

ENVIRONMENTAL RADIOMETRIC SURVEYS
MOBIL OIL CORPORATION
IN SITU URANIUM PROJECT
MCKINLEY COUNTY, NEW MEXICO

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1.0 INTRODUCTION

Under a Term Contract with Mobil Oil Corporation (No. EMD 3910), Camp Dresser & McKee Inc. (CDM) is to provide certain environmental and laboratory services to Mobil Oil at their In Situ Uranium Leaching Project in McKinley County, New Mexico approximately six miles northwest of Crownpoint, New Mexico in Section 9 of T17N, R13W. The particular services to be performed are described in detail in the executed contract and include monitoring well and wastewater, radon gas, soils, gamma radiation, alpha contamination, personnel bioassay and dosimetry.

A first baseline survey of the Crownpoint Section 9 site was conducted by CDM during April 1979. A report of this April survey was issued in October 1979.

A second baseline survey was carried out during the week of October 15, 1979. A third survey was carried out during the week of November 12, 1979, approximately one week after start-up of in situ leaching operations. A fourth survey was conducted at the site during the week of December 10, 1979. These surveys, in accordance with the contract terms, will be conducted by CDM on a continuing monthly basis.

The following material presents the results of the monthly surveys at the Crownpoint site for the period October 1979 through April 1980.

Figure 1-1 shows the project site and identifies the locations used for the radiometric surveys. The following tables, figures and discussions present the results of the October 1979 through April 1980 surveys. The analytical procedures used were as described in material previously provided to Mobil by CDM and in the Radiation Protection Manual submitted by Mobil to the New Mexico Environmental Improvement Agency.

well hole flush
 injection well
 6-10-81 Start

EXPLANATION
 MW Monitor well
 P Production well
 I Injection well



MOBIL CROWNPOINT
 SECTION 9 PROJECT SITE

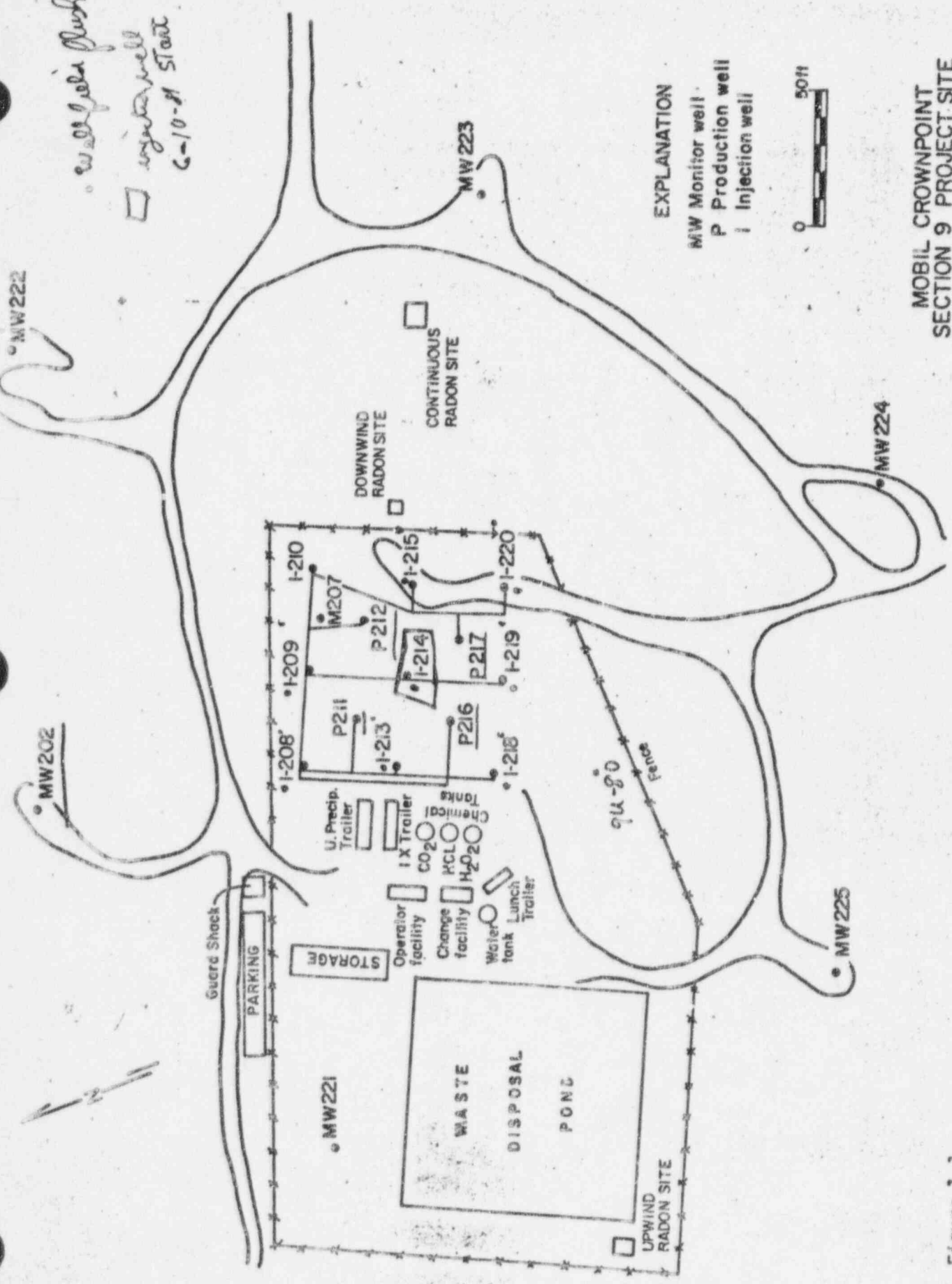


Figure 1-1

Table 2-1, 2-2, and 2-3 present the results of October, December 1979, and January 1980 uranium levels (as U_3O_8) in urine samples collected from individuals working at the well field and plant site. As can be seen from the tables, all of the 116 samples except one were at or less than the detection limit of 5 μg uranium per liter. These levels are considered to be at background levels and indicate no elevated exposure to uranium.

