

# CONFIRMATORY SURVEY REPORT FOR AREA B1S/B2S

CHEVRON MINING  
WASHINGTON REMEDIATION PROJECT,  
WASHINGTON, PENNSYLVANIA

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Prepared for the  
Office of Federal and State Materials and  
Environmental Management Programs  
U.S. Nuclear Regulatory Commission

  
O R I S E

Oak Ridge Institute for Science and Education

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## **INTRODUCTION**

The U.S. Nuclear Regulatory Commission (NRC) requested the Oak Ridge Institute for Science and Education (ORISE) interface with Pennsylvania Department of Environmental Protection (PADEP) personnel in a joint effort to perform confirmatory radiological surveys of the Chevron Mining Washington Remediation Project (CMWRP) facility in Washington, Pennsylvania (Figure 1). The ORISE confirmatory radiological surveys consisted of gamma scans, soil sampling and the review of available final status survey (FSS) data. PADEP personnel will continue to submit soil samples that they collect to ORISE for analyses. PADEP sample results will be provided to the NRC and PADEP in a separate report so that decisions regarding the radiological status of the surveyed areas can be determined.

ORISE performed radiological surveys during the period of October 2 and 3, 2007. The area available for ORISE radiological survey activities included Area B1S/B2S. The CMWRP final status survey (FSS) scan results for these areas were reviewed prior to ORISE survey activities; CMWRP's site contractor, Malcolm Pirnie (MP), was in the process of collecting the FSS soil samples during ORISE confirmatory survey activities. Figure 2 depicts the CMWRP Areas A through D; ORISE surveys performed during this trip were limited to portions of Area B.

## **PROCEDURES**

Confirmatory surveys conducted by ORISE, in Area B1S/B2S, were performed in accordance with a site-specific survey plan that was submitted to and approved by the NRC (ORISE 2006). The site-specific survey plan follows the guidance provided in the ORISE Survey Procedures and Quality Program Manuals (ORISE 2007a and 2007b).

## **SURFACE SCANS**

### **Area B1S/B2S**

Gamma surface scans were performed on approximately 75% of accessible land areas within Area B1S/B2S using sodium iodide (NaI) scintillation detectors coupled to ratemeters with audible indicators. Due to the elevated gamma radiation levels associated with a soil pile and another adjacent area that had yet to be remediated, the eastern section of these areas were not surveyed by ORISE.

## **SOIL SAMPLING**

### **Background Soil Samples**

Background surface (0 to 0.5 ft) soil samples were collected at six judgmental locations in the immediate vicinity of the CMWRP facility during a previous survey (ORISE 2007c). Background samples were collected since the soil concentration limits for the site are intended to be applied after correcting for natural background radioactivity in soil (MP 2005).

## Area B1S/B2S

ORISE collected 20 judgmental soil samples from Area B1S/B2S based on elevated gamma radiation levels determined by the surface scan results (Figure 3). In order to directly compare soil sample concentrations with MWRP guidelines, ORISE collected a two-foot core sample from each sampling location as specified in the approved technical basis document (TBD) for sampling lifts (MP 2005).

## **SAMPLE ANALYSIS AND DATA INTERPRETATION**

Radiological data and sample media were returned to the ORISE laboratory in Oak Ridge, TN for analysis and interpretation. Radioanalyses were performed in accordance with the ORISE Laboratory Procedures Manual (ORISE 2007d). The soil samples were analyzed by gamma spectroscopy for the primary radionuclides-of-concern [ROC (i.e., Ra-226, thorium and uranium)]. However, spectra were also reviewed for other identifiable total absorption peaks. The soil sample radionuclide concentrations were reported in units of picocuries per gram (pCi/g).

## **FINDINGS AND RESULTS**

### **SURFACE SCANS**

Gamma surface scans identified multiple locations of elevated direct gamma radiation on the excavated soil surface in Area B1S/B2S. Additional investigations determined that the majority of the elevated gamma radiation locations detected were due to slag materials that remained within the excavation. MP personnel removed several pieces of slag and disposed of them as radiological waste.

