1215821

WCH-521
Rev. 1

[0092146]

River Corridor
Closure Contract

100-F and 100-IU-2/6 Remedial Investigation/ Feasibility Study Data Quality Assessment Report

July 2012

RECEIVED
AUG 02 2012
EDMC

For Public Release

Washington Closure Hanford

Prepared for the U.S. Department of Energy, Richland Operations Office
Office of Assistant Manager for River Corridor

TRADEMARK DISCLAIMER

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

This report has been reproduced from the best available copy.

Printed in the United States of America

DOCUMENT CONTROL 7/26/2012 a 8

WCH-521
Rev. 1

STANDARD APPROVAL PAGE

Title: 100-F and 100-IU-2/6 Remedial Investigation/Feasibility Study Data Quality Assessment Report

Author Name: R. P. Wells

Approval: R. W. Ovink, Environmental Protection

Roger W. Ovink
Signature

7-26-2012
Date

The approval signature on this page indicates that this document has been authorized for information release to the public through appropriate channels. No other forms or signatures are required to document this information release.

WCH-521
Rev. 1

River Corridor
Closure Contract

100-F and 100-IU-2/6 Remedial Investigation/Feasibility Study Data Quality Assessment Report

July 2012

Author:
R. P. Wells

For Public Release

Washington Closure Hanford

Prepared for the U.S. Department of Energy, Richland Operations Office
Office of Assistant Manager for River Corridor

TABLE OF CONTENTS

1.0 INTRODUCTION 1-1

2.0 LABORATORY QUALITY CONTROL PARAMETERS DISCUSSION 2-1

2.1 HOLDING TIMES 2-7

2.2 DETECTION LIMITS 2-9

2.3 METHOD BLANK RESULTS 2-9

2.4 FIELD EQUIPMENT BLANK RESULTS 2-10

2.5 FIELD TRIP BLANK RESULTS 2-10

2.6 MATRIX SPIKE RECOVERIES 2-11

2.7 LABORATORY CONTROL SAMPLES 2-12

2.8 MATRIX SPIKE DUPLICATES 2-12

2.9 LABORATORY DUPLICATE RESULTS 2-12

2.10 FIELD DUPLICATE RESULTS 2-12

3.0 DATA USABILITY 3-1

4.0 REFERENCES 4-1

APPENDIX

A 100-F AND 100-IU-2/6 REMEDIAL INVESTIGATION RELATIVE PERCENT DIFFERENCE CALCULATIONS ..... A-i

TABLES

1. Analytical Laboratories. 1-1
2. Laboratory Analytical Methods. (2 Pages) 1-1
3. Summary of Sample Delivery Groups Subject to Data Assessment 2-3
4. Holding Times. 2-8
5. Field Trip Blank and Field Transfer Blank Volatile Organic Analysis Results. 2-11
6. Field Duplicate/Split Quality Control Review. 2-13
7. 100-F Review Qualifiers for Inorganic Analytes 3-3
8. 100-F Review Qualifiers for Radionuclides. 3-7
9. 100-F Review Qualifiers for Pesticides. 3-8
10. 100-F Review Qualifiers for Volatile Organic Compounds. 3-9
11. 100-F Review Qualifiers for Special Extraction. 3-11

REVISION HISTORY

Revision	Date	Reason for revision	Revision initiator
1	07/2012	Update review qualifiers	R. P. Wells
0	02/2012	Initial issuance	R. P. Wells

1.0 INTRODUCTION

This data quality assessment (DQA) has been prepared to support the vadose zone characterization component of the 100-F and 100-IU-2/6 Remedial Investigation/Feasibility Study. The DQA was performed in accordance with EPA/240/B-06/002, *Data Quality Assessment: A Reviewer's Guide*, and EPA/240/B-06/003, *Data Quality Assessment: Statistical Methods for Practitioners*. The contents of this DQA specifically address laboratory quality control (QC) results. The laboratory QC results were evaluated against the requirements and guidelines provided in the *Sampling and Analysis Plan for the 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units Remedial Investigation/Feasibility Study* (SAP) (DOE/RL-2009-43).

Table 1 presents information on the analytical laboratories whose work was reviewed. Table 2 presents a summary of the analytical methods.

Table 1. Analytical Laboratories.

Name	Address
Lionville Laboratory, Inc.	208 Welsh Pond Road, Exton, Pennsylvania 19341
Eberline Analytical Corporation/Eberline Services	2030 Wright Avenue, Richmond, California 94804
Test America Laboratories	2800 George Washington Way, Richland, Washington 99354
	13715 Rider Trail North, Earth City, Missouri 63045

Table 2. Laboratory Analytical Methods. (2 Pages)

Parameter	Analytical Method
ICP metals	EPA Method 6010B [a] EPA Method 6020
Mercury	EPA Method 7471A
Hexavalent chromium (Cr-VI)	EPA Method 7196A
Anions	EPA Method 300.0
Nitrate/nitrite	EPA Method 353.1 EPA Method 353.2
Volatile organic compounds	EPA Method 8260B
pH	EPA Method 9045 (soil) EPA Method 9040 (water)
Pesticides	EPA Method 8081A
Polychlorinated biphenyls	EPA Method 8082
Polynuclear aromatic hydrocarbons	EPA Method 8310
Gamma-emitting radioisotopes	Gamma energy analysis

Table 2. Laboratory Analytical Methods. (2 Pages)

Parameter	Analytical Method
Carbon-14	LSC - C-14
Tritium	LSC – Tritium
Total Radiostrontium	Gas-flow proportional counting
Nickel-63	LSC - Ni-63
Technetium-99	Gas-flow proportional counting
Americium-241	Alpha energy analysis
Plutonium-238, -239/240	Alpha energy analysis
Uranium-233/234, -235, -238	Alpha energy analysis

[a] Analysis was performed for the expanded list of ICP metals, including aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, calcium, chromium (total), cobalt, copper, iron, lead, lithium, magnesium, manganese, molybdenum, nickel, phosphorous, potassium, selenium, silicon, silver, sodium, strontium, thallium, tin, vanadium, and zinc.

EPA = U.S. Environmental Protection Agency
ICP = inductively coupled plasma
LSC = liquid scintillation counting
pH = hydrogen ion concentration

2.0 LABORATORY QUALITY CONTROL PARAMETERS DISCUSSION

A total of 92 sample delivery groups (SDGs) were reviewed with a combined 222 field samples and 758 sample analyses between them.

Each SDG that was assessed contained at least one, and often several, different analytical methods that were assessed as part of the DQA. Table 3 presents the reviewed SDGs, sorted by sample authorization forms. Also shown in Table 3 are the laboratory analyses, including the number of samples per analysis, that were performed for each SDG.

Data assessment was not conducted for certain wet chemistry parameters (e.g., total solids and percent moisture) or physical property parameters (e.g., particle size distribution, porosity, bulk density, and saturated hydraulic conductivity), but these analyses are listed in Table 3 for completeness.

Table 3. Summary of Sample Delivery Groups Subject to Data Assessment. (4 Pages)

Sample Delivery Group	Site	Number of Samples in Sample Delivery Group	Analyses Performed																			
			Cr-VI	Tritium	Carbon-14	Nickel-63	Total Radiostrontium	Technetium-99	Isotopic Plutonium	Isotopic Uranium	Americium-241	GEA	Metals	pH	Percent Solids	Percent Moisture	Physical Properties	Special Extraction	Pesticides	PCBs	Anions	NO_2/NO_3	VOA
Sampling Authorization Form RC-187 (Soil)																							
K2163	C7790	1	1										1		1								
K2167	C7790	2					2					2											
K2173	C7790	4	2										2	2	2	2	2	2					
K2175	C7790	1					1					1											
K2179	C7790	4					4					4											
K2182	C7790	2	1										1	1	1	1	1	1					
K2187	C7790	5	3										3	2	3	1	1	2					
K2192	C7790	2					2					2											
K2195	C7790	3	2										2	1	2	1	2	1					
K2230	C7792	1					1					1											
K2234	C7792	2					2					2											
K2237	C7792	1					1					1											
K2241	C7792	2					2					2											
K2250	C7792	1	1										1		1								
K2258	C7792	4	2										2	2	2	1	1	2					
K2263	C7792	6	3										3	3	3	1	2	3					
K2275	C7792	3					3					3											
K2285	C7792	7	4										4	3	4	2	2	3					
K2297	C7792	1					1					1											
K2391	C7791	1	1										1		1								
K2406	C7791	2					2					2											
K2420	C7791	1																1					
K2421	C7791	1	1										1	1	1	1	1						
K2477	C7791	1					1					1											
K2487	C7791	1					1					1											
K2495	C7791	1	1										1		1								
K2502	C7791	1																					1
K2514	C7791	5					5					5											
K2523	C7791	2																					2
K2540	C7791	4																					4
K2559	C7791	3	3										3	3	3	1	2						

Table 3. Summary of Sample Delivery Groups Subject to Data Assessment. (4 Pages)

Sample Delivery Group	Site	Number of Samples in Sample Delivery Group	Analyses Performed																				
			Cr-VI	Tritium	Carbon-14	Nickel-63	Total Radiostrontium	Technetium-99	Isotopic Plutonium	Isotopic Uranium	Americium-241	GEA	Metals	pH	Percent Solids	Percent Moisture	Physical Properties	Special Extraction	Pesticides	PCBs	Anions	NO_2/NO_3	VOA
K2564	C7791	3																3					
K2569	C7791	2																2					
K2580	C7791	1																					1
K2653	C7791	3	3										3	3	3	3	1						
Sample Authorization Form RC-188 (Water)																							
J00819	C7790	1	1																				
J00840	C7792	1	1																				
J00915	C7791	1	1																				
J01014	C7970	2	2																				
J01015	C7971	2	2																				
J01019	C7972	2	2																				
J01059	C7970	1	1																				
J01071	C7972	1	1																				
K2184	C7790	1											1	1									
K2262	C7792	1											1	1									
K2536	C7791	1											1	1									
K3149	C7970	2					2																
	C7971	2					2																
K3174	C7970	2											2	1									
K3175	C7971	2											2	1									
K3200	C7972	2					2																
K3203	C7972	2											2	1									
K3289	C7970	1					1																
	C7972	1					1																
K3294	C7970	1											1	1									
K3295	C7972	1											1	1									
Sampling Authorization Form RC-194 (Soil)																							
J00984	C7972	2											1	1		1			1	1	1	1	1
J01018	C7972	1	1	1	1	1	1	1	1	1	1	1											
K3129	C7970	1		1	1	1	1	1	1			1											
	C7971	1		1	1	1	1	1	1	1	1	1											

Table 3. Summary of Sample Delivery Groups Subject to Data Assessment. (4 Pages)

Sample Delivery Group	Site	Number of Samples in Sample Delivery Group	Analyses Performed																				
			Cr-VI	Tritium	Carbon-14	Nickel-63	Total Radiostrontium	Technetium-99	Isotopic Plutonium	Isotopic Uranium	Americium-241	GEA	Metals	pH	Percent Solids	Percent Moisture	Physical Properties	Special Extraction	Pesticides	PCBs	Anions	NO_2/NO_3	VOA
K3131	C7970	7		6	6	6	7	6	6			6											
	C7971	2		1	1	1	2	1	1	1	1	1											
K3140	C7970	1	1										1	1	1	1			1		1	1	
K3141	C7971	1	1										1	1	1	1					1	1	
K3144	C7970	2																					2
K3145	C7971	1																					1
K3148	C7970	1		1	1	1	1	1	1			1											
	C7971	4		4	4	4	4	4	4	4	4	4											
K3154	C7972	1		1	1	1	1	1	1	1	1	1											
K3156	C7970	2		2	2	2	2	2	2			2											
	C7972	6		5	5	5	6	5	5	5	5	5											
K3159	C7970	2					1											2					
K3160	C7970	7																					7
K3162	C7971	3																					3
K3163	C7971	1												1		1	1						
K3164	C7970	2	2										2	2	2	2			2		2	2	
K3166	C7970	4					4											4					
K3167	C7971	1																1					
K3169	C7970	5	5										5	5	5	5			4		4	4	
K3170	C7971	2	2										2	2	2	2					1	1	
K3172	C7970	1																					1
K3173	C7971	4																					4
K3176	C7970	1	1										1	1	1	1			1		1	1	
K3177	C7971	4	4										4	4	4	4					4	4	
K3178	C7970	1					1											1					
K3179	C7971	3																3					
K3187	C7970	1					1											1					
K3188	C7972	5																5					
K3190	C7972	2																					2
K3193	C7972	1	1										1	1	1	1			1	1	1	1	
K3195	C7970	2																					2
K3196	C7972	6																					6