No urine samples have been received for uranium analysis since the January samples.

3.0 PERSONNEL DOSIMETRY

During the October survey, Thermoluminescent Dosimeters (TLDs) were given to Mobil well field and production plant workers along with "control" TLDs. During the period October 9, 1979 to January 28, 1980 no detectable exposures were recorded by the TLDs worn by the workers. During the calendar year January 1 to December 31, 1979 all TLDs worn by the workers showed less than 0.010 Rem exposure.

Table 3-1 presents the TLD results for the October 9, 1979 - January 28, 1980 period and Table 3-2 presents the calendar year 1979 summary.

Tables 3-3 and 3-4 present the TLD results for the periods January 1 through March 31, 1980 and February 1 through April 8, 1980. These results indicate no significant personnel radiation exposure.

4.0 RADIATION SURVEYS

4.1 Radon

Table 4-1 presents the results of grab air samples for analysis of radon-222 at four locations on the site where work personnel are located, one grab sample upwind at the site boundary and one grab sample approximately 30 feet downwind of the site boundary.

As can be seen from the table, the radon values have been generally the same from month to month. The December, January, and February values are slightly elevated which may reflect the beginning of yellow-cake production. They are still considered to be low meteorological influences on the variability of results are not significant.

Table 4-1 Atmospheric Radon Grab Samples

SAMPLE LOCATION	RADON-222 CONCENTRATIONS (pCi/l)						
	OCTOBER 17, 1979	NOVEMBER 14, 1979	DECEMBER 12, 1979	JANUARY 22, 1980	FEBRUARY 20, 1980	MARCH 24, 1980	APRIL 23, 1980
Base of Ion Exchange Column	0 ± 0.09	0.03 ± 0.12	0 ± 0.27	1.07 ± 0.38	0.34 ± 0.43	0	0.15 ± 0.37
Top of Ion Exchange Column	0.30 ± 0.37	0 ± 0.25	0.97 ± 0.44	2.10 ± 0.50	-	0	0
NE Corner of Waste Pond	0 ± 0.25	0 ± 0.30	0.03 ± 0.40	0.36 ± 1.58	0.57 ± 0.41	0	0
Center of Well Pattern	0 ± 0.24	0 ± 0.28	0.17 ± 0.19	1.00 ± 0.48	0.53 ± 0.46	0	0
Downwind of Site	0 ± 0.21	0 ± 0.25	0 ± 0.31	1.51 ± 1.19	0.43 ± 0.59	0	0
Upwind of Site	0 ± 0.24	0 ± 0.17	0 ± 0.36	1.80 ± 1.10	0.07 ± 0.20	0	0
Wellhead Shack	-	-	-	-	1.30 ± 0.61	0	0
Compressor Shack Next to IX Column	-	-	-	-	0.06 ± 1.61	0	0

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

4.2 Radon Progeny

At each of the six sites where grab air samples were taken for radon-222 determinations, a five-minute air particulate sample was taken for radon progeny determinations. These samples were taken using a calibrated air pump at a flow of two liters per minute. Table 4-2 presents the results of the radon progeny analyses for the monthly surveys.

The results shown in Table 4-2 reflect natural background levels and are consistent with the levels found during the April 1979 survey.

4.3 Air Particulate Sample

Eight-hour particulate samples were collected during the monthly surveys at the yellowcake slurry packaging station. These samples were collected for a continuous eight hours at a flow rate of 30 liters per minute. The results of these three samples were all less than 1 pCi/l of gross alpha activity.

Table 4-2 Results of Radon Progeny Samples

SAMPLE LOCATION	OCTOBER 1979		NOVEMBER 1979		DECEMBER 1979	
	DPM/LITER	WORKING LEVEL	DPM/LITER	WORKING LEVEL	DPM/LITER	WORKING LEVEL
Base of Ion Exchange Column	0.24 ± 0.16 ^a	1.6 × 10 ⁻³	0.17 ± 0.08	9.3 × 10 ⁻³	0.43 ± 0.45	5.2 × 10 ⁻³
Top of Ion Exchange Column	1.01 ± 0.41	10 × 10 ⁻³	0.21 ± 0.05	11.6 × 10 ⁻³	0.64 ± 0.63	10.2 × 10 ⁻³
NE Corner of Waste Pond	1.04 ± 0.42	18.9 × 10 ⁻³	0.46 ± 0.10	25.6 × 10 ⁻³	0.77 ± 0.60	9.4 × 10 ⁻³
Center of Well Pattern	1.01 ± 0.41	9.2 × 10 ⁻³	0.59 ± 0.12	14.0 × 10 ⁻³	0.43 ± 0.49	6.2 × 10 ⁻³
Downwind of Site	1.6 ± 0.52	14.5 × 10 ⁻³	0.36 ± 0.08	23.3 × 10 ⁻³	0.64 ± 0.58	10.7 × 10 ⁻³
Upwind of Site	1.16 ± 0.44	20.7 × 10 ⁻³	0.13 ± 0.03	16.3 × 10 ⁻³	0.68 ± 0.62	5.8 × 10 ⁻³

SAMPLE LOCATION	JANUARY 1980		FEBRUARY 1980		MARCH 1980		APRIL 1980	
	DPM/LITER	WORKING LEVEL	DPM/LITER	WORKING LEVEL	DPM/LITER	WORKING LEVEL	DPM/LITER	WORKING LEVEL
Base of Ion Exchange Column	0.7	5.3 × 10 ⁻³	0.3	2.3 × 10 ⁻³	2.2	17 × 10 ⁻³	0.7	5.4 × 10 ⁻³
Top of Ion Exchange Column	1.2	9.1 × 10 ⁻³	-	-	0	0	0	0
NE Corner of Waste Pond	0	0	0.1	0.8 × 10 ⁻³	2.9	22 × 10 ⁻³	0	0
Center of Well Pattern	0	0	0.2	1.6 × 10 ⁻³	2.9	26 × 10 ⁻³	0.2	1.7 × 10 ⁻³
Upwind of Site	0	0	0.2	1.6 × 10 ⁻³	4.2	40 × 10 ⁻³	0.4	3.4 × 10 ⁻³
Downwind of Site	0	0	0	0	0	0	0	0

^aVariability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

4.4 Alpha Contamination Survey

Tables 4-3, 4-4, 4-5 and 4-6 present the results of alpha contamination surveys at the project site during the monthly surveys. From these tables it can be seen that all values found are at or below background levels. The results are consistent with those found during the April 1979 survey.