### **SOIL SAMPLING**

#### Background Soil Samples

Background surface soil concentration ranges and average concentrations are listed in the table below.

<b>Range (and Average) of Radionuclide Concentrations in Background Soil Samples (pCi/g)</b>		
<b>Ra-226</b>	<b>Total Thorium</b>	<b>Total Uranium</b>
0.74 to 1.04 (0.89)	1.33 to 3.05 (2.57)	1.96 to 4.3 (3.0)

A complete listing of the background soil sample radionuclide concentrations is provided in Table 1 of the ORISE report issued on August 30, 2007 (ORISE 2007d).

## Area B1S/B2S

ORISE collected soil samples from eight judgmental sample locations where elevated radiation levels were detected during field scanning. The radionuclide concentration ranges (backgrounds subtracted) for these judgmental samples were as follows:

Range of Radionuclide Concentrations in Judgmental Soil Samples from Area B1S/B2S (pCi/g) <sup>a</sup>		
Ra-226	Total Thorium	Total Uranium
-0.17 to 1.95	-0.22 to 89.4	-1.3 to 9.5

<sup>a</sup>Average backgrounds subtracted.

ORISE also collected four samples from adjacent grid blocks in the same soil sampling layer to determine grid block averaging at three locations (twelve total judgmental samples) within the surveyed areas. The radionuclide concentration ranges (backgrounds subtracted) for the three grid blocks (twelve total judgmental samples) were as follows:

Range of Radionuclide Concentrations in Judgmental Grid Block Soil Samples from Area B1S/B2S (pCi/g) <sup>a</sup>		
Ra-226	Total Thorium	Total Uranium
-0.05 to 5.65	-0.22 to 207	-0.9 to 24.6

<sup>a</sup>Average backgrounds subtracted.

A complete listing of the Area B1S/B2S soil sample radionuclide concentrations is provided in Table 1.

## SUBSURFACE SOIL GUIDELINES COMPARISON

Table 4-2 of MP's TBD, containing the subsurface soil guidelines, is presented as Table 2 in this report (MP 2005). The confirmatory soil sample results from Area B1S/B2S indicated that two judgmental soil samples exceeded the average guideline level of 53.0 and 73.8 pCi/g total thorium at the 8 to 10 and 12 to 14 foot layers (locations 73 and 63, respectively). Sample 73 also exceeded the maximum in layer criteria of 69.2 pCi/g at the 8 to 10 foot layer. The other judgmental sample (sample 63) and the grid block average samples were well below the applicable soil averaging limits.

## SUMMARY

During the period of October 2 and 3, 2007, the Oak Ridge Institute for Science and Education (ORISE) performed confirmatory radiological survey activities which included gamma surface scans within Area B1S/B2S and the collection of soil samples from these areas.

Gamma surface scans identified multiple locations of elevated direct gamma radiation within Area B1S/B2S. Additional investigation of these locations indicated that the majority of the elevated radiation levels were attributable to slag material that remained within the Area B1S/B2S excavation. Several pieces of slag material were removed by CMWRP personnel and ORISE collected soil samples from several of these locations. The soil sample results from these locations indicated residual radium, thorium and uranium concentrations above background levels; at two locations, the total thorium concentrations exceeded the site-specific subsurface averaging criteria. ORISE also collected four samples from adjacent grid blocks for a grid block averaging determination at three locations within the surveyed area. These results were well below the site criteria.