Table 3. Summary of Sample Delivery Groups Subject to Data Assessment. (4 Pages)

Sample Delivery Group	Site	Number of Samples in Sample Delivery Group	Analyses Performed																				
			Cr-VI	Tritium	Carbon-14	Nickel-63	Total Radiostrontium	Technetium-99	Isotopic Plutonium	Isotopic Uranium	Americium-241	GEA	Metals	pH	Percent Solids	Percent Moisture	Physical Properties	Special Extraction	Pesticides	PCBs	Anions	NO_2/NO_3	VOA
K3197	C7970	2	2										2	2	2	2			2		2	2	
K3198	C7972	6	6										6	6	6	6			5	5	5	5	
K3207	C7972	3		3	3	3	3	3	3	3	3	3											
K3208	C7972	2																2					
K3209	C7972	1																					1
K3210	C7972	3	3										3	3	3	3			3	3	3	3	

GEA = gamma energy analysis
PCB = polychlorinated biphenyl
pH = hydrogen ion concentration
VOA = volatile organic analysis

The QC parameters evaluated for each SDG included the following as appropriate and applicable for each analytical method:

- Holding time
- Method detection limits
- Method blank results
- Field equipment blank results
- Field trip blank results
- Matrix spikes/matrix spike duplicates
- Laboratory control sample (LCS) results
- Laboratory duplicate results
- Field duplicate results
- Field split results.

Each QC parameter was assessed, and noncompliant results were summarized on DQA worksheets. Reviewer qualifications applied to the data were also noted on the worksheets. The individual worksheets as Microsoft® Excel® files are maintained in the project file.

Minor and major deficiencies were identified in the data packages. Minor deficiencies noted by the reviewer resulted in a "J" flag being assigned to the laboratory result. Major deficiencies resulted in an "R" flag being assigned to the laboratory result. In addition to the data qualifiers that have been assigned by the analytical laboratory, the following data qualifiers were assigned during data assessment:

- UJ – The compound or analyte was analyzed for and detected in the sample. However, due to a minor QC deficiency associated with method blank results, the associated results are labeled as estimated quantitation limits (EQLs). The data are considered usable for decision-making purposes.

- J – Due to a minor QC deficiency identified during the data assessment, the associated concentration is an estimate. The data are considered usable for decision-making purposes.

- UR – Indicates that the constituent was analyzed for and not detected; however, due to an identified major QC deficiency, the data are not considered usable for decision-making purposes.

Due to the large volume of data that were reviewed, it is not possible to discuss in detail each of the qualifiers that were applied to the individual results. The following sections provide a general discussion of the data quality issues identified.

2.1 HOLDING TIMES

Holding times that comply with the established limit are in compliance with the requirement. Holding times between one and two times the limit defined by the method are considered minor deficiencies with all associated sample results qualified as estimated and flagged "J" for detects

® Microsoft is a registered trademark of the Microsoft Corporation in the United States and/or other countries.
® Excel is a registered trademark of the Microsoft Corporation in the United States and/or other countries.

and "UJ" for nondetects. Holding times greater than two times the limit are considered major deficiencies with all associated detectable sample results qualified as estimates and flagged "J" and all nondetects are rejected and flagged "UR." Table 4 lists the holding times applicable to the analytical methods by matrix.

Table 4. Holding Times.

Parameter	Method	Soil Holding Time	Water Holding Time
ICP metals	EPA Method 6010B EPA Method 6020	6 months	6 months
Mercury	EPA Method 7471A	28 days	[a]
Hexavalent chromium	EPA Method 7196A	30 days	24 hours
Anions	EPA Method 300.0	28 days/48 hours [b]	[a]
Nitrate/nitrite	EPA Method 353.1 EPA Method 353.2	28 days	[a]
Volatile organic compounds	EPA Method 8260B	14 days	[a]
pH	EPA Method 9045 (soil) EPA Method 9040 (water)	As soon as possible	As soon as possible
Polychlorinated biphenyls	EPA Method 8082	1 year/1 year	[a]
Pesticides	EPA Method 8081A	14 days/40 days	[a]
Gamma-emitting radioisotopes	Gamma energy analysis	6 months	[a]
Carbon-14	LSC – C-14	6 months	[a]
Tritium	LSC – tritium	6 months	[a]
Total radiostrontium	Gas-flow proportional counting	6 months	6 months
Nickel-63	LSC – Ni-63	6 months	[a]
Technetium-99	Gas-flow proportional counting	6 months	[a]
Americium-241	Alpha energy analysis	6 months	[a]
Plutonium isotopes	Alpha energy analysis	6 months	[a]
Uranium isotopes	Alpha energy analysis	6 months	[a]

[a] Samples did not undergo this particular analysis.
[b] Holding time for anions is 28 days except for nitrate, nitrite, and phosphate for which the holding time is 48 hours.
EPA = U.S. Environmental Protection Agency
ICP = inductively coupled plasma
LSC = liquid scintillation counter
pH = hydrogen ion concentration

Anions with a 48-hour holding time (nitrate, nitrite, and phosphate) frequently exceeded the requirement by more than double, resulting in the qualification of data as "J" if the result is a detectable concentration or "UR" if the result is a nondetect. The delays in analyses were attributed to the delays between sample collection and analysis because of shipping preparation, sample screening for radionuclides, and shipping time. This was a consistent problem with the data that affected all nitrate, nitrite, and phosphate analytical results.

The pH analyses were analyzed as soon as possible by the laboratory, which recognized that there would be a delay between sample collection and analysis because of the same problems experienced for the nitrate, nitrite, and phosphate analyses. Ideally, pH analysis would be performed within 24 hours of sample collection. Because this was never achieved, the pH results for all samples requiring analysis were flagged "J" as estimated quantities.

2.2 DETECTION LIMITS

Estimated quantitation limits for individual analytes and tables for specific methods are defined in Section 2.0 and Appendix A of the SAP (DOE/RL-2009-43). Reported analytical detection levels for undetected analytes are compared against the EQLs to ensure that laboratory detection levels met the required criteria.

For most analytes, the EQLs were met. However, the EQL was occasionally exceeded for several gamma-emitting radionuclides. The EQL being exceeded was minor in absolute terms, with the minimum detectable activity (MDA) achieved for the analyses being below the action levels provided in the SAP. No qualification of the gamma-emitting radionuclide results is required for exceeding the EQL, and none were applied.

Similarly, the EQLs for iron and zinc were frequently exceeded with the quantitation limits achieved by the laboratory being below the action levels provided in the SAP (DOE/RL-2009-43). For both iron and zinc, the concentrations in the field samples always were at detectable levels; therefore, the fact that the EQLs were exceeded was inconsequential. For field quality assurance samples such as field blanks, the iron and zinc concentrations were frequently below detection; however, this does not affect the overall quality of the data generated for the field samples themselves.

The EQLs for anions were frequently exceeded; however, as with the gamma-emitting radionuclides and the metals, the quantitation limits achieved by the laboratory were below the action levels provided in the SAP. Again, no qualification of the data is required.

2.3 METHOD BLANK RESULTS

Method blank samples are analyzed to determine if positive results may be attributed to laboratory reagent, sample container, or detector contamination. At least 1 acceptable method blank analysis must be conducted for every 20 samples. If the method blank analysis results indicate the presence of an analyte above the method detection limit or MDA, the following qualifiers are applied:

- All positive sample results less than five times the highest blank concentration are qualified as estimates and flagged "J."
- Sample results below the EQL or MDA are qualified as undetected and flagged "UJ."
- Sample results above the EQL or MDA and greater than five times the highest blank concentration are not qualified.

Method blank contamination was regularly observed in inductively coupled plasma metal analyses, primarily for tin. Generally, the amount observed in the blank was between the detection level and the reporting level. Because the concentration of tin detected in the sample was usually low, the method blank contamination usually required applying a "UJ" flag to the result.

Occasionally, blank contamination was encountered for other analyses as noted in the worksheets. The analytical data were flagged appropriately in accordance with the above criteria.

2.4 FIELD EQUIPMENT BLANK RESULTS

Field equipment blank samples are analyzed to determine if positive results may be attributed to contaminants introduced as a result of the field sampling process. If the field equipment blank analysis results indicate the presence of an analyte above the method detection limit or MDA, the following qualifiers may be applied:

- All positive sample results less than five times the highest blank concentration are qualified as estimates and flagged "J"
- Sample results below the EQL or MDA are qualified as undetected and flagged "UJ"
- Sample results above the EQL or MDA and greater than five times the highest blank concentration are not qualified.

Periodically, field equipment blanks contained detectable concentrations of specific analytes above concentrations seen in field samples. Notation was made in the individual worksheets, and the data flagged in accordance with the above criteria. Only those samples in the same analytical group as the offending field equipment blank were qualified because it could not be determined whether the contamination was attributed to field sample collection techniques or laboratory analytical techniques. More often than not, the same contamination was detected in the laboratory method blank, providing evidence that the discrepancy was attributed to the laboratory rather than the field.

2.5 FIELD TRIP BLANK RESULTS

Field trip blank samples are analyzed to determine if positive results may be attributed to contaminants introduced as a result of the transfer of samples from the field to the laboratory. In addition to field trip blanks, field transfer blanks were collected specifically for volatile organic analysis (VOA) samples. The two primary analytes detected in both field trip blanks and field transfer blanks are methylene chloride and acetone. These are common laboratory contaminants and are frequently detected in the laboratory method blanks. The field trip blank and field transfer blank results for VOAs are provided in Table 5.

Table 5. Field Trip Blank and Field Transfer Blank Volatile Organic Analysis Results.

Location	Interval	Sample	Concentration (µg/kg)		
			Methylene Chloride	Acetone	2-Hexanone
Field Transfer Blanks					
C7791	I-005	B28N11	3.29	U	U
C7970	I-001	B28NM3	2.56	5.62	U
C7971	I-003	B28VN6	2.89	6.85	U
C7972	I-002	B29395	3.54	15.7	U
Trip Blanks					
C7791	I-004	B28NL3	U	U	6.01
C7970	I-004	B28NM4	4.25	7.31	U
C7971	I-001	B28VM0	1.87	5.22	U
C7972	I-006	B293D3	U	11.2	U

U = undetect

2.6 MATRIX SPIKE RECOVERIES

Matrix spike recoveries allow for evaluation of accuracy. Measured concentrations or activities are compared to the known added amounts. The SAP (DOE/RL-2009-43) defines the acceptable recovery range as 70% to 130%, with data falling outside this range being flagged "J."

The accuracy criteria provided in the SAP (DOE/RL-2009-43) are based on the initial guidance values for percent recoveries as defined in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*. As per SW-846 Method 8000 and applicable to all SW-846 organic analyses, it is essential that laboratories calculate in-house performance criteria for matrix spike recoveries and surrogate recoveries. It may also be useful to calculate such in-house criteria for LCS recoveries and for the initial demonstration of proficiency when experience indicates that the criteria recommended in specific methods are frequently missed for some analytes or matrices. The development of in-house performance criteria and the use of control charts or similar procedures to track laboratory performance cannot be over-emphasized. Many data systems and commercially available software packages support the use of control charts. The SW-846 outlines the procedures for the calculation of in-house performance criteria for matrix spike recovery and surrogate recovery. The procedures may also be applied to the development of in-house criteria for the initial demonstration of proficiency and for LCS recoveries. For organic analyses where the laboratory has defined acceptance criteria for matrix spike recoveries, these criteria will be used to assess the quality of the data rather than the 70% to 130% limits provided in the SAP (DOE/RL-2009-43).