4.5 Gamma Surveys

During the October survey at the project site 44 gamma survey readings were taken at various locations. These readings were taken at ground level and at waist height (approximately three feet). Figure 4-1 presents the ground level readings which were obtained at the site. Table 4-7 presents the average of gamma readings for several groupings of locations at the site for the October survey.

Tables 4-8 and 4-9 present the gamma readings obtained at the site during the February, March, and April 1980 surveys. The gamma levels shown in Tables 4-7, 4-8 and 4-9 are higher than the values found during the April 1979 survey but they are within background levels. The dose rate values shown in the tables can be compared to natural background dose rate at various locations in the United States. Table 4-10 presents such a comparison. The radiation dose rate at the Crownpoint site is about three times the U.S. average and about twice the Colorado Eastern Slope average dose rate.

Table 4-3 Alpha Contamination Survey (October 15, 1979)

TIME	SAMPLE LOCATION	LOCATION #	SWIPE FILTER #	SURFACE ACTIVITY CPM	REMOVABLE ACTIVITY CPM
0945	Operator Trailer-Workbench	1	1	12	7
0945	Operator Trailer-Control Panel Desk	1	2	6	8
0945	Operator Trailer-W. Bottle Stand	1	3	7	2
0950	Background			5	
0955	Change Trailer-West Sinks	2	4	4	6
0955	Change Trailer-East Sinks	2	5	3	3
0955	Change Trailer-South Toilet	2	6	7	5
1000	Change Trailer-Urinal	2	7	7	2
1000	Change Trailer-Washer Top	2	8	10	9
1000	Change Trailer-Dryer Top	2	9	1	6
1030	Ion Exchange Trailer-H. Rail	3	10	17	1
1030	Ion Exchange Trailer-Control Box	3	11	6	5
1030	Ion Exchange Trailer-Tank Rail	3	12	5	7
1030	Precipitation Trailer-S. Entry Rail	4	13	5	13
1030	Precipitation Trailer-Tank Instr.	4	14	4	7
1035	Precipitation Trailer-Y. Cake Loading	4	15	10	6
1100	Guard Shack Desk	5	16	10	5
1115	NW Injection Well	6	17	4	12
1115	NE Injection Well	6	18	3	8
1115	SE Injection Well	6	19	5	8
1115	SW Injection Well	6	20	0	7

Table 4-4 Alpha Contamination Survey (November 15, 1979)

TIME	SAMPLE LOCATION	LOCATION	SWIPE FILTER μ	SURFACE ACTIVITY CPM	REMOVABLE ACTIVITY CPM
	Operator Trailer-Workbench	1	1	3	3
	Operator Trailer-Control Panel Desk	1	2	1	1
	Operator Trailer-W. Bottle Stand	1	3	4	0
	Background			3	
	Change Trailer-West Sinks	2	4	1	3
	Change Trailer-East Sinks	2	5	1	0
	Change Trailer-Urinal	2	6	3	0
	Change Trailer-Washer Top	2	7	2	5
	Change Trailer-Dryer Top	2	8	1	4
	Ion Exchange Trailer-H. Rail	3	9	5	1
	Ion Exchange Trailer-Control Box	3	10	7	0
	Precipitation Trailer-Y. Cake Loading	4	11	8	4
	Guard Shack Desk	5		1	2
	Lunch Trailer Table	6	13	12	3
	Injection Well 209	6	14	6	3
	Injection Well 214	6	15	3	6

Table 4-5 Alpha Contamination Survey (December 13, 1979)

SAMPLE LOCATION	LOCATION #	SWIPE FILTER #	SURFACE ACTIVITY CPM	REMOVABLE ACTIVITY CPM
Operator Trailer-Workbench	1	1	4	3
Operator Trailer-Control Panel Desk	1	2	0	2
Operator Trailer-Bookcase	1	11	5	1
Background			16	
Change Trailer-West Sinks	2	3	6	1
Change Trailer-East Sinks	2	4	2	0
Change Trailer-Urinal	2	5	3	3
Change Trailer-Washer Top	2	6	1	2
Change Trailer-Dryer Top	2	7	1	1
Ion Exchange Trailer-Control Box	3	8	10	0
Precipitation Trailer-Y. Cake Loading	4	9	12	1
Guard Shack Desk	5	10	3	3
Lunch Trailer Table	6	12	0	4
Ion Exchange Trailer Steps	7	13	8	4
Injection Well 209	8	14	10	3
Injection Well 214	8	15	4	0

Table 4-6 Alpha Contamination Survey (January 22, 1980, February 23, 1980, March 24, 1980, and April 23, 1980)

