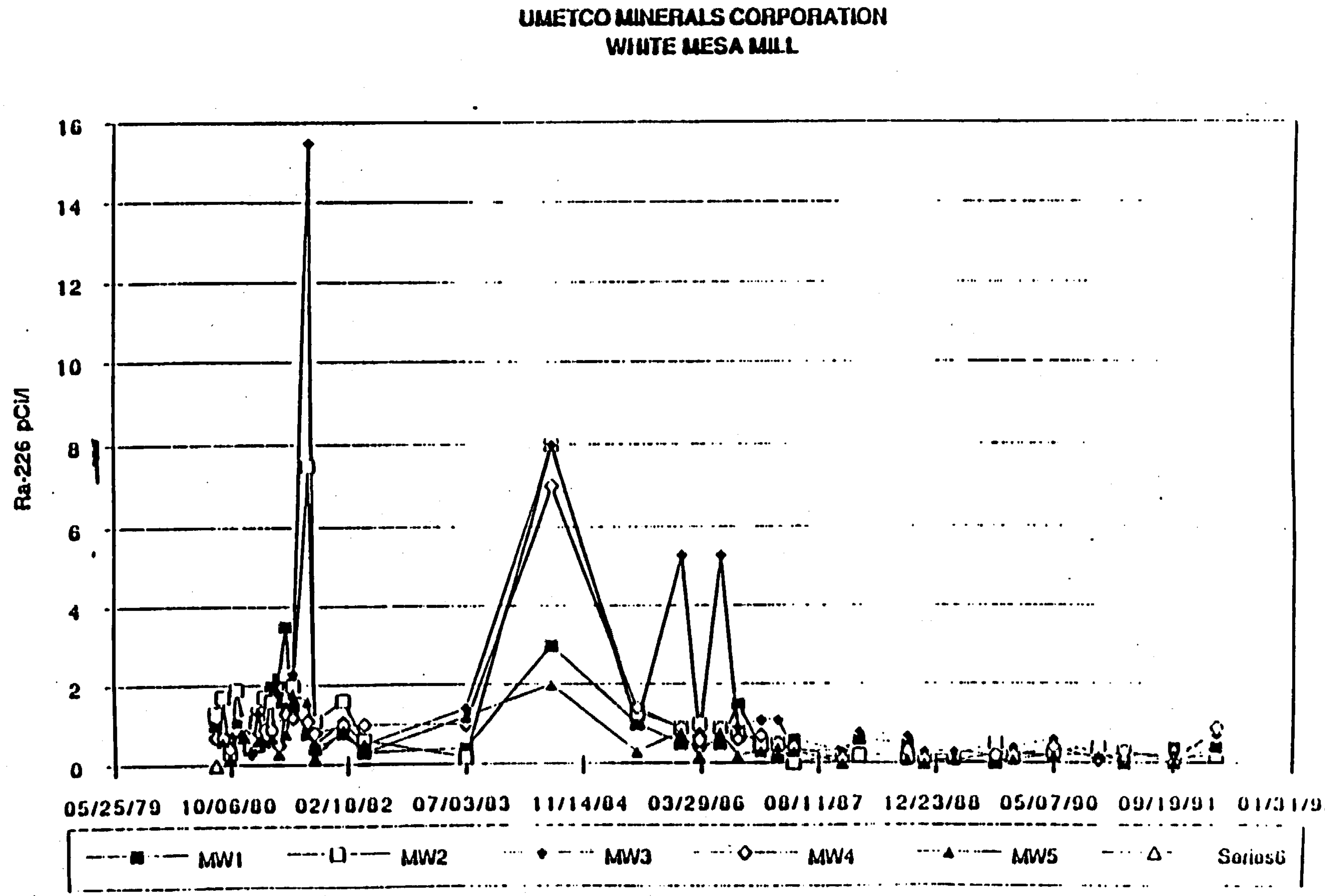


UMETCO MINERALS CORPORATION
WHITE MESA MILL



UMETCO MINERALS CORPORATION
WHITE MESA MILL




UMETCO MINERALS CORPORATION
WHITE MESA MILL
Ra-226 pCi/l
16
14
12
10
8
6
4
2
0
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
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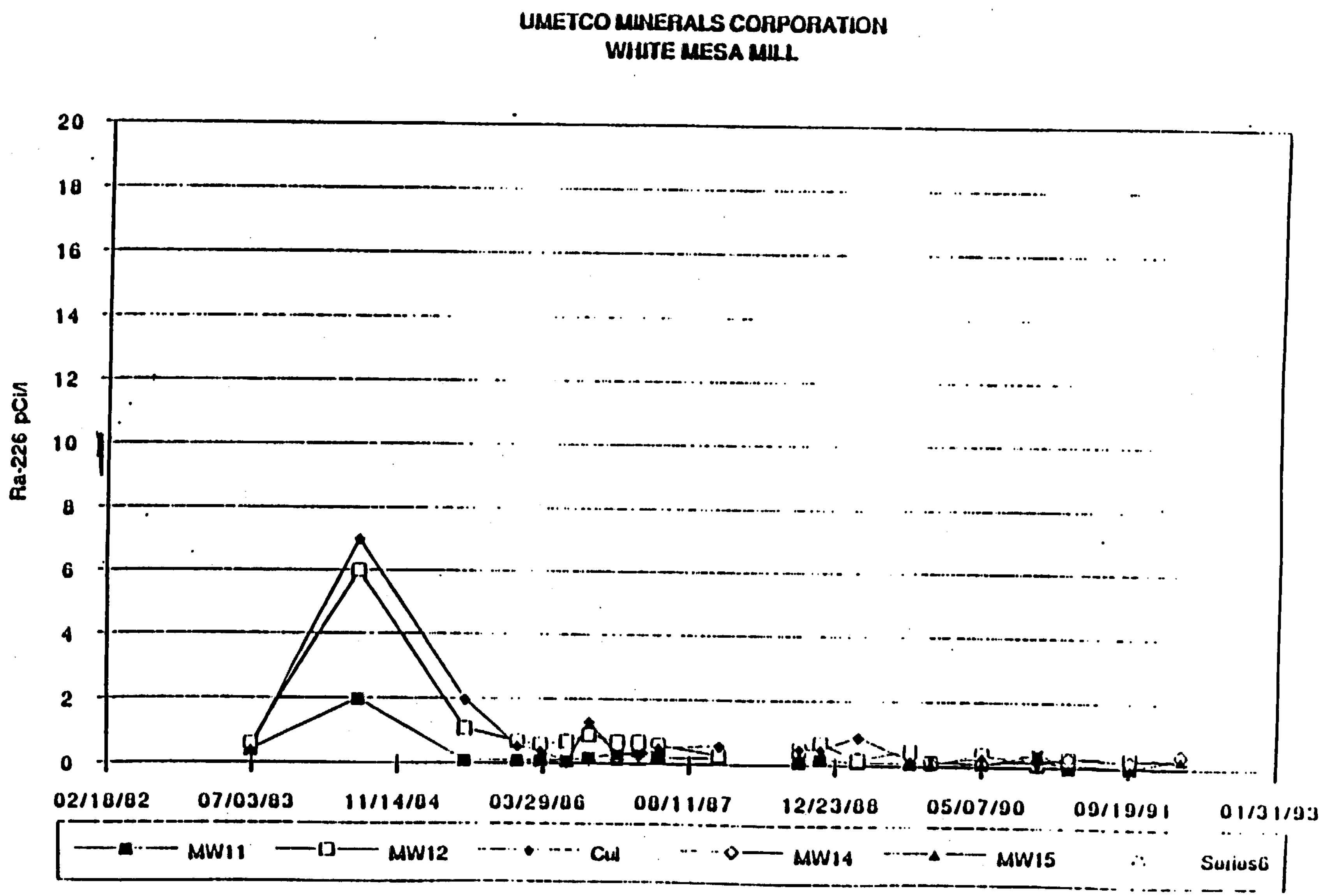
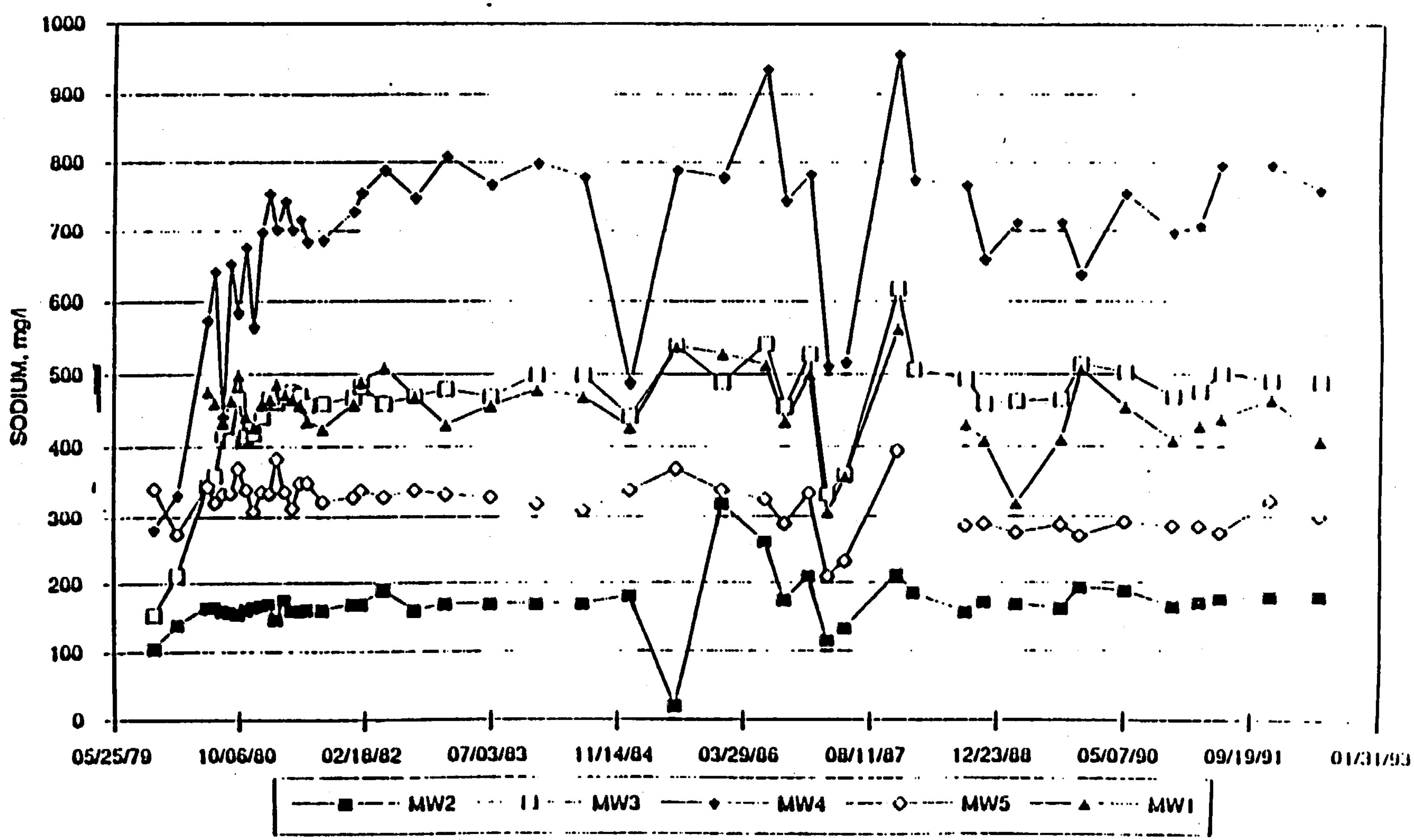
MW2
MW3
MW4
MW5
Series6

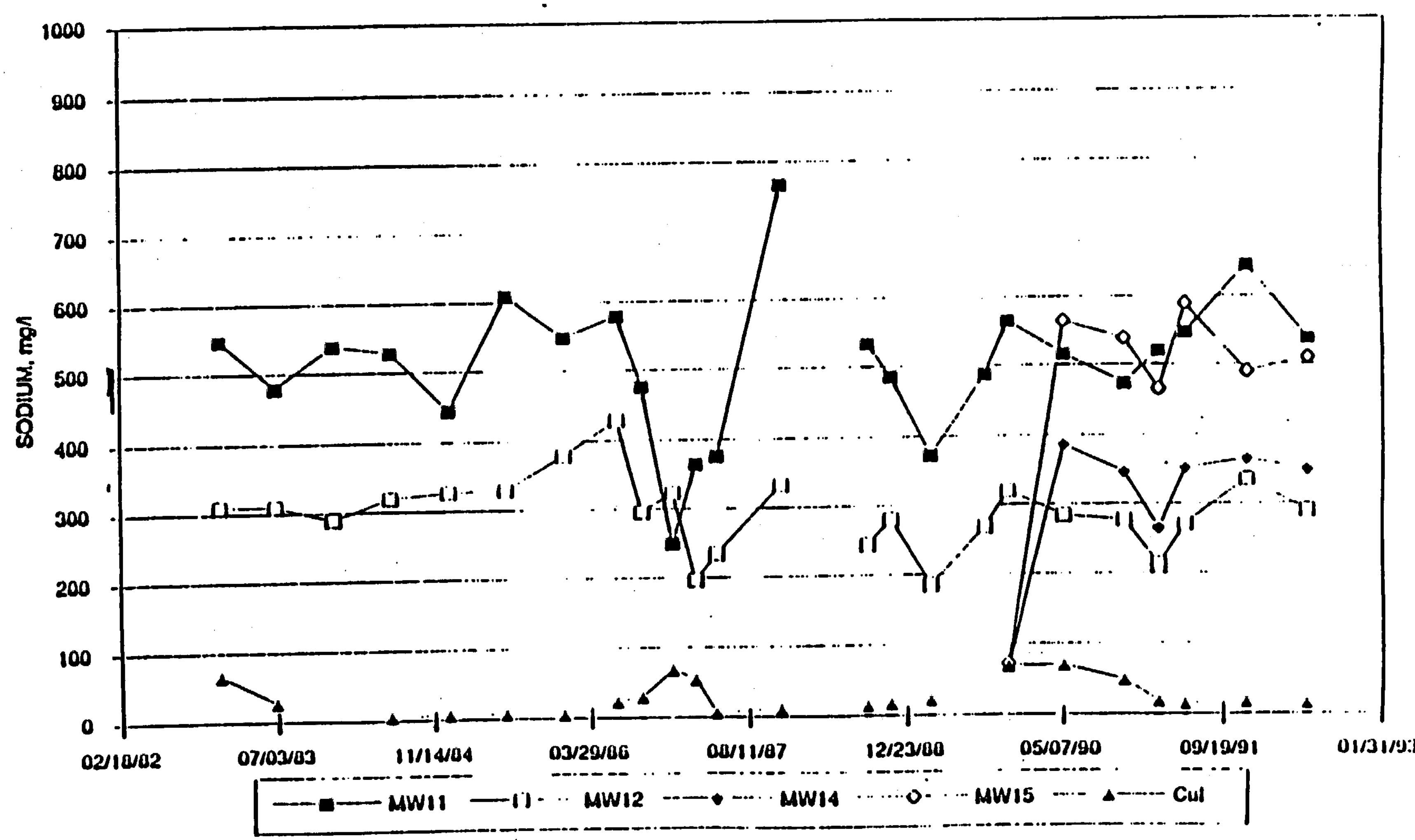


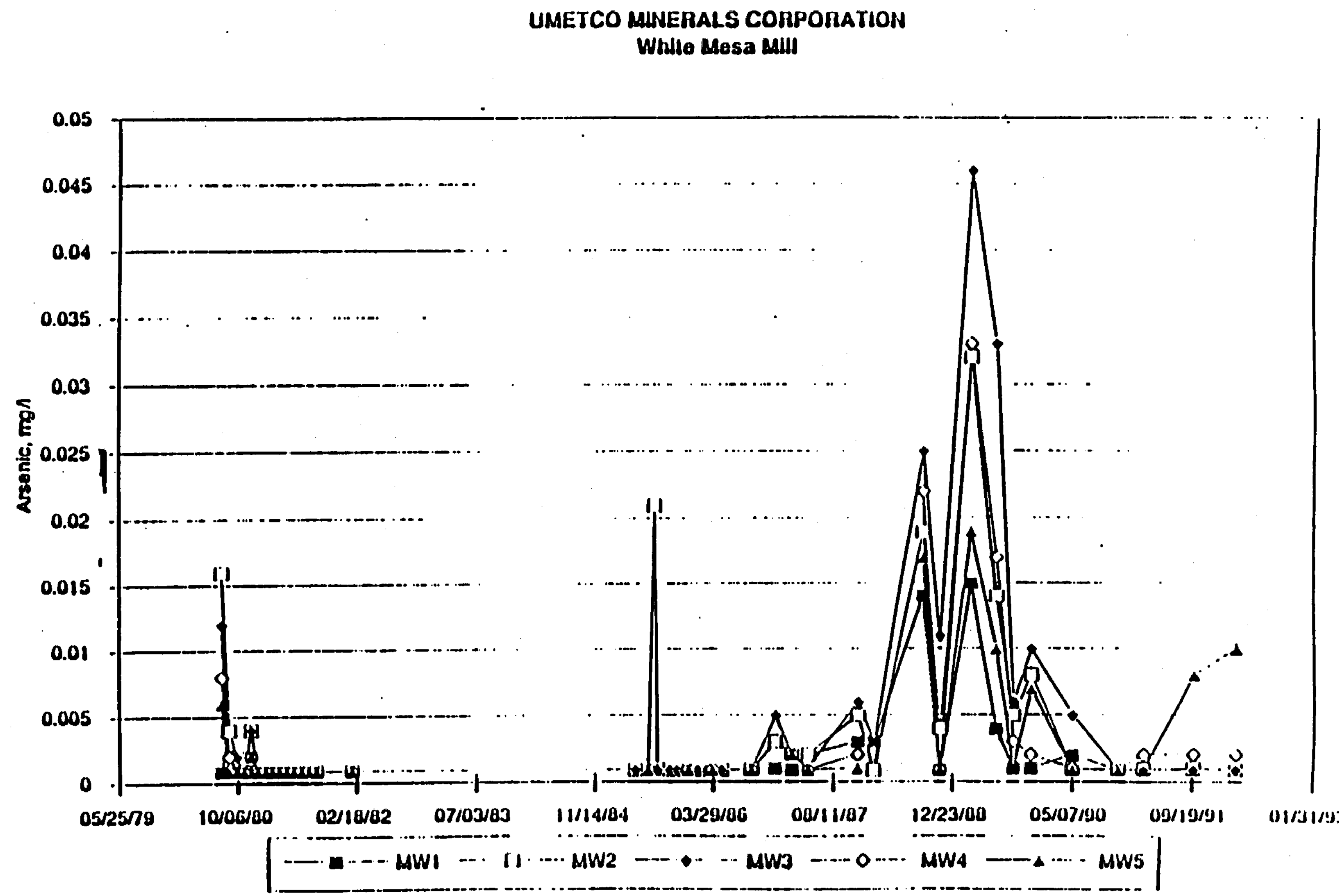
UMETCO MINERALS CORPORATION
WHITE MESA MILL
Ra-226 pCi/l
20
18
16
14
12
10
8
6
4
2
0
02/18/82
07/03/83
11/14/84
03/29/86
08/11/87
12/23/88
05/07/90
09/19/91
01/31/93
MW11
MW12
Cul
MW14
MW15
Series6

