

**ISRA 009 – AP/STP-1E3.  
Soil Sampling for Radionuclides.  
Results and Statistical Analysis.  
Waste Certification.**

This data package provides the laboratory results and statistical analysis of the 4 samples taken at the ISRA Outfall 009, AP/STP-1E3 area. This analysis and data interpretation complies with the procedure approved by the California Department of Public Health<sup>1</sup>.

Samples taken for waste disposal characterization were analyzed for strontium-90, tritium and gamma emitting radionuclides by gamma spectroscopy, using an off-site laboratory. Minimum detectable activity (MDA) for cesium-137 and strontium-90 averaged ~0.041 pCi/g and ~0.042 pCi/g respectively. Minimum detectable activity for tritium averaged ~0.65 pCi/g. The gamma spectroscopy library also included the following contaminants-of-concern: Na-22, K-40, Mn-54, Co-60, Cs-134, Cs-137, Eu-152, Eu-154, Th-228, Th-232, U-235, U-238 and Am-241.

Statistical evaluation of sample analytical results to determine whether or not the sampled waste contains Cs-137 or Sr-90 activity elevated above local background was conducted using the Wilcoxon Rank Sum Test using protocols described in NUREG-1505<sup>2</sup> and DTSC guidance<sup>3</sup> (See Appendix 1). Appendix 2 shows the complete analytical results for all radionuclides. Complete laboratory data packages are available on request.

Local background data for cesium-137 and strontium-90 was taken from Table 20 of the 1995 McLaren/Hart report<sup>4</sup>. Background for tritium in soil is not well established, and is not reported in the 1995 McLaren/Hart report, therefore tritium background in soil is conservatively assumed to be zero. Tritium data is therefore compared to the MDA of the analysis and the EPA preliminary remediation goal (PRG)<sup>5</sup> for residential 10<sup>-6</sup> risk.

## **Conclusions**

**Cesium-137** - Based on the results of the statistical analysis of Appendix 1, soil to be excavated from AP/STP-1E3 does not exceed the local background for Cs-137. The incremental dose from Cs-137 above background is therefore zero mrem/y. All except one Cs-137 results are non-detect. The highest Cs-137 result is 0.045 pCi/g which is less than the highest background result

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<sup>1</sup> Boeing, "Northern Drainage Waste Sampling for Radionuclides." Revision 9, November 5, 2007. (Attachment 3 to Northern Drainage Work Plan) and "ISRA Waste Sampling for Radionuclides", Attachment A to the ISRA Soil Management Plan.

<sup>2</sup> NUREG-1505, Nuclear Regulatory Commission, "A Non-parametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys." January 1998. [http://www.philrutherford.com/Radiation\\_Cleanup\\_Standards/NUREG-1505.pdf](http://www.philrutherford.com/Radiation_Cleanup_Standards/NUREG-1505.pdf)

<sup>3</sup> DTSC, "Selecting Inorganic Constituents as Chemicals of Concern at Risk Assessments at Hazardous Waste Sites and Permitted Facilities." February 1997.

<sup>4</sup> McLaren/Hart, "Additional Soil and Water Sampling at the Brandeis-Bardin Institute and Santa Monica Mountains Conservancy." Jan 19, 1995. <http://www.etec.energy.gov/Health-and-Safety/Documents/BrandeisBardin/AddSoilandWaterSamp.pdf>

<sup>5</sup> EPA preliminary remediation goals for radionuclides (Effective January 1, 2007) - <http://epa-prgs.ornl.gov/radionuclides/>.

of 0.213 pCi/g. The highest non-background subtracted Cs-137 result is equivalent to an effective dose of 0.042 mrem/y<sup>6</sup>.

**Strontium-90** - Based on the results of the statistical analysis of Appendix 1, soil to be excavated from AP/STP-1E3 does not exceed the local background for Sr-90. The incremental dose from Sr-90 above background is therefore zero mrem/y. All Sr-90 results are non-detect. The highest Sr-90 result is 0.019 pCi/g which is non-detect and less than the highest background result of 0.13 pCi/g. The highest non-background subtracted, non-detect Sr-90 result is equivalent to an effective dose of 0.0011 mrem/y<sup>6</sup>.

