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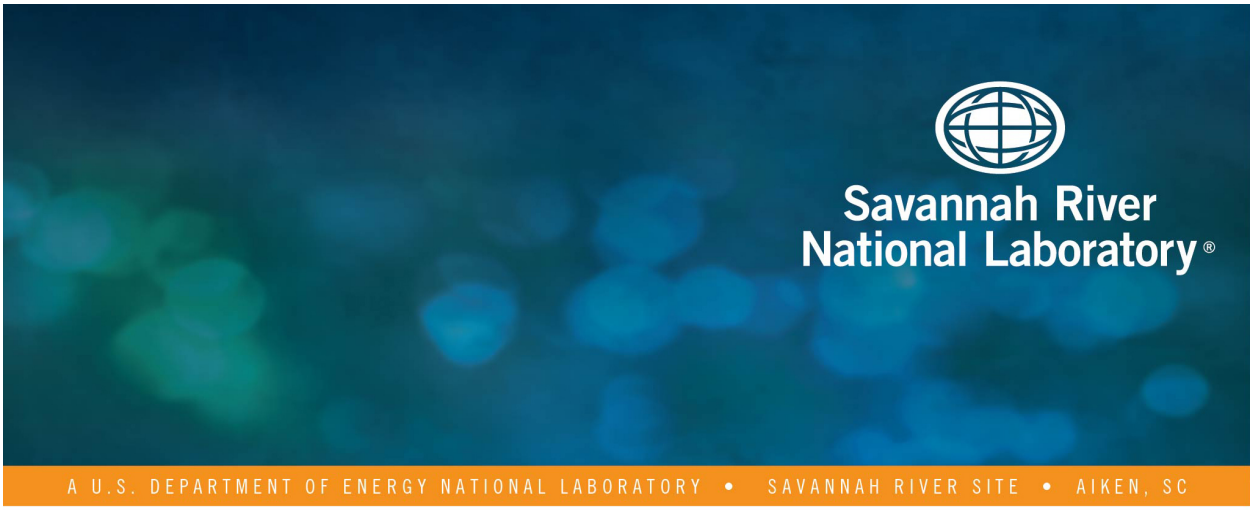

Saltstone First Quarter Calendar Year 2021 (1QCY21) Toxicity Characteristic Leaching Procedure (TCLP) Results

K. A. Hill

August 2021

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EXECUTIVE SUMMARY

The aqueous waste from Tank 50 (salt solution) is sampled quarterly for transfers to the Saltstone Production Facility (SPF). Salt solution is treated at SPF and disposed of in the Saltstone Disposal Facility (SDF). Per request of customer, X-TTR-Z00023, Revision 0, two SDF waste form (saltstone) samples were prepared in the Savannah River National Laboratory (SRNL) from the Tank 50 Waste Acceptance Criteria (WAC) sample and Z-Area premix material for the first quarter of calendar year 2021(1QCY21). One sample contained a Full Premix which included 10:45:45 (by weight) of cement, slag and fly ash. The second sample contained 60:40 (by weight) of slag and fly ash only referred to as the "Cement-Free grout sample". Results from this technical report support Task 2: 'Grout Leaching Analyses' of the Task Technical Request (TTR) prepared by Savannah River Remediation (SRR). After at least 28 days cured, a sample of each of the SDF waste forms was collected and shipped to a certified laboratory for analysis using the Toxicity Characteristic Leaching Procedure (TCLP). The 1QCY21 saltstone (Full Premix) and the Cement-Free grout samples met the South Carolina (SC) Code of Regulations for Hazardous Waste Management Regulations (HWMR) 61-79.261.24 and 61-79-268.48 requirements for a non-hazardous waste form with respect to Resource Conservation and Recovery Act (RCRA) metals and Underlying Hazardous Constituents (UHCs), and also met the SPF WAC that was in effect at the time of the tank sampling.