UMETCO MINERALS CORPORATION
WHITE MESA MILL



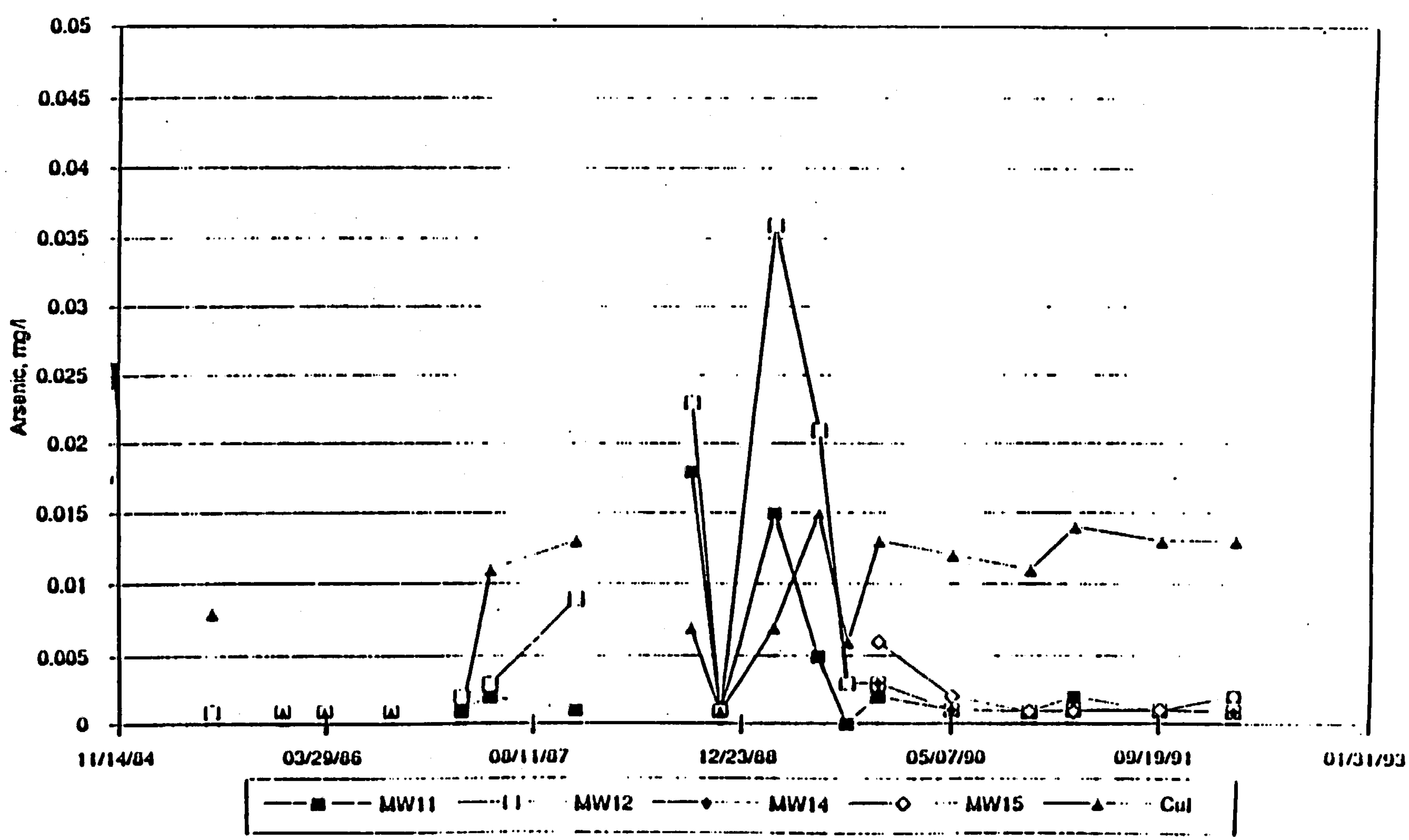
UMETCO MINERALS CORPORATION
WHITE MESA MILL



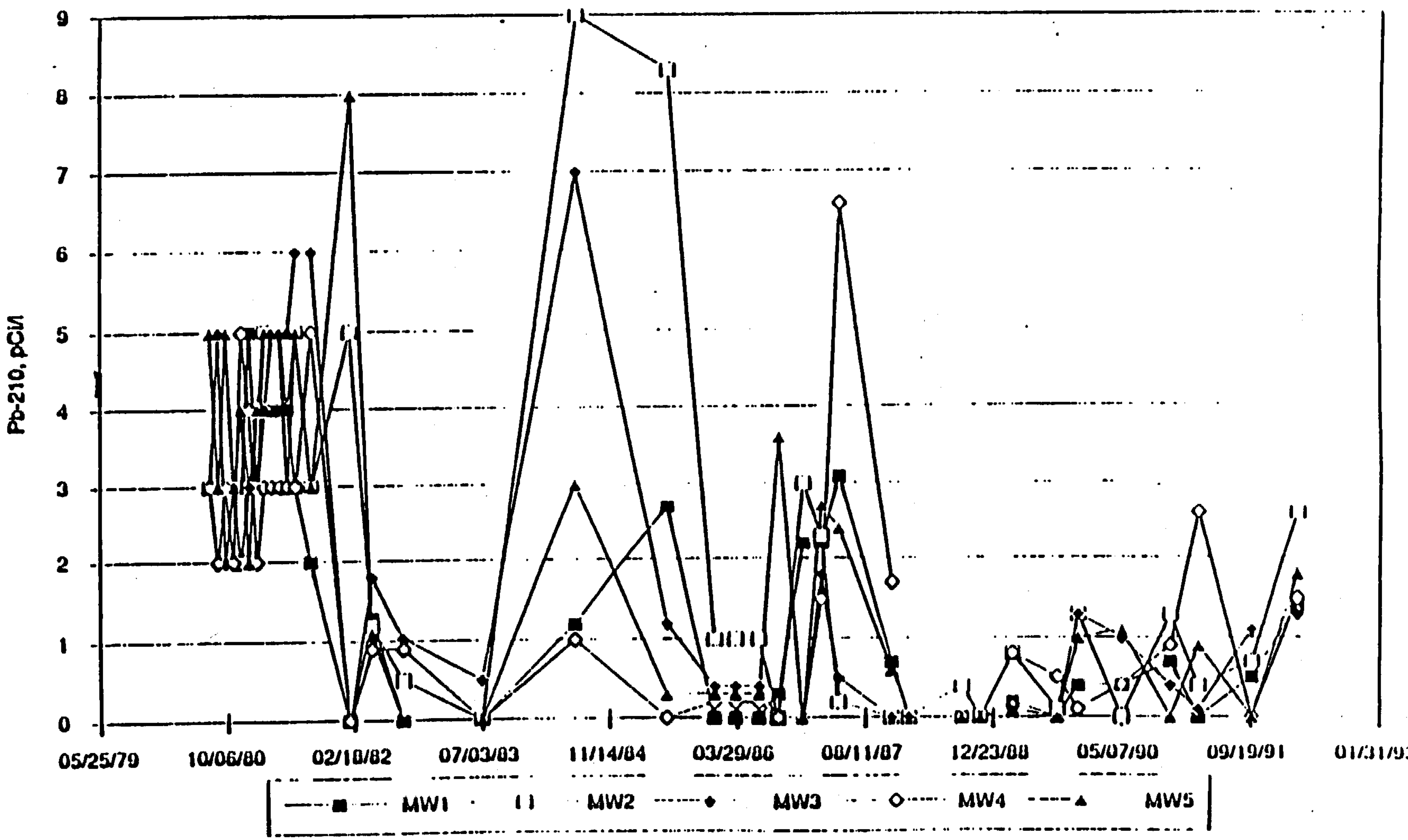


UMETCO MINERALS CORPORATION
White Mesa Mill
Arsenic, mg/l
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
05/25/79
10/06/80
02/18/82
07/03/83
11/14/84
03/29/86
08/11/87
12/23/88
05/07/90
09/19/91
MW1
MW2
MW3
MW4
MW5

UMETCO MINERALS CORPORATION
White Mesa Mill



UMETCO MINERALS CORPORATION
WHITE MESA MILL



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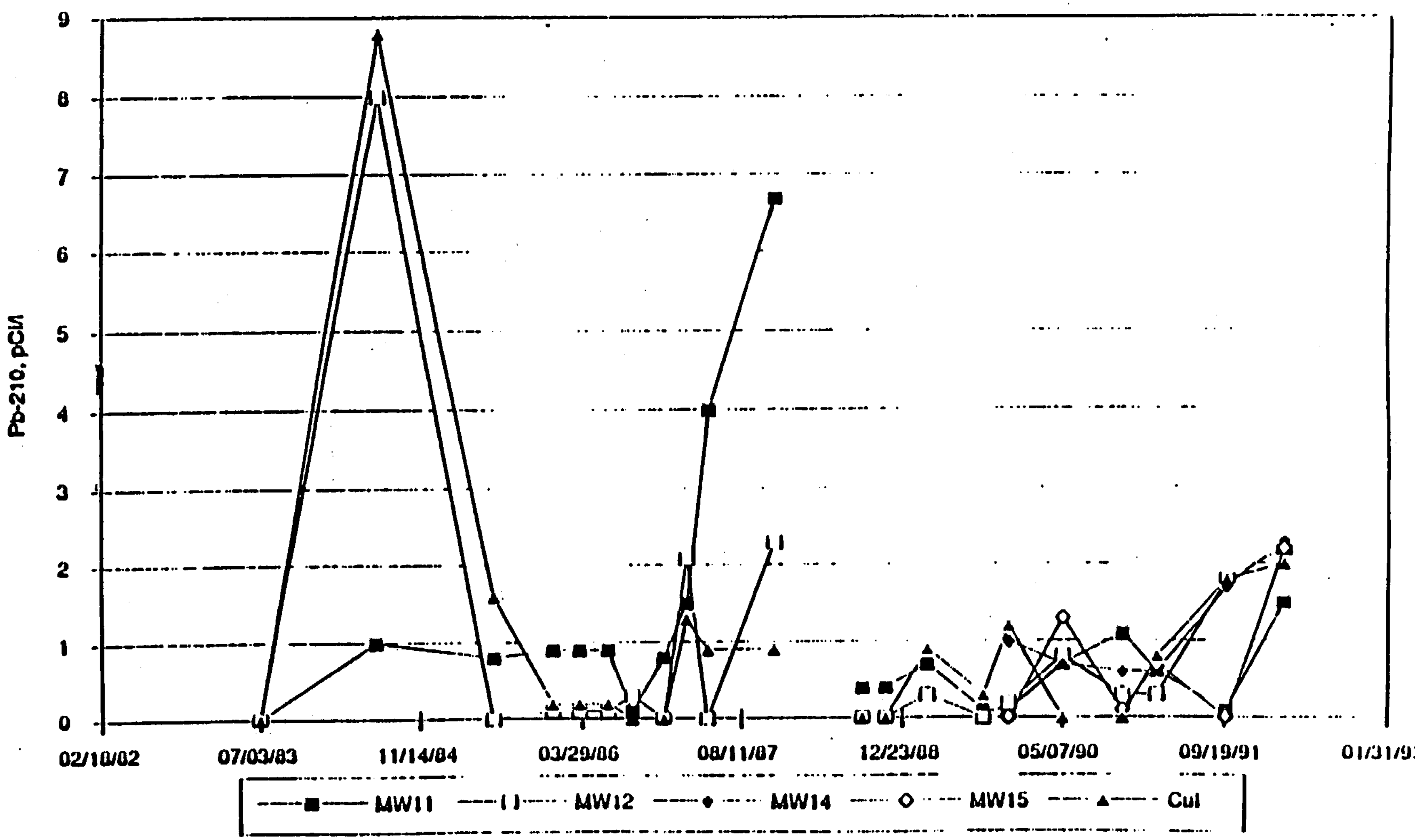
WHITE MESA MILL



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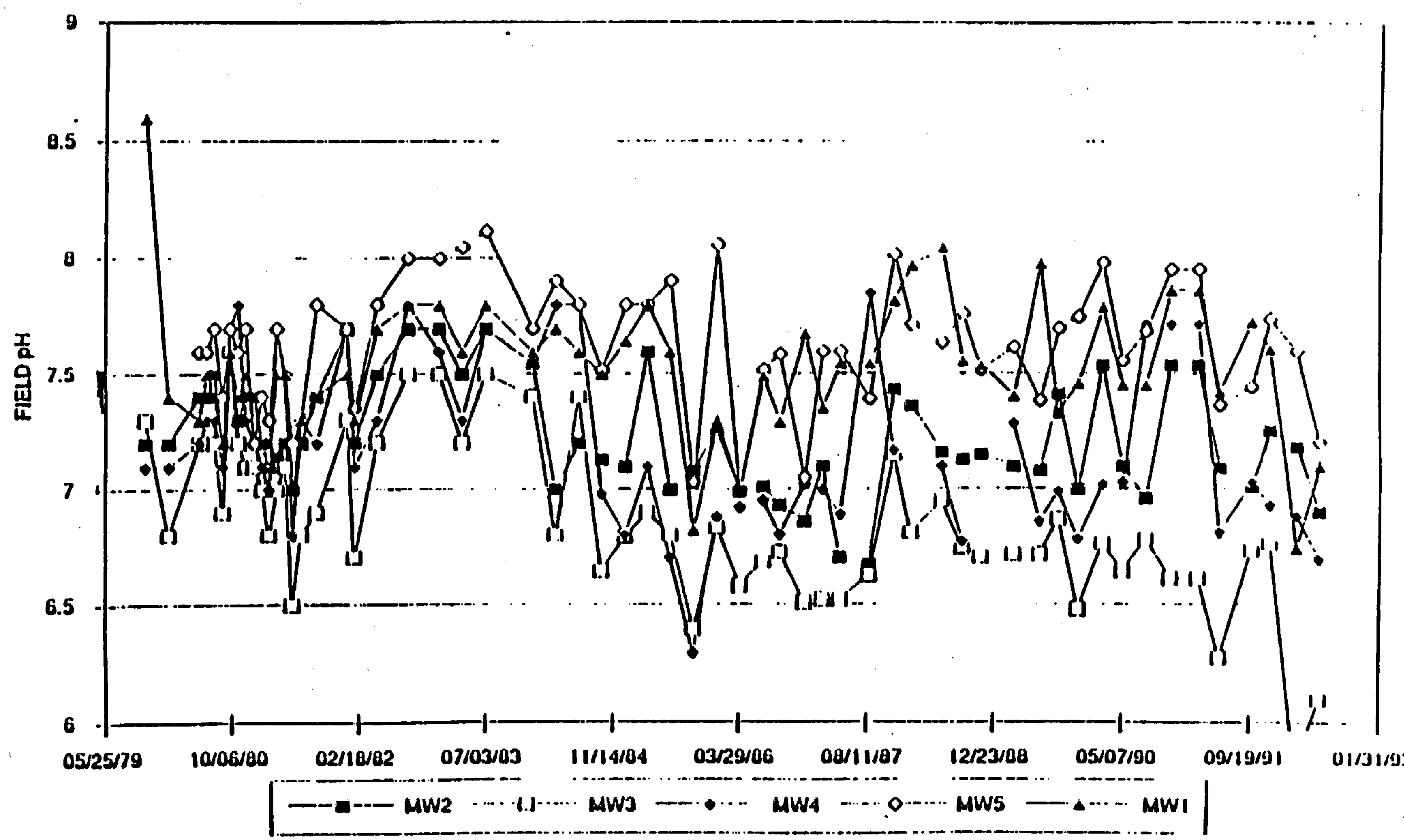