## FIGURES

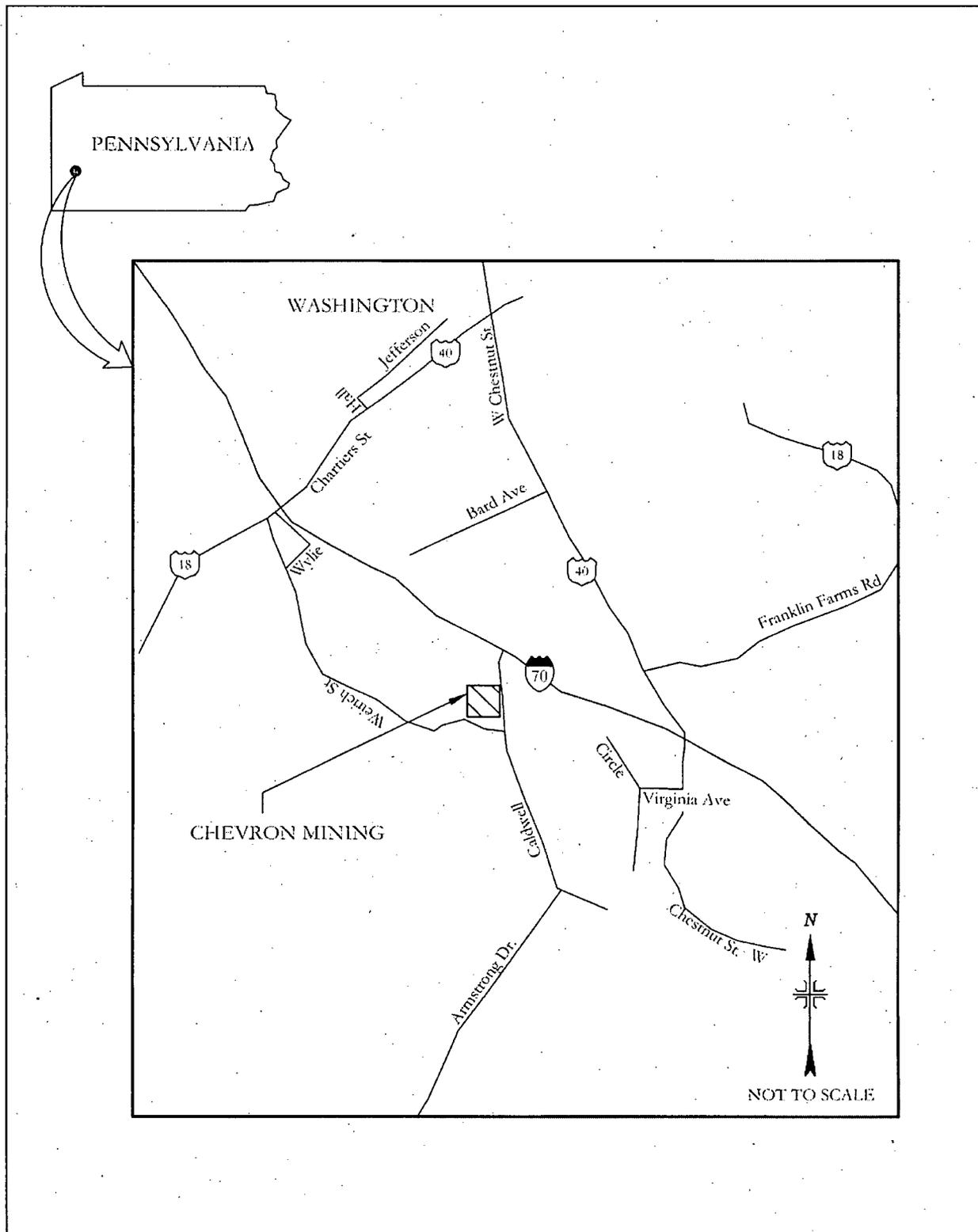


FIGURE 1: Location of Chevron Mining Washington Remediation Project – Washington, Pennsylvania