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LIST OF ABBREVIATIONS

ARP/MCU	Actinide Removal Process / Modular Caustic Side Solvent Extraction Unit
BSRA	Batelle Savannah River Alliance
D&S-FE	DWPF & Saltstone Facility Engineering
DSSHT	Decontaminated Salt Solution Hold Tank
EC&ACP	Environmental Compliance & Area Completion Projects
EM&ES	Environmental, Materials & Energy Sciences
EPA	Environmental Protection Agency
ETF	Effluent Treatment Facility
LOD	Limit of Detection
LOQ	Limit of Quantitation
MRL	Minimum Reporting Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NRC	Nuclear Regulatory Commission
RCRA	Resource Conservation and Recovery Act
RPD	Relative Percent Difference
RL	Reporting Limit
SDF	Saltstone Disposal Facility
SPF	Saltstone Production Facility
SRNL	Savannah River National Laboratory
SRR	Savannah River Remediation
SWPF	Salt Waste Processing Facility
SwRI®	Southwest Research Institute
TCLP	Toxicity Characteristic Leaching Procedure
TTQAP	Task Technical and Quality Assurance Plan
TTR	Technical Task Request
UHC	Underlying Hazardous Constituents
WAC	Waste Acceptance Criteria

1.0 Introduction

The SPF receives waste from Tank 50 for treatment. The following dates were selected starting from the last quarterly sampling date when regulatory saltstone samples were prepared (3QCY19) to the current 1QCY21 quarterly sampling date. Tank 50 accepted the following transfers from August 6, 2019 to January 19, 2021 totaling ~ 721 kgal:[1]

- ~2.8 kgal from 211-H
- ~65.2 kgal from Effluent Treatment Facility (ETF)
- ~498 kgal from the Salt Waste Processing Facility (SWPF)
- ~149.5 kgal from Tank 11
- ~0.39 kgal from LWHT and flush water
- ~5.54 kgal from Other

During this same time period there was a total of 923 kgal of Tank 50 material transferred out to Z Area.[2] Other SDF waste form samples were prepared and analyzed during this time period from a Tank 50 sample that was obtained on October 28, 2020 as the 4QCY20 WAC sample. Results from that testing related to the SDF vault classification task have been previously reported.[2]

On January 19, 2021, a salt solution sample was taken from Tank 50[3] and later used to prepare two SDF waste form samples, referred to as a Full Premix saltstone sample and Cement-Free grout sample.[4] The Full Premix sample is the baseline, historical formulation for saltstone and is the sample used to determine that saltstone produced by the SPF is a non-hazardous waste form. The Cement-Free sample is included as a preliminary examination of the potential use of a Cement-Free formulation in future saltstone processing. The 1QCY21 Full Premix and Cement-Free saltstone samples were prepared on February 23, 2021.[4] The 1QCY21 saltstone samples cured for 65 days, they were crushed, sieved, packaged, and deemed "collected".[4, 5] The samples were then shipped to Southwest Research Institute (SwRI®) to analyze for toxicity per the TCLP method.[6, 7] The full premix saltstone sample determines whether the non-hazardous nature of the grout meets the requirements of the SC Code of Regulations 61-79.261.24[8] for RCRA metals and 61-79.268.48[9] for inorganic/organic UHCs (for informational purposes only[6]).

2.0 Experimental

Saltstone preparation was performed at SRNL. DWPF & Saltstone Facility Engineering (D&S-FE) provided SRNL with the saltstone grout recipe as well as the premix components.[6] Table 2-1 shows the premix components obtained for the last quarterly TCLP sample (3QCY19) and the premix components that have been obtained to date, including specific LOT numbers.[4] SRR provided SRNL personnel with the premix formulation for the 1QCY21 saltstone samples.[4]

Table 2-1. Premix Components for 3QCY19 and Latest 1QCY2021.

Premix Component	Date SRNL Received	LOT #
Holcim Cement 3QCY19	6/27/2019	2019-IR-05-0487
Lehigh Slag 3QCY19	6/27/2019	2019-IR-05-1040
SE Fly Ash 3QCY19	6/27/2019	2019-IR-05-0714
Holcim Cement 1QCY21	6/27/2019	2019-IR-05-0487
Lehigh Slag 1QCY21	11/11/2020	2020-IR-05-976
SE Fly Ash 1QCY21	11/11/2020	2020-IR-05-0910