**Tritium** - All tritium results are non-detect, the average tritium result is -0.126 pCi/g and the highest tritium result is 0.136 pCi/g. The highest non-detected, non-background subtracted tritium result is equivalent to an effective dose of 0.029 mrem/y<sup>6</sup>.

This waste is certified to be “radiologically” acceptable for shipment to, and disposal at, any waste disposal facility. The waste requires no further radiological controls.

This waste meets the requirements of disposal facility permits<sup>7,8</sup> and complies with the California Health & Safety Code<sup>9</sup>.

The Governor’s Executive Order D-62-02 prohibits the “*disposal of decommissioned materials to Class III landfills or unclassified management units.*” The soil from AP/STP-1E3 is not decommissioned material, and does not originate from the proximity of any radiological facility. The sampling in this certification has therefore been conducted as a best management practice that complies with the requirements of D-62-02. Verification sampling and/or approval by the

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<sup>6</sup> EPA dose compliance considerations for radionuclides (Effective August 3, 2010) - <http://epa-dccs.ornl.gov/>. Soil concentrations that meet the 10<sup>-6</sup> residential risk PRG are < 0.5 mrem/y. The Cs-137 residential PRG of 0.0597 pCi/g is equivalent to 0.056 mrem/y. The Sr-90 residential PRG of 0.231 pCi/g is equivalent to 0.014 mrem/y. The tritium residential PRG of 2.28 pCi/g is equivalent to 0.486 mrem/y.

<sup>7</sup> This waste is exempt from regulation and licensing or is expressly authorized for disposal under the Radiation Control Law (Division 104, Part 9, Chapter 8 of the California Health & Safety Code).

<sup>8</sup> This waste is not prohibited from disposal by any government agency with jurisdictional authority over this waste.

<sup>9</sup> Division 104, Part 9, Chapter 5, Article 1, Section 114715, “No person shall bury, throw away, or in any manner dispose of radioactive wastes within the state except in a manner and at locations as will result in no significant radioactive contamination of the environment.” For the purposes of this requirement, “significant” is defined in Section 114710 as amounts of radioactive materials that are likely to expose persons to ionizing radiation greater than the guide levels published by the Federal Radiation Council (FRC). The FRC no longer exists, but the applicable guide level last published by the FRC was 500 mrem per year to a member of the public. Because the regulatory dose limit to members of the public has since been lowered to 100 mrem per year, CDPH/RHB conservatively utilizes the lower dose for purposes of defining “significant” radioactive contamination in this Article of the California Health and Safety Code.  
<http://www.leginfo.ca.gov/cgi-bin/displaycode?section=hsc&group=114001-115000&file=114705-114780>

California Department of Public Health (CDPH) Radiologic Health Branch (RHB) are not required for the off-site disposal of decommissioned material or of the subject material<sup>10</sup>.



Phil Rutherford  
Manager, Health, Safety & Radiation Services

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<sup>10</sup> The California Department of Public Health (CDPH) Radiologic Health Branch (RHB) has stated in a November 9, 2007 email to Phil Rutherford (Boeing) ... *"The Governor's Executive Order D-62-02, does not specifically require the Department of Health Services (now the Department of Public Health) to perform verification sampling of decommissioned material or to provide approval for disposal of specific decommissioned material shipped offsite (e.g., to Class I or II landfills). The California DPH has not imposed a requirement that Boeing or the Department of Energy (DOE) seek DPH verification sampling or approval of all decommissioned material destined for Class I or II landfills in compliance with the Governor's Executive Order."*