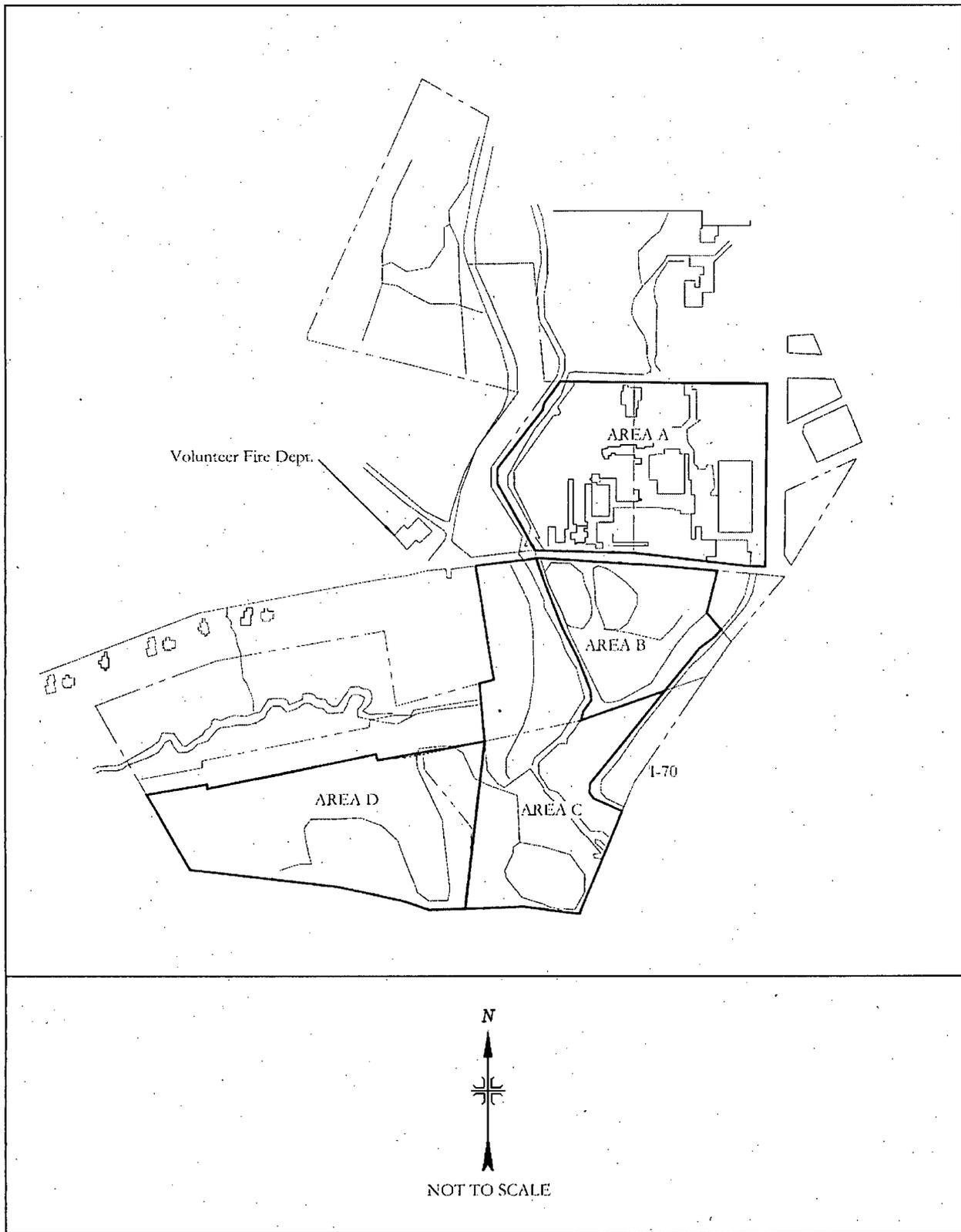


FIGURE 2: Chevron Mining Washington Remediation Project – Plot Plan

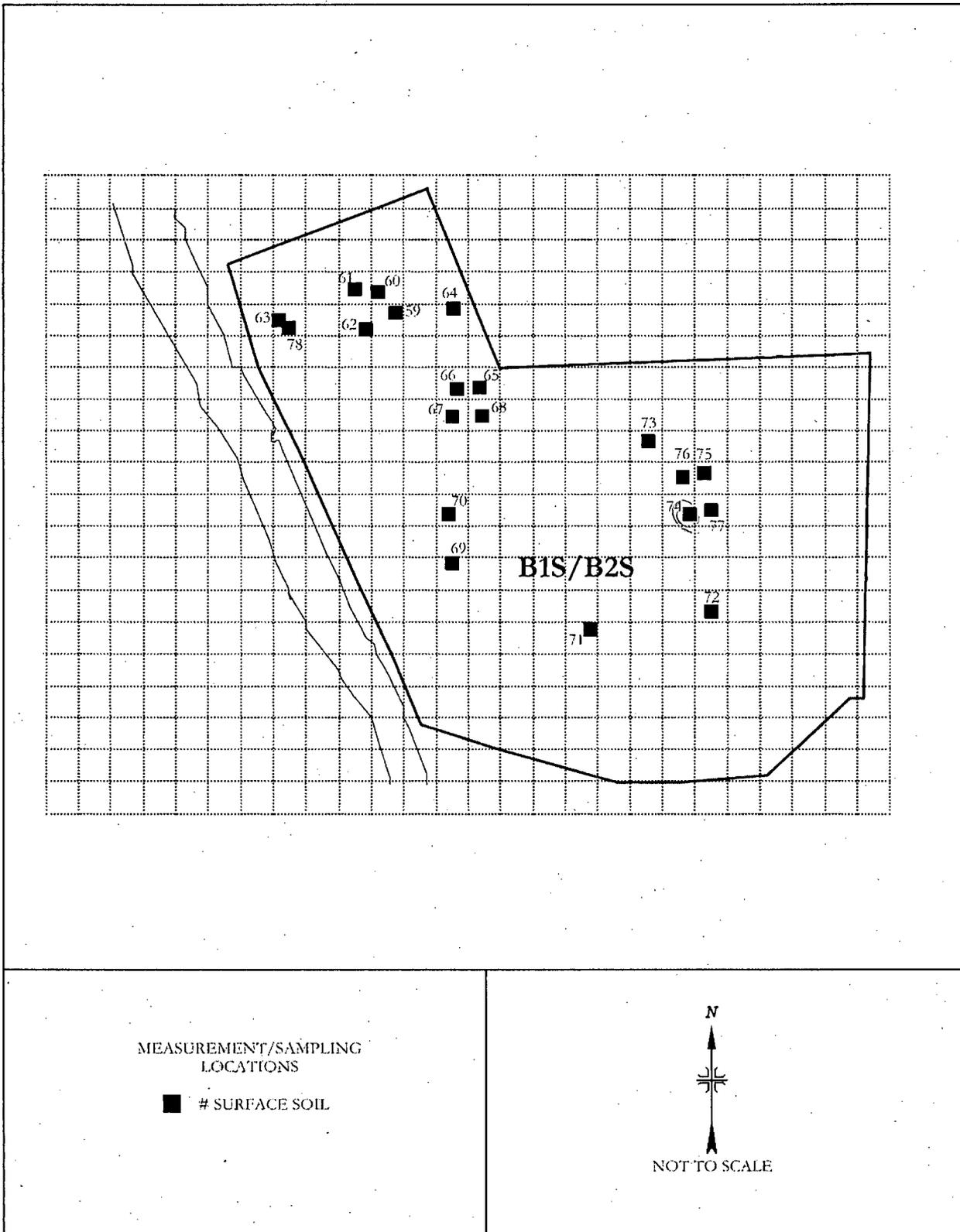


FIGURE 3: Area B1S/B2S – Soil Sampling Locations

## **TABLES**

TABLE 1

**RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES COLLECTED BY ORISE  
FROM AREA B1S/B2S  
CHEVRON MINING WASHINGTON REMEDIATION PROJECT  
WASHINGTON, PENNSYLVANIA**