The 1QCY21 salt solution had been stored since collection in a zero-headspace Teflon® bottle refrigerated at <10 ºC to preserve the mercury species present in the sample. The saltstone samples were prepared using the mixing method outlined in SRNL Environmental, Materials & Energy Sciences (EM&ES) work instructions[10] and the 1QCY21 premix components in Table 2-1.[4] One sample contained a Full Premix which included 10:45:45 (by weight) of cement, slag and fly ash. The second sample contained 60:40 (by weight) of slag and fly ash only referred to as the "Cement-Free grout sample". The samples cured in a Ziploc® sealed plastic bag for 65 days. After curing, the samples were crushed and sieved using the method outlined in EM&ES work instructions.[11] Material that passed through the 3/8-inch (0.375") sieve (9.252 mm) was subsequently screened through a No. 4 sieve (4.76 mm). The material retained on the No. 4 sieve was packaged in a primary container (250 mL High Density Polyethylene (HDPE) bottle) and shipped on the same day that it was prepared to SwRI® by Environmental Compliance & Area Completion Projects (EC&ACP).

3.0 Results

Table 3-1 summarizes the analytical results provided by the vendor, SwRI.[12] The first eight rows show data for the RCRA metals and the next four rows show data for the UHC metals from the TCLP leachates. The last four rows show results from solids analyses of the saltstone for benzene, phenol, total and amenable cyanide. The entire vendor report is documented and included as a reference.[12] Some of the data values are flagged with qualifier letters (U, L, D, J, B) that are shown as footnotes to the table. Further explanation for these qualifiers can be found in the vendor report.[12] For comparison, the previous quarter and four quarter average results for the Full Premix sample are shown. The four-quarter average values contain a qualifier (*, +, ^) if past values have been reported as a non-detectable analyte ('U'). The Regulatory Toxicity[8] values and the WAC Limits are from Table 6 of the WAC[3] and reflect the requirements in the applicable version of the document. Note that the vendor used a "modified" Method 1311 where sample mass was restricted due to the elevated activity of the sample.[12] This methodology is consistent with the joint guidance from the Nuclear Regulatory Commission (NRC) and Environmental Protection Agency

(EPA) for mixed radioactive and hazardous waste.[13] For 1QCY21 the TCLP extraction was performed on the Full Premix using extraction fluid #2 and the Cement-Free samples using extraction fluid #1.[4] Extraction fluid #2 is an aqueous acetic acid solution with pH= 2.88 ± 0.05 prepared by diluting 5.7 mL of glacial acetic acid into reagent water for a total volume of 1 Liter. Extraction fluid #1 is an aqueous acetic acid solution with pH= 4.93 ± 0.05 prepared by diluting 5.7 mL of glacial acetic acid into 500 mL of reagent water, then adding 64.3 mL of sodium hydroxide and diluting with reagent water for a total volume of 1 Liter.[7] Determination of the extract fluid used in the TCLP uses Section 7.1.4 'Determination of Appropriate Extraction Fluid' of the TCLP method.[7] A size reduced portion of the solid is mixed with water and if the resulting pH of the contacted water is below pH 5.0, then extraction fluid #1 is used. However, if the resulting pH is above 5.0, then an additional step using HCl acid is performed. Both samples resulted in high pH near 12 of the contacted water so the HCl step was applied. The resulting pH from the HCl step showed a pH of 5.01 for the Full Premix sample and a pH of 4.68 for the Cement-Free sample. Thus the extraction fluid #2 was applied for the Full Premix and extraction fluid #1 was applied for the Cement-Free.[12]

Full-Premix Saltstone

Table 3-1 shows the reported value for Se of 0.0433 mg/L is above the LOQ of 0.025 mg/L compared to the previous quarter (3QCY19) in which a quarterly full-premix saltstone sample was analyzed. Lead has remained as less than detectable at <0.0075 mg/L in comparison to the previous quarter. The analyzed value for Be of <0.005 mg/L is below the quantitation limit, which is the same as the previous quarter. The reported value for Cr for this quarter was measured at <0.005 mg/L and is similar to the previous quarter. The reported TCLP value for Ba of 0.626 mg/L is comparable to the previous quarter.