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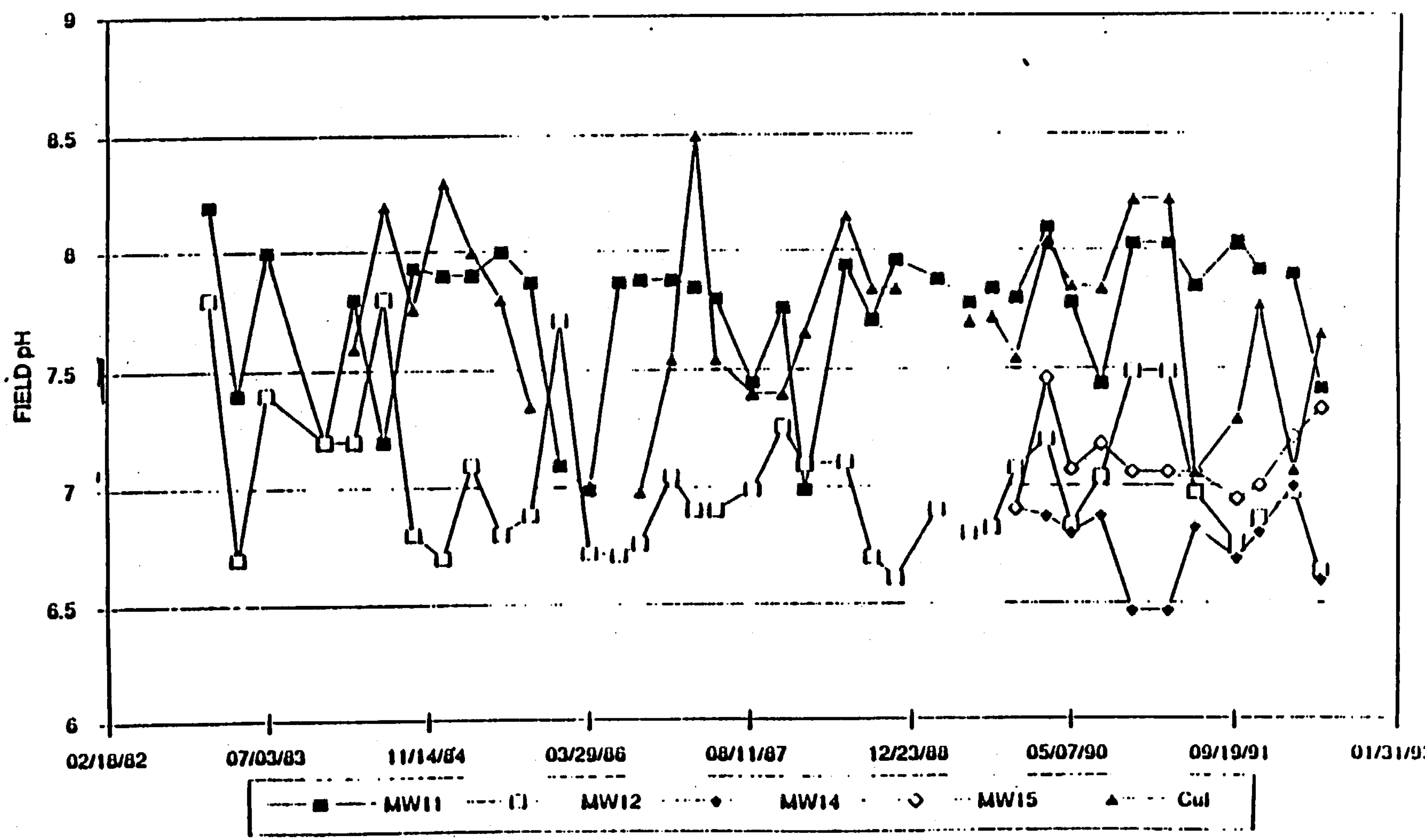

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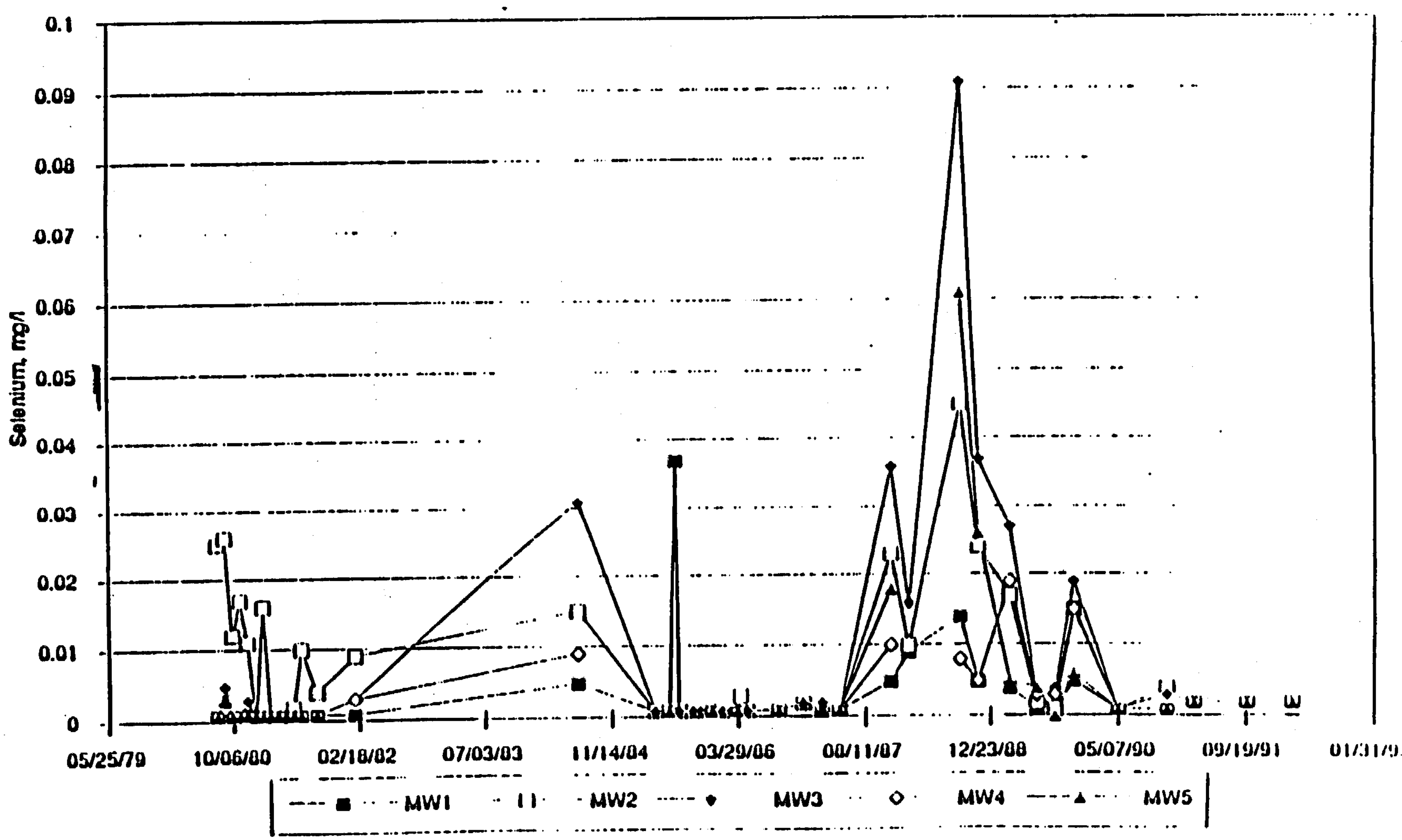
WHITE MESA MILL



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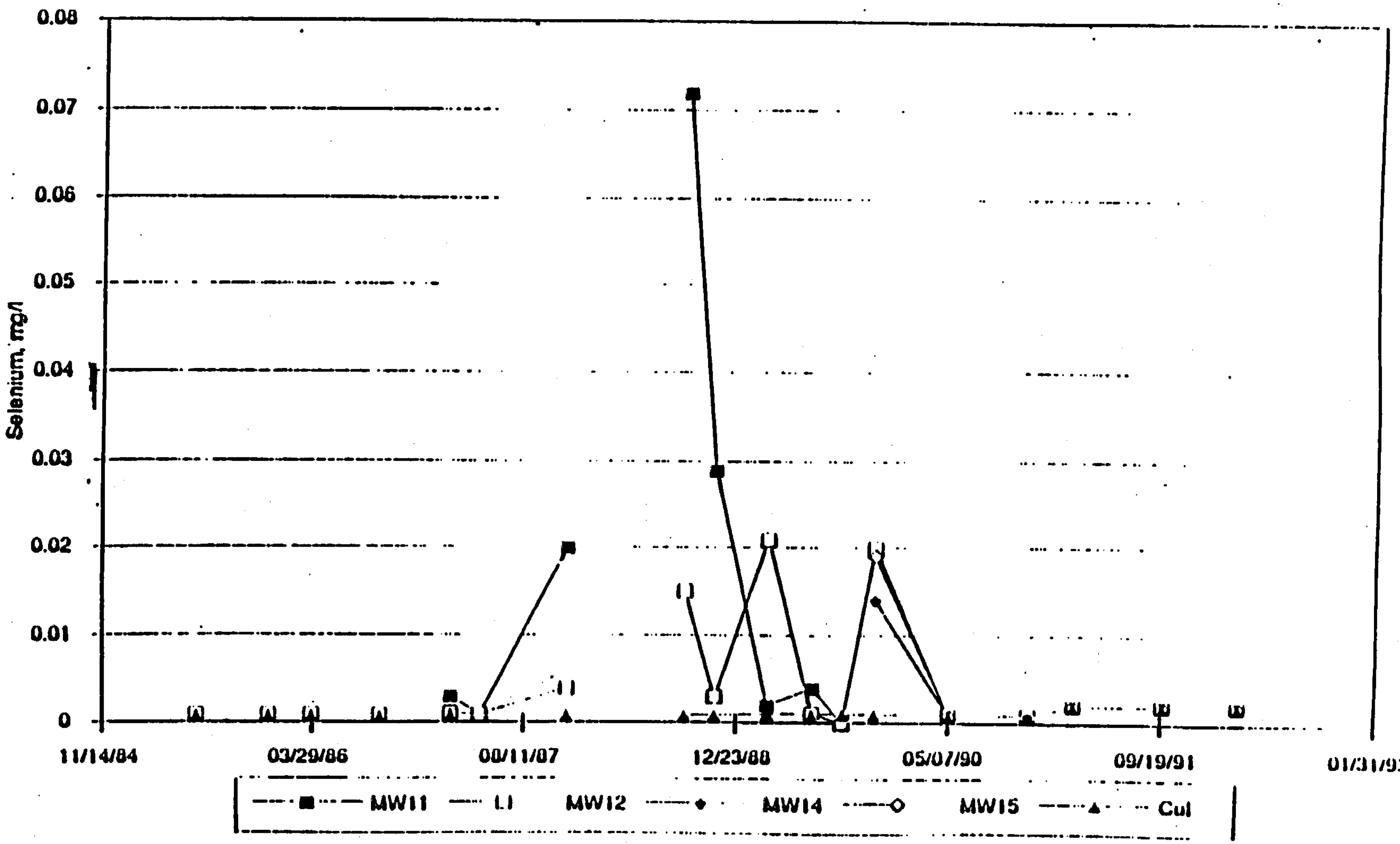
WHITE MESA MILL



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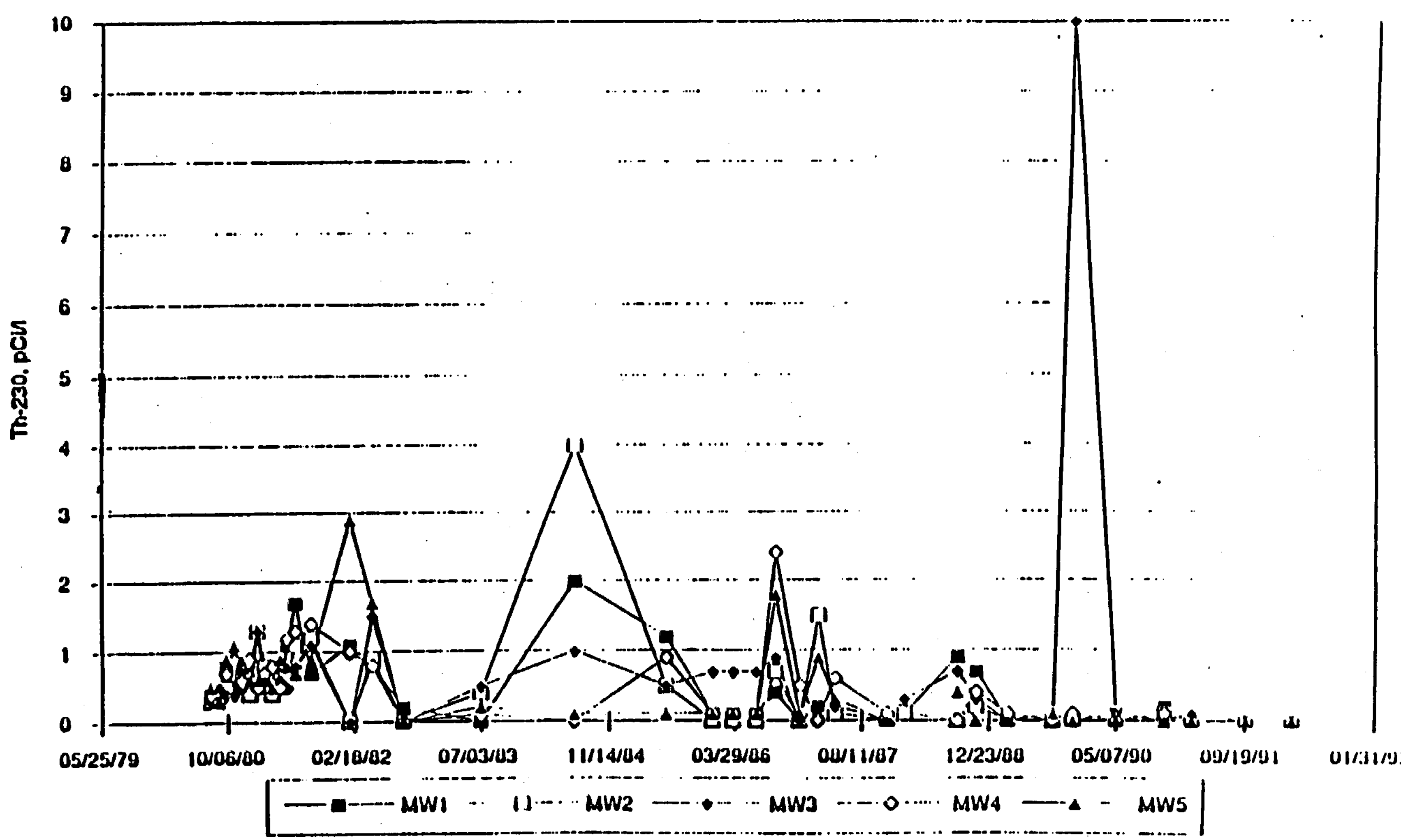
WHITE MESA MILL



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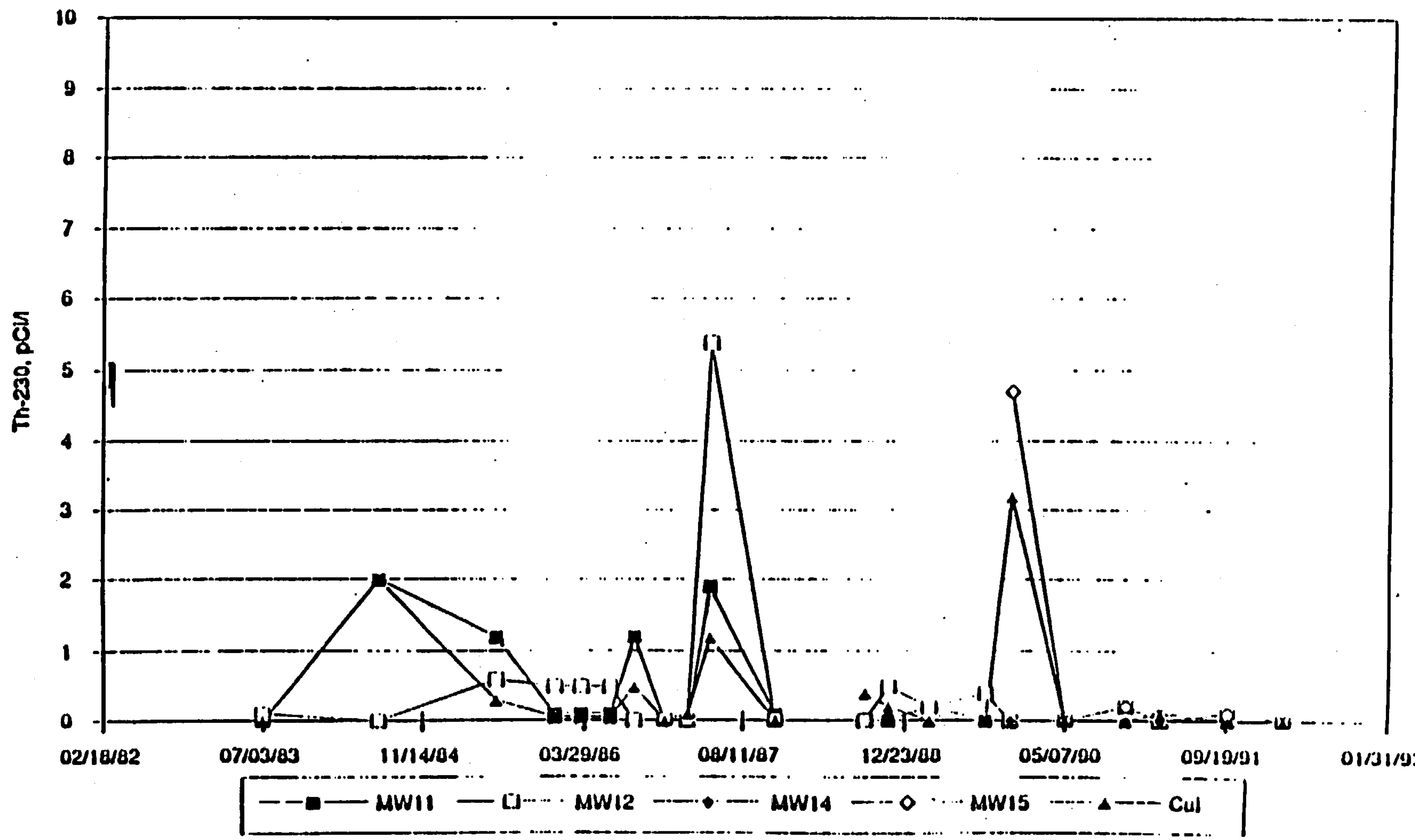
WHITE MESA MILL