ORISE Sample ID	Sample Depth (ft) <sup>a</sup>	Radionuclide Concentrations in Soil Samples (pCi/g)						
		Ra-226	Th-228	Th-232	Total Thorium <sup>b</sup>	U-235	U-238	Total Uranium <sup>c</sup>
<b>Background Samples<sup>d</sup></b>								
<i>BKG Average</i>	<i>0 to 0.5</i>	<i>0.89 ± 0.26<sup>e</sup></i>	<i>1.26 ± 0.26</i>	<i>1.31 ± 0.57</i>	<i>2.57 ± 0.62</i>	<i>0.10 ± 0.37</i>	<i>1.5 ± 1.8</i>	<i>3.0 ± 3.6</i>
<b>Area B1S/B2S Judgmental Soil Samples<sup>f,g</sup></b>								
1706S0063	12 to 14	1.95 ± 0.50	43.7 ± 2.6	45.7 ± 3.8	89.4 ± 4.6	-0.21 ± 0.57	4.8 ± 3.4	9.5 ± 6.8
1706S0064	10 to 12	-0.17 ± 0.28	0.33 ± 0.28	0.44 ± 0.60	0.77 ± 0.66	-0.03 ± 0.38	-0.4 ± 1.9	-0.8 ± 3.7
1706S0069	10 to 12	0.33 ± 0.32	3.53 ± 0.40	3.89 ± 0.77	7.42 ± 0.86	-0.05 ± 0.41	1.9 ± 2.2	3.8 ± 4.4
1706S0070	10 to 12	-0.06 ± 0.29	-0.04 ± 0.28	-0.18 ± 0.61	-0.22 ± 0.66	-0.02 ± 0.38	-0.7 ± 1.9	-1.3 ± 3.8
1706S0071	8 to 10	0.03 ± 0.32	2.07 ± 0.34	2.24 ± 0.70	4.31 ± 0.77	-0.08 ± 0.40	-0.5 ± 2.1	-1.0 ± 4.1
1706S0072	6 to 8	0.18 ± 0.28	0.23 ± 0.28	0.32 ± 0.61	0.55 ± 0.67	0.06 ± 0.39	0.1 ± 1.9	0.3 ± 3.8
1706S0073	8 to 10	1.27 ± 0.42	35.0 ± 2.0	35.9 ± 3.1	70.9 ± 3.7	-0.27 ± 0.54	4.0 ± 2.8	7.8 ± 5.5
1706S0078	8 to 10	0.35 ± 0.35	9.89 ± 0.71	10.2 ± 1.2	20.0 ± 1.4	0.12 ± 0.45	1.1 ± 2.4	2.4 ± 4.8

TABLE 1 (continued)

**RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES COLLECTED BY ORISE  
FROM AREA B1S/B2S  
CHEVRON MINING WASHINGTON REMEDIATION PROJECT  
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ORISE Sample ID	Sample Depth (ft) <sup>a</sup>	Radionuclide Concentrations in Soil Samples (pCi/g)						
		Ra-226	Th-228	Th-232	Total Thorium <sup>b</sup>	U-235	U-238	Total Uranium <sup>c</sup>
<b>Area B1S/B2S Judgmental Grid Block Samples<sup>f,g</sup></b>								
1706S0059	10 to 12	0.29 ± 0.34	7.11 ± 0.56	7.47 ± 0.99	14.6 ± 1.1	-0.11 ± 0.43	1.6 ± 2.4	3.2 ± 4.8
1706S0060	10 to 12	-0.05 ± 0.28	0.34 ± 0.28	0.46 ± 0.61	0.80 ± 0.67	-0.05 ± 0.39	0.3 ± 2.0	0.6 ± 3.9
1706S0061	10 to 12	0.01 ± 0.29	-0.08 ± 0.28	-0.04 ± 0.60	-0.12 ± 0.66	-0.01 ± 0.38	0.0 ± 1.9	0.1 ± 3.8
1706S0062	10 to 12	0.21 ± 0.30	4.54 ± 0.44	4.31 ± 0.79	8.85 ± 0.90	-0.04 ± 0.41	0.5 ± 2.1	1.1 ± 4.2
<i>Grid Average<sup>b</sup></i>	<i>10 to 12</i>	<i>0.12 ± 0.61</i>	<i>2.98 ± 0.82</i>	<i>3.1 ± 1.5</i>	<i>6.0 ± 1.7</i>	<i>-0.05 ± 0.80</i>	<i>0.6 ± 4.2</i>	<i>1.3 ± 8.4</i>
1706S0065	10 to 12	0.08 ± 0.30	2.72 ± 0.35	2.80 ± 0.70	5.52 ± 0.78	-0.15 ± 0.39	0.5 ± 2.0	1.0 ± 3.9
1706S0066	12 to 14	1.57 ± 0.41	15.09 ± 0.98	14.7 ± 1.5	29.8 ± 1.8	0.05 ± 0.46	3.0 ± 2.3	6.2 ± 4.6
1706S0067	10 to 12	-0.05 ± 0.27	-0.14 ± 0.27	-0.03 ± 0.59	-0.17 ± 0.65	-0.06 ± 0.39	-0.4 ± 1.9	-0.9 ± 3.7
1706S0068	10 to 12	0.37 ± 0.28	-0.13 ± 0.27	-0.09 ± 0.60	-0.22 ± 0.65	0.00 ± 0.39	0.8 ± 1.9	1.6 ± 3.8
<i>Grid Average<sup>b</sup></i>	<i>10 to 12</i>	<i>0.49 ± 0.64</i>	<i>4.4 ± 1.1</i>	<i>4.3 ± 1.9</i>	<i>8.7 ± 2.2</i>	<i>-0.04 ± 0.81</i>	<i>1.0 ± 4.1</i>	<i>2.0 ± 8.0</i>

TABLE 1 (continued)

**RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES COLLECTED BY ORISE  
FROM AREA B1S/B2S  
CHEVRON MINING WASHINGTON REMEDIATION PROJECT  
WASHINGTON, PENNSYLVANIA**

ORISE Sample ID	Sample Depth (ft) <sup>a</sup>	Radionuclide Concentrations in Soil Samples (pCi/g)						
		Ra-226	Th-228	Th-232	Total Thorium <sup>b</sup>	U-235	U-238	Total Uranium <sup>c</sup>
<b>Area B1S/B2S Judgmental Grid Block Samples<sup>d,e</sup>-continued</b>								
1706S0074	8 to 10	5.65 ± 0.71	104.3 ± 6.0	101.1 ± 8.1	207 ± 10	-0.29 ± 0.86	12.4 ± 4.3	24.6 ± 8.6
1706S0075	8 to 10	0.69 ± 0.35	11.06 ± 0.77	11.7 ± 1.2	22.7 ± 1.4	-0.14 ± 0.45	0.8 ± 2.5	1.6 ± 5.0
1706S0076	8 to 10	0.14 ± 0.29	0.01 ± 0.28	0.11 ± 0.60	0.12 ± 0.66	-0.07 ± 0.38	0.4 ± 1.9	0.8 ± 3.8
1706S0077	8 to 10	0.08 ± 0.28	0.26 ± 0.28	0.29 ± 0.61	0.55 ± 0.66	0.10 ± 0.42	-0.0 ± 1.9	0.1 ± 3.9
<i>Grid Average<sup>h</sup></i>	<i>8 to 10</i>	<i>1.64 ± 0.89</i>	<i>28.9 ± 6.1</i>	<i>28.3 ± 8.3</i>	<i>58 ± 10</i>	<i>-0.1 ± 1.1</i>	<i>3.4 ± 5.7</i>	<i>7 ± 11</i>

<sup>a</sup>Sample depths provided by Chevron Mining personnel.