The mercury TCLP value for the 1QCY21 sample of 0.0045 mg/L is higher than the previous TCLP regulatory quarterly (3QCY19) measuring 0.0016 mg/L. The average mercury TCLP value for the vault classification triplicate samples produced from the 4QCY20 Tank 50 sampling measured 0.0168 mg/L.[2] Total mercury in the Tank 50 WAC samples for the past two quarterly WAC samples are lower at 47.4 mg/L for 4QCY20 and 59.0 mg/L for 1QCY21[3] than all previous quarters dating back to 2QCY17.[14] Mercury speciation analyses for recent past 2QCY17 through 1QCY21 show that the total mercury levels in the Tank 50 supernate have ranged from a low of 47.4 mg/L for 4QCY20 to a high of 81.4 mg/L for the 3QCY17 sample as shown in Table 3-2. The corresponding methyl Hg values expressed as mg Hg/L ranged from 13.1 mg/L to 36.6 mg/L. The methyl Hg species is the dominant Hg species in the Tank 50 supernate (relative to other Hg species measured like elemental Hg(0) or ionic Hg(I) and/or Hg(II)) with methyl Hg to total Hg ratios shown in Table 3-2 that are in the range of 0.22 to 0.51.

Cement-Free Saltstone

All of the RCRA metals and UHCs shown in Table 3-1 for the Full Premix and Cement-Free samples are comparable, i.e., within 50% of the value. The amenable and total cyanide and phenol for the Cement-Free sample are higher than for the Full Premix sample. The cement-free values for total cyanide and phenol are also higher than the four-quarter average of the Full Premix.

Table 3-1. 1QCY21 Saltstone Sample TCLP and Solids Analysis Results

Analyte	Full Premix Result (mg/L)[12]	Cement-Free Result (mg/L)[12]	Regulatory Toxicity[8] (mg/L)	WAC Limit[15] (mg/L)	Results Full Premix	
					Previous Quarter[16] (mg/L)	Previous Four Quarter Average[16-19] (mg/L)
RCRA Metals						
Arsenic (As)	0.032	0.022	5.0	2.5	<0.025[U]	0.026[+]
Barium (Ba)	0.626[D]	0.138[D]	100.0	50	0.450[D]	0.441
Cadmium (Cd)	<0.005[U]	<0.005[U]	1.0	0.5	<0.005[U]	0.005^
Chromium (Cr)	<0.005[U]	<0.005[U]	5.0	2.5	<0.005[U]	0.007*
Lead (Pb)	<0.0075[U]	<0.0075[U]	5.0	2.5	<0.0075[U]	0.008*
Mercury (Hg)	0.0045	0.008	0.2	0.1	0.0016[B]	0.006
Selenium (Se)	<0.043[B]	<0.050[B]	1.0	0.5	<0.025[UJ]	0.004*
Silver (Ag)	<0.010[U]	<0.010[U]	5.0	2.5	<0.010[U]	0.010^
Underlying Hazardous Constituents (UHCs)						
Antimony (Sb)	<0.025[U]	<0.025[U]	-	-	<0.025[U]	0.0250^
Beryllium (Be)	<0.005[UD]	<0.005[UD]	-	-	<0.005[U]	0.005*
Nickel (Ni)	<0.025[U]	<0.025[U]	-	-	<0.005[U]	0.008*
Thallium (Tl)	<0.005[UD]	<0.005[UD]	-	-	<0.005[UD]	0.005^
Select Solids Analyses of Regulatory Interest						
	(mg/kg)	(mg/kg)			(mg/kg)	(mg/kg)
Benzene	<0.00099[U]	<0.00098[U]	-	-	<0.00098[U]	0.00094[+]
Amenable Cyanide	1.90[J]	5.80[J]	-	-	<0.214[U]	2.38*
Total Cyanide	18.3	21.8	-	-	11.8	13.2
Phenol	<0.940[UJ]	<0.831[UJ]	-	-	<0.937[UJ]	0.851[+]

-Indicates a location in the table for which an entry would not be appropriate.