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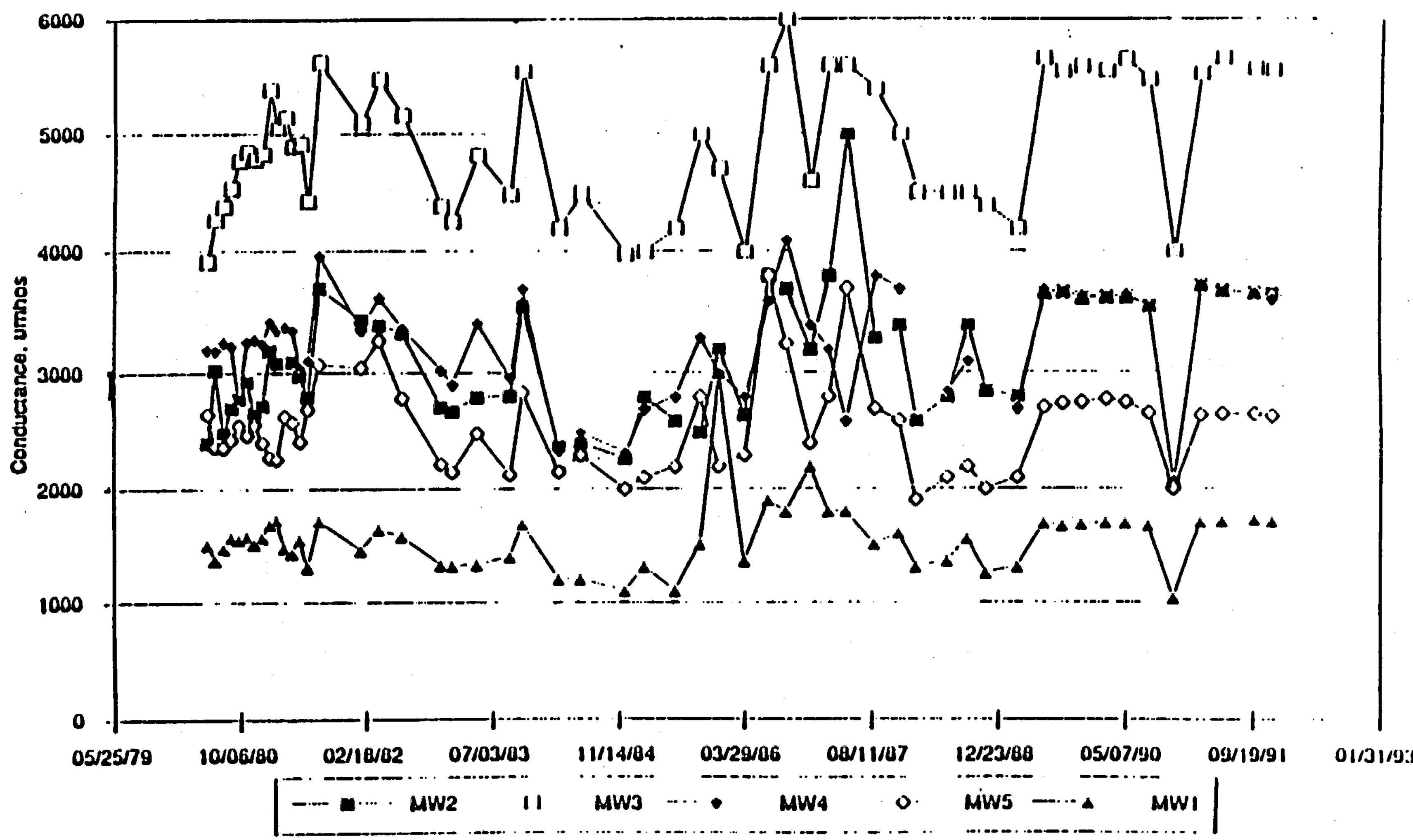
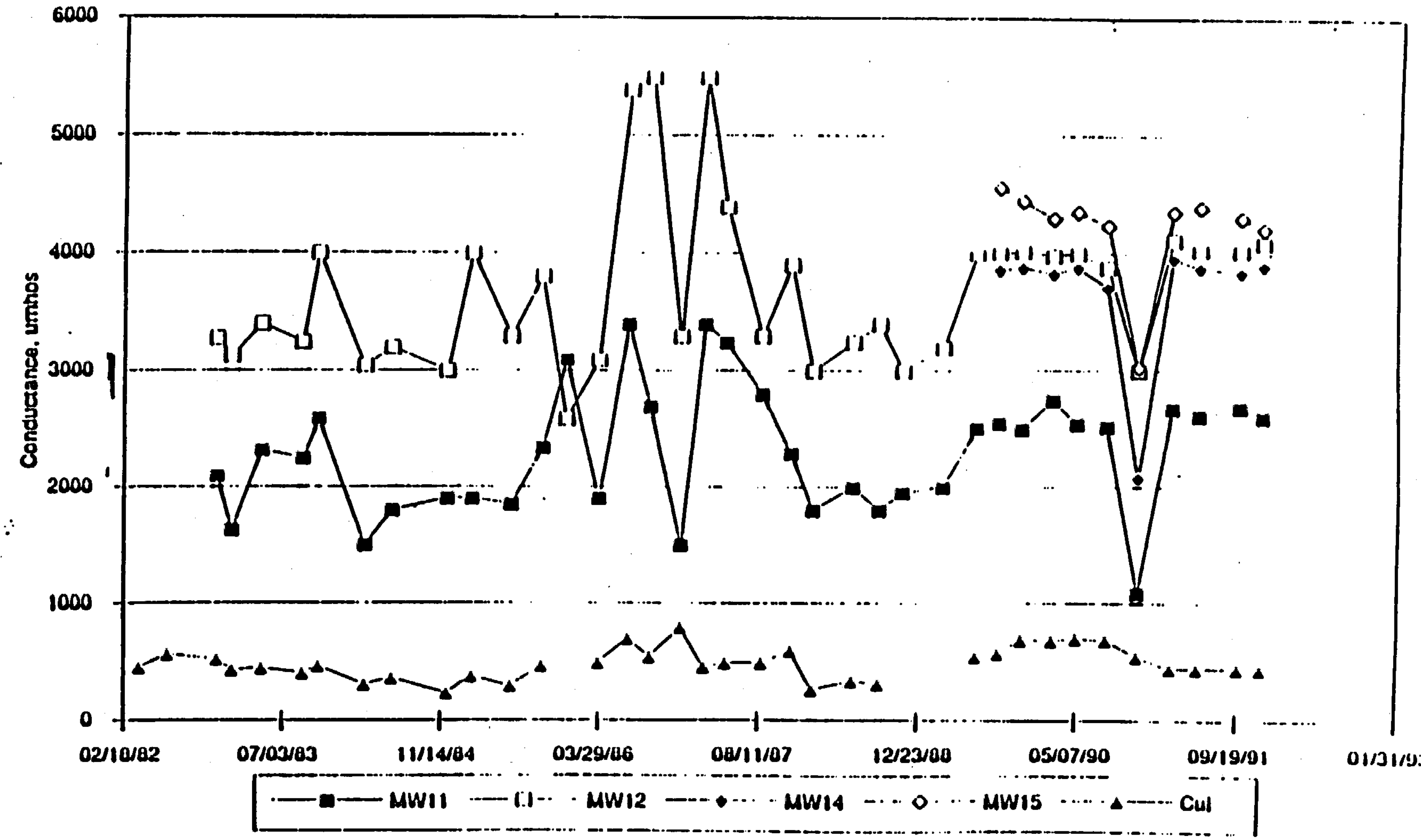
WHITE MESA MILL



UMETCO MINERALS CORPORATION
WHITE MESA MILL



ATTACHMENT 11

TITAN Environmental

Points of Compliance White Mesa Uranium Mill

Prepared For:

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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:

$$Z_i = (\bar{X}_i - \mu)\frac{\sqrt{n_i}}{\sigma}$$

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.

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

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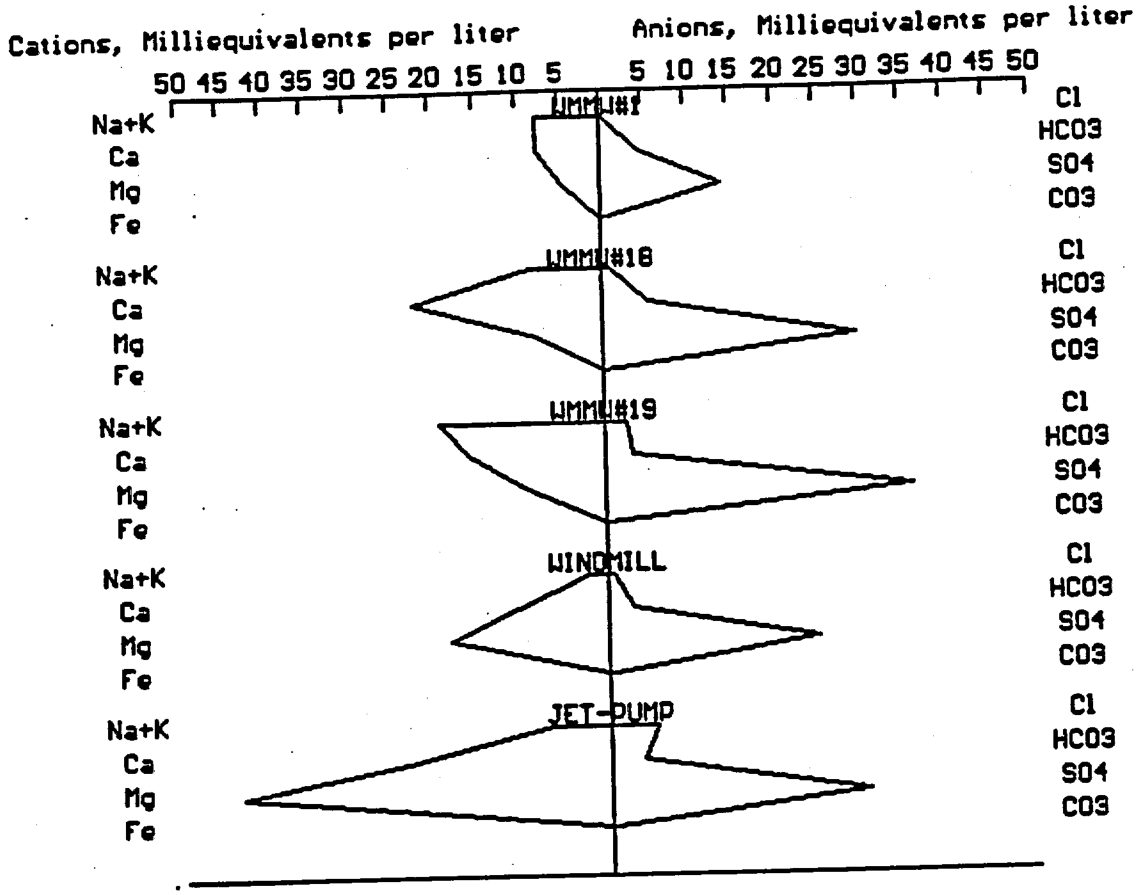


STIFF DIAGRAMS FOR JET PUMP WELL, WINDMILL, WMMW-1, WMMW-18 AND WMMW-19

PREPARED FOR

ENERGY FUELS NUCLEAR
DENVER, COLORADO

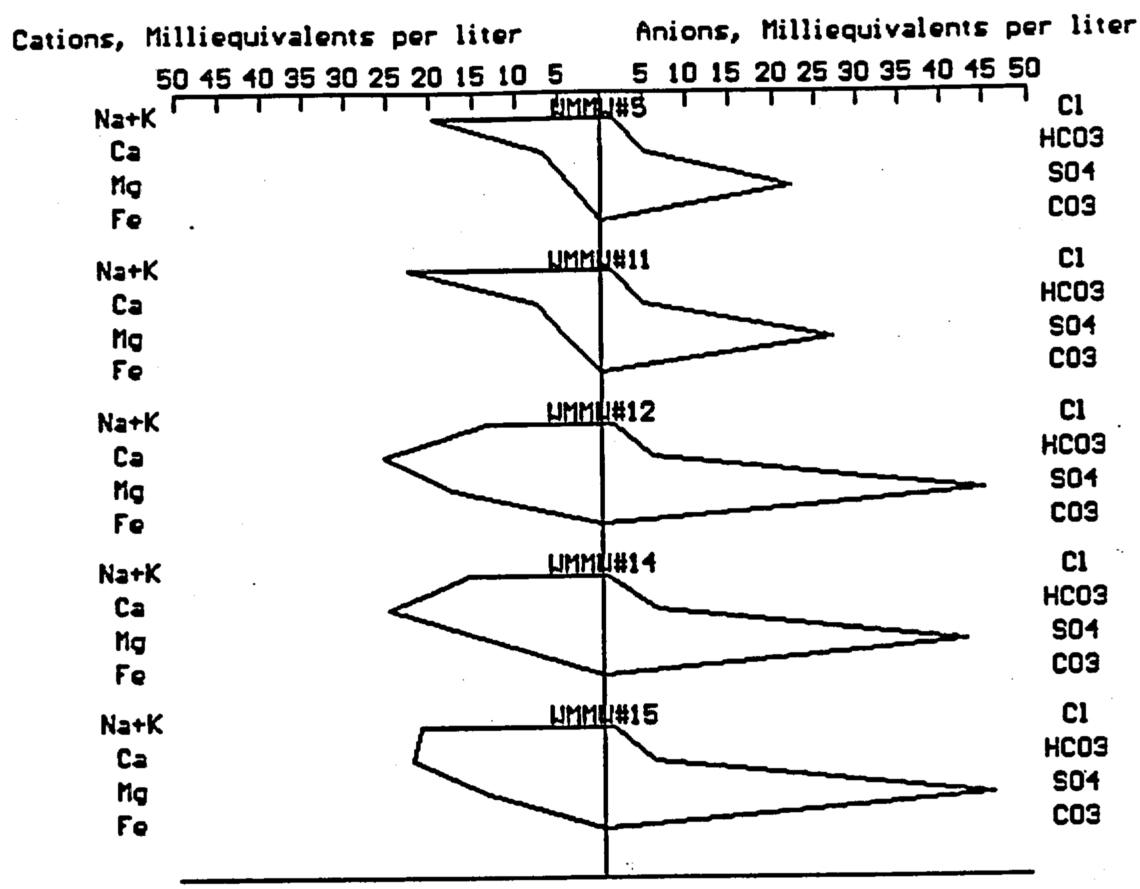
TITAN Environmental

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
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

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TITAN Environmental

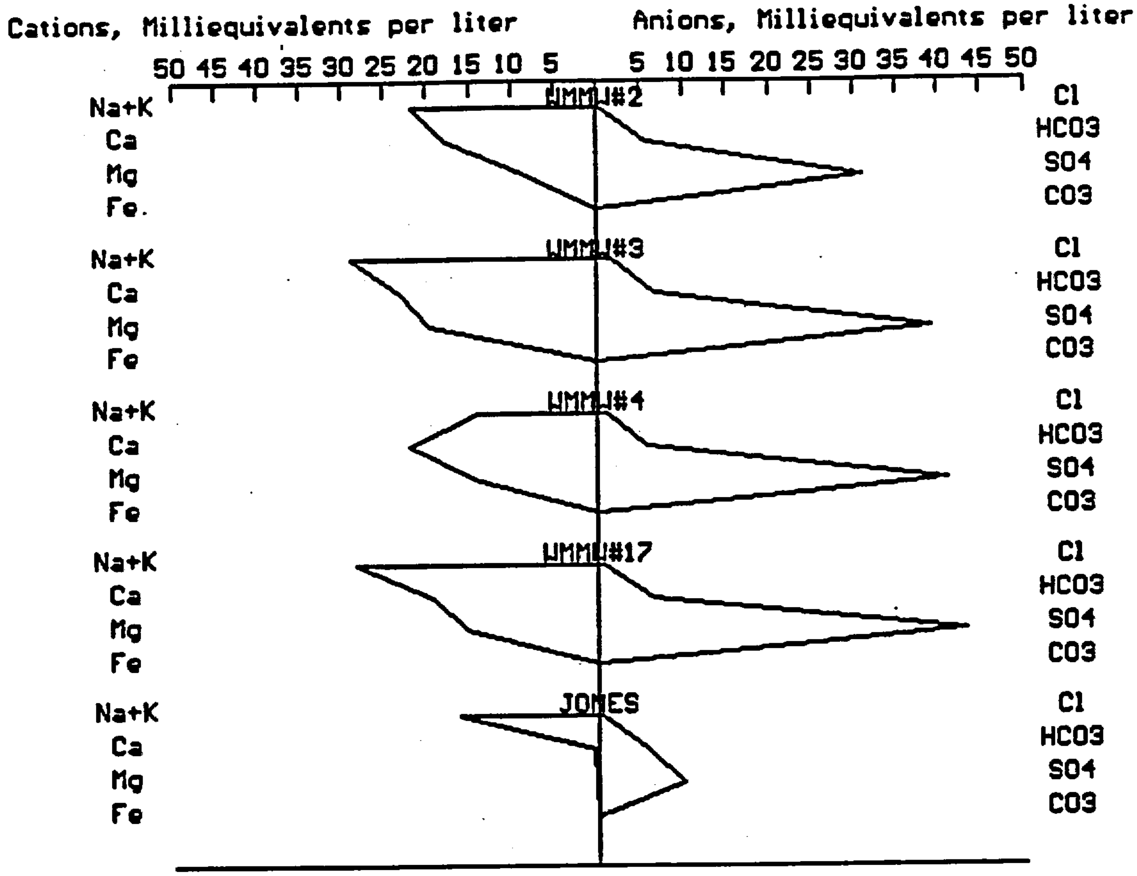
No.	DATE	ISSUE / REVISION	DWN.	CHK'D	APP'D
1		ISSUED FOR FINAL SUBMITTAL	T.M.C.		