**Appendix 1**

**Wilcoxon Rank Sum Statistical Test for Cesium-137 and Strontium-90**

### Soil Data from ISRA 009 - AP/STP-1E3

No.	Sample ID	Stockpile ID	Sampling Date	Laboratory Batch	Cesium-137 (pCi/g)				Strontium-90 (pCi/g)				Tritium (pCi/g)			
					Activity	+/- 2σ Error	MDA	Non-detect?	Activity	+/- 2σ Error	MDA	Non-detect?	Activity	+/- 2σ Error	MDA	Non-detect?
1	APWC0601	N/A	7/30/2010	257645	0.0451	0.0272	0.0358		0.0185	0.0243	0.0416	NDA	-0.305	0.384	0.788	NDA
2	APWC0602	N/A	7/29/2010	257563	-0.00293	0.0272	0.0482	NDA	0.0112	0.0233	0.0422	NDA	0.136	0.305	0.534	NDA
3	APWC0603	N/A	7/29/2010	257563	-0.0176	0.0236	0.0383	NDA	-0.0182	0.0232	0.0452	NDA	-0.0384	0.278	0.514	NDA
4	APWC0604	N/A	7/30/2010	257645	-0.00769	0.0234	0.0401	NDA	0.00661	0.0205	0.0381	NDA	-0.298	0.375	0.771	NDA

	Cesium-137 (pCi/g)				Strontium-90 (pCi/g)				Tritium (pCi/g)			
	Activity	MDA	Non-detect?		Activity	MDA	Non-detect?		Activity	MDA	Non-detect?	
Average	0.004	0.041			0.005	0.042			-0.126	0.652		
Maximum	0.045	0.048			0.019	0.045			0.136	0.788		
Minimum	-0.018	0.036			-0.018	0.038			-0.305	0.514		
Count			4				4				4	
Number of Non-Detects			3				4				4	
% Non-Detects			75%				100%				100%	

## Soil Data from ISRA 009 - AP/STP-1E3

### Wilcoxon Rank Sum Test -- (Cesium-137)

#### General Information:

The Wilcoxon Rank Sum method tests whether or not measurements of samples from a survey area (S) tend to be consistently larger than those from a background reference area (R) by more than the DCGL.

The null hypothesis,  $H_0$ , is: Survey sample concentrations exceed those in the background by more than the DCGL.

The alternative hypothesis,  $H_a$ , is: Survey sample concentrations do not exceed those in the background by more than the DCGL.

#### How to use this template:

- 1) Enter analysis results in Data Tab.
- 2) The Wilcoxon Rank Sum test is prescribed in, NUREG-1505, Nuclear Regulatory Commission, "A Non-parametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys." January 1998.

Derived Concentration Guideline Level, DCGL (pCi/g)	0.00
Type I Error Rate, alpha:	0.05
Type II Error Rate, beta:	0.05
Number of Background Samples, m:	51
Number of Survey Samples, n:	4
z-value for alpha	1.645
No. of groups of tied measurements, g	10
Critical Value (excluding ties)	1478.8
<b>Critical Value (including ties)</b>	<b>1478.7</b>
<b>Sum of Reference Ranks</b>	<b>1510.0</b>
Sum of Survey Ranks	30.0
Sum of All Ranks	1540
Check Rank Sum $(n+m)*(n+m+1)/2$	1540

If the sum of the reference ranks is larger than the critical value, there is enough evidence to reject the null hypothesis and accept the alternative hypothesis. Otherwise the null hypothesis is accepted.

#### Test Result:

**Survey sample concentrations do not exceed those in the background by more than the DCGL**

	Bkgd Ref (R)	Survey (S)
Mean	0.087	0.004
Max	0.213	0.045
Min	0.015	-0.018
$\sigma$	0.062	0.028
$m-1.96*\sigma$	-0.035	-0.051
$m+1.96*\sigma$	0.210	0.059

No.	Soil ID	Cs-137	Adjusted Cs-137	Area	Ranks	Reference Ranks
1		0.092	0.092	R	32	32
2		0.020	0.020	R	10	10
3		0.020	0.020	R	10	10
4		0.100	0.100	R	36.5	36.5
5		0.020	0.020	R	10	10
6		0.158	0.158	R	47.5	47.5
7		0.175	0.175	R	49	49
8		0.209	0.209	R	54	54
9		0.180	0.180	R	50	50
10		0.030	0.030	R	18	18
11		0.213	0.213	R	55	55
12		0.025	0.025	R	15	15
13		0.020	0.020	R	10	10
14		0.020	0.020	R	10	10
15		0.074	0.074	R	28	28
16		0.147	0.147	R	43	43
17		0.100	0.100	R	36.5	36.5