[U] Non-detected analyte

[L] Sample result was less than the reporting limit.
[D] Results reported from a dilution.
[J] Matrix spike and/or matrix spike duplicate criteria was not met.
[B] Analyte was detected at the instrument at or above Limits of Detection (LOD), but less than Limit of Quantitation (LOQ).
* Contains qualifier of "U" in at least one quarter.
[+] Contains qualifier of "U" in all quarters with multiple Reporting Limits (RL) or Limits of Detection (LOD).
^ Contains qualifier of "U" in all quarters with same RL or LOD.

Table 3-2. Mercury Speciation Data from Past Tank 50 Salt Solutions

Tank 50 Sample	Total Hg (mg/L)	Methyl Hg (mg/L)	Ratio Methyl Hg/Total Hg
2QCY17	72.2	32.2	0.446
3QCY17	81.4	28.2	0.346
1QCY18	71.8	36.6	0.510
2QCY18	69.8	28.5	0.408
3QCY18	70.4	30.7	0.436
4QCY18	61.7	18.8	0.305
1QCY19	67.4	24.0	0.356
2QCY19	63.0	19.3	0.306
3QCY19	67.6	19.9	0.294
4QCY20	47.4	21.0	0.443
1QCY21	59.0	13.1	0.222

Table 3-3 provides comparison between analytical results for each analyte to SwRI®'s Limit of Detection (LOD) and Limit of Quantitation (LOQ) for the TCLP leachates and to the Reporting Limits (RL) for the solids analyses. Antimony, beryllium, cadmium, chromium, lead, nickel, silver and thallium were all less than the detection limit or reporting limit for the Full Premix sample. The same was true for the Cement-Free. Appendix A includes summaries of results from blanks, laboratory control samples, matrix spikes, and matrix spike duplicates.

Table 3-3. RCRA Metal TCLP Result Concentrations, Limit of Detection, and Limit of Quantitation[12]

Analyte	Methods	LOD	LOQ	Full premix Sample Results	Cement Free Sample Results
		(µg/L)	(µg/L)	(µg/L)	(µg/L)
Antimony (Sb)	6010D	25.0	50.0	<25.0[U]	<25.0[U]
Arsenic (As)	6020B	5.00	10.0	32.3	22.2
Barium (Ba)	6010D	50.0	100.0	626[D]	138[D]
Beryllium (Be)	6020B	5.00	10.0	<5.00[UD]	<5.00[UD]
Cadmium (Cd)	6010D	5.00	10.0	<5.00[U]	<5.00[U]
Chromium (Cr)	6010D	5.00	10.0	<5.00 [U]	<5.00[U]
Lead (Pb)	6010D	7.50	15.0	<7.50[U]	<7.50[U]
Mercury (Hg)	7470A	1.00	2.00	4.47	7.92
Nickel (Ni)	6010D	25.0	50.0	<25.00[U]	<25.00[U]
Selenium (Se)	6010D	25.0	50.0	43.3[B]	49.5[B]
Silver (Ag)	6010D	10.0	20.0	<10.0[U]	<10.0[U]
Thallium (Tl)	6020B	5.00	10.0	<5.00[UD]	<5.00[UD]
-	-	-	RL (mg/kg)	(mg/kg)	
Benzene	8260D	-	-	<0.00099[U]	<0.00098[U]
Amenable Cyanide	9012C	-	0.472	1.90[J]	5.80[J]
Total Cyanide	9012C	-	0.411	18.3	21.8
Phenol	9065	-	0.940	<0.940[UJ]	<0.831[UJ]

- Indicates a location in the table for which an entry would not be appropriate.
[U] Result is less than the Limit of Detection (LOD) and/or Reporting Limit (RL).
[D] Result is reported from a dilution.
[J] Matrix spike and/or matrix spike duplicate criteria was not met.
[B] Analyte was detected at the instrument at or above Limits of Detection (LOD), but less than Limit of Quantitation (LOQ).

4.0 Conclusions

Analyses of the SDF Full Premix and Cement-Free waste forms prepared from the 1QCY21 Tank 50 salt solution sample and premix material resulted in the following findings.