SAMPLE LOCATION	JANUARY 22, 1980		FEBRUARY 23, 1980		MARCH 24, 1980	APRIL 23, 1980
	REMOVABLE ACTIVITY, CPM	TOTAL ACTIVITY CPM	REMOVABLE ACTIVITY, CPM	REMOVABLE ACTIVITY, CPM	REMOVABLE ACTIVITY, CPM	REMOVABLE ACTIVITY, CPM
Operators Workbench	0.7	5	2	7	2.1	
Operators Bookcase	0	3	2	3	0.4	
Process Trailer Desk	0	7	1	3	4.1	
Top of Washer	0	7	1	0	4.1	
Top of Dryer	0	3	2	1	0	
North Sink	0	3	0	7	2.1	
South Sink	0	0	2	0	0	
Urinal	0	0	2	11	2.1	
Lunch Trailer Table	0	1	0	2	0.1	
Trailer A Steps	6	11	2	4	-	
Trailer A Inst. Panel	4	5	3	20	-	
Yellowcake Loading Area	4	4	0	4	15	
Monitor Well 214	4	14	3	0	18	
Monitor Well 209	0	14	2	0	21	
Guard Shack	0	2	2	3	4	
Well Head Shack N	-	-	1	1	1	
Well Head Shack S	-	-	3	-	-	
Well Head Shack Center	-	-	2	-	-	
1 X Column N	-	-	2	-	-	
1 X Column S	-	-	2	-	-	
West Berm Area	-	-	2	-	-	
East Berm Area	-	-	3	-	-	
Yellowcake Drum Area	-	-	1	-	-	
			3	-	-	

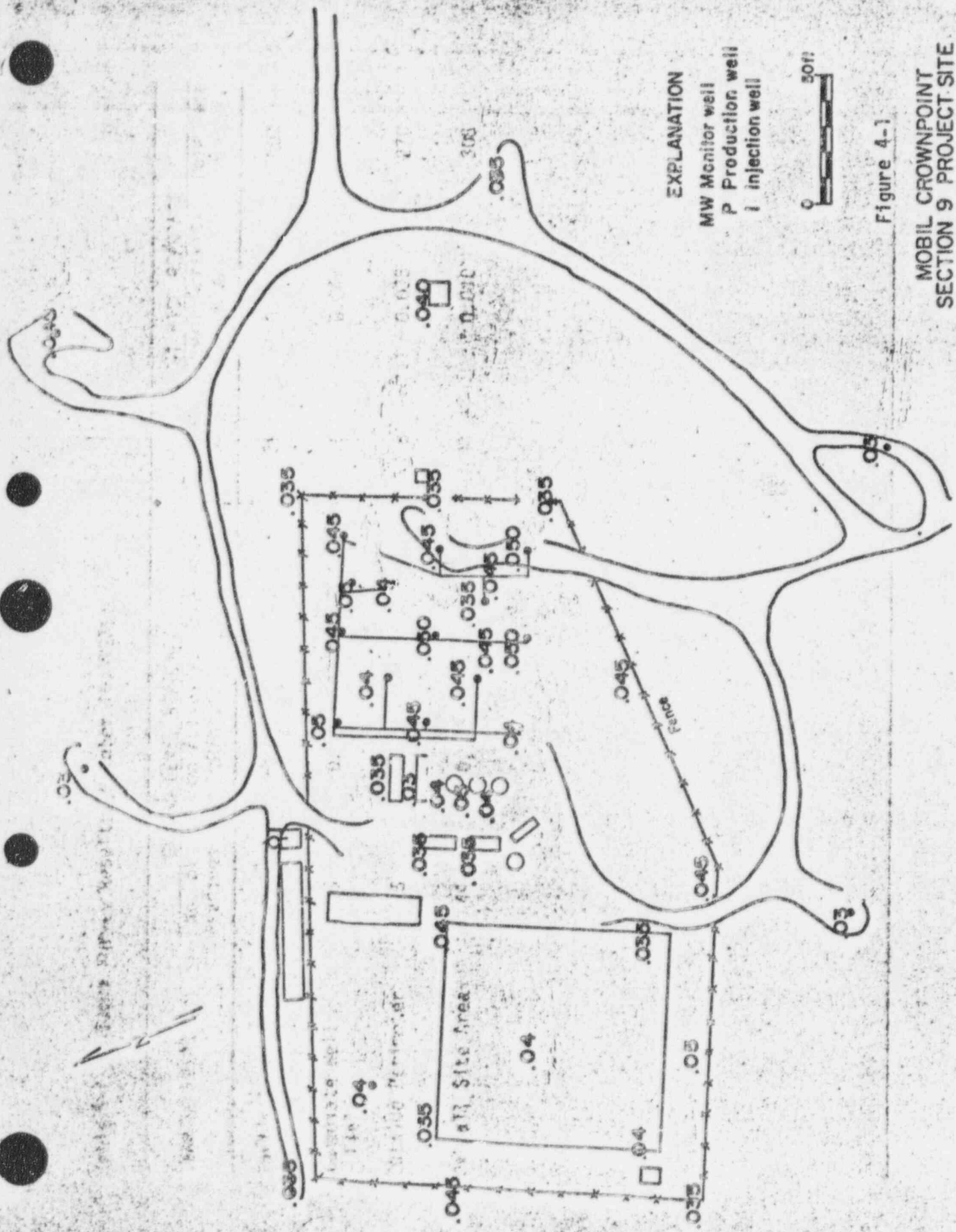


Table 4-7 Gamma Survey Results (October 16, 1979)

SAMPLE LOCATION	GROUND LEVEL READINGS			WAIST HIGH READINGS		
	No. of Readings	Gamma Activity mR/hr.	Dose Rate mrem/yr.	No. of Readings	Gamma Activity mR/hr.	Dose Rate mrem/yr.
Inside Perimeter Fence	39	0.046	355	39	0.040	308
Immediate Well Field	16	0.048	370	16	0.045	347
Outside Perimeter Fence	5	0.037	285	5	0.035	270
Overall Site Area	44	0.045	347	44	0.040	308

Table 4-8 Gamma Survey Results (February and April 1980)