No.	Soil ID	Cs-137	Adjusted Cs-137	Area	Ranks	Reference Ranks
18		0.067	0.067	R	26.5	26.5
19		0.099	0.099	R	35	35
20		0.101	0.101	R	38	38
21		0.148	0.148	R	44	44
22		0.153	0.153	R	46	46
23		0.025	0.025	R	15	15
24		0.188	0.188	R	51	51
25		0.198	0.198	R	53	53
26		0.030	0.030	R	18	18
27		0.079	0.079	R	29	29
28		0.158	0.158	R	47.5	47.5
29		0.109	0.109	R	39	39
30		0.059	0.059	R	25	25
31		0.067	0.067	R	26.5	26.5
32		0.113	0.113	R	40	40
33		0.015	0.015	R	5	5
34		0.031	0.031	R	20	20
35		0.042	0.042	R	23	23
36		0.097	0.097	R	33.5	33.5
37		0.015	0.015	R	5	5
38		0.020	0.020	R	10	10
39		0.085	0.085	R	31	31
40		0.080	0.080	R	30	30
41		0.015	0.015	R	5	5
42		0.020	0.020	R	10	10
43		0.035	0.035	R	21.5	21.5
44		0.035	0.035	R	21.5	21.5
45		0.025	0.025	R	15	15
46		0.150	0.150	R	45	45
47		0.140	0.140	R	41.5	41.5
48		0.190	0.190	R	52	52
49		0.097	0.097	R	33.5	33.5
50		0.030	0.030	R	18	18
51		0.140	0.140	R	41.5	41.5
52	APWC0601	0.045	0.045	S	24	0
53	APWC0602	-0.003	-0.003	S	3	0
54	APWC0603	-0.018	-0.018	S	1	0
55	APWC0604	-0.008	-0.008	S	2	0
<b>Sum</b>					<b>1540.0</b>	<b>1510.0</b>

## Soil Data from ISRA 009 - AP/STP-1E3

### Wilcoxon Rank Sum Test -- (Strontium-90)

#### General Information:

The Wilcoxon Rank Sum method tests whether or not measurements of samples from a survey area (S) tend to be consistently larger than those from a background reference area (R) by more than the DCGL.

The null hypothesis,  $H_0$ , is: Survey sample concentrations exceed those in the background by more than the DCGL.

The alternative hypothesis,  $H_a$ , is: Survey sample concentrations do not exceed those in the background by more than the DCGL.

#### How to use this template:

- 1) Enter analysis results in Data Tab.
- 2) The Wilcoxon Rank Sum test is prescribed in, NUREG-1505, Nuclear Regulatory Commission, "A Non-parametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys." January 1998.

Derived Concentration Guideline Level, DCGL (pCi/g)	0.00
Type I Error Rate, alpha:	0.05
Type II Error Rate, beta:	0.05
Number of Background Samples, m:	51
Number of Survey Samples, n:	4
z-value for alpha	1.645
No. of groups of tied measurements, g	9
Critical Value (excluding ties)	1478.8
<b>Critical Value (including ties)</b>	<b>1478.4</b>
<b>Sum of Reference Ranks</b>	<b>1523.0</b>
Sum of Survey Ranks	17.0
Sum of All Ranks	1540
Check Rank Sum $(n+m)*(n+m+1)/2$	1540

If the sum of the reference ranks is larger than the critical value, there is enough evidence to reject the null hypothesis and accept the alternative hypothesis. Otherwise the null hypothesis is accepted.