DATE: 9-15-94
SCALE: N.T.S.

FIGURE 2

DRAWING NUMBER 4111-A30

DRAWING NUMBER 4111-A31



STIFF DIAGRAMS FOR
WMMW-2, WMMW-3, WMMW-4
WMMW-17 AND JONES WELL

PREPARED FOR

ENERGY FUELS NUCLEAR
DENVER, COLORADO

TITAN Environmental

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1		ISSUED FOR FINAL SUBMITTAL	T.M.G.		

DATE: 9-15-94
SCALE: N.T.S.

FIGURE 3

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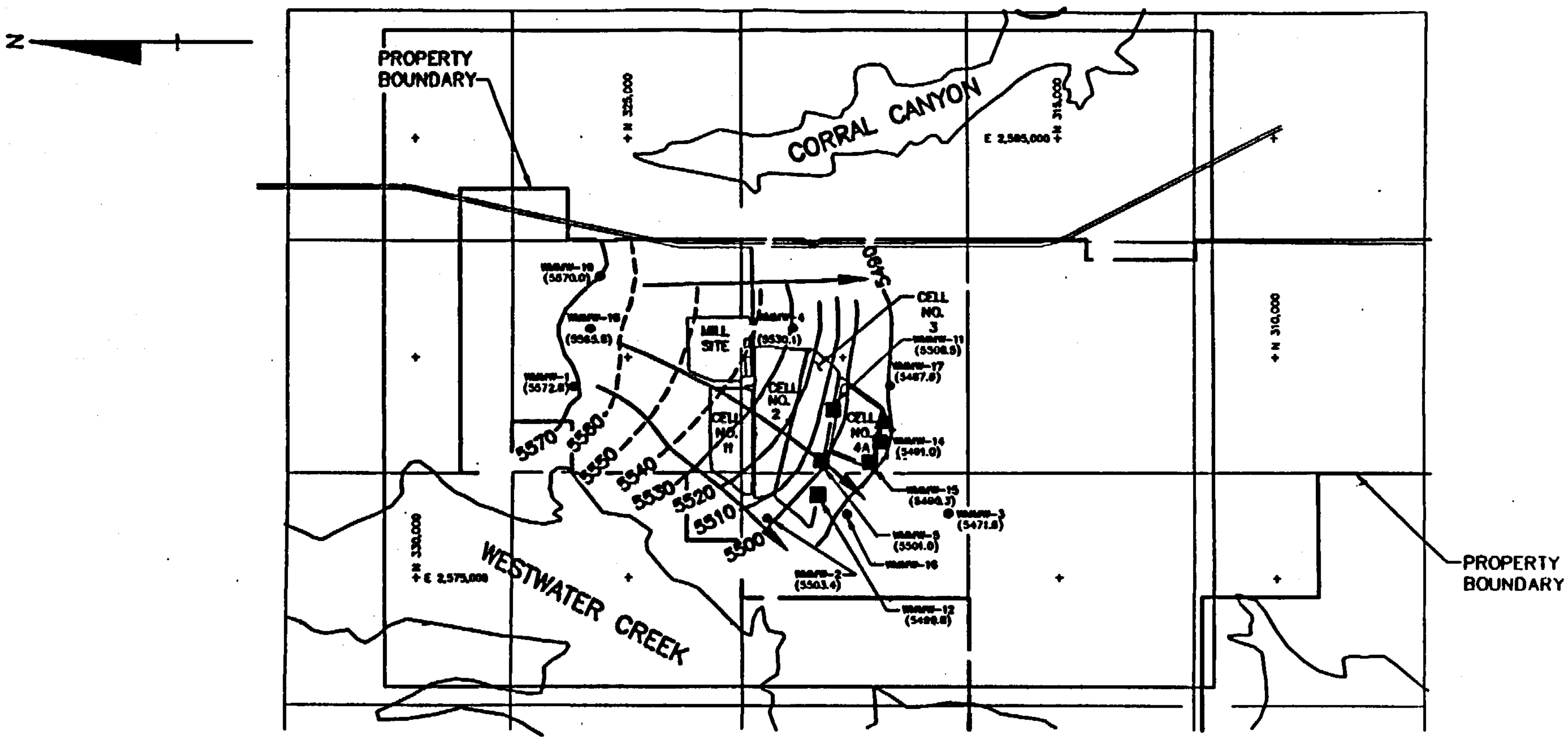
DRAWING NUMBER 4111-B9



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
- ● 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

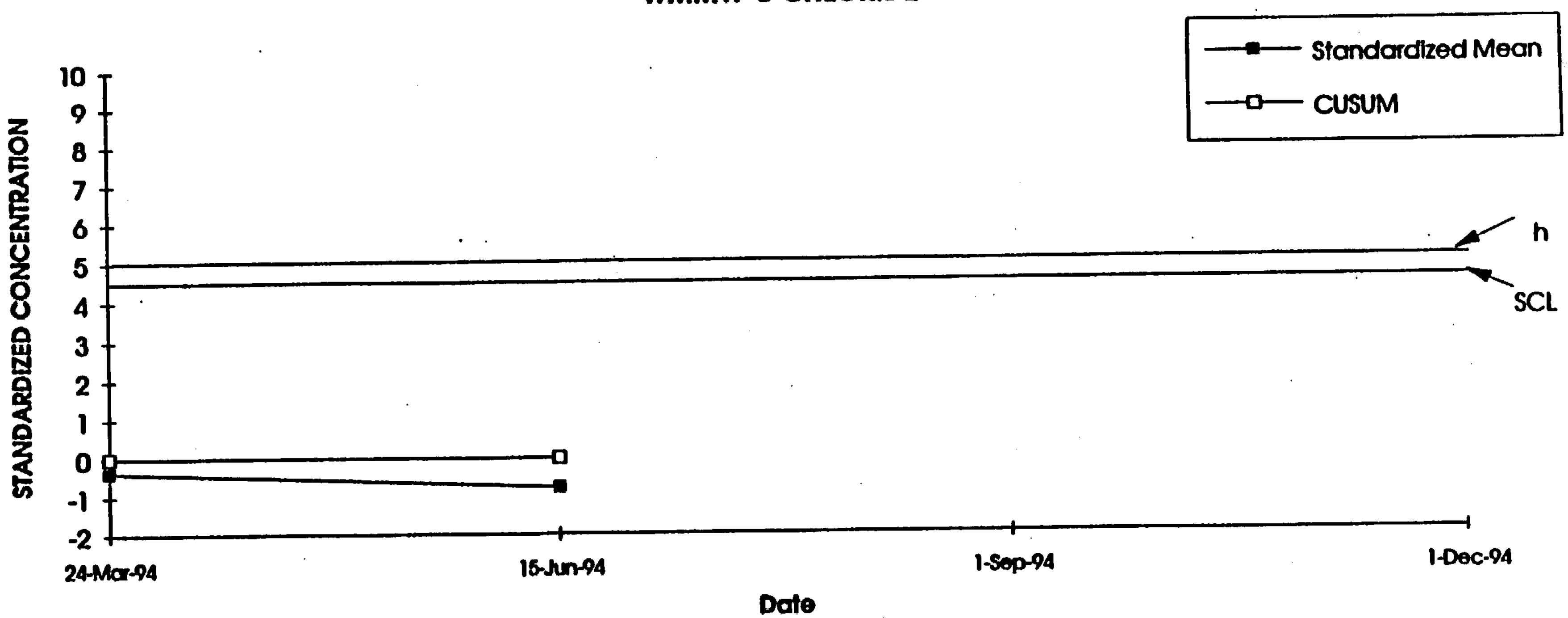
No.	DATE	ISSUE / REVISION			
△		ISSUED FOR FINAL SUBMITTAL	T.M.B.		