LOCATION	FEBRUARY 1980		APRIL 1980	
	Waist High mR/hr	Dose Rate mrem/yr	Waist High mR/hr	Dose Rate mrem/yr
West Brim NW Corner	0.03	232	0.04	309
" " NE Corner	0.05	385	0.03	232
" " Center	0.05	385	0.05	385
" " SW Corner	0.09	695	0.05	385
" " SE Corner	0.05	385	0.06	463
East Brim NW Corner	0.04	309	0.02	154
" " NE Corner	0.05	385	0.04	309
" " Center	0.06	463	0.04	309
" " SW Corner	0.05	385	0.05	385
" " SE Corner	0.04	309	0.03	232
Wellhead Shack NW Corner	0.05	385	0.05	385
" " NE Corner	0.05	385	0.07	540
" " Center	0.06	463	0.06	463
" " SW Corner	0.06	463	0.03	232
" " SE Corner	0.07	540	0.03	232
Yellowcake Spill Area	0.06	463	0.04	309
" Packaging	0.09	695	0.06	463
Compressor Shack to Side Detrailer 2	0.07	540	0.07	540
Ion Exchange Column Top Platform	0.095	733	0.08	617
1 X Column - Base	0.11	849	0.10	772
" " - Ground Area	0.075	579	0.06	463

Table 4-9 Gamma Survey Results (March 1980)

LOCATION	MARCH 1980	
	Waist High mR/hr	Dose Rate mrem/yr
Yellowcake Area	0.14	1080
Yellowcake Spill Area	0.05	385
1 X Column Base	0.07	540
Operator Building	0.04	309
Wellhead Shack Near Fence	0.05	385

Table 4-10 Natural Background Radiation Dose Rates

SOURCE	U.S. (AVERAGE)	COLORADO EASTERN SLOPE
Cosmic Radiation	44 mrem/yr.	90 mrem/yr.
Terrestrial	40 mrem/yr.	46 mrem/yr.
Internal (K-40)	18 mrem/yr.	18 mrem/yr.
TOTAL	102 mrem/yr.	154 mrem/yr.

Crownpoint, New Mexico Radiation Dose Rate: 347 mrem/yr.

Colorado Energy Resources Handbook, Volume 3: Uranium, Colorado School of Mines, December 1977.

4.6 Monitor Wells

Samples of ground water have been collected during each monthly survey from three monitor wells at the project site for radiometric analyses. Waste pond water was collected monthly beginning in November. Table 4-11 presents the results. It can be seen that there is a steady increase in the radionuclide concentrations in the three monitor wells from October 1979 through March 1980. The site waste pond also had significantly increased radiometric concentrations beginning in November.

Table 4-11 Radioactivity Concentrations in Water Samples (pCi/l \pm Precision*)

SAMPLING LOCATION AND RADIONUCLIDE	OCTOBER 1979	NOVEMBER 1979	DECEMBER 1979	JANUARY 1980	FEBRUARY 1980
Monitor Well 221					
Radium-226	1.8 \pm 1.2	2.1 \pm 1.2	4.9 \pm 1.9	8.4 \pm 4.0	8.6 \pm 2.7
Thorium-230	0.0 \pm 0.4	1.3 \pm 0.6	0.0 \pm 0.3	1.0 \pm 0.6	1.0 \pm 0.7
Uranium (as U, mg/l)	<0.002	<0.002	0.007	0.27	0.073
Lead-210	0.4 \pm 0.6	0.7 \pm 0.9	4.1 \pm 3.4	9.4 \pm 3.8	10.8 \pm 3.6
Monitor Well 222					
Radium-226	0.1 \pm 0.3	0.3 \pm 0.3	2.9 \pm 1.7	14 \pm 5	0.8 \pm 0.5
Thorium-230	0.0 \pm 0.5	0.0 \pm 0.3	0.0 \pm 0.3	0.7 \pm 0.5	0.0 \pm 0.4
Uranium (as U, mg/l)	<0.002	<0.002	0.005	0.05	0.001
Lead-210	0.2 \pm 0.7	0.0 \pm 0.9	2.9 \pm 3.1	880 \pm 20	1.7 \pm 3.3
Monitor Well 224					
Radium-226	2.2 \pm 1.3	0.7 \pm 0.4	3.6 \pm 1.5	53 \pm 10	8.5 \pm 2.7
Thorium-230	0.0 \pm 0.4	1.5 \pm 0.6	0.0 \pm 0.3	2 \pm 0.8	0.2 \pm 0.5
Uranium (as U, mg/l)	<0.002	<0.002	0.004	0.32	0.17
Lead-210	0.6 \pm 0.6	1.1 \pm 1.2	5.4 \pm 4.0	21 \pm 5	6.6 \pm 3.4
Waste Pond					
Radium-226	-	1.4 \pm 1.1	14 \pm 4	96 \pm 13	102 \pm 1
Thorium-230	-	0.5 \pm 0.4	19 \pm 2	122 \pm 6	350 \pm 10
Uranium (as U, mg/l)	-	0.008	4.7	30	37
Lead-210	-	0.5 \pm 1.0	200 \pm 10	850 \pm 20	74 \pm 8

*Variation of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96 σ .

4.7 Continuous Radon-222 Samples

Continuous 48-hour sampling for radon-222 has been carried out at three sites: an upwind and downwind site and a site in the center of the well field. The results are presented in Table 4-12. The values shown are consistent with the April 1979 baseline summary and do not indicate elevated levels of ambient radon-222.

Table 4-12 Forty-eight Hour Radon-222 Air Samples

<u>SAMPLING SITE</u>	<u>DATE</u>	<u>RADON CONCENTRATION</u> (pCi/l)
Upwind	October, 1979	0 + 1.08*
	November, 1979	0 + 3.15
	December, 1979	0 + 1.65
	January, 1980	3.46 + 0.73
	February, 1980	0.51 + 0.56
	April, 1980	0 + 0.51
	April, 1980	0.1 + 0.50
Downwind	October, 1979	0 + 1.43
	November, 1979	0 + 2.87
	December, 1979	0.53 + 2.12
	January, 1980	5.37 + 1.14
	April, 1980	0 + 0.57
	April, 1980	0.30 + 0.60
	April, 1980	0.20 + 0.80
Center of Well Field	October, 1979	0 + 1.13
	November, 1979	0 + 1.77
	December, 1979	0 + 1.63
	January, 1980	5.04 + 0.86

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

4.8 Surface Soil Samples

Twenty surface soil samples were collected at the site during the November 1979 survey. Table 4-13 lists the locations at the site where surface soil samples were collected and Figure 4-2 shows these locations on a site map. Table 4-14 presents the radionuclide concentrations in the surface soil samples. In addition three soil samples were collected at the site during the February 1980 survey. These results are shown in Table 4-15. From these tables it can be seen that the radioactivity levels are within background levels for the area soils and do not vary significantly over the site area.