For tritium and carbon-14 analyses, matrix spikes are required by the method validation procedure, but are not routinely included by the analytical method for soil samples. Therefore, the tritium and carbon-14 data from soil analyses are flagged "J" as estimated quantities because matrix spikes were not analyzed with the SDGs.

2.7 LABORATORY CONTROL SAMPLES

Laboratory control samples allow for evaluation of accuracy. Measured concentrations or activities are compared to the known added amounts. The acceptable recovery range is 70% to 130%. Results less than 70% or greater than 130% will be flagged "J" as estimated quantities. As discussed above, laboratory-established criteria were used to assess LCS results for organic analyses where such criteria are provided.

2.8 MATRIX SPIKE DUPLICATES

Analytical precision is expressed by the relative percent difference (RPD) between the recoveries of duplicate matrix spike analyses performed on a sample in the analytical batch. If both the sample and replicate concentrations are greater than five times the EQL and the RPD is less than 30%, no qualification is required. If either concentration is less than five times the EQL, the RPD control limit is less than or equal to two times the EQL. If the RPD is outside the applicable control limit, associated results are qualified as estimated detects or estimated nondetects and flagged "J" accordingly. Sample results greater than five times the spike concentration require no qualification.

2.9 LABORATORY DUPLICATE RESULTS

Laboratory duplicate results are a second method by which to assess analytical precision. Precision may be assessed using unspiked duplicate analyses performed on a sample in the analytical batch. If both the sample and replicate concentrations are greater than five times the EQL and the RPD is less than 30%, no qualification is required. If either concentration is less than five times the EQL, the RPD control limit is less than or equal to two times the EQL. If the RPD is outside the applicable control limit, associated results are qualified as estimated detects or estimated nondetects and flagged "J" accordingly.

Out-of-compliance laboratory duplicate analyses were one of the most common deficiencies noted in the reviewed data sets. All of the laboratory duplicates that were out of compliance were minor and required applying a "J" flag to the appropriate results. No results were rejected based on the laboratory duplicates.

2.10 FIELD DUPLICATE RESULTS

Field duplicate results are a method by which to assess field precision. Precision is assessed from the analysis of a primary sample and its duplicate collected in the field. If both the sample and its field duplicate concentrations are greater than five times the EQL and the RPD is less than 30%, no qualification is required. Where direct evaluation of the sample data showed that a given analyte was not detected in the primary, duplicate, or split sample, further evaluation of the RPD was not performed.

When an analyte is detected in the primary or duplicate/split sample, but is quantified at less than five times the EQL in one or both samples, an additional parameter is evaluated. In this case, if the difference between the primary and duplicate/split results exceeds a control limit of two times the EQL, further assessment regarding the usability of the data is performed whereby the RPD control limit will be considered as less than or equal to two times the EQL.

A calculation brief was prepared to assess the RPD between duplicate and split sample pairs (Calculation No. 0100X-CA-V0069). This calculation brief is presented in Appendix A.

Ten sample pairs were evaluated, including seven soil field duplicates, two groundwater field duplicates, and one split sample. Based on the methodology explained in the calculation, RPDs were calculated for 139 analyte pairs. Of these 139 RPDs, 16 exceeded the 30% guideline. Of the 16, 10 were not contaminants of interest (e.g., aluminum, calcium, silicon) and were not evaluated further. The remaining six RPDs were further assessed as required by the method. Further assessment showed that none were below the secondary parameter being quantified at less than five times the EQL with the RPD control limit considered to be two times the EQL. The remaining six listed in Table 6 were reviewed for laboratory QC issues, such as matrix spikes or duplicate analyses that were out of specification. Those analytes with laboratory QC issues have been qualified as estimated by the laboratory, the analytical data validator, and/or the DQA reviewer.

Table 6. Field Duplicate/Split Quality Control Review.

Location	Analyte	Relative Percent Difference	Laboratory Quality Control Issue
C7970 I-002	Carbon-14	101.2%	Yes
C7971 I-003	Barium	37.1%	No
	Copper	42.4%	No
	Manganese	39.8%	No
	Zinc	42.5%	No
C7972 I-003	Barium	31.9%	No

Further assessment showed that one of the six analyte pairs had laboratory QC issues in one or both (e.g., matrix spikes or duplicate analyses that were out of specification. Those analytes with laboratory QC issues have been qualified as estimates by the laboratory, the validator, and/or the data reviewer. The remaining five analyte pairs have no apparent laboratory QC issues.

Field duplicate and split sample pair analyses results that exceed guidelines are considered a minor deficiency. No further qualification of the data is required.

3.0 DATA USABILITY

Based on the results of this DQA, all of the laboratory analytical results that were not qualified as rejected are considered useable for their intended purpose. Table 7 presents the reviewer qualifiers that were applied to the sample results for inorganic analytes including metals, anions, and pH. Table 8 presents the qualifiers for radionuclides. Table 9 lists the qualifiers for the pesticides. Tables 10 and 11 provide the reviewer qualifiers for VOAs and special extraction analyses, respectively. No qualifiers were assigned to any samples undergoing polychlorinated biphenyl (PCB) analyses; therefore, a table is not presented specifically for PCBs.

Table 7. 100-F Review Qualifiers for Inorganic Analytes. (3 Pages)

Sample Delivery Group	Sample Number	Metals																								Anions								pH
		Aluminum	Antimony	Barium	Boron	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Lithium	Magnesium	Manganese	Nickel	Phosphorous	Potassium	Selenium	Silicon	Silver	Sodium	Strontium	Tin	Vanadium	Zinc	Cr-VI	Bromide	Chloride	Fluoride	Nitrate (as N)	Nitrite (as N)	Orthophosphate	Sulfate	NO_2/NO_3	pH
Sampling Authorization Form RC-187 (Soil)																																		
K2163	B26T26	J					J			J								UJ	J															
K2173	B26T18	J	J					J							J				J															J
	B26T20	J	J					J							J				J															J
K2182	B26T44	J	J				J									J			J															J
K2187	B26T22		J						J																									
	B26T25		J						J																									J
	B26T30		J						J																									J
K2195	B26T32		J					J											J															J
	B26T34		J					J											J															
K2250	B26Y79	J					J												J															
K2258	B26Y73		J										J						J															J
	B26Y75		J										J						J															J
K2263	B26Y76		J					J							J				J															J
	B26Y77		J					J							J				J															J
	B26Y82		J					J							J				J															J
K2285	B26Y74		J																															
	B26Y78		J																															J
	B26Y80		J																															J
	B26Y81		J																															J
K2391	B27358	J								J						J			J	J														
K2421	B27369	J	J					J							J	J			J		J													J
K2495	B27630	J								J		UJ							J				UJ											
K2502	B28NL3																																	
K2559	B27370		J										J						J				UJ			J								J
	B27375		J										J						J				UJ											J
	B27381		J										J						J				UJ											J
K2653	B27360		J						J				J						J				UJ											J
	B27372		J						J				J						J				UJ											J
	B27374		J						J				J						J				UJ			J								J
Sample Authorization Form RC-188 (Water)																																		
K2184	B26T48	UJ																																J
K2262	B26YB0																																	J
K2536	B273B1	UJ				J																												

Table 7. 100-F Review Qualifiers for Inorganic Analytes. (3 Pages)

Sample Delivery Group	Sample Number	Metals																								Anions								pH
		Aluminum	Antimony	Barium	Boron	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Lithium	Magnesium	Manganese	Nickel	Phosphorous	Potassium	Selenium	Silicon	Silver	Sodium	Strontium	Tin	Vanadium	Zinc	Cr-VI	Bromide	Chloride	Fluoride	Nitrate (as N)	Nitrite (as N)	Orthophosphate	Sulfate	NO_2/NO_3	pH
K3174	B28NX3	UJ																	J						J										J
	B28NX4	UJ																	J						J										
K3175	B28VW0	UJ																	J						J										J
	B28VW3	UJ																	J						J										
K3203	B293J2	UJ																	J						J										J
	B293J5	UJ																	J						J										
K3294	B2C688																																		J
K3295	B2C6R8																																		J
Sampling Authorization Form RC-194 (Soil)																																			
J00984	B293B2	J					J						J				J		J		J													J	J
K3140	B28NW8	J					UJ			J								J	J				UJ				J	J	J	UR	UR	UR	J		J
K3141	B28VN0	J					UJ			J								J	J				UJ				J	J	J	UR	UR	UR	J	J	J
K3164	B28NR3		J	J	J		J						J						J			J	UJ				J	J	J	J	UR	UR	J	J	J
	B28NR8		J	J	J		J						J						J			J	UJ				J	J	J	J	UR	UR	J	J	J
K3169	B28NR5		J					J					J		J				J				UJ							J	UR	UR			J
	B28NR6		J					J					J		J				J				UJ							J	UR	UR			J
	B28NR7		J					J					J		J				J				UJ							J	UR	UR			J
	B28NT5		J					J					J		J				J				UJ							J	UR	UR			J
	B28NM6		J					J					J		J				J				UJ												J
K3170	B28VV1		J											J					J				UJ							J	UR	UR		J	J
	B28VV4		J											J					J				UJ												J
K3176	B28NR9	J	J						J				J			J			J				UJ							J	UR	J	J		J
K3177	B28VL9	J	J					J							J								UJ				J		J	J	UR	UR			J
	B28VM4	J	J					J							J								UJ				J		J	J	UR	UR			J
	B28VM7	J	J					J							J								UJ				J		J	J	UR	UR			J
	B28VN5	J	J					J							J								UJ				J		J	J	UR	UR			J
K3193	B293B6	J					UJ			J								J	J				UJ							UR	UR	UR			J
K3197	B28NR4		J				J		J				J	J								J	UJ	J	J					J	UR	UR	J	J	J
	B28NX1		J				J		J				J	J								J	UJ	J	J					J	UR	UR	J	J	J

Table 7. 100-F Review Qualifiers for Inorganic Analytes. (3 Pages)

Sample Delivery Group	Sample Number	Metals																								Anions								pH
		Aluminum	Antimony	Barium	Boron	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Lithium	Magnesium	Manganese	Nickel	Phosphorous	Potassium	Selenium	Silicon	Silver	Sodium	Strontium	Tin	Vanadium	Zinc	Cr-VI	Bromide	Chloride	Fluoride	Nitrate (as N)	Nitrite (as N)	Orthophosphate	Sulfate	NO_2/NO_3	pH
K3198	B29390	J	J								J												UJ							J	UR	UR		J	J
	B29394	J	J								J												UJ							J	UR	UR			J
	B293B0	J	J								J												UJ							J	UR	UR			J
	B293C0	J	J								J												UJ							J	UR	UR			J
	B293F2	J	J								J												UJ							J	UR	UR			J
	B293H9	J	J								J												UJ												J
K3210	B293C5	J	J		UJ		J							J					J				UJ							J	UR	UR			J
	B293C9	J	J		UJ		J							J					J				UJ							J	UR	UR			J
	B293D2	J	J		UJ		J							J					J				UJ							J	UR	UR			J

J = Due to a minor quality control deficiency identified during the data assessment, the associated concentration is an estimate. The data are considered usable for decision-making purposes.
pH = hydrogen ion concentration
UJ = The compound or analyte was analyzed for and detected in the sample. However, due to a minor quality control deficiency associated with method blank results, the associated results are labeled as estimated quantitation limits. The data are considered usable for decision-making purposes.
UR = Indicates that the constituent was analyzed for and not detected; however, due to an identified quality control issue, the data should be considered unusable for decision-making purposes.