DATE: 7-18-94	FIGURE 4	DRAWING NUMBER 4111-B9
SCALE: AS SHOWN		

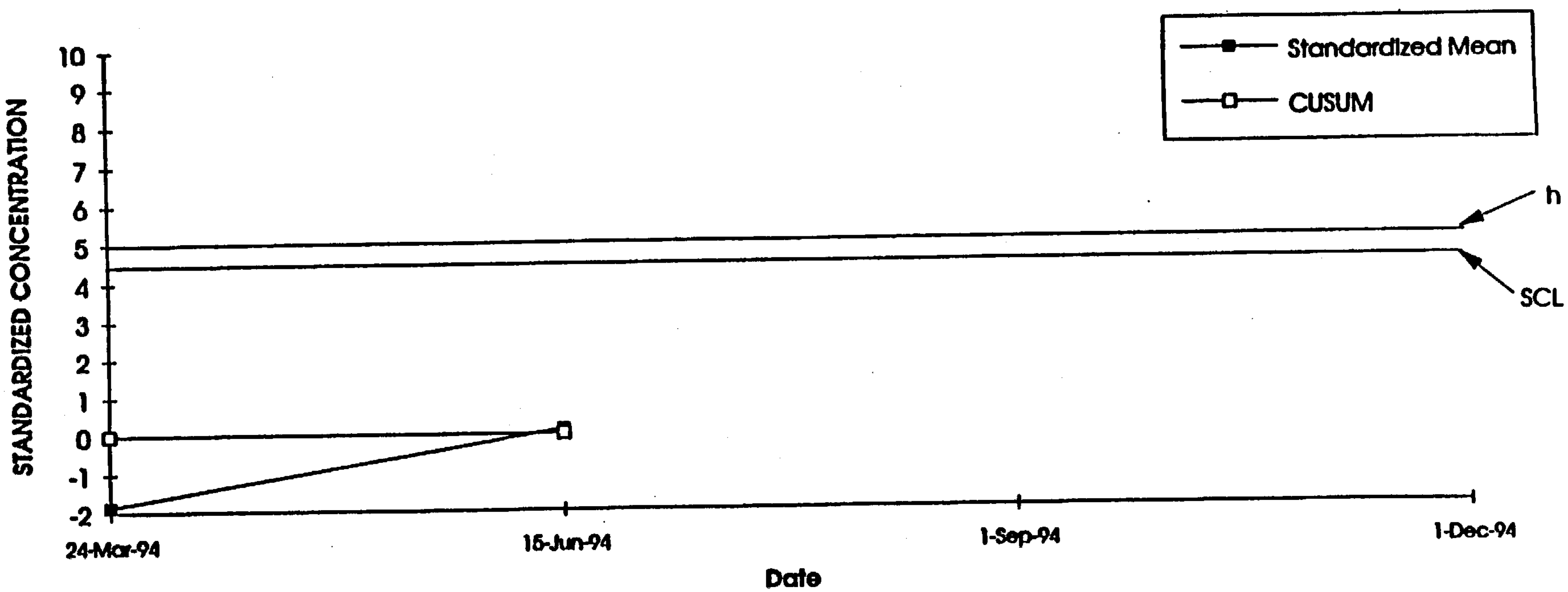
APPENDIX B

COMBINED SHEWHART/CUSUM CONTROL CHARTS FOR WHITE MESA POC's

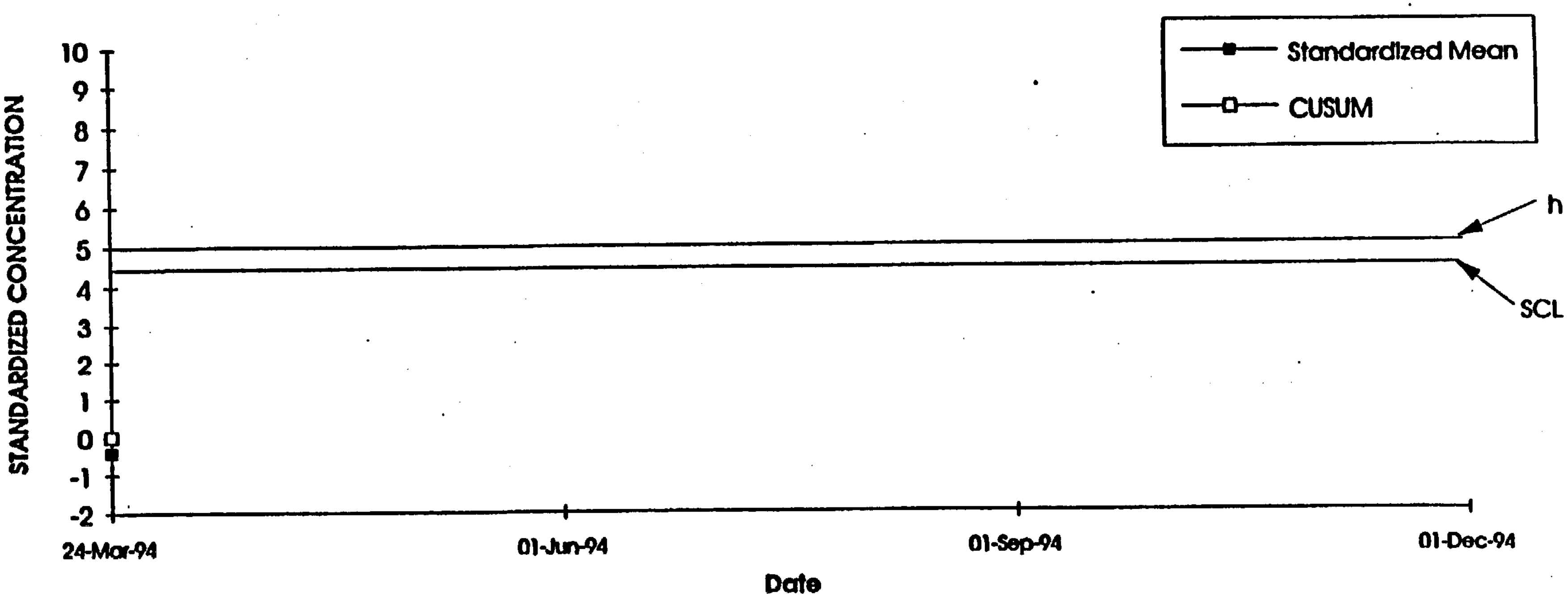
COMBINED SHEWHART-CUSUM CHART
WMMW-5 CHLORIDE



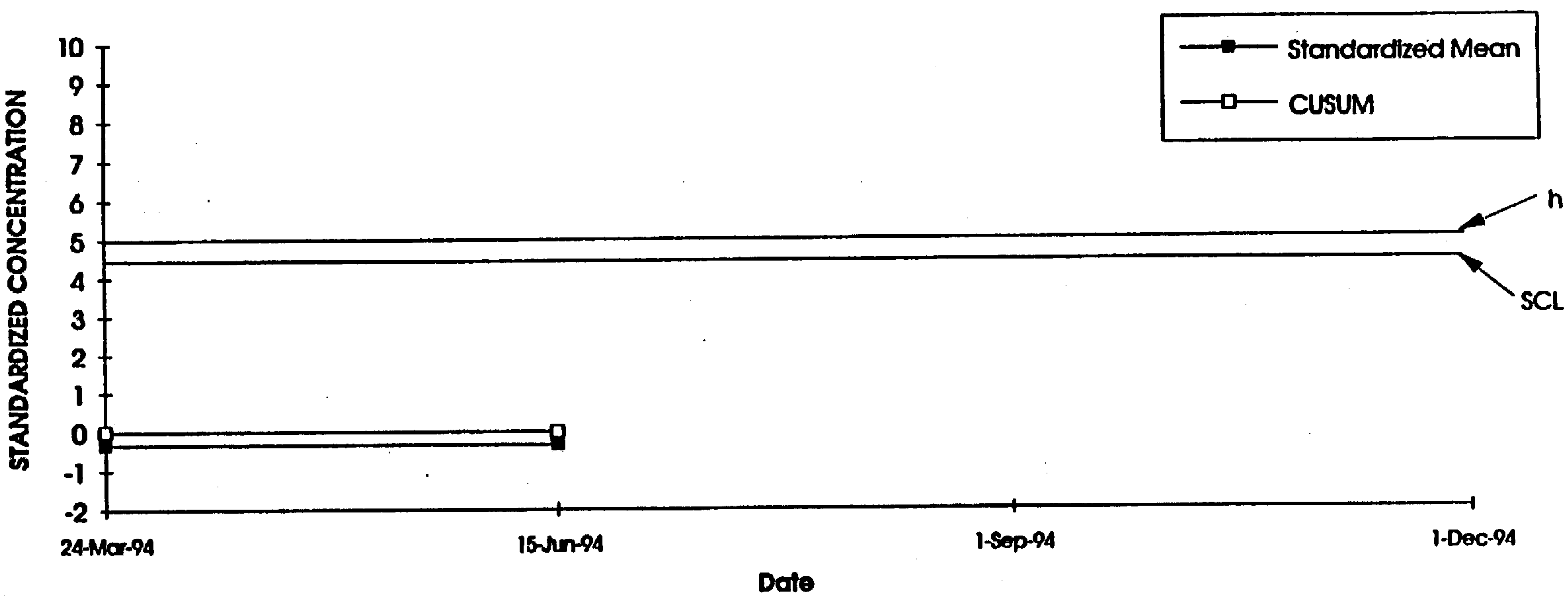
COMBINED SHEWHART-CUSUM CHART
WMMW-5 POTASSIUM



COMBINED SHEWHART-CUSUM CHART
WMMW-5 NICKEL

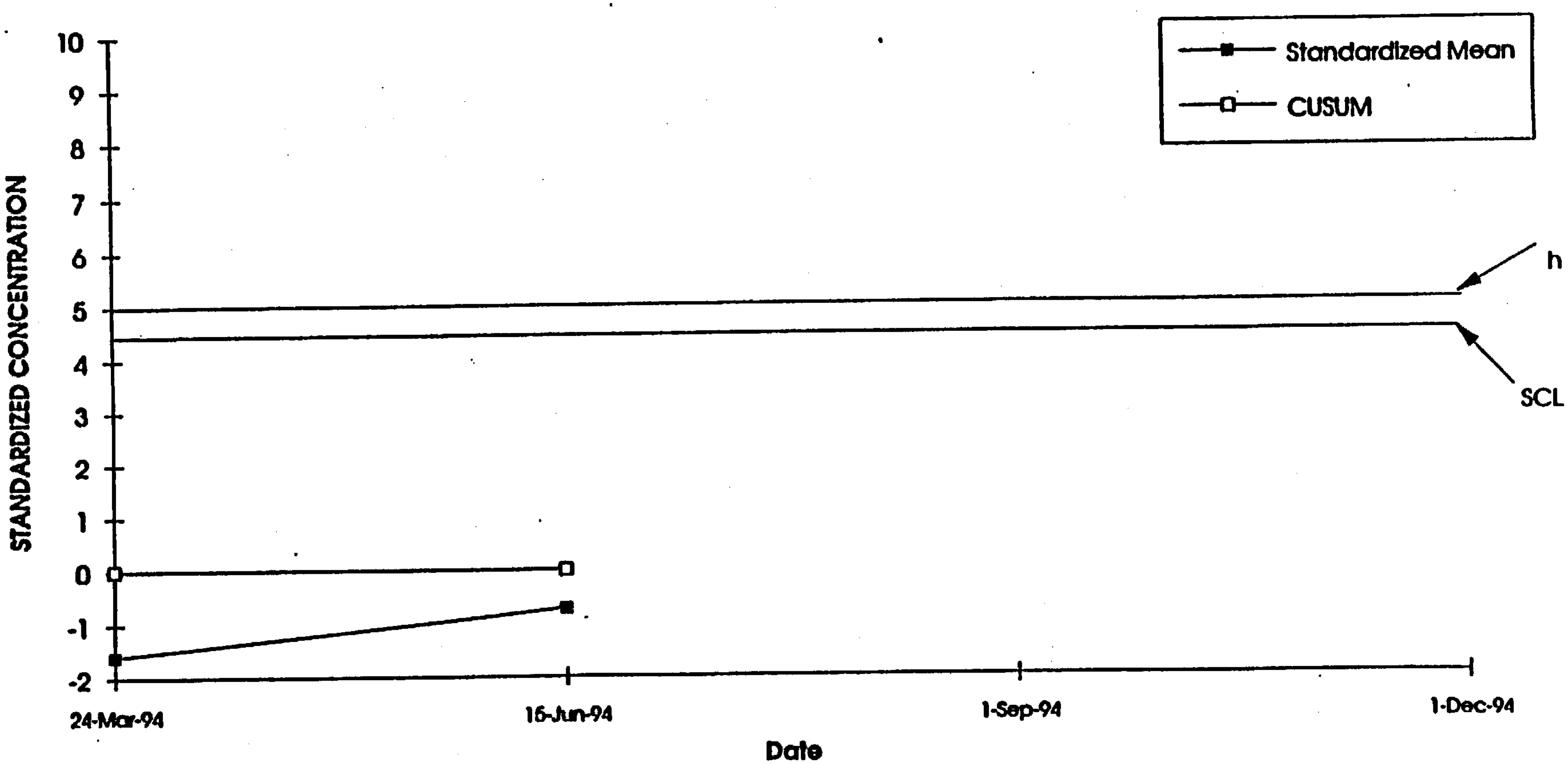


COMBINED SHEWHART-CUSUM CHART
WMMW-11 CHLORIDE

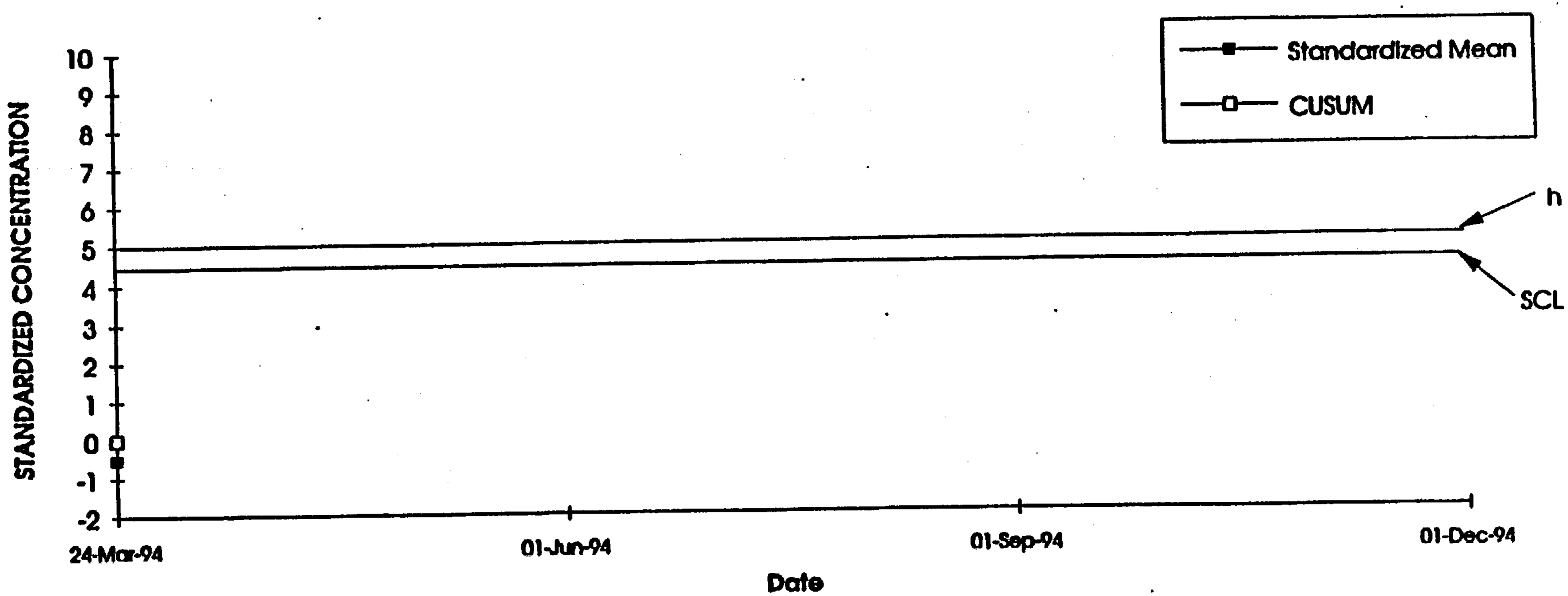


COMBINED SHEWHART-CUSUM CHART

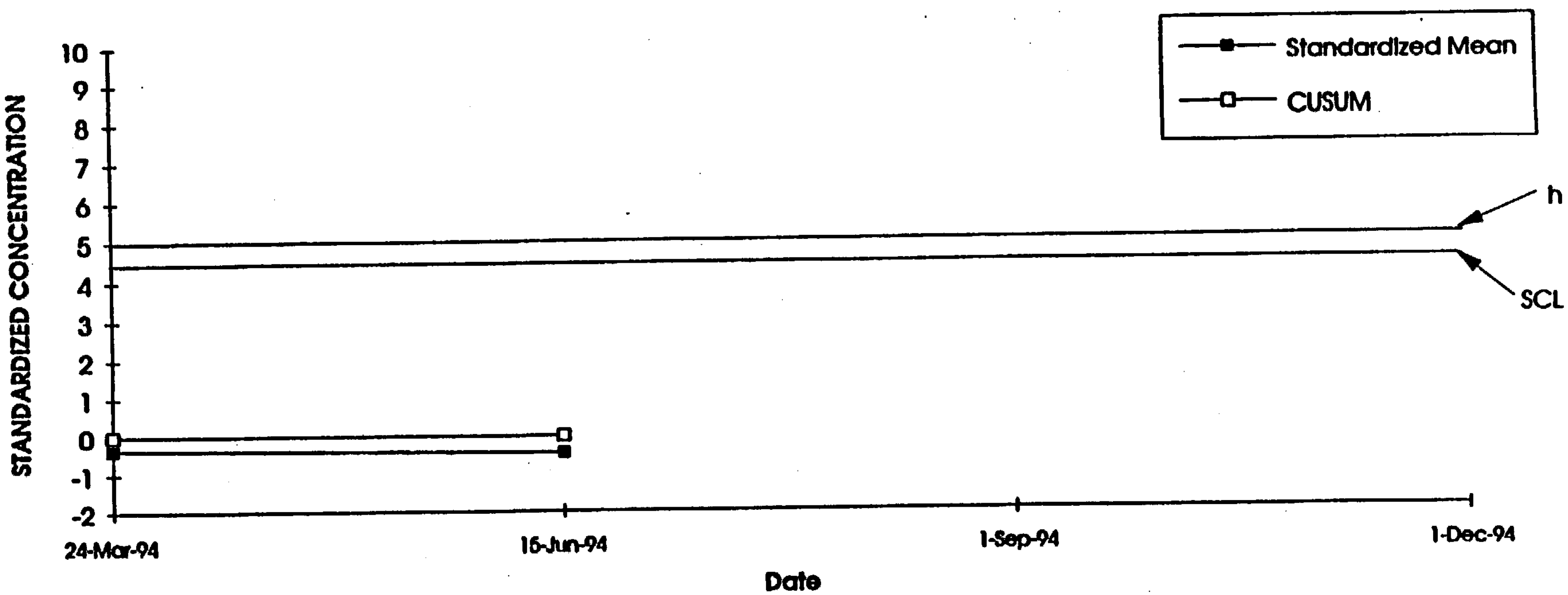
WMMW-11 POTASSIUM



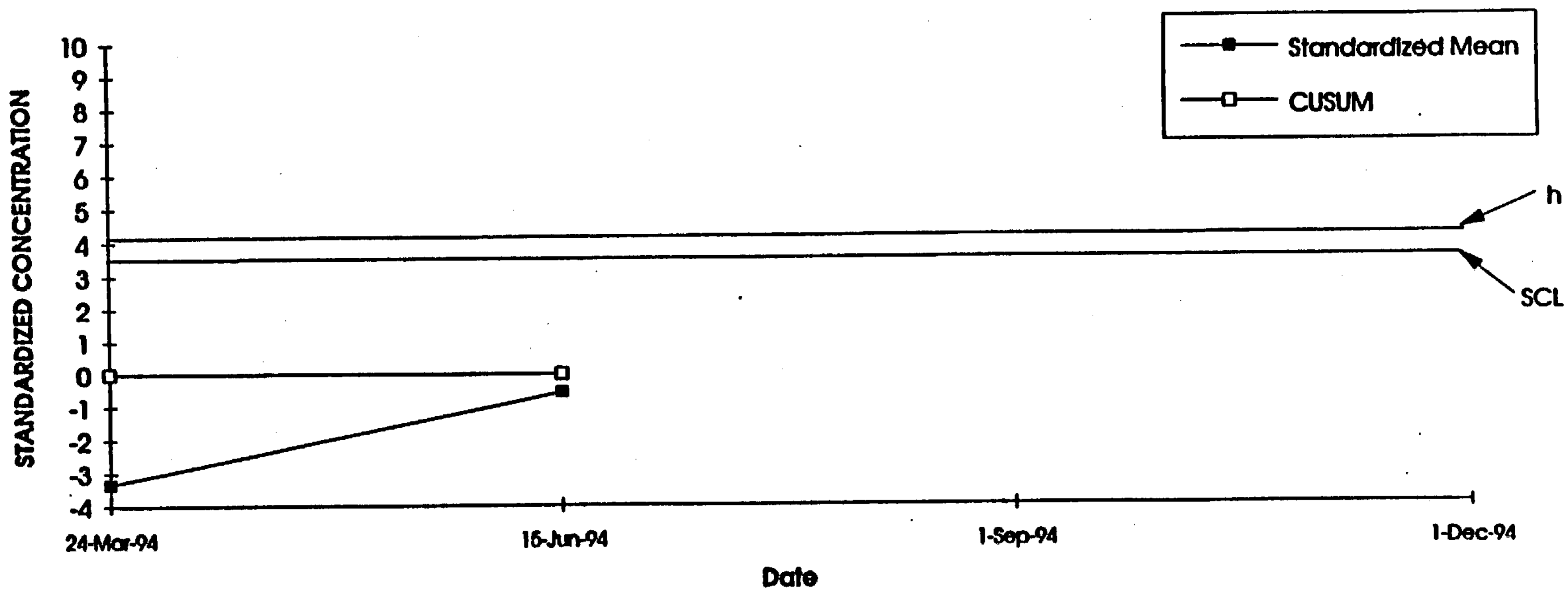
COMBINED SHEWHART-CUSUM CHART
WMMW-11 NICKEL



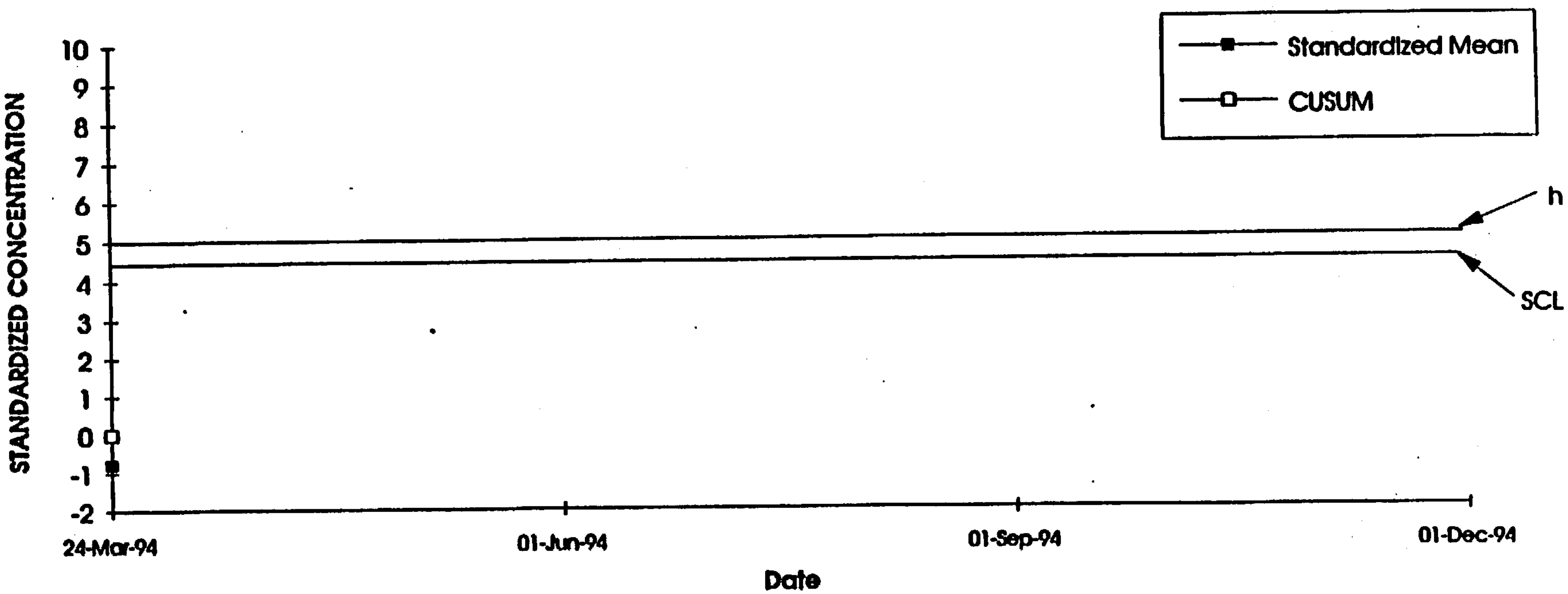
COMBINED SHEWHART-CUSUM CHART
WMMW-12 CHLORIDE