- The RCRA metal TCLP result concentrations met the SC Code of Regulations 61-79.261.24 requirements for a nonhazardous waste form.[8]

- The measured concentrations of the TCLP RCRA metals and additional inorganic/organic UHCs met the SC Code of Regulations 61-79.268.48 non-wastewater standards.[9]

- The measured concentrations of the TCLP RCRA metals met the SPF WAC.[15]

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Appendix A. Quality Assurance

The following subsections include summaries of results from blanks, laboratory control samples, matrix spikes, and matrix spike duplicates. The data package also includes data for calibration verifications, interference checks and serial dilutions.[12]

Table A- 1 shows all TCLP extraction fluid blank concentrations and the solid matrix blank concentrations. In the extraction fluid blank, antimony, arsenic, barium, cadmium, chromium, lead, mercury, nickel, selenium, silver and thallium were all less than detection limit or reporting limit. Thallium and beryllium were detected at the instrument at or above the LOD, but less than the LOQ. Benzene, amenable cyanide, total cyanide and phenol were all less than detection limit or reporting limit.

Table A- 1. TCLP Extraction Fluid Blank and Solid Matrix Blank[12]

Analyte	TCLP Blank (µg/L)	Qualifiers
Antimony (Sb)	<25.0	U
Arsenic (As)	<5.00	U
Barium (Ba)	<5.00	U
Beryllium (Be)	<5.00	UD
Cadmium (Cd)	<5.00	U
Chromium (Cr)	<5.00	U
Lead (Pb)	<7.50	U
Mercury (Hg)	<0.100	U
Nickel (Ni)	<25.0	U
Selenium (Se)	<25.0	U
Silver (Ag)	<10.0	U
Thallium (Tl)	<5.00	UD
Analyte	Solid Matrix Blank (mg/Kg)	Qualifiers
Benzene	<0.00050	U
Amenable Cyanide	<0.600	U
Total Cyanide	<0.600	U
Phenol	<0.979	U

[U] Result is less than the Limit of Detection (LOD) and/or Reporting Limit (RL).
[D] Result is reported from a dilution.

Table A- 2 shows all LCS recoveries meet SwRI®'s acceptance limit in the range of 80% to 120% for metals and phenol, 70% to 130% for benzene and 90.9% for total cyanide, which was within the manufacturers acceptance limit.[17] The laboratory control samples are clean aqueous solutions analyzed to assure integrity of the analytical technique exclusive of matrix effects.

Table A- 2 Laboratory Control Sample[12]

Analyte	Laboratory Control (µg/L)		Recovery (%)
	True	Found	
Antimony (Sb)	500	507	101.4%
Arsenic (As)	2000	2010	100.5%
Barium (Ba)	2000	2070	103.5%
Beryllium (Be)	50.0	51.5	103.0%
Cadmium (Cd)	50.0	51.1	102.2%
Chromium (Cr)	200	208	104.0%
Lead (Pb)	500	502	100.4%
Mercury (Hg)	1.00	0.943	94.3%
Nickel (Ni)	500	509	101.8%
Selenium (Se)	2000	1920	96.0%
Silver (Ag)	50.0	49.9	99.8%
Thallium (Tl)	2000	1930	96.5%
Analyte	**Laboratory Control (mg/Kg)**		**Recovery (%)**
	True	**Found**	
Benzene	0.020	0.018	90.0%
Amenable Cyanide	-	-	-
Total Cyanide	58.1	52.8	90.9%
Phenol	25.0	24.6	98.4%

- Indicates a location in the table for which an entry would not be appropriate.

Results from analysis of the matrix spike (MS) and the matrix spike duplicate (MSD) are given in Table A-3 and Table A-4. These results shown in Table A- 3 indicate all analytes met the recommended quality control acceptance criteria for MS and MSD percent recoveries (75-125%) and the Relative Percent Difference (RPD) acceptance limits (0-20%). In Table A-4, results show benzene met the recommended quality control acceptance criteria for MS, MSD and RPDs. In Table A-4, results show phenol did not meet the recommended quality control acceptance criteria for MS, MSD and RPDs. However, a post-digestion spike recovery sample showed a phenol recovery ≥ 75% within the control limit of 60% to 120%.