Table 8. 100-F Review Qualifiers for Radionuclides.

Sample Delivery Group	Sample Number	Radionuclides											
		Tritium	Carbon-14	Nickel-63	Total Radiostrontium	Technetium-99	Plutonium-238	Plutonium-239/240	Uranium-233/234	Uranium-235	Uranium-238	Americium-241	GEA
Sampling Authorization Form RC-194 (Soil)													
J01018	B293B1	J	J										
K3129	B28NW7	J	J										
	B28VM8	J	J										
K3131	B28NT6	J	J										
	B28NT8	J	J										
	B28NT9	J	J										
	B28NV0	J	J										
	B28NV1	J	J										
	B28NV8	J	J										
	B2B6M3	J	J						J				
K3148	B28NV2	J	J										
	B28VL6	J	J										
	B28VM1	J	J										
	B28VM5	J	J										
	B28VN2	J	J										
K3154	B293B3	J	J										
K3156	B28NT7	J	J										
	B28NX0	J	J										
	B29387	J	J										
	B29391	J	J										
	B29397	J	J										
	B293B7	J	J										
	B293D9	J	J										
K3207	B293C2	J	J										
	B293C6	J	J										
	B293D0	J	J										

GEA = gamma energy analysis
J = Due to a minor quality control deficiency identified during the data assessment, the associated concentration is an estimate. The data are considered usable for decision-making purposes.

Table 9. 100-F Review Qualifiers for Pesticides.

Sample Delivery Group	Sample Number	4,4'-DDD	4,4'-DDE	4,4'-DDT	alpha-BHC	beta-BHC	delta-BHC	gamma-BHC	alpha-Chlordane	gamma-Chlordane	Aldrin	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan Sulfate	Endrin	Endrin Aldehyde	Endrin Ketone	Heoptachlor	Heoptachlor Expoxide	Methoxychlor	Toxaphene
Sampling Authorization Form RC-194 (Soil)																						
J00984	B293B2																		J			
K3140	B28NW8	J	J	J	J	J	J		J	J	J	J	J	J		J	J	J	J	J		
K3169	B28NR5																	J				
	B28NR6																	J				
	B28NR7																	J				
	B28NT5					J												J				
K3193	B293B6	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J
K3198	B29390	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J
	B29394	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J
	B293B0																J					
	B293C0																J					
	B293F2																J					
K3210	B293C5										J											
	B293C9										J											
	B293D2										J											

BHC = benzene hexachloride
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethene
DDT = dichlorodiphenyltrichloroethane
J = Due to a minor quality control deficiency identified during the data assessment, the associated concentration is an estimate. The data are considered usable for decision-making purposes.

Table 10. 100-F Review Qualifiers for Volatile Organic Compounds.

Sample Delivery Group	Sample Number	VOAs																																		
		1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	1,2-Dichloroethene (Total)	1,2-Dichloropropane	2-Butanone	2-Hexanone	4-Methyl-2-pentanone	Acetone	Benzene	Bromodichloromethane	Bromoform	Bromomethane	Carbon Disulfide	Carbon Tetrachloride	Chlorobenzene	Chloroethane	Chloroform	Chloromethane	cis-1,2-Dichloroethene	cis-1,3-Dichloropropene	Dibromochloromethane	Ethylbenzene	Methylene Chloride	Styrene	Tetrachloroethene	trans-1,2-Dichloroethene	Toluene	trans-1,3-Dichloropropene	Trichloroethene	Vinyl Chloride	Xylenes, Total
Sampling Authorization Form RC-187 (Soil)																																				
K2523	B28N11																		J									UJ								
	B28N12																		J									UJ								
K2580	B28MY9	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J
Sampling Authorization Form RC-194 (Soil)																																				
J00984	B293P4	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J
K3144	B28NM3												UJ															UJ								
	B28NW6												UJ															UJ								
K3145	B28VM9												UJ															UJ								
K3160	B28NM9																											UJ								
	B28NN0																											UJ								
	B28NN2																											UJ								
	B28NN9																											UJ								
	B28NM4																											UJ								
	B28NN1																											UJ								
	B28NM7																											UJ								
K3162	B28VM0												UJ															UJ								
	B28VN6												UJ															UJ								
	B28VV0												UJ															UJ								
K3172	B28NN3																											UJ								
K3173	B28VL7												UJ															UJ								
	B28VM2												UJ															UJ								
	B28VM6												UJ															UJ								
	B28VN3												UJ																							
K3190	B293B4												UJ																							
	B29395												UJ																							
K3209	B293C3												UJ																							

J = Due to a minor quality control deficiency identified during the data assessment, the associated concentration is an estimate. The data are considered usable for decision-making purposes.
UJ = The compound or analyte was analyzed for and detected in the sample. However, due to a minor quality control deficiency associated with method blank results, the associated results are labeled as estimated quantitation limits. The data are considered usable for decision-making purposes.
VOA = volatile organic analysis

Table 11. 100-F Review Qualifiers for Special Extraction. (2 Pages)

Sample Delivery Group	Sample Number	Arsenic	Barium	Cadmium	Chromium	Hexavalent Chromium	Lead	Selenium	Silver	Strontium-90
Sampling Authorization Form RC-187 (Soil)										
K2173	B26T19				J	J				
	B26T21					J				
K2182	B26T45				J	J				
K2187	B26T23					J				
	B26T31				J	J				
K2195	B26T33					J				
K2258	B26Y86					J				
	B26Y88					J				
K2263	B26Y89				J	J				
	B26Y90				J	J				
	B26Y95				J	J				
K2285	B26Y91	J	J	J	J	J	J	J	J	
	B26Y93	J	J	J	J	J	J	J	J	
	B26Y94	J	J	J	J	J	J	J	J	
K2420	B27356	J	J	J	J	J	J	J	J	
K2564	B27357	J	J	J	J		J	J	J	
	B27362	J	J	J	J		J	J	J	
	B27368	J	J	J	J		J	J	J	
K2569	B27359					J				
	B27361	J				J				
Sampling Authorization Form RC-194 (Soil)										
K3159	B28NP0					J				
	B28NP5					J				
K3166	B28NP2				J					
	B28NP3				J					
	B28NP4				J					
	B28NR2				J					
K3167	B28VV2	J	J	J	J	J	J	J	J	
K3178	B28NP6	J	J	J	J		J	J	J	
K3179	B28VL8	J	J	J	J		J	J	J	
	B28VM3	J	J	J	J	J	J	J	J	
	B28VN4	J	J	J	J		J	J	J	
K3187	B28NP1	J	J	J	J		J	J	J	
K3188	B29393				J					
	B29399				J	J				
	B293B9				J					

Table 11. 100-F Review Qualifiers for Special Extraction. (2 Pages)

Sample Delivery Group	Sample Number	Arsenic	Barium	Cadmium	Chromium	Hexavalent Chromium	Lead	Selenium	Silver	Strontium-90
K3208	B293C8						J			

J = Due to a minor quality control deficiency identified during the data assessment, the associated concentration is an estimate. The data are considered usable for decision-making purposes.

4.0 REFERENCES

DOE/RL-2009-43, 2010, *Sampling and Analysis Plan for the 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units Remedial Investigation/Feasibility Study*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

EPA/240/B-06/002, 2006, *Data Quality Assessment: A Reviewer's Guide*, EPA QA/G-9R, U.S. Environmental Protection Agency, Office of Environmental Information, Washington, D.C.

EPA/240/B-06/003, 2006, *Data Quality Assessment: Statistical Methods for Practitioners,* EPA QA/G-9S, U.S. Environmental Protection Agency, Office of Environmental Information, Washington, D.C.

SW-846, 1990, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods,* Update IV of the Third Edition, U.S. Environmental Protection Agency, Office of Environmental Information, Washington, D.C.

APPENDIX A

100-F and 100-IU-2/6 REMEDIAL INVESTIGATION RELATIVE PERCENT DIFFERENCE CALCULATIONS

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation **Job No. 14655**

Area: 100-F, 100-IU-2, and 100-IU-6

Discipline: Environmental *Calculation No: 0100X-CA-V0069

Subject: 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation Relative Percent Difference (RPD) Calculations

Computer Program: Excel Program No: Excel 2007

The attached calculations have been generated for a specific purpose and task. Use of the calculations by persons who do not have access to all pertinent facts may lead to incorrect conclusions and/or results. Before applying these calculations to your work, the underlying basis, rationale, and other pertinent information relevant to these calculations must be thoroughly reviewed with appropriate Washington Closure Hanford LLC (WCH) officials or other authorized personnel. WCH is not responsible for the use of a calculation not under its direct control.

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 13 Total = 14	P. L. Benjamin	H. M. Sulloway		J. M. Capron	
						8/31/11

SUMMARY OF REVISION

WCH-DE-019 (06/08/2007) *Obtain Calc. No. from Document Control and Form from Intranet

CALCULATION SHEET

Washington Closure Hanford

Originator P. L. Benjamin PB | Date 8/25/2011 | Calc. No. 0100X-CA-V0069 | Rev. No. 0
Project 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation | Job No. 14655 | Checked H. M. Sulloway | Date 8/31/11
Subject 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation Relative Percent Difference (RPD) Calculations | Sheet No. 1 of 13

Summary

PURPOSE:

Provide documentation to support the calculation of the relative percent difference (RPD) for primary-duplicate and primary-split sample pairs from 100-F, 100-IU-2, and 100-IU-6 operable units remedial investigation sample results, as necessary.

TABLE OF CONTENTS:

Sheets 1 to 3 – Summary
Sheet 4 - C7790 Interval 4 Soil Samples
Sheet 5 - C7791 Interval 3 Soil Samples
Sheet 6 - C7792 Interval 5 Soil Samples
Sheet 7 - C7970 Interval 2 Soil Samples
Sheet 8 - C7970 Interval 15 Groundwater Samples
Sheet 9 - C7971 Interval 3 Soil Samples
Sheet 10 - C7971 Interval 13 Groundwater Samples
Sheet 11 - C7972 Interval 3 Soil Samples
Sheet 12 - C7972 Interval 6 Soil Samples
Sheet 13 - C7972 Interval 13 Groundwater Samples

GIVEN/REFERENCES:

1) DOE-RL, 2009, *Sampling and Analysis Plan for the100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units Remedial Investigation/Feasibility Study,* DOE/RL-2009-43, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

SOLUTION:

1) Use data obtained from remedial investigation soil, aquifer sediment, and groundwater samples to perform the RPD calculations for primary-duplicate and primary-split sample pairs, as required.

METHODOLOGY:

The RPD is calculated when both the primary sample value and either the duplicate or split sample value for a given analyte are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method. The 100-F, 100-IU-2, and 100-IU-6 SAP lists laboratory performance standards as estimated quantitation limits (EQLs) for soil/aquifer sediment samples from sampling targets in Tables 2-2, 2-3, and 2-4 of the SAP (DOE-RL 2009) for selected constituents. Where TDL values lower than those listed in the SAP were available, the lower values were used.

Where direct evaluation of the attached sample data showed that a given analyte was not detected in the primary, duplicate, and/or split sample, further evaluation of the RPD value was not performed.

The RPD calculations use the following formula:

$$RPD = [\,|M-D|/((M+D)/2)]*100$$

where, M = main sample value D = duplicate (or split) sample value

When an analyte is detected in the primary or duplicate/split sample, but is quantified at less than 5 times the TDL in one or both samples, an additional parameter is evaluated. In this case, if the difference between the primary and duplicate/split results exceeds a control limit of 2 times the TDL, further assessment regarding the usability of the data is performed as part of the overall quality assessment.