#### Test Result:

**Survey sample concentrations do not exceed those in the background by more than the DCGL**

	Bkgd Ref (R)	Survey (S)
Mean	0.051	0.005
Max	0.130	0.019
Min	0.005	-0.018
$\sigma$	0.030	0.016
$m-1.96*\sigma$	-0.008	-0.027
$m+1.96*\sigma$	0.109	0.036

No.	Soil ID	Sr-90	Adjusted Sr-90	Area	Ranks	Reference Ranks
1		0.030	0.030	R	16	16
2		0.010	0.010	R	4.5	4.5
3		0.045	0.045	R	30.5	30.5
4		0.045	0.045	R	30.5	30.5
5		0.050	0.050	R	40	40
6		0.040	0.040	R	22	22
7		0.035	0.035	R	18.5	18.5
8		0.050	0.050	R	40	40
9		0.050	0.050	R	40	40
10		0.130	0.130	R	54.5	54.5
11		0.120	0.120	R	53	53
12		0.040	0.040	R	22	22
13		0.045	0.045	R	30.5	30.5
14		0.130	0.130	R	54.5	54.5
15		0.050	0.050	R	40	40
16		0.088	0.088	R	48	48
17		0.080	0.080	R	45	45



No.	Soil ID	Sr-90	Adjusted Sr-90	Area	Ranks	Reference Ranks
18		0.100	0.100	R	52	52
19		0.069	0.069	R	44	44
20		0.097	0.097	R	50	50
21		0.084	0.084	R	47	47
22		0.098	0.098	R	51	51
23		0.045	0.045	R	30.5	30.5
24		0.045	0.045	R	30.5	30.5
25		0.020	0.020	R	10	10
26		0.045	0.045	R	30.5	30.5
27		0.089	0.089	R	49	49
28		0.050	0.050	R	40	40
29		0.045	0.045	R	30.5	30.5
30		0.050	0.050	R	40	40
31		0.045	0.045	R	30.5	30.5
32		0.040	0.040	R	22	22
33		0.045	0.045	R	30.5	30.5
34		0.045	0.045	R	30.5	30.5
35		0.045	0.045	R	30.5	30.5
36		0.025	0.025	R	13.5	13.5
37		0.082	0.082	R	46	46
38		0.045	0.045	R	30.5	30.5
39		0.040	0.040	R	22	22
40		0.035	0.035	R	18.5	18.5
41		0.025	0.025	R	13.5	13.5
42		0.005	0.005	R	2	2
43		0.020	0.020	R	10	10
44		0.010	0.010	R	4.5	4.5
45		0.020	0.020	R	10	10
46		0.020	0.020	R	10	10
47		0.050	0.050	R	40	40
48		0.030	0.030	R	16	16
49		0.030	0.030	R	16	16
50		0.020	0.020	R	10	10
51		0.040	0.040	R	22	22
52	APWC0601	0.019	0.019	S	7	0
53	APWC0602	0.011	0.011	S	6	0
54	APWC0603	-0.018	-0.018	S	1	0
55	APWC0604	0.007	0.007	S	3	0
<b>Sum</b>					<b>1540.0</b>	<b>1523.0</b>