Table 4-13 Surface Soil Sampling Locations (November 15, 1979)
Mobil Crownpoint Section 9 Site

Sample Designation	Location
SS-1	Production Well 211
SS-2	Production Well 212
SS-3	Production Well 216
SS-4	Production Well 217
SS-5	Injection Well 214
SS-6	Northeast Corner of Site
SS-7	Middle of East Fence
SS-8	Middle of Southeast Fence, Northwest of Monitor Well 224
SS-9	South Fence Corner, Northeast of Monitor Well 225
SS-10	Southwest Fence Corner
SS-11	Northwest Fence Corner
SS-12	Behind Storage at Contaminated Pipe Area
SS-13	Inside Fence at Guard Station
SS-14	Northwest Corner of Processing Pad Area
SS-15	Northeast Corner of Processing Pad Area
SS-16	Between Trailers A and B in Processing Pad Area
SS-17	West at Edge of Trailer A (ix columns)
SS-18	South Edge of Trailer A
SS-19	West Behind HCI Tank
SS-20	Entrance of Influent Pipe to Waste Pond

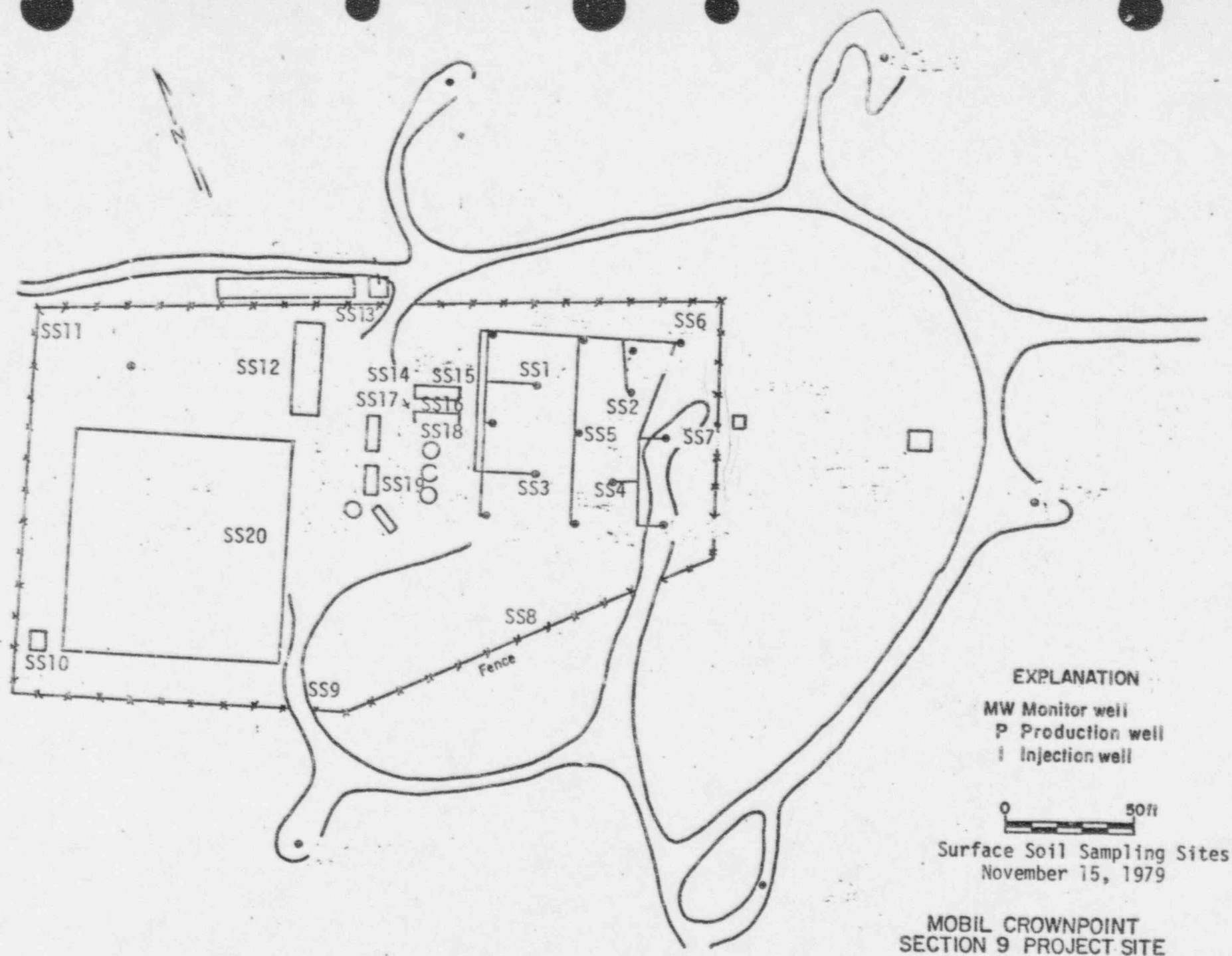


Table 4-14 Radionuclide Concentrations of Surface Soils
Mobil Crownpoint Section 9 Project Site (November 15, 1979)