CALCULATION SHEET

Washington Closure Hanford

Originator P. L. Benjamin PB Date 8/25/2011 Calc. No. 0100X-CA-V0069 Rev. No. 0
Project 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation Job No. 14655 Checked H. M. Sulloway HMS Date 8/31/11
Subject 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation Relative Percent Difference (RPD) Calculations Sheet No. 2 of 13

Summary

METHODOLOGY CONTINUED:

For quality assurance/quality control (QA/QC) duplicate RPD calculations, a value less than 30% indicates the data compare favorably. If the RPD is greater than 30%, further investigation regarding the usability of the data is performed. Additional discussion is provided in the data quality assessment.

RESULTS:

The results presented in the tables that follow include the summary of the results of the RPD calculations and are for use in data quality assessment of the remedial investigation sampling.

Washington Closure Hanford **CALCULATION SHEET**

Originator P. L. Benjamin PB **Date** 8/25/2011 **Calc. No.** 0100X-CA-V0069 **Rev. No.** 0
Project 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation **Job No.** 14655 **Checked** H. M Sulloway **Date** 8/31/11
Subject 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation Relative Percent Difference (RPD) Calculations **Sheet No.** 3 of 13

Summary (continued)

Relative Percent Difference Results and QA/QC Analysis

Analyte	C7790, Soil, Interval 4	C7791, Soil, Interval 3	C7792, Soil, Interval 5	C7970, Soil, Interval 2	C7970, Groundwater, Interval 15	C7971, Soil, Interval 3	C7971, Groundwater, Interval 13	C7972, Soil, Interval 3	C7972, Soil, Interval 6	C7972, Groundwater, Interval 13
	Duplicate Analysis	Duplicate Analysis	Duplicate Analysis	Duplicate Analysis	Duplicate Analysis	Duplicate Analysis	Duplicate Analysis	Split Analysis	Duplicate Analysis	Duplicate Analysis
Carbon-14	–	–	–	101.2%	–	–	–	–	–	–
Cesium-137	–	–	–	2.5%	–	–	–	–	–	–
Cobalt-60	–	–	–	26.6%	–	–	–	–	–	–
Europium-152	–	–	–	12.5%	–	–	–	–	–	–
Europium-154	–	–	–	14.1%	–	–	–	–	–	–
Nickel-63	–	–	–	6.2%	–	–	–	–	–	–
Potassium-40	10.3%	3.7%	12.6%	9.5%	–	10.5%	–	15.4%	5.6%	–
Total beta radiostrontium	–	–	–	8.2%	1.8%	–	–	–	–	–
Aluminum	0.3%	13.8%	8.5%	2.4%	–	51.9%	–	1.9%	1.7%	–
Barium	9.1%	0.2%	39.7%	7.0%	0.0%	37.1%	3.7%	31.9%	3.8%	3.5%
Calcium	0.9%	18.1%	2.4%	3.5%	0.9%	38.7%	3.9%	7.9%	4.7%	3.6%
Chromium	12.8%	1.6%	23.2%	23.0%	–	16.1%	–	29.9%	1.0%	–
Copper	10.2%	17.9%	21.5%	14.1%	–	42.4%	–	16.6%	20.9%	–
Hexavalent chromium	–	–	–	2.8%	–	–	–	–	–	–
Iron	4.7%	4.8%	1.1%	15.1%	–	40.0%	–	2.3%	1.3%	–
Lead	–	–	–	25.9%	–	–	–	–	0.0%	–
Magnesium	5.3%	23.4%	0.8%	5.9%	1.4%	53.7%	3.9%	5.6%	1.3%	4.4%
Manganese	1.5%	13.3%	2.7%	14.4%	1.8%	39.8%	3.8%	2.1%	2.4%	5.8%
Phosphorus	2.1%	19.8%	0.4%	7.9%	–	–	–	5.8%	1.4%	–
Silicon	40.6%	60.3%	29.1%	23.0%	0.8%	17.6%	4.7%	107.2%	34.1%	4.3%
Sodium	5.2%	3.9%	1.7%	–	0.1%	–	4.9%	18.0%	7.0%	3.4%
Strontium	2.6%	26.1%	7.7%	1.1%	1.2%	32.5%	5.2%	11.6%	1.1%	3.2%
Vanadium	7.2%	4.1%	9.8%	5.0%	–	21.6%	–	1.6%	0.5%	–
Zinc	5.6%	7.1%	1.0%	13.0%	1.7%	42.5%	–	1.3%	0.3%	–
Nitrate	–	–	–	21.6%	–	1.2%	–	–	–	–
Sulfate	–	–	–	15.9%	–	–	–	–	3.2%	–

– = Analysis not required

RPD JC 8/31/11

CALCULATION SHEET

Washington Closure Hanford

Originator P. L. Benjamin DB
Project 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation
Subject 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation Relative Percent Difference (RPD) Calculations

Date 8/25/2011
Job No. 14655

Calc. No. 0100X-CA-V0069
Checked H. M. Sulloway

Rev. No. 0
Date 8/31/11
Sheet No. 4 of 13

Duplicate Analysis - C7790 Interval 4 Soil Samples

Sampling Area	Sample Number	Sample Date	Potassium-40 pCi/g	Q	MDA	Radium-226 pCi/g	Q	MDA	Radium-228 pCi/g	Q	MDA
C7790; I-004	B26T10	8/5/10	12.2		0.430	0.338		0.652	0.513		0.652
C7790; I-004 DUP	B26T07	8/5/10	11.0		0.526	0.280		0.652	0.439		0.652

Analysis:

	TDL	0.5	0.1	0.2
Duplicate Analysis	Both > PQL?	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)
	Both >5xTDL?	Yes (calc RPD)		
	RPD	10.3%		
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable

Sampling Area	HEIS Number	Sample Date	Aluminum mg/kg	Q	PQL	Arsenic mg/kg	Q	PQL	Barium mg/kg	Q	PQL	Beryllium mg/kg	Q	PQL	Boron mg/kg	Q	PQL	Cadmium mg/kg	Q	PQL	Calcium mg/kg	Q	PQL	Chromium mg/kg	Q	PQL	Cobalt mg/kg	Q	PQL
C7790; I-004	B26T30	8/5/10	6530		4.63	1.81		0.93	75.6		0.46	0.185		0.19	0.759	B	1.85	0.107	B	0.19	4200		92.6	24.1		0.19	7.22		1.85
C7790; I-004 DUP	B26T25	8/5/10	6510		3.63	1.78		0.73	69.0		0.36	0.178		0.15	0.693	B	1.45	0.098	B	0.15	4240		72.6	21.2		0.15	6.61		1.45

Analysis:

	TDL	5	1	0.5	0.2	2	0.2	100	0.2	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)				Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD	0.3%		9.1%				0.9%	12.8%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable

Sampling Area	HEIS Number	Sample Date	Copper mg/kg	Q	PQL	Hexavalent chromium mg/kg	Q	PQL	Iron mg/kg	Q	PQL	Lead mg/kg	Q	PQL	Lithium mg/kg	Q	PQL	Magnesium mg/kg	Q	PQL	Manganese mg/kg	Q	PQL	Molybdenum mg/kg	Q	PQL	Nickel mg/kg	Q	PQL
C7790; I-004	B26T30	8/5/10	15.5		0.93	0.11	B	0.20	19400		18.5	2.10		0.46	5.61		2.32	3680		69.5	275		4.63	1.52	B	1.85	13.9		3.71
C7790; I-004 DUP	B26T25	8/5/10	14.0		0.73	0.13	B	0.20	18500		14.5	1.86		0.36	5.36		1.82	3490		54.5	271		3.63	1.35	B	1.45	12.5		2.91

Analysis:

	TDL	1	0.5	5	0.5	2.5	75	5	2	4
Duplicate Analysis	Both > PQL?	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)		Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)		No-Stop (acceptable)
	RPD	10.2%		4.7%			5.3%	1.5%		
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable

Sampling Area	Sample Number	Sample Date	Phosphorus mg/kg	Q	PQL	Potassium mg/kg	Q	PQL	Silicon mg/kg	Q	PQL	Sodium mg/kg	Q	PQL	Strontium mg/kg	Q	PQL	Vanadium mg/kg	Q	PQL	Zinc mg/kg	Q	PQL
C7790; I-004	B26T30	8/5/10	661		46.3	1050		371	517		1.85	705		46.3	27.0		0.93	61.5		2.32	38.7		9.26
C7790; I-004 DUP	B26T25	8/5/10	647		36.3	989		291	780		1.45	669		36.3	26.3		0.73	57.2		1.82	36.6		7.26

Analysis:

	TDL	100	400	2	50	1	2.5	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)
	RPD	2.1%		40.6%	5.2%	2.6%	7.2%	5.6%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

CALCULATION SHEET

Washington Closure Hanford

Originator P. L. Benjamin PB
Project 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation
Subject 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation Relative Percent Difference (RPD) Calculations

Date 8/25/2011
Job No. 14655

Calc. No. 0100X-CA-V0069
Checked H. M. Sulloway

Rev. No. 0
Date 8/31/11
Sheet No. 5 of 13

Duplicate Analysis - C7791 Interval 3 Soil Samples

Sampling Area	Sample Number	Sample Date	Potassium-40 pCi/g	Q	MDA	Radium-226 pCi/g	Q	MDA
C7791; I-003	B27385	11/2/10	13.1		0.574	0.428		0.652
C7791; I-003 DUP	B27386	11/2/10	13.8		0.525	0.239		0.652

Analysis:

	TDL	0.5	0.1
Duplicate Analysis	Both > PQL?	Yes (continue)	No-Stop (acceptable)
	Both >5xTDL?	Yes (calc RPD)	
	RPD	3.7%	
	Difference > 2 TDL?	Not applicable	No - acceptable

Sampling Area	HEIS Number	Sample Date	Aluminum mg/kg	Q	PQL	Arsenic mg/kg	Q	PQL	Barium mg/kg	Q	PQL	Beryllium mg/kg	Q	PQL	Boron mg/kg	Q	PQL	Cadmium mg/kg	Q	PQL	Calcium mg/kg	Q	PQL	Chromium mg/kg	Q	PQL	Cobalt mg/kg	Q	PQL
C7791; I-003	B27372	11/2/10	5270		3.88	1.51		0.78	64.0		0.39	0.168		0.16	0.566	B	1.55	0.101	B	0.16	3270		77.7	19.1		0.16	4.44		1.55
C7791; I-003 DUP	B27360	11/2/10	6050		3.66	2.07		0.73	63.9		0.37	0.183		0.15	0.624	B	1.47	0.096	B	0.15	3920		73.3	18.8		0.15	5.13		1.47

Analysis:

	TDL	5	1	0.5	0.2	2	0.2	100	0.2	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)			Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD	13.8%		0.2%				18.1%	1.6%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable

Sampling Area	HEIS Number	Sample Date	Copper mg/kg	Q	PQL	Iron mg/kg	Q	PQL	Lead mg/kg	Q	PQL	Lithium mg/kg	Q	PQL	Magnesium mg/kg	Q	PQL	Manganese mg/kg	Q	PQL	Molybdenum mg/kg	Q	PQL	Nickel mg/kg	Q	PQL	Phosphorus mg/kg	Q	PQL
C7791; I-003	B27372	11/2/10	12.2		0.78	16100		15.5	2.74		0.39	5.50		1.94	3400		58.3	225		3.88	0.769	B	1.55	12.7		3.11	586		38.8
C7791; I-003 DUP	B27360	11/2/10	14.6		0.73	16900		14.7	2.44		0.37	7.02		1.83	4300		54.9	257		3.66	0.751	B	1.47	10.0		2.93	715		36.6

Analysis:

	TDL	1	5	0.5	2.5	75	5	2	4	100
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)		No-Stop (acceptable)	Yes (calc RPD)
	RPD	17.9%	4.8%			23.4%	13.3%			19.8%
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	Not applicable