Table A- 3 TCLP Leachates Matrix Spike and Duplicate Results[12]

Analyte	Initial Concentrations (µg/L)			Spiked Sample** (µg/L)		Recovery (%)		RPD (%)
	Parent Sample Result	Qualifiers	Spike Added	Spike	Spike Duplicate	Spike	Spike Duplicate	
Antimony (Sb)	<25.0	U	500	530	535	106.0	107.0	0.9
Arsenic (As)	32.3	-	500	586	587	110.7	110.9	0.2
Barium (Ba)	626	D	500	1220	1140	118.8	102.8	14.0
Beryllium (Be)	<5.00	UD	500	444	453	88.8	90.6	2.0
Cadmium (Cd)	<5.00	U	500	454	450	90.8	90.0	0.9
Chromium (Cr)	<5.00	U	500	470	471	94.0	94.2	0.2
Lead (Pb)	<7.50	U	500	438	442	87.6	88.4	0.9
Mercury (Hg)	4.47	-	500	384	394	75.9	77.9	2.6
Nickel (Ni)	<25.0	U	500	476	477	95.2	95.4	0.2
Selenium (Se)	43.3	B	500	561	549	103.5	101.1	2.3
Silver (Ag)	<10.0	U	500	523	520	104.6	104.0	0.6
Thallium (Tl)	<5.00	UD	500	430	434	86.0	86.8	0.9

[U] Result is less than the Limit of Detection (LOD) and/or Reporting Limit (RL).
[D] Result is reported from a dilution.
[B] Analyte was detected at the instrument at or above Limits of Detection (LOD), but less than Limit of Quantitation (LOQ).
[J] Matrix spike and/or matrix spike duplicate criteria was not met.
** SwRI® Sample ID = W-18366-00001 MS/MSD

Table A-4. Organic UHCs Matrix Spike and Duplicate Results[12]

Analyte	Initial Concentrations (mg/kg)				Spiked Sample (mg/kg)		Recovery (%)		RPD (%)
	Result	Qualifiers	MS-Spike Added	MSD-Spike Added	Spike	Spike Duplicate	Spike	Spike Duplicate	
Benzene*	0.0	-	0.039	0.039	0.034	0.039	87	100	20.0
Amenable Cyanide	-	-	-	-	-	-	-	-	-
Total Cyanide***	18.3**	-	1.43	1.64	20.2	22.0	132.9	225.6	52.0
Phenol***	0.940	UJ	19.4	21.2	0.776	0.847	0.0	0.0	0.0

[U] Result is less than the Limit of Detection (LOD) and/or Reporting Limit (RL).
[J] Matrix spike and/or matrix spike duplicate criteria was not met.
* SwRI® Sample ID = W-18366-00001
**Parent value exceeded 4 times the spike added; therefore, MS/MSD %Recovery and %RPD are not required for evaluation
- Indicates a location in the table for which an entry would not be appropriate.
*** SwRI® Sample ID = W-18366-00001 MS/MSD

Distribution:

J. P. Arnold	J. Manna
M. J. Barnes	K. B. Martin
K. Bice	J. J. Mayer
M. N. Borders	M. W. McCoy
J. M. Bricker	R. T. McNew
K. M. Brotherton	D. J. McCabe
R. L. Brown	G. A. Morgan
N. F. Chapman	P. W. Norris
J. H. Christian	J. E. Occhipinti
W. A. Condon	J. F. Iaukea
A. D. Cozzi	F. M. Pennebaker
C. L. Crawford	J. Polk
J. Crenshaw	P. A. Polk
K. D. Dixon	M. M. Potvin
E. M. Doman	B. M. Price
R. E. Edwards	A. A. Ramsey
A. P. Fellinger	W. G. Ramsey
E. J. Freed	J. W. Ray
J. N. Hall, Jr.	C. Ridgeway
E. W. Harrison	L. B. Romanowski
C. C. Herman	K. H. Rosenberger
K. A. Hill	A. Samadi-Dezfouli
P. J. Hill	F. M. Smith
T. H. Huff	A. V. Staub
R. M. Hoeppel	M. Stone
V. Jain	P. C. Suggs
R. C. Jolly, Jr.	P. A. Westover
J. P. Lampert	B. J. Wiedenman
C. A. Langton	A. W. Wiggins
J. D. Ledbetter	L. A. Wooten
B. Lee	T. L. Young
K. R. Liner	Records Administration (EDWS)