SAMPLING LOCATION	Radium-226 pCi/g	Thorium-230 pCi/g	Lead-210 pCi/g	Uranium % U_3O_8
SS-1	1.1 ± 1.3*	5.7 ± 0.8	1.1 ± 2.8	0.0006
SS-2	1.6 ± 1.4	5.8 ± 0.8	0.0 ± 3.0	0.0004
SS-3	0.7 ± 1.4	6.2 ± 0.9	0.9 ± 2.8	0.0009
SS-4	1.0 ± 1.4	5.1 ± 0.8	0.0 ± 2.2	0.0008
SS-5	2.0 ± 1.8	3.7 ± 0.7	1.4 ± 2.5	0.0008
SS-6	0.7 ± 1.1	3.2 ± 0.6	0.8 ± 2.4	0.0004
SS-7	0.5 ± 1.4	4.1 ± 0.7	0.4 ± 2.8	0.0004
SS-8	1.0 ± 1.5	3.2 ± 0.6	0.7 ± 2.6	0.0003
SS-9	0.4 ± 1.4	4.1 ± 0.7	2.7 ± 2.2	0.0003
SS-10	0.5 ± 1.2	2.6 ± 0.6	0.0 ± 4.0	0.0004
SS-11	0.4 ± 1.3	3.9 ± 0.7	1.2 ± 1.9	0.0002
SS-12	0.9 ± 1.2	3.5 ± 0.7	1.6 ± 2.2	0.0002
SS-13	1.4 ± 1.4	3.9 ± 0.7	0.0 ± 2.4	0.0002
SS-14	0.8 ± 0.5	0.7 ± 0.3	0.0 ± 2.9	0.0002
SS-15	0.8 ± 0.4	1.3 ± 0.4	0.0 ± 3.7	0.0002
SS-16	0.2 ± 1.0	0.6 ± 0.3	0.0 ± 3.6	0.0002
SS-17	0.8 ± 0.5	1.0 ± 0.4	0.0 ± 5.4	0.0004
SS-18	0.9 ± 0.5	0.7 ± 0.3	0.0 ± 3.5	0.0004
SS-19	1.0 ± 1.1	2.9 ± 0.6	0.5 ± 5.0	0.0004
SS-20	0.6 ± 1.4	3.9 ± 0.7	0.2 ± 2.2	0.0003
AVERAGE	0.87 ± 1.2	3.3 ± 0.6	0.6 ± 3.0	0.004 0.0004

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

Table 4-15 Surface Soil Samples (February 19, 1980)

	pCi/g		
	New East Berm Area Center	New West Berm Area Center	Yellowcake Area
Radium-226	1.1 \pm 1.0	0.8 \pm 0.9	0.7 \pm 0.5
Uranium (U_3O_8), %	0.0002	0.0004	0.0020
Thorium-230	0.5 \pm 0.3	0.4 \pm 0.3	1.2 \pm 0.4
Lead-210	1.1 \pm 2.0	0.0 \pm 2.3	0.0 \pm 1.8
Gross Alpha	8.6 \pm 5.1	11.5 \pm 5.5	40 \pm 10
Gross Beta	29 \pm 16	14 \pm 15	26 \pm 15

Except for the ground-water samples collected from the three monitor wells, the results presented in this report from the monthly surveys show no significant elevations of radioactivity levels above expected natural background. The data from the monitor wells would suggest some movement of radioactive materials from the mine well field to the monitor wells. Other survey data are consistent with the levels reported for the April 1979 survey which was carried out prior to start-up of in situ leaching.