Sampling Area	Sample Number	Sample Date	Potassium mg/kg	Q	PQL	Silicon mg/kg	Q	PQL	Sodium mg/kg	Q	PQL	Strontium mg/kg	Q	PQL	Tin mg/kg	Q	PQL	Vanadium mg/kg	Q	PQL	Zinc mg/kg	Q	PQL
C7791; I-003	B27372	11/2/10	766		311	323		1.55	324		38.8	24.0		0.78	2.24	B	7.77	45.4		1.94	29.7		7.77
C7791; I-003 DUP	B27360	11/2/10	844		293	602		1.47	337		36.6	31.2		0.73	2.08	B	7.33	47.3		1.83	31.9		7.33

Analysis:

	TDL	400	2	50	1	10	2.5	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)		Yes (calc RPD)	Yes (calc RPD)
	RPD		60.3%	3.9%	26.1%		4.1%	7.1%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable

CALCULATION SHEET

Washington Closure Hanford

Originator P. L. Benjamin PB
Project 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation
Subject 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation Relative Percent Difference (RPD) Calculations

Date 8/25/2011
Job No. 14655

Calc. No. 0100X-CA-V0069
Checked H. M. Sulloway HMS

Rev. No. 0
Date 3/31/11
Sheet No. 6 of 13

1 **Duplicate Analysis - C7792 Interval 5 Soil Samples**

	Sampling Area	Sample Number	Sample Date	Potassium-40 pCi/g	Q	MDA	Radium-226 pCi/g	Q	MDA	Radium-228 pCi/g	Q	MDA
4	C7792; I-005	B26Y65	8/23/10	13.5		0.402	0.382		0.652	0.633		0.193
5	C7792; I-005 DUP	B26Y61	8/23/10	11.9		0.525	0.404		0.652	0.592		0.268

6 **Analysis:**

7		TDL	0.5	0.1	0.2
8	Duplicate Analysis	Both > PQL?	Yes (continue)	No-Stop (acceptable)	Yes (continue)
9		Both >5xTDL?	Yes (calc RPD)		No-Stop (acceptable)
10		RPD	12.6%		
11		Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable

	Sampling Area	HEIS Number	Sample Date	Aluminum mg/kg	Q	PQL	Arsenic mg/kg	Q	PQL	Barium mg/kg	Q	PQL	Beryllium mg/kg	Q	PQL	Boron mg/kg	Q	PQL	Cadmium mg/kg	Q	PQL	Calcium mg/kg	Q	PQL	Chromium mg/kg	Q	PQL	Cobalt mg/kg	Q	PQL
15	C7792; I-005	B26Y78	8/23/10	5540		3.68	1.68		0.74	40.4		0.37	0.196		0.15	0.561	B	1.47	0.099	B	0.15	3400		73.6	13.0		0.15	4.88		1.47
16	C7792; I-005 DUP	B26Y74	8/23/10	5090		4.14	1.38		0.83	60.4		0.41	0.172		0.17	0.466	B	1.65	0.114	B	0.17	3320		82.7	10.3		0.17	5.15		1.65

17 **Analysis:**

18		TDL	5	1	0.5	0.2	2	0.2	100	0.2	2
19	Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)
20		Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)			Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
21		RPD	8.5%		39.7%				2.4%	23.2%	
22		Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable

	Sampling Area	HEIS Number	Sample Date	Copper mg/kg	Q	PQL	Iron mg/kg	Q	PQL	Lead mg/kg	Q	PQL	Lithium mg/kg	Q	PQL	Magnesium mg/kg	Q	PQL	Manganese mg/kg	Q	PQL	Molybdenum mg/kg	Q	PQL	Nickel mg/kg	Q	PQL	Phosphorus mg/kg	Q	PQL
26	C7792; I-005	B26Y78	8/23/10	14.4		0.74	17700		14.7	2.41		0.37	6.21		1.84	3540		55.2	263		3.68	1.10	B	1.47	10.2		2.94	531		36.8
27	C7792; I-005 DUP	B26Y74	8/23/10	11.6		0.83	17900		16.5	2.16		0.41	4.87		2.07	3570		62.0	256		4.14	0.717	B	1.65	8.08		3.31	533		41.4

28 **Analysis:**

29		TDL	1	5	0.5	2.5	75	5	2	4	100
30	Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)
31		Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)		No-Stop (acceptable)	Yes (calc RPD)
32		RPD	21.5%	1.1%			0.8%	2.7%			0.4%
33		Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	Not applicable

	Sampling Area	Sample Number	Sample Date	Potassium mg/kg	Q	PQL	Silicon mg/kg	Q	PQL	Sodium mg/kg	Q	PQL	Strontium mg/kg	Q	PQL	Tin mg/kg	Q	PQL	Vanadium mg/kg	Q	PQL	Zinc mg/kg	Q	PQL
37	C7792; I-005	B26Y78	8/23/10	688		294	384		1.47	287		36.8	20.1		0.74	1.25	B	7.36	46.6		1.84	30.6		7.36
38	C7792; I-005 DUP	B26Y74	8/23/10	590		331	515		1.65	292		41.4	21.7		0.83	1.39	B	8.27	51.4		2.07	30.3		8.27

39 **Analysis:**

40		TDL	400	2	50	1	10	2.5	1
41	Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)
42		Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)		Yes (calc RPD)	Yes (calc RPD)
43		RPD		29.1%	1.7%	7.7%		9.8%	1.0%
44		Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable

CALCULATION SHEET

Washington Closure Hanford

Originator P. L. Benjamin PB
Project 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation
Subject 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation Relative Percent Difference (RPD) Calculations

Date 8/25/2011
Job No. 14855

Calc. No. 0100X-CA-V0069
Checked H. M. Sullaway

Rev. No. 0
Date 8/31/11
Sheet No. 7 of 13

1 **Duplicate Analysis - C7970 Interval 2 Soil Samples**

	Sampling Area	Sample Number	Sample Date	Carbon-14			Cesium-137			Cobalt-60			Europium-152			Europium-154			Nickel-63			Plutonium-239/240			Potassium-40			Total beta radiostrontium			Tritium		
3				pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
4	C7970; I-002	B28NT7	2/9/11	48.8		1.81	4.49		0.675	3.68		0.303	150		1.72	11.2		0.957	528		2.64	1.77		0.222	19.0		1.45	7.73		0.258	4.52		3.31
5	C7970; I-002 DUP	B28NX0	2/9/11	18.0		1.84	4.38		0.449	2.97		0.217	170		1.30	12.9		0.798	562		2.61	2.80		0.277	20.9		1.24	7.12		0.253	7.31		3.27

6 **Analysis:**

7		TDL		1			0.1			0.05			0.1			0.1			30			1			0.5			1			10		
8	Duplicate Analysis	Both > PQL?		Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)		
9		Both >5xTDL?		Yes (calc RPD)			Yes (calc RPD)			Yes (calc RPD)			Yes (calc RPD)			Yes (calc RPD)			Yes (calc RPD)			No-Stop (acceptable)			Yes (calc RPD)			Yes (calc RPD)			No-Stop (acceptable)		
10		RPD		101.2%			2.5%			28.6%			12.5%			14.1%			6.2%			9.5%			8.2%								
11		Difference > 2 TDL?		Not applicable			Not applicable			Not applicable			Not applicable			Not applicable			Not applicable			No - acceptable			Not applicable			Not applicable			No - acceptable		

12

	Sampling Area	HEIS Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium			Boron			Cadmium			Calcium			Chromium			Cobalt			Copper			Hexavalent chromium		
13																																				
14				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
15	C7970; I-002	B28NR4	2/9/11	5790		3.34	1.29		0.67	56.8		0.33	0.288		0.13	0.479	B	1.34	0.725		0.13	3370		66.9	100		0.13	3.61		1.34	15.8		0.67	3.23		0.52
16	C7970; I-002 DUP	B28NX1	2/9/11	5650		5.24	1.38		1.05	60.9		0.52	0.278		0.21	0.697	B	2.10	0.745		0.21	3490		105	126		0.21	3.95		2.10	18.2		1.05	3.14		0.52

17 **Analysis:**

18		TDL		5			1			0.5			0.2			2			0.2			100			0.2			2			1			0.5		
19	Duplicate Analysis	Both > PQL?		Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			No-Stop (acceptable)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)		
20		Both >5xTDL?		Yes (calc RPD)			No-Stop (acceptable)			Yes (calc RPD)			No-Stop (acceptable)						No-Stop (acceptable)			Yes (calc RPD)			Yes (calc RPD)			No-Stop (acceptable)			Yes (calc RPD)			Yes (calc RPD)		
21		RPD		2.4%						7.0%												3.5%			23.0%						14.1%			2.8%		
22		Difference > 2 TDL?		Not applicable			No - acceptable			Not applicable			No - acceptable			No - acceptable			No - acceptable			Not applicable			Not applicable			No - acceptable			Not applicable			Not applicable		

23

	Sampling Area	HEIS Number	Sample Date	Iron			Lead			Lithium			Magnesium			Manganese			Molybdenum			Nickel			Phosphorus			Potassium			Silicon			Sodium		
24																																				
25				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
26	C7970; I-002	B28NR4	2/9/11	15300		13.4	8.79		0.33	8.58		1.67	3430		50.1	188		3.34	1.08	B	1.34	8.19		2.67	619		33.4	816		267	679		1.34	255		33.4
27	C7970; I-002 DUP	B28NX1	2/9/11	17800		21.0	11.4		0.52	8.08		2.62	3640		78.6	194		5.24	4.52		2.10	9.96		4.19	670		52.4	633		419	539		2.10	242		52.4

28 **Analysis:**

29		TDL		5			0.5			2.5			75			5			2			4			100			400			2			50		
30	Duplicate Analysis	Both > PQL?		Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			No-Stop (acceptable)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)		
31		Both >5xTDL?		Yes (calc RPD)			Yes (calc RPD)			No-Stop (acceptable)			Yes (calc RPD)			Yes (calc RPD)						No-Stop (acceptable)			Yes (calc RPD)			No-Stop (acceptable)			Yes (calc RPD)			No-Stop (acceptable)		
32		RPD		15.1%			25.9%						5.9%			14.4%									7.9%						23.0%					
33		Difference > 2 TDL?		Not applicable			Not applicable			No - acceptable			Not applicable			Not applicable			No - acceptable			No - acceptable			Not applicable			No - acceptable			Not applicable			No - acceptable		

34

	Sampling Area	Sample Number	Sample Date	Strontium			Tin			Vanadium			Zinc			Chloride			Nitrate			Nitrogen in Nitrite and Nitrate			Sulfate			alpha-Chlordane			gamma-Chlordane		
35																																	
36				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
37	C7970; I-002	B28NR4	2/9/11	17.8		0.67	1.26	B	6.69	38.8		1.67	137		6.69	2.6	B	5.1	17.3		5.1	4.40		0.52	1850	D	256	7.93	D	1.37	5.66	JD	1.37
38	C7970; I-002 DUP	B28NX1	2/9/11	18.0		1.05	1.62	B	10.5	40.8		2.62	156		10.5	3.0	B	5.1	21.5		6.1	3.49		0.51	2170	D	256	7.66	D	1.38	5.22	JD	1.38

39 **Analysis:**

40		TDL		1			10			2.5			1			2			2.5			0.75			5			16.5			16.5		
41	Duplicate Analysis	Both > PQL?		Yes (continue)			No-Stop (acceptable)			Yes (continue)			Yes (continue)			No-Stop (acceptable)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)		
42		Both >5xTDL?		Yes (calc RPD)						Yes (calc RPD)			Yes (calc RPD)						Yes (calc RPD)			No-Stop (acceptable)			Yes (calc RPD)			No-Stop (acceptable)			No-Stop (acceptable)		
43		RPD		1.1%						5.0%			13.0%						21.6%						15.9%									
44		Difference > 2 TDL?		Not applicable			No - acceptable			Not applicable			Not applicable			No - acceptable			Not applicable			No - acceptable			Not applicable			No - acceptable			No - acceptable		