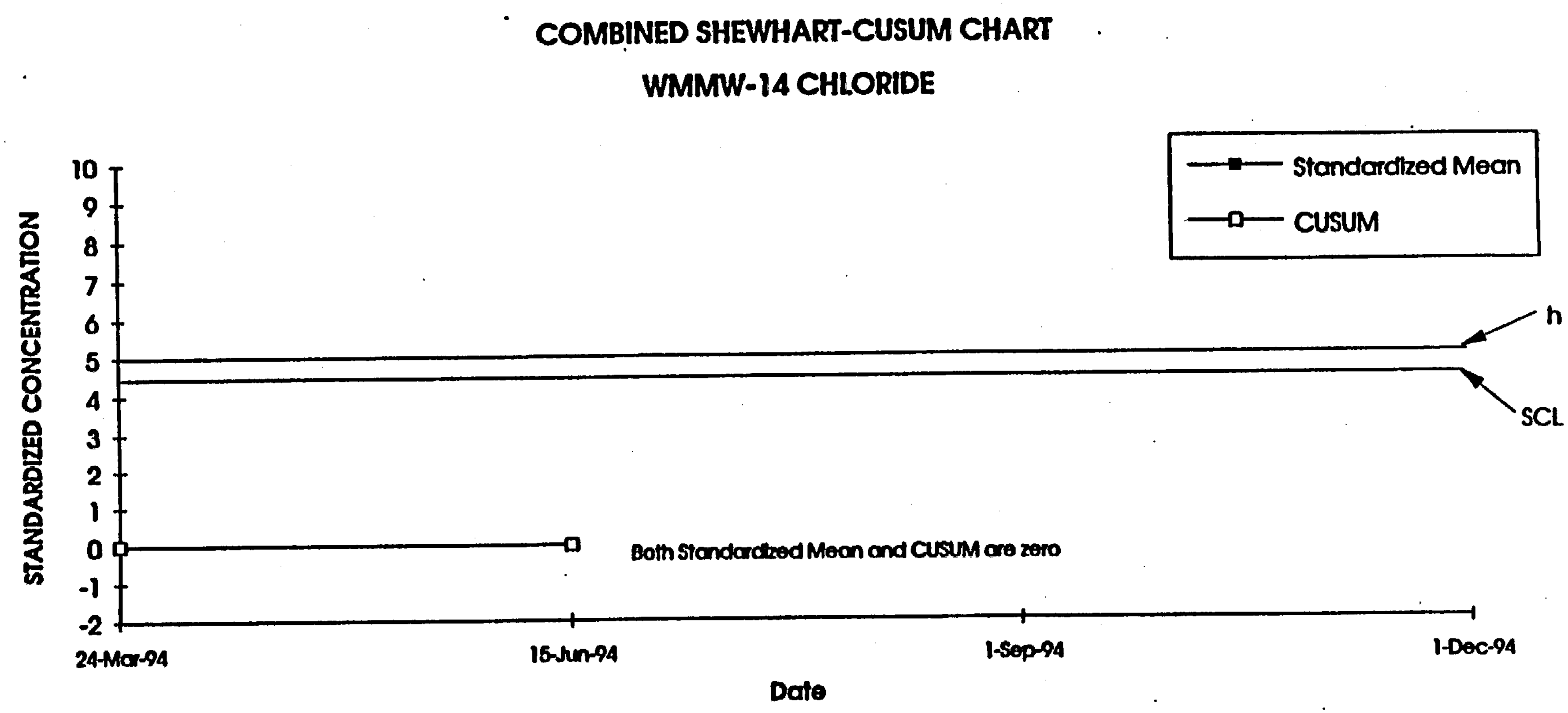


COMBINED SHEWHART-CUSUM CHART
WMMW-12 POTASSIUM

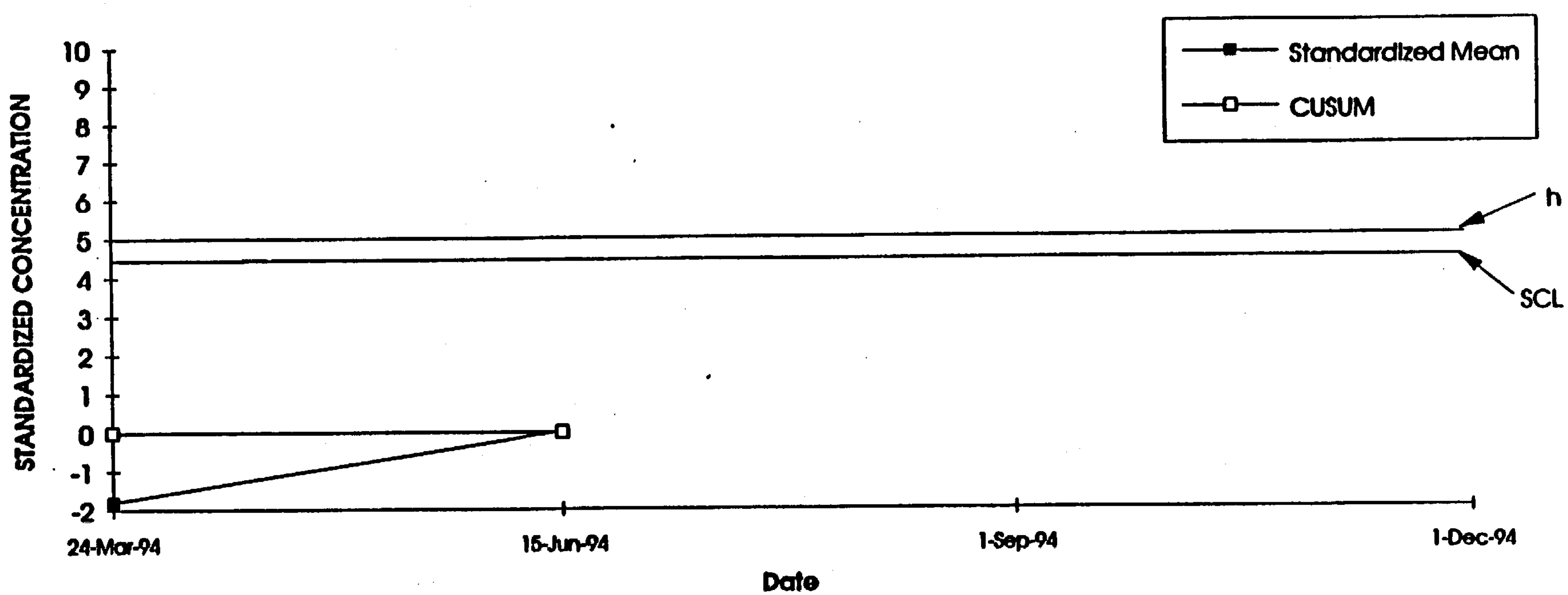


COMBINED SHEWHART-CUSUM CHART
WMMW-12 NICKEL

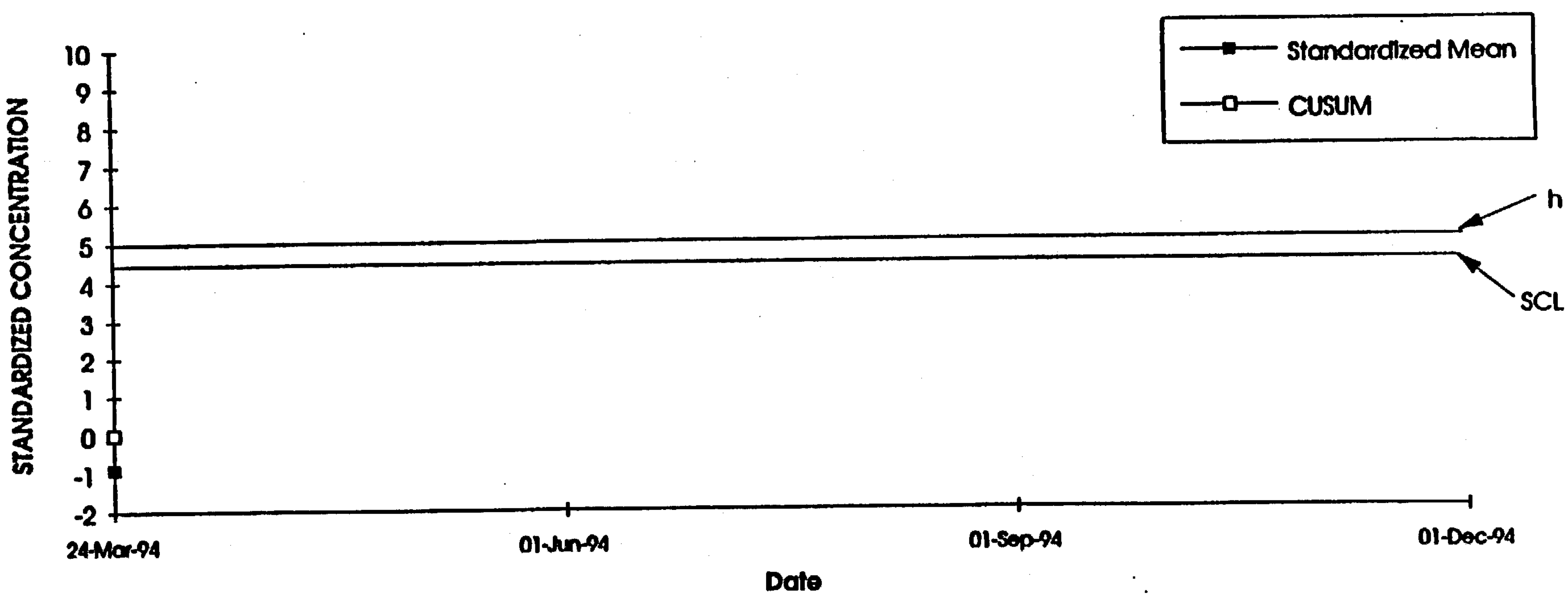



COMBINED SHEWHART-CUSUM CHART
WMMW-14 CHLORIDE
STANDARDIZED CONCENTRATION
10
9
8
7
6
5
4
3
2
1
0
-1
-2
Standardized Mean
CUSUM
h
SCL
Both Standardized Mean and CUSUM are zero
24-Mar-94
15-Jun-94
1-Sep-94
1-Dec-94
Date

COMBINED SHEWHART-CUSUM CHART
WMMW-14 POTASSIUM

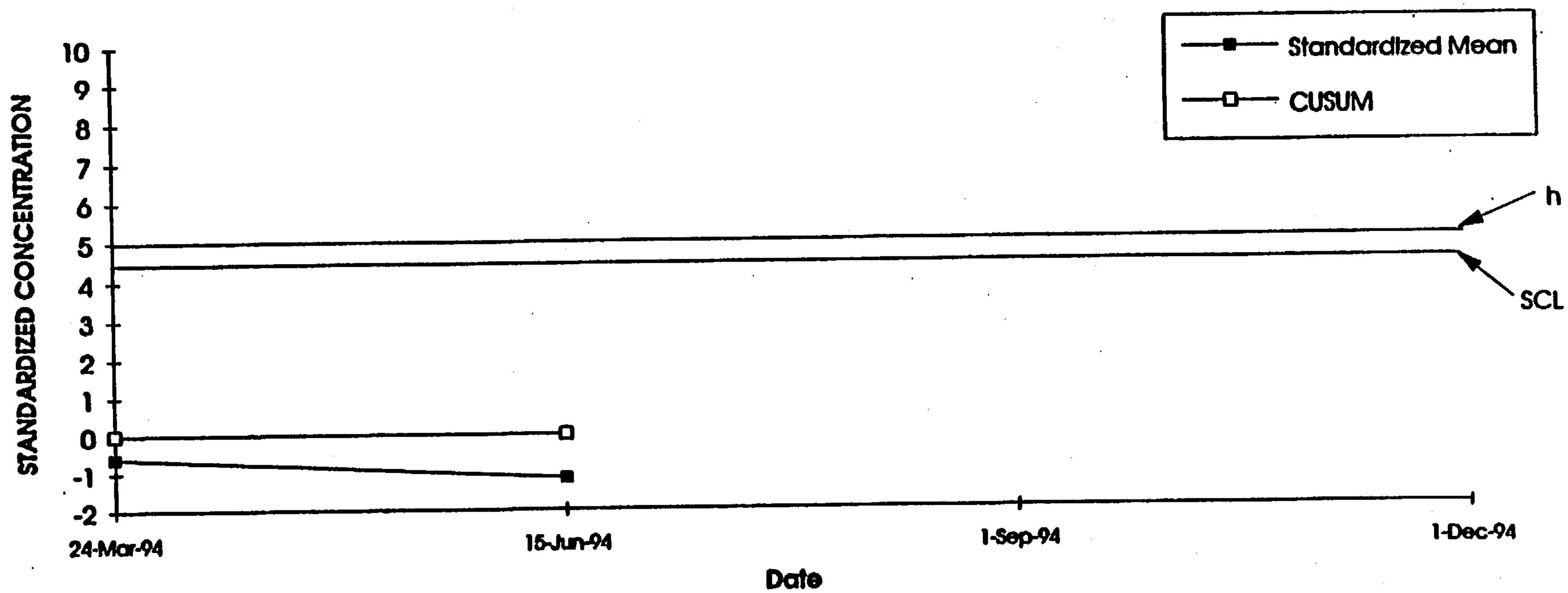


COMBINED SHEWHART-CUSUM CHART
WMMW-14 NICKEL

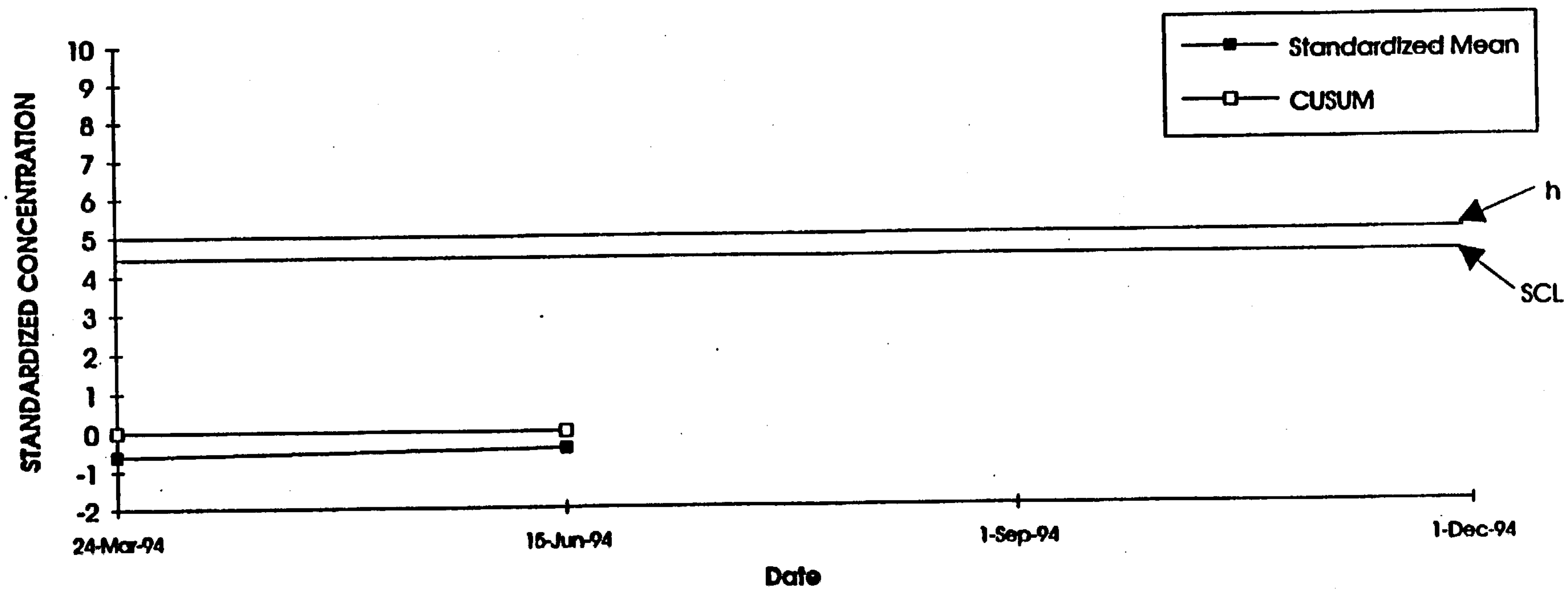


COMBINED SHEWHART-CUSUM CHART

WMMW-15 CHLORIDE

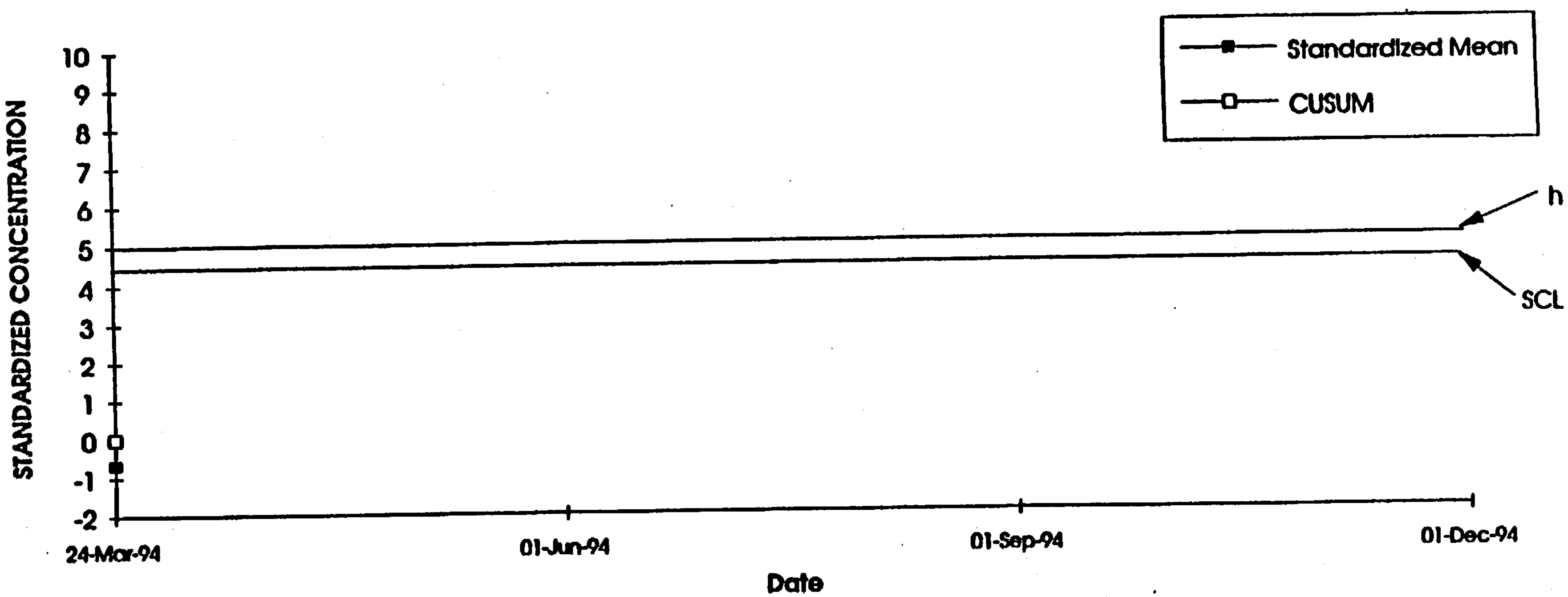


COMBINED SHEWHART-CUSUM CHART
WMMW-15 POTASSIUM



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).