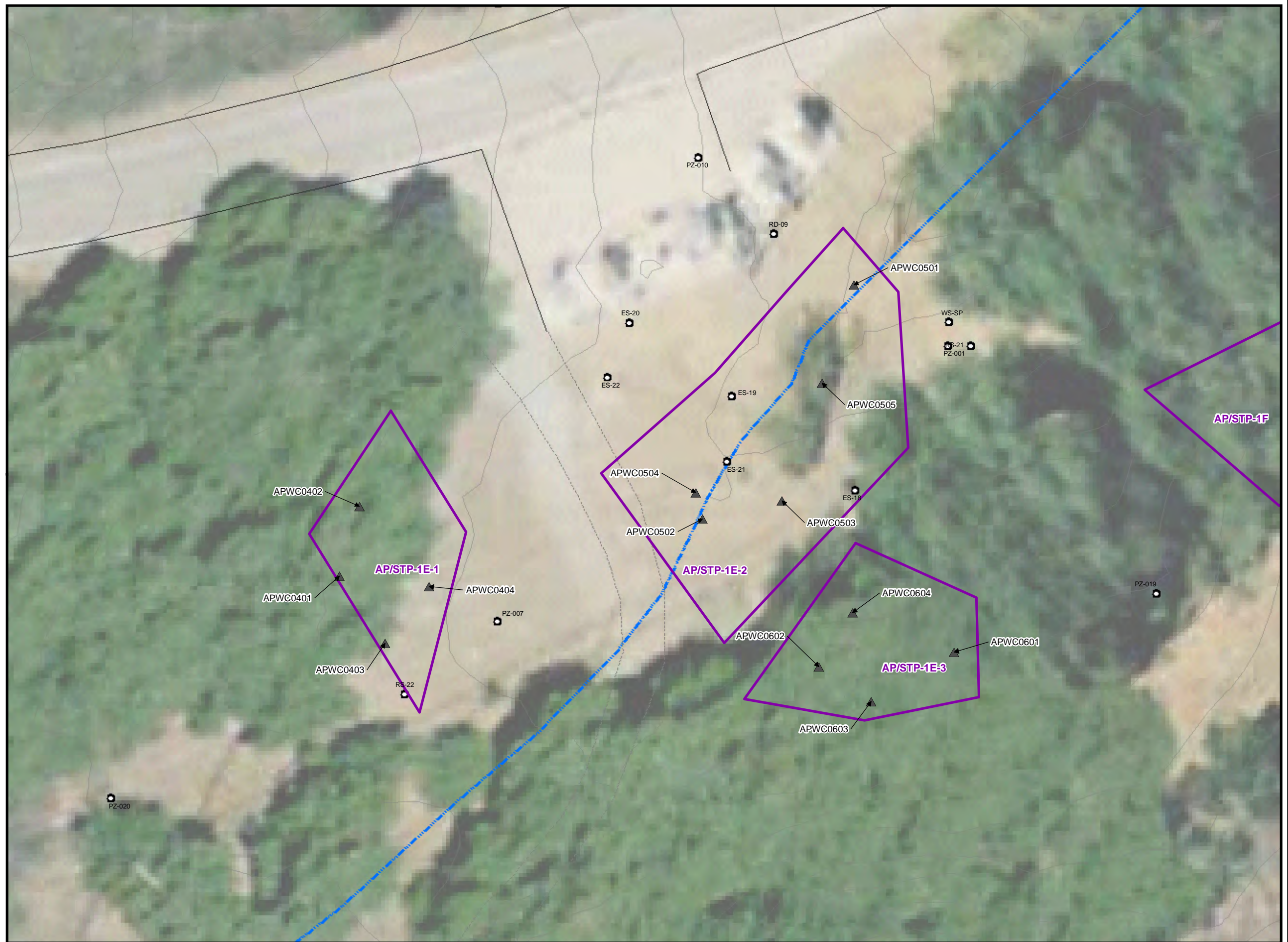
**Appendix 2**  
**Radionuclide Results**



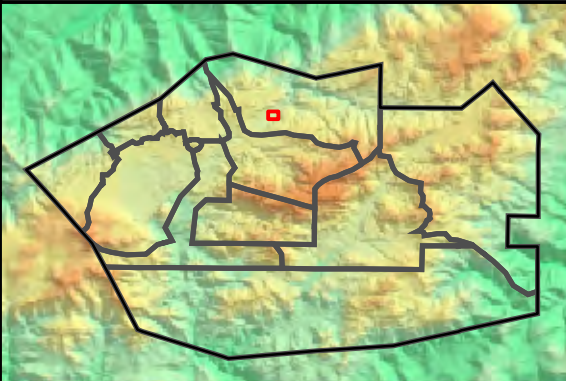
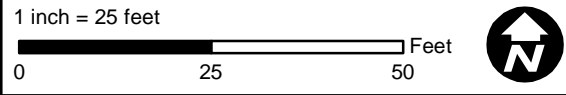
**Outfall 009**  
**Sample Locations for AP/STP - 1E-1,**  
**AP/STP - 1E-2, AP/STP - 1E-3**

- Base Map Legend**
- Administrative Area Boundary
  - RFI Site Boundary
  - Report Group Boundary
  - NPDES Outfall
  - Dirt Road
  - A/C Paving
  - Drainage
  - Non Jurisdictional Surface Water Pathway
  - Surface Water Divide
  - Elevation Contour

- Figure Legend**
- ▲ Waste Characterization Sample



Document: ISRA\_Plots\_SP\_RD47\_SampleLocations\_060710.mxd Date: Jun 22, 2010



SANTA SUSANA FIELD LABORATORY

FIGURE X