45

	Sampling Area	Sample Number	Sample Date	Acetone			Methylene chloride		
46									
47				µg/kg	Q	PQL	µg/kg	Q	PQL
48	C7970; I-002	B28NM8	2/9/11	12.2	J	12.5	2.28	J	6.25
49	C7970; I-002 DUP	B28NW9	2/9/11	7.91	J	10.4	1.98	J	5.20

50 **Analysis:**

51		TDL	20	5
52	Duplicate Analysis	Both > PQL?	No-Stop (acceptable)	No-Stop (acceptable)
53		Both >5xTDL?		
54		RPD		
55		Difference > 2 TDL?	No - acceptable	No - acceptable

CALCULATION SHEET

Washington Closure Hanford

Originator P. L. Benjamin PB **Date** 8/25/2011 **Calc. No.** 0100X-CA-V0069, **Rev. No.** 0

Project 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation **Job No.** 14655 **Checked** H. M. Sullaway **Date** 8/29/11

Subject 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation Relative Percent Difference (RPD) Calculations **Sheet No.** 8 of 13

1 **Duplicate Analysis - C7970 Interval 15 Groundwater Samples**

	Sampling Area	Sample Number	Sample Date	Total beta radiostrontium pCi/L	Q	MDA
4	C7970; I-015	B28NX5	2/14/11	219		0.949
5	C7970; I-015 DUP	B28NX6	2/14/11	215		0.884

6 **Analysis:**

7	TDL	2
8	Duplicate Analysis: Both > PQL?	Yes (continue)
9	Duplicate Analysis: Both >5xTDL?	Yes (calc RPD)
10	Duplicate Analysis: RPD	1.8%
11	Duplicate Analysis: Difference > 2 TDL?	Not applicable

12

13	Sampling Area	HEIS Number	Sample Date	Aluminum µg/L	Q	PQL	Barium µg/L	Q	PQL	Boron µg/L	Q	PQL	Calcium µg/L	Q	PQL	Chromium µg/L	Q	PQL	Cobalt µg/L	Q	PQL	Iron µg/L	Q	PQL	Magnesium µg/L	Q	PQL	Manganese µg/L	Q	PQL
15	C7970; I-015	B28NX3	2/14/11	25.4	B	50	41.7		2	31.9		10	57600		100	0.839	B	2	0.675	B	2	192		50	14000		100	97.8		2
16	C7970; I-015 DUP	B28NX4	2/14/11	24.7	B	50	41.7		2	33.2		10	57100		100	1.10	B	2	0.889	B	2	192		50	13800		100	96.1		2

17 **Analysis:**

		Aluminum	Barium	Boron	Calcium	Chromium	Cobalt	Iron	Magnesium	Manganese
18	TDL	50	5	20	1000	2	20	50	750	5
19	Duplicate Analysis: Both > PQL?	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)
20	Duplicate Analysis: Both >5xTDL?		Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)			No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
21	Duplicate Analysis: RPD		0.0%		0.9%				1.4%	1.8%
22	Duplicate Analysis: Difference > 2 TDL?	No - acceptable	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable

23

24	Sampling Area	HEIS Number	Sample Date	Molybdenum µg/L	Q	PQL	Nickel µg/L	Q	PQL	Phosphorus µg/L	Q	PQL	Potassium µg/L	Q	PQL	Silicon µg/L	Q	PQL	Sodium µg/L	Q	PQL	Strontium µg/L	Q	PQL	Vanadium µg/L	Q	PQL	Zinc µg/L	Q	PQL
26	C7970; I-015	B28NX3	2/14/11	2.02		2	1.86	B	5	50.2		50	3070		500	9460		50	8180		100	252		5	8.07		5	58.4		20
27	C7970; I-015 DUP	B28NX4	2/14/11	3.46		2	1.52	B	5	52.4		50	3140		500	9540		50	8170		100	249		5	8.19		5	57.4		20

28 **Analysis:**

		Molybdenum	Nickel	Phosphorus	Potassium	Silicon	Sodium	Strontium	Vanadium	Zinc
29	TDL	20	40	100	4000	20	500	10	25	10
30	Duplicate Analysis: Both > PQL?	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
31	Duplicate Analysis: Both >5xTDL?	No-Stop (acceptable)		No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
32	Duplicate Analysis: RPD					0.8%	0.1%	1.2%		1.7%
33	Duplicate Analysis: Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable	Not applicable	No - acceptable	Not applicable

CALCULATION SHEET

Washington Closure Hanford

Originator P. L. Benjamin **Date** 8/25/2011 **Calc. No.** 0100X-CA-V0069 **Rev. No.** 0
Project 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation **Job No.** 14655 **Checked** H. M. Sullowey **Date** 3/31/11
Subject 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation Relative Percent Difference (RPD) Calculations **Sheet No.** 9 of 13

1 **Duplicate Analysis - C7971 Interval 3 Soil Samples**

	Sampling Area	Sample Number	Sample Date	Potassium-40			Radium-226			Radium-228			Uranium-233/234			Uranium-238		
3				pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
4	C7971; I-003	B28VN2	2/11/11	14.0		0.652	0.396		0.150	0.599		0.333	0.535		0.227	0.357		0.227
5	C7971; I-003 DUP	B28VM5	2/11/11	12.6		0.662	0.386		0.135	0.623		0.258	0.342		0.262	0.274		0.262

6 **Analysis:**

7		TDL	0.5	0.1	0.2	1	1
8	Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
9		Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
10		RPD	10.5%				
11		Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable

12

	Sampling Area	HEIS Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium			Boron			Cadmium			Calcium			Chromium			Cobalt			Copper		
14				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
15	C7971; I-003	B28VN5	2/11/11	6070		4.44	1.27		0.89	40.9		0.44	0.185		0.18	0.610	B	1.77	0.052	B	0.18	5120		88.7	6.85		0.18	5.42		1.77	13.7		0.89
16	C7971; I-003 DUP	B28VM7	2/11/11	3570		3.72	1.07		0.74	28.1		0.37	0.120	B	0.15	0.483	B	1.49	0.054	B	0.15	3460		74.4	5.83		0.15	3.47		1.49	8.91		0.74

17 **Analysis:**

18		TDL	5	1	0.5	0.2	2	0.2	100	0.2	2	1
19	Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
20		Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)				Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
21		RPD	51.9%		37.1%				38.7%	16.1%		42.4%
22		Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable

23

	Sampling Area	HEIS Number	Sample Date	Iron			Lead			Lithium			Magnesium			Manganese			Molybdenum			Nickel			Phosphorus			Potassium			Silicon		
25				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
26	C7971; I-003	B28VN5	2/11/11	16800		17.7	2.16		0.44	7.62		2.22	4160		66.5	244		4.44	0.591	B	1.77	6.61		3.55	555		44.4	696		355	366		1.77
27	C7971; I-003 DUP	B28VM7	2/11/11	11200		14.9	1.48		0.37	4.12		1.86	2400		55.8	163		3.72	0.572	B	1.49	5.02		2.98	389		37.2	491		298	306		1.49

28 **Analysis:**

29		TDL	5	0.5	2.5	75	5	2	4	100	400	2
30	Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
31		Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)		No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)
32		RPD	40.0%			53.7%	39.8%					17.6%
33		Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	Not applicable

34

	Sampling Area	Sample Number	Sample Date	Sodium			Strontium			Tin			Vanadium			Zinc			Chloride			Nitrate			Nitrogen in Nitrite and Nitrate			Sulfate		
36				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
37	C7971; I-003	B28VN5	2/11/11	349		44.4	26.5		0.89	1.93	B	8.87	40.5		2.22	35.1		8.87	2.4	B	5.1	16.6		5.1	3.14		0.51	16.1		5.1
38	C7971; I-003 DUP	B28VM7	2/11/11	227		37.2	19.1		0.74	1.71	B	7.44	32.6		1.86	22.8		7.44	2.3	B	5.3	16.8		5.3	3.27		0.53	14.9		5.3

39 **Analysis:**

40		TDL	50	1	10	2.5	1	2	2.5	0.75	5
41	Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)
42		Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)		Yes (calc RPD)	Yes (calc RPD)		Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)
43		RPD		32.5%		21.6%	42.5%		1.2%		
44		Difference > 2 TDL?	Yes - assess further	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable

45

	Sampling Area	Sample Number	Sample Date	Acetone		
47				µg/kg	Q	PQL
48	C7971; I-003	B28VN3	2/11/11	3.92	BJ	10.0
49	C7971; I-003 DUP	B28VM6	2/11/11	4.87	BJ	11.6

50 **Analysis:**

51		TDL	20
52	Duplicate Analysis	Both > PQL?	No-Stop (acceptable)
53		Both >5xTDL?	
54		RPD	
55		Difference > 2 TDL?	No - acceptable

CALCULATION SHEET

Washington Closure Hanford

Originator P. L. Benjamin PB
Project 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation
Subject 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation Relative Percent Difference (RPD) Calculations

Date 8/25/2011
Job No. 14655

Calc. No. 0100X-CA-V0069
Checked H. M. Sulloway HMS

Rev. No. 0
Date 8/31/11
Sheet No. 10 of 13

1 **Duplicate Analysis - C7971 Interval 13 Groundwater Samples**

2 Sampling Area	Sample Number	Sample Date	Total beta radiostrontium pCi/L	Q	MDA
4 C7971; I-013	B28VV9	2/15/11	8.51		0.505
5 C7971; I-013 DUP	B28VW2	2/15/11	7.99		0.500

6 **Analysis:**

7		
	TDL	2
8 Duplicate Analysis	Both > PQL?	Yes (continue)
9	Both >5xTDL?	No-Stop (acceptable)
10	RPD	
11	Difference > 2 TDL?	No - acceptable

12

13 Sampling Area	HEIS Number	Sample Date	Aluminum µg/L	Q	PQL	Arsenic µg/L	Q	PQL	Barium µg/L	Q	PQL	Boron µg/L	Q	PQL	Calcium µg/L	Q	PQL	Chromium µg/L	Q	PQL	Cobalt µg/L	Q	PQL	Copper µg/L	Q	PQL	Iron µg/L	Q	PQL
15 C7971; I-013	B28VW0	2/15/11	37.4	B	50	5.22	B	10	105		2	76.6		10	126000		100	1.53	B	2	0.809	B	2	3.21	B	10	102		50
16 C7971; I-013 DUP	B28VW3	2/15/11	42.0	B	50	2.52	B	10	109		2	79.4		10	131000		100	1.26	B	2	0.897	B	2	4.66	B	10	111		50

17 **Analysis:**

18		Aluminum	Arsenic	Barium	Boron	Calcium	Chromium	Cobalt	Copper	Iron
	TDL	50	10	5	20	1000	2	20	10	50
19 Duplicate Analysis	Both > PQL?	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)
20	Both >5xTDL?			Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)				No-Stop (acceptable)
21	RPD			3.7%		3.9%				
22	Difference > 2 TDL?	No - acceptable	No - acceptable	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable

23

24 Sampling Area	HEIS Number	Sample Date	Lead µg/L	Q	PQL	Lithium µg/L	Q	PQL	Magnesium µg/L	Q	PQL	Manganese µg/L	Q	PQL	Molybdenum µg/L	Q	PQL	Nickel µg/L	Q	PQL	Phosphorus µg/L	Q	PQL	Potassium µg/L	Q	PQL	Silicon µg/L	Q	PQL
26 C7971; I-013	B28VW0	2/15/11	6.36	B	10	24.0		20	32800		100	156		2	5.23		2	2.21	B	5	23.3	B	50	7800		500	18600		50
27 C7971; I-013 DUP	B28VW3	2/15/11	6.89	B	10	24.2		20	34100		100	162		2	4.39		2	2.41	B	5	25.1	B	50	8160		500	19500		50