KMB 9/28/94

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

$$Z_i = (\bar{X}_i - \mu) \sqrt{n_i}/\sigma$$

$4.5 = \bar{X} - \mu \frac{1}{\sigma}$

$\sigma 4.5 + \mu = \bar{X}$ 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_8. Both the CUSUM scheme and the Shewhart control limit were exceeded by S_8 and Z_8, 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

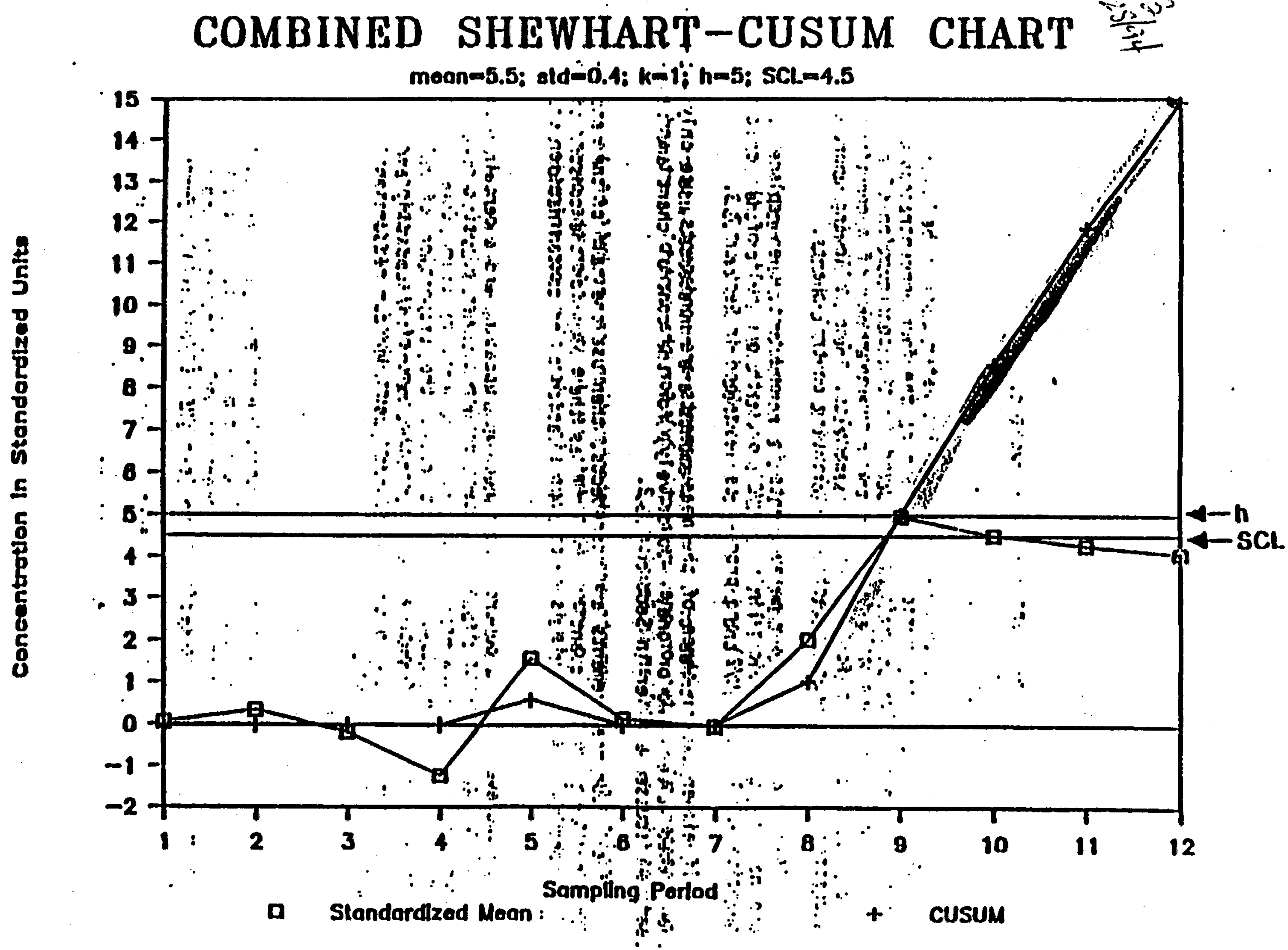


Figure 7-2 Combined Shewhart-CUSUM chart

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		FLY ASH POND				
	C2 LDS	Blind Duplicate	Upper Pool	Lower Pool	Previous Sample	Simes 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	0.005	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	1.0E-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	1393	2898	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.

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	260	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	53	40	0.0
Ra-228, pCi/l	1.50	1.60	1.0	0.7	1.8	1.9	1.4
Th-230, pCi/l	0.00	0.00	2.4	2.9	30	3650	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 pthalate, 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)pthalate, 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 pthalate, mmg/l	ND	ND	ND	ND	NS	2.70	ND
diethyl pthalate, mmg/l	ND	ND	ND	ND	NS	18.10	ND
Al, mg/l	0.08	0.08	0.46	0.33	1.8	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	0.10	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	1.0	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, mg/l	4.1	4.1	ND	ND	23	128	ND
Mo, mg/l	0.030	0.030	1.6	2.8	0.49	0.44	ND

Sept 1991

ATTACHMENT 12

ENVIRONMENTAL ASSESSMENT
FOR RENEWAL OF
SOURCE MATERIAL LICENSE NO. SUA-1358

ENERGY FUELS NUCLEAR, INC.
WHITE MESA URANIUM MILL
SAN JUAN COUNTY, UTAH

FEBRUARY 1997

DOCKET NO. 40-8681

U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety
and Safeguards
Division of Waste Management

The requirements were incorporated into SUA-1358 when initially issued. The requirements have been modified following subsequent amendments to the MOA. The most recent modifications were incorporated into SUA-1358 through the issuance of a license amendment on May 11, 1983. These requirements will be included in the renewed license.

The licensee will also be required to conduct, as a minimum, an archaeological and historical artifact survey of areas not previously surveyed prior to their disturbance.

4.4 Impacts to Water Resources

4.4.1 Surface Water Impacts

Continued operation of the mill should have negligible impacts on surface waters on and in the vicinity of the project site, because (1) mill effluents are not discharged to local surface waters; (2) sanitary wastes are discharged to State-approved leach fields; and (3) tailings from mill operations are discharged by pipeline to partially below-grade, lined impoundments. In addition, as noted above, EFN has committed to regular inspections of the tailings disposal system, including disposal cell embankments.

4.4.2 Groundwater Impacts

For the following reasons, the NRC staff does not believe that groundwater beneath or in the vicinity of the site will be adversely impacted by continued operation of the mill:

1. Four tailings cell have been constructed to accept tailings slurry and solutions and other approved wastes. Each of the cells has been designed and constructed to minimize seepage of tailings fluids into the subsurface. Cells 1-I, 2, and 3 have a 6-inch compacted sandstone bedding layer, an overlying synthetic liner, and a leak detection system consisting of: (1) a 12-inch thick compacted sand layer on the upstream face of the downstream retention dike, (2) a 3-inch diameter perforated pipe installed at the toe of the sand layer, and connecting to (3) a 12-inch diameter access riser pipe.

   Cell 4A is constructed with a 12-inch thick clay base layer overlain by a synthetic liner covering both the bottom and side slopes of the cell. A leak detection system is located beneath the synthetic liner. This system is composed of 4-inch perforated pipes embedded in granular materials in synthetically-lined trenches excavated into the clay base. These pipes are connected in turn to a 12-inch diameter access pipe.

   As part of EFN's inspection procedures for the tailings management system, daily measurements are taken of liquid levels in the leak detection system for each cell. If specific changes in these levels are recorded, site management is notified immediately. Quarterly sampling of a number of monitor wells completed in the Burro Canyon perched water zone and located around and among the tailings cells, is also required by EFN's inspection procedures. Further discussion of the licensee's groundwater detection monitoring program is provided in Section 4.6.1.

2. Based on estimates of net infiltration and volumetric moisture content of the vadose zone (i.e., the unsaturated portions of the Dakota and Burro Canyon Sandstones) and an average thickness of the vadose zone, EFN estimates that it would take 50 to 150 years for moisture to travel from the bottom of a tailings disposal cell to the perched water zone, depending on the extent of failure of the tailings disposal cell liner (Titan, 1994). Tailings disposal cell seepage traveling along joints or fractures in the Dakota Sandstone could potentially reduce this travel time to a few days or months. Jointing is common in the Dakota along the mesa's rim; however, coring studies to date have revealed no evidence of continuous fractures or joints with depth. Once in the saturated portion of the Burro Canyon, the travel time for seepage from a tailings impoundment to the downgradient edge of the mesa has been estimated at 8900 to 13,400 years (Titan, 1994b).

3. The Morrison and Summerville Formations form an approximately 1200-foot thick low-permeability barrier to ground water flow separating the Entrada/Navajo Aquifer from the Burro Canyon perched zone. The NRC staff considers that this barrier makes it unlikely that constituents from the tailings disposal cells would ever impact water quality of this aquifer.

4.5 Impacts on Ecological Systems

4.5.1 Endangered Species

In the vicinity of the site, four animal species classified as either endangered or threatened (i.e., the bald eagle (*Haliaeetus leucocephalus*), the American peregrine falcon (*Falco peregrinus anatum*), the black-footed ferret (*Mustela nigripes*), and the Southwestern willow flycatcher (*Empidonax traillii extimus*)) could occur. While the ranges of the bald eagle, peregrine falcon, and willow flycatcher encompass the project area, their likelihood of utilizing the site is extremely low. The black-footed ferret has not been seen in Utah since 1952 and is not expected to occur any longer in the area.

No populations of fish are present on the project site, nor are any known to exist in the immediate area of the site. Four species of fish designated as endangered or threatened occur in the San Juan River 29 km (18 miles) south of the site. There are no discharges of mill effluents to surface waters, and therefore, no impacts are expected for the San Juan River due to operations of the White Mesa mill.

Currently, no designated endangered plant species occur on or near the plant site.

4.5.2 Wetlands

No true wetlands exist on the project site. Two small catch basins approximately 18 m (60 feet) in diameter, fill for brief times in the fall or spring if heavy rainfall occurs. These catch basins are the only "aquatic" habitat found on the project site, and they more properly represent terrestrial environments. No wetland plants have been found in these basins.

d. Direct Gamma Exposure

Direct radiation exposure measurements are made quarterly at the four air particulate monitoring stations. The greatest differential between measured exposure rate and background for the same time period since 1989 was 8.6 mR/qtr. However, measured exposure rates are normally at or slightly above or below background rates.

e. Surface Water Sampling

Surface water monitoring is conducted at two sampling locations, known as Westwater Canyon and Cottonwood Creek, adjacent to the mill. Grab samples are collected annually from Westwater Canyon and quarterly from Cottonwood Creek. The samples are analyzed for total and dissolved U-nat, Ra-226, and Th-230, as well as for pH, specific conductivity, temperature, total dissolved and suspended solids, gross alpha concentrations. Measured values for these consituents and parameters over the period of mill operations since 1980 have been consistently low.

f. Ground Water Sampling

Groundwater monitoring samples have been collected quarterly from seven monitoring wells and the culinary water well. These samples were analyzed for pH, specific conductance, chlorides, sulfates, TDS, and U-nat, and water level measurements were also taken. Groundwater samples were analyzed semiannually for arsenic, selenium, sodium, Ra-226, Th-230, and Pb-210. No trends are apparent from measurements taken since 1985.

With this license renewal, EFN proposed that groundwater detection monitoring be conducted in accordance with the program described in the document entitled, "Points of Compliance, White Mesa Uranium Mill," submitted by letter dated October 5, 1994. Under this program, samples will be collected quarterly from five "point of compliance" (POC) wells, completed in the Burro Canyon Formation (wells WMMW-5, -11, -12, -14, and -15) (see Figure 4.1). These samples will be analyzed for chloride, potassium, and nickel, and water level measurements also will be taken. EFN selected these indicator parameters, because the concentrations of these species are significantly higher in the tailings pond fluid than in the perched water of the Burro Canyon, and they are representative of both anionic and cationic species.

The data will be analyzed using the Shewhart-Cusum control chart technique. These charts have been developed on a well-by-well basis, with a separate control chart for each of the four indicator parameters. If limits on the control charts are exceeded for a parameter at a well, a program of confirmatory sampling will commence. This will involve monthly sampling for six months; a separate analysis-of-variance technique will be employed to determine whether there is a significant difference between these samples and those collected prior to the confirmatory sampling program. If the data are significantly different, then a corrective action plan will be developed.

The NRC staff found the proposed groundwater detection monitoring program to be acceptable, with modifications as follows: (1) that well WMMW-17 be included in the sampling program; and (2) that uranium be added as an indicator parameter to be analyzed for. EFN agreed to these modifications in a telephone conversation on December 11, 1996. EFN will be required, by license condition, to conduct its groundwater detection monitoring in accordance with the proposed program, as modified.

Finally, the licensee will continue to be required to (1) analyze liquid found in the leak detection system during weekly inspections for specified constituents; (2) conduct statistical analyses to determine if significant linear trends exist, and (3) propose corrective action for NRC review and approval if such trends do exist.

4.6.2 Radiological Assessment

a. Offsite Impacts

The radiological impacts from milling operations at the White Mesa site have been assessed previously and documented in the FES (NRC, 1979) and the 1985 EA (NRC, 1985a). In the previous EA, the staff analyzed impacts associated with milling at a nominal rate of 2000 tons of ore per day, and an average ore grade of 0.60 percent, for a yellowcake production rate of 4380 tons per year, and determined that both site boundary radionuclide concentrations and individual dose commitments were small fractions of the applicable standards.

As part of its November 22, 1994, amendment request for authorization to install a second dryer, EFN provided updated MILDOS-AREA calculations and results. In approving EFN's request, the NRC staff determined, based on its review of the MILDOS-AREA results, that releases from the mill would not result in a member of the public receiving a radiation dose in excess of the 10 CFR Part 20 limit (i.e., 100 mrem per year).

It should be noted that actual radiation doses to the public will likely be less than modeled, because EFN normally processes lower grade ores, at a rate less than 2000 tons of ore per day.

b. Radiological Impact on Biota Other than Humans

Although no guidelines concerning acceptable limits of radiation exposure have been established for the protection of species other than man, it is generally agreed that the limits for humans are also conservative for other species. Doses from gaseous effluents to terrestrial biota (such as birds and mammals) are quite similar to those calculated for man and arise from the same dispersion pathways and considerations. Because the effluents of the facility will be monitored and

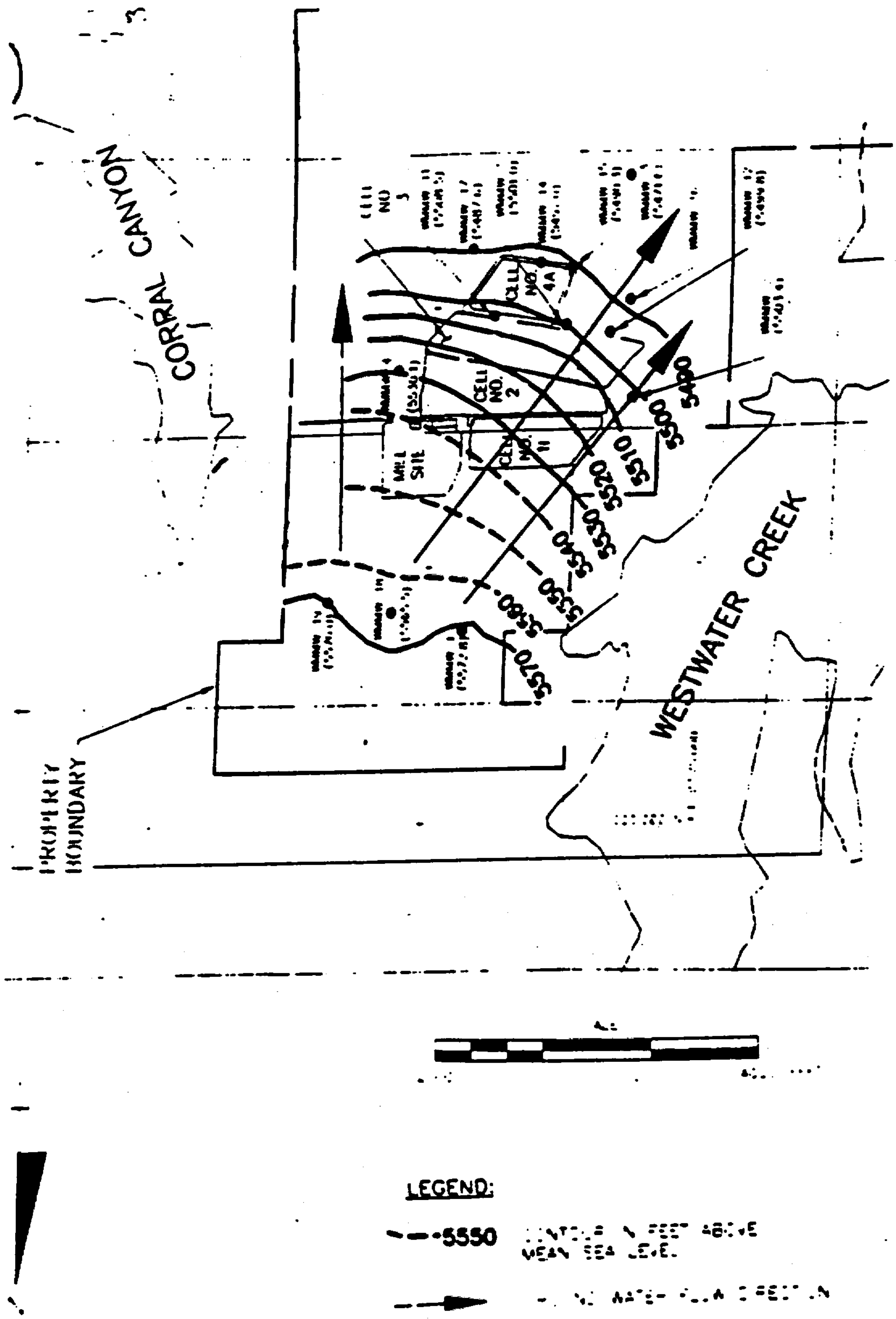

Figure 4.1 White Mesa Point of Compliance Well Locations (after Titan, 1994a)