<sup>b</sup>Total thorium calculated by adding Th-228 to Th-232 concentrations.

<sup>c</sup>Total uranium calculated by doubling the U-238 concentration and adding the U-235 concentration.

<sup>d</sup>Background sample results previously submitted in ORISE letter report dated on August 30, 2007.

<sup>e</sup>Uncertainties represent the 95% confidence level based on total propagated uncertainties.

<sup>f</sup>Refer to Figure 3.

<sup>g</sup>Average background concentrations for each radionuclide were subtracted from the site soil samples.

<sup>h</sup>Grid layer average determined by averaging the individual soil sample locations from the adjacent grid block square pattern.

<sup>i</sup>Zero values due to rounding.

TABLE 2

SITE-SPECIFIC SUBSURFACE SOIL AVERAGING LIMITS  
CHEVRON MINING WASHINGTON REMEDIATION PROJECT  
WASHINGTON, PENNSYLVANIA

TABLE 4-2  
Site-Specific Subsurface Soil Averaging Limits - Molycorp's Washington, PA Site

Layer #	Layer	# of Quadrants	Volume (ft <sup>3</sup> )	Uranium (238 + 234)	Average, pCi/g Thorium (232 + 228)	Ra (226)
1	0 to 2 feet Layer				Average	
	4 Samples from Layer Area	4	2153	18.7	14.2	7.4
	Maximum in Layer	1	538	25.4	17.8	9.4
2	0 to 4 feet Layer					
	2 Vertical Quadrants	2	1076	21.8	15.7	8.2
	4 Samples from Layer Area	4	2153	30.9	25.7	13.2
	8 Samples from Surface to this Layer	8	4306	15.5	12.9	6.6
	Maximum in Layer	1	538	43.6	31.5	16.5
3	0 to 6 feet Layer					
	3 Vertical Quadrants	3	1615	20.1	14.9	7.8
	4 Samples from Layer Area	4	2153	40.0	35.7	18.1
	12 Samples from Surface to this Layer	12	6458	13.3	11.9	6.0
	Maximum in Layer	1	538	60.2	44.7	23.3
4	0 to 8 feet Layer					
	4 Vertical Quadrants	4	2153	18.7	14.2	7.4
	4 Samples from Layer Area	4	2153	47.2	44.8	22.5
	16 Samples from Surface to this Layer	16	8611	11.8	11.2	5.6
	Maximum in Layer	1	538	74.8	56.9	29.6
5	0 to 10 feet Layer					
	5 Vertical Quadrants	5	2691	17.8	13.8	7.2
	4 Samples from Layer Area	4	2153	53.3	53.0	26.4
	20 Samples from Surface to this Layer	20	10764	10.7	10.6	5.3
	Maximum in Layer	1	538	88.8	69.2	35.9
6	0 to 12 feet Layer					
	6 Vertical Quadrants	6	3229	16.9	13.5	7.0
	4 Samples from Layer Area	4	2153	63.8	63.4	31.6
	24 Samples from Surface to this Layer	24	12917	10.6	10.6	5.3
	Maximum in Layer	1	538	101.5	80.9	41.8
7	0 to 14 feet Layer					
	7 Vertical Quadrants	7	3767	16.2	13.2	6.8
	4 Samples from Layer Area	4	2153	74.2	73.8	36.8
	28 Samples from Surface to this Layer	28	15069	10.6	10.5	5.3
	Maximum in Layer	1	538	113.1	92.1	47.7
8	Each Layer deeper than 14 feet					
	Maximum in Layer	1	538	129.2	105.2	54.6
<b>Assumptions</b>		Area:	100	m <sup>2</sup>	1076	ft <sup>2</sup>
		Quadrants:	25	m <sup>2</sup>	269	ft <sup>2</sup>
		Thickness:	NA		2	ft
		Area Volume:	NA		2153	ft <sup>3</sup>
		Quadrant Volume:	NA		538	ft <sup>3</sup>

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