28 **Analysis:**

29		Lead	Lithium	Magnesium	Manganese	Molybdenum	Nickel	Phosphorus	Potassium	Silicon
	TDL	5	25	750	5	20	40	100	4000	20
30 Duplicate Analysis	Both > PQL?	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)
31	Both >5xTDL?		No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)			No-Stop (acceptable)	Yes (calc RPD)
32	RPD			3.9%	3.8%					4.7%
33	Difference > 2 TDL?	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	Not applicable

34

35 Sampling Area	HEIS Number	Sample Date	Sodium µg/L	Q	PQL	Strontium µg/L	Q	PQL	Vanadium µg/L	Q	PQL	Zinc µg/L	Q	PQL
37 C7971; I-013	B28VW0	2/15/11	49600		100	1120		5	21.0		5	35.8		20
38 C7971; I-013 DUP	B28VW3	2/15/11	52100		100	1180		5	21.3		5	40.9		20

39 **Analysis:**

40		Sodium	Strontium	Vanadium	Zinc
	TDL	500	10	25	10
41 Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
42	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)
43	RPD	4.9%	5.2%		
44	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	No - acceptable

CALCULATION SHEET

Washington Closure Hanford

Originator P. L. Benjamin PB
Project 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation
Subject 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation Relative Percent Difference (RPD) Calculations

Date 8/25/2011
Job No. 14655

Calc. No. 0100X-CA-V0069
Checked H. Sullaway HMS

Rev. No. 0
Date 8/31/11
Sheet No. 11 of 13

Split Analysis - C7972 Interval 3 Soil Samples

Sampling Area	Sample Number	Sample Date	Potassium-40			Radium-226			Radium-228			Total beta			Uranium-233/234			Uranium-238		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
C7972; I-003	B28397	2/16/11	13.2		0.652	0.444		0.0450	0.598		0.115	0.575		0.249	0.313		0.218	0.626		0.218
C7972; I-003 SPLIT	B293B1	2/16/11	15.4		0.652	0.478		0.0395	0.542		0.096	0.540		0.190	0.406		0.186	0.424		0.219

Analysis:

	TDL	0.5	0.1	0.2	1	1	1
Split Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	15.4%					
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable

Sampling Area	HEIS Number	Sample Date	Aluminum			Barium			Calcium			Chromium			Cobalt			Copper			Iron			Lead		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
C7972; I-003	B293B0	2/16/11	6760		3.85	65.3		0.39	5730		76.9	36.5		0.15	5.49		1.54	18.8		0.77	17900		15.4	2.1		0.39
C7972; I-003 SPLIT	B293B2	2/16/11	6630		28.4	90.1		0.51	6200		27.0	27.0		0.62	9.4	B	1.90	22.2		1.5	17500		6.0	2.2		0.35

Analysis:

	TDL	5	0.5	100	0.2	2	1	5	0.5
Split Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD	1.9%	31.9%	7.9%	29.9%		16.6%	2.3%	
	Difference > 2 TDL?	Not applicable	Not applicable	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable

Sampling Area	HEIS Number	Sample Date	Lithium			Magnesium			Manganese			Nickel			Phosphorus			Potassium			Silicon			Sodium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
C7972; I-003	B293B0	2/16/11	8.94		1.92	4370		57.7	281		3.85	20.3		3.08	568		38.5	1240		308	405		1.54	555		38.5
C7972; I-003 SPLIT	B293B2	2/16/11	9.1	B	1.3	4130		16.9	287		0.31	16.4		0.46	602		1.4	1700		685	1340		20.3	665		95.7

Analysis:

	TDL	2.5	75	5	4	100	400	2	50
Split Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD		5.6%	2.1%		5.8%		107.2%	18.0%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable	No - acceptable	Not applicable	Not applicable

Sampling Area	Sample Number	Sample Date	Strontium			Vanadium			Zinc			Chloride			Nitrogen in Nitrite and			Sulfate		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
C7972; I-003	B293B0	2/16/11	31.0		0.77	50.9		1.92	36.9		7.69	6.7		5.1	2.3		0.51	27.1		5.1
C7972; I-003 SPLIT	B293B2	2/16/11	34.8		0.51	50.1		2.6	37.4		4.0	5.9	X	0.20	1.5	C	0.048	23.2		0.51

Analysis:

	TDL	1	2.5	1	2	0.75	5
Split Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	11.6%	1.6%	1.3%			
	Difference > 2 TDL?	Not applicable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable

CALCULATION SHEET

Washington Closure Hanford

Originator P. L. Benjamin PB — Date 8/25/2011 — Calc. No. 0100X-CA-V0069 — Rev. No. 0
Project 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation — Job No. 14655 — Checked H. M. Sulloway — Date 3/31/11
Subject 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation Relative Percent Difference (RPD) Calculations — Sheet No. 12 of 13

1 **Duplicate Analysis - C7972 Interval 6 Soil Samples**

Sampling Area	Sample Number	Sample Date	Potassium-40			Radium-226			Radium-228			Total beta			Uranium-233/234			Uranium-235		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
C7972; I-006	B293C6	2/17/11	13.9		0.652	0.382		0.165	0.500		0.357	0.494		0.258	0.446		0.244	0.382		0.244
C7972; I-006 DUP	B293D0	2/17/11	14.7		0.652	0.437		0.113	0.458		0.236	0.500		0.242	0.334		0.232	0.334		0.232

Analysis:

	TDL	0.5	0.1	0.2	1	1	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	5.6%					
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable

Sampling Area	HEIS Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium			Boron			Cadmium			Calcium			Chromium			Cobalt			Copper		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
C7972; I-006	B293C9	2/17/11	5970		4.42	1.61		0.88	49.7		0.44	0.185		0.18	0.909	B	1.77	0.072	B	0.18	4730		88.3	10.2		0.18	4.87		1.77	12.4		0.88
C7972; I-006 DUP	B293D2	2/17/11	6070		3.82	1.41		0.77	51.6		0.38	0.192		0.15	0.853	B	1.53	0.082	B	0.15	4960		76.5	10.1		0.15	5.12		1.53	15.3		0.77

Analysis:

	TDL	5	1	0.5	0.2	2	0.2	100	0.2	2	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)			Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD	1.7%		3.8%				4.7%	1.0%		20.9%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable

Sampling Area	HEIS Number	Sample Date	Iron			Lead			Lithium			Magnesium			Manganese			Molybdenum			Nickel			Phosphorus			Potassium			Silicon		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
C7972; I-006	B293C9	2/17/11	15900		17.7	2.55		0.44	8.49		2.21	3810		66.3	252		4.42	0.614	B	1.77	7.93		3.53	519		44.2	1060		353	535		1.77
C7972; I-006 DUP	B293D2	2/17/11	16100		15.3	2.55		0.38	8.09		1.91	3760		57.4	258		3.82	0.725	B	1.53	7.72		3.06	512		38.2	941		306	379		1.53

Analysis:

	TDL	5	0.5	2.5	75	5	2	4	100	400	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)		No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD	1.3%	0.0%		1.3%	2.4%			1.4%		34.1%
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	Not applicable	No - acceptable	Not applicable

Sampling Area	Sample Number	Sample Date	Sodium			Strontium			Tin			Vanadium			Zinc			Chloride			Nitrate			Nitrogen in Nitrite and Nitrate			Sulfate			Alpha-BHC		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	µg/kg	Q	PQL
C7972; I-006	B293C9	2/17/11	438		44.2	27.3		0.88	1.56	B	8.83	43.1		2.21	33.9		8.83	3.5	B	5.1	9.70		5.1	2.22		0.51	30.3		5.1	1.58	JD	1.33
C7972; I-006 DUP	B293D2	2/17/11	470		38.2	27.6		0.77	1.08	B	7.65	43.3		1.91	34.0		7.65	4.4	B	5.1	11.3		5.1	1.97		0.51	31.3		5.1	1.39	JD	1.35

Analysis:

	TDL	50	1	10	2.5	1	2	2.5	0.75	5	1.65
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)		Yes (calc RPD)	Yes (calc RPD)		No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)
	RPD	7.0%	1.1%		0.5%	0.3%				3.2%	
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable	Not applicable	No - acceptable

CALCULATION SHEET

Washington Closure Hanford

Originator P. L. Benjamin PB
Project 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation
Subject 100-F, 100-IU-2, and 100-IU-6 Remedial Investigation Relative Percent Difference (RPD) Calculations

Date 8/25/2011
Job No. 14655

Calc. No. 0100X-CA-V0069
Checked H. M. Sulloway

Rev. No. 0
Date 8/31/11
Sheet No. 13 of 13

Duplicate Analysis - C7972 Interval 13 Groundwater Samples

Sampling Area	Sample Number	Sample Date	Total beta radiostrontium pCi/L	Q	MDA
C7972; I-013	B293J1	2/18/11	5.20		0.616
C7972; I-013 DUP	B293J4	2/18/11	5.34		0.552

Analysis:

TDL		2
Duplicate Analysis	Both > PQL?	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)
	RPD	
	Difference > 2 TDL?	No - acceptable

Sampling Area	HEIS Number	Sample Date	Aluminum µg/L	Q	PQL	Arsenic µg/L	Q	PQL	Barium µg/L	Q	PQL	Boron µg/L	Q	PQL	Calcium µg/L	Q	PQL	Chromium µg/L	Q	PQL	Cobalt µg/L	Q	PQL	Iron µg/L	Q	PQL	Lithium µg/L	Q	PQL
C7972; I-013	B293J2	2/18/11	32.9	B	50	2.64	B	10	66.0		2	34.2		10	100000		100	2.49		2	1.04	B	2	175		50	14.4	B	20
C7972; I-013 DUP	B293J5	2/18/11	36.2	B	50	3.22	B	10	63.7		2	32.5		10	96500		100	2.21		2	0.813	B	2	176		50	11.9	B	20

Analysis:

TDL		50	10	5	20	1000	2	20	50	25
Duplicate Analysis	Both > PQL?	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)
	Both >5xTDL?			Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)		No-Stop (acceptable)	
	RPD			3.5%		3.6%				
	Difference > 2 TDL?	No - acceptable	No - acceptable	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable

Sampling Area	HEIS Number	Sample Date	Magnesium µg/L	Q	PQL	Manganese µg/L	Q	PQL	Molybdenum µg/L	Q	PQL	Nickel µg/L	Q	PQL	Phosphorus µg/L	Q	PQL	Potassium µg/L	Q	PQL	Selenium µg/L	Q	PQL	Silicon µg/L	Q	PQL	Sodium µg/L	Q	PQL
C7972; I-013	B293J2	2/18/11	25400		100	107		2	4.38		2	2.31	B	5	28.0	B	50	7280		500	4.24	B	10	14100		50	56900		100
C7972; I-013 DUP	B293J5	2/18/11	24300		100	101		2	3.64		2	2.54	B	5	26.8	B	50	7050		500	3.90	B	10	13500		50	55000		100

Analysis:

TDL		750	5	20	40	100	4000	100	20	500
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)			No-Stop (acceptable)		Yes (calc RPD)	Yes (calc RPD)
	RPD	4.4%	5.8%						4.3%	3.4%
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable

Sampling Area	HEIS Number	Sample Date	Strontium µg/L	Q	PQL	Vanadium µg/L	Q	PQL	Zinc µg/L	Q	PQL
C7972; I-013	B293J2	2/18/11	686		5	17.8		5	20.9		20
C7972; I-013 DUP	B293J5	2/18/11	666		5	16.9		5	25.8		20

Analysis:

TDL		10	25	10
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	3.2%		
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable

DISTRIBUTION

Washington Closure Hanford

J. A. Lerch	H4-22
R. W. Ovink	H4-21
R. L. Weiss	H4-21
R. P. Wells	H4-22
Document Control	H4-11
DOE-RL Public Reading Room	H2-53
Hanford Technical Library	P8-55