mw 222

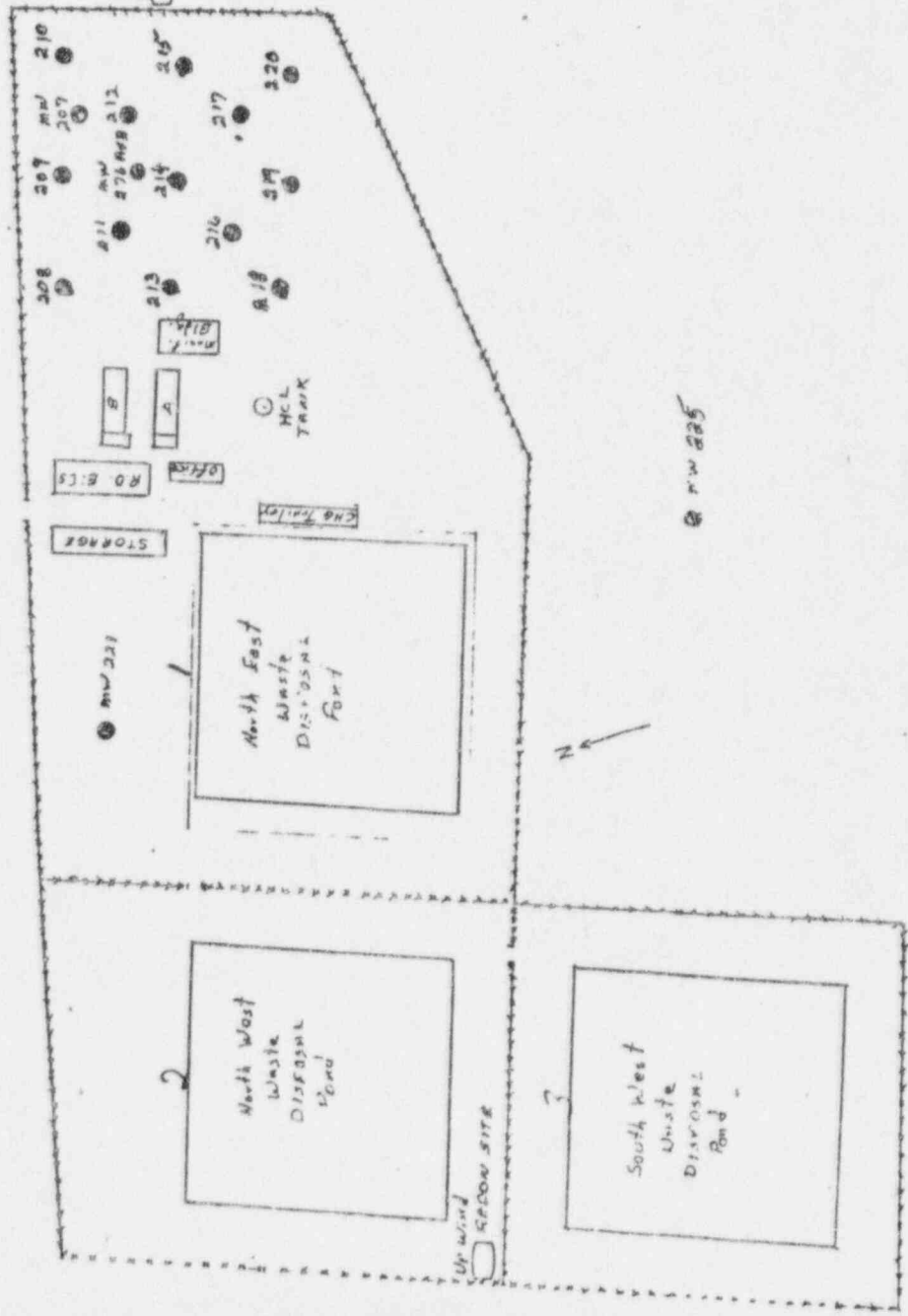
mw 202

mw 219
mw 278
mw 280
mw 273

mw 223

mw 224

mw 225



ATTACHMENT 3

RADIATION PROTECTION PROGRAM

PERSONNEL HEALTH AND SAFETY

Training

Each site employee, both process and administration personnel, will receive a briefing of approximately one hour's duration. Topics discussed during this orientation include:

- A. Plant processes
- B. Radiation dose limits
- C. Inhalation of radon and progeny
- D. Internal deposition of uranium
- E. Radiation protection manual

A copy of the radiation protection manual is available for employee review and will be maintained by the facility radiation safety officer.

Additional written instructions is provided to each employee who is required to work in the process operations. The following represents general instructions that will be given in written form:

Prior to working in the process area, you must receive a briefing on use of equipment for personal protection in this area. Every effort shall be made to keep from spreading any material that may be spilled. Eating or smoking is prohibited. Uranium slurry spills shall be cleaned up

promptly. Prior to eating, smoking or going home, you shall wash your hands. As an additional procedure to verify adequate control, you shall be asked to submit periodic urine samples to detect any uranium uptake through inhalation samples to detect any uranium uptake through inhalation or ingestion. By following these written and other verbal instructions, persons working with uranium can do so safely. If you have any questions about the radiological safety program or any potential hazard to yourself or others ask your supervisor.

Upon completion of his orientation, each employee will sign a statement certifying his understanding of the topics discussed and his receipt of pertinent written instructions.

RADIATION PROTECTION PROGRAM

General

The radiation protection program is based on need as determined by environmental programs to date, project plans, projected impacts and applicable health and safety regulations and standards.

Surveys to date have demonstrated that since discontinuing the pumping of solution from the well field, Radon and Radon progeny levels have been reduced to background levels. Additionally, alpha contamination surveys have indicated no areas in excess of limits for unrestricted areas.

Gamma Exposure rates also are background (less than 30 micro R/hr) throughout the site, with the exception of three process tanks. The exposure rates at 1' from these tanks is less than 1 mR/hr.

Responsibility for control of potentially hazardous conditions is that of the RSO.

The RSO will ensure that all personnel under his operational influence involved in activities with radioactive materials are properly trained, which includes familiarity with the procedures, recommendations and standards set forth in the Radiation Protection Manual. This manual attempts to present in

a general format basic health physics considerations pertinent to operations. Visiting personnel will be familiarized with pertinent information contained within this manual by the radiation a safety officer prior to entry into restricted areas.

BASIC RADIATION PROTECTION PROGRAM

Inhalation or ingestion of uranium or its particulate daughters is an occupational exposure pathway of primary importance. Additionally, some direct radiation exposure to personnel could occur from tanks and filters which accumulate and concentrate radioactive materials.

Inhalation of suspended dusts of uranium or other long-lived alpha emitting radionuclides is not a probable hazard. These dusts would originate from processing equipment and become airborne by drying and suspension. However, internal deposition and bioassay programs will be retained in order to monitor such exposures.

In addition, release surveys for fixed and removable alpha contamination will monitor and demonstrate alpha contamination levels during the decommissioning of the site.

Direct radiation exposure to personnel from tanks and sand filters is expected to be a small fraction of the applicable occupational exposure limits. However, employees who work in the process area will be issued thermal luminescent dosimeter (TLD) dosimetry badges. The badge will estimate external radiation dose equivalent (skin and whole body) to each person. The exact number of persons to whom badges will be issued is expected to be less than ten.

Employees who work in the process area will be issued TLD badges. The badges will be changed and read quarterly to estimate external radiation does equivalent to each person. The exact number of persons to whom badges will be issued has not been established but is expected to be less than ten. Results will be recorded in total does equivalent (mrem) to the skin (penetrating plus non-penetrating) and does equivalent of penetrating radiation to the total body.

INTERNAL DISPOSITION AND BIOASSAY

Employees who work routinely in the process area will submit urine samples (single voiding) once every two weeks. Maintenance personnel who work occasionally in the process area will submit urine samples if air particulate sampler results indicate exposure above 40 MPC-hours/week. Urine samples will be collected from any employee when a potential uptake has occurred due to a spill or some other similar incident. Each sample will be analyzed fluorometrically for uranium. No use of respiratory protective equipment is required.

CONTAMINATION SURVEYS

Contamination surveys will be performed as articles are surveyed for release to uncontrolled areas.

A record of contamination surveys will be maintained in terms of dmpm/100 cm² total and removable alpha activity. Total alpha activity will be monitored using an alpha survey meter. Removable alpha activity will be monitored by dry swipes counted in an Eberline SAC-4 or equivalent.

PROJECT SAFEGUARDS

General

The portable plant is designed to meet all OSHA and other applicable requirements. Safety-shower eye wash stations and fire extinguishers will be placed at strategic locations on the site. A first-aid kit is located at the operator's trailer. Telephone service is available, and a company vehicle with a two-way radio will be on site for communications. The 12 1/4 KVA portable generator is available in case of line power failure.