LABORATORY DATA CONSULTANTS, INC.
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Windward Environmental, LLC
200 West Mercer Street, Suite 401
Seattle, WA 98119
ATTN: Amara Vandervort
amarav@windwardenv.com

December 23, 2021

SUBJECT: Duwamish AOC4 - Data Validation

Dear Ms. Vandervort,

Enclosed are the final validation reports for the fractions listed below. These SDGs were received on November 18 and December 1, 2021. Attachment 1 is a summary of the samples that were reviewed for each analysis.

LDC Project #52703:

SDG #	Fraction
21J0131, 21J0134, 21J0137 21J0142, 21K0332	Semivolatiles, PAHs, Hexachlorobenzene, PCBs, Metals, Dioxins, Wet Chemistry

The data validation was performed under Stage 4 guidelines. The analyses were validated using the following documents, as applicable to each method:

- Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020)
- USEPA National Functional Guidelines (NFG) for Organic Superfund Methods Data Review (January 2017)
- USEPA National Functional Guidelines (NFG) for Inorganic Superfund Methods Data Review (January 2017)
- USEPA National Functional Guidelines (NFG) for High Resolution Superfund Methods Data Review (April 2016)
- EPA SW 846, Third Edition, Test Methods for Evaluating Solid Waste, update 1, July 1992; update IIA, August 1993; update II, September 1994; update IIB, January 1995; update III, December 1996; update IIIA, April 1998; IIIB, November 2004; update IV, February 2007; update V, July 2014; update VI, July 2018

Please feel free to contact us if you have any questions.

Sincerely,

Pei Geng
Project Manager/Senior Chemist
pgeng@lab-data.com

98 pages-ADV R1 (added E) Attachment 1

2B/4 (client select) EDD

LDC# 52703 (Windward Environmental, LLC - Seattle, WA / Duwamish AOC4)

LDC	SDG#	DATE REC'D	(3) DATE DUE	SVOA (8270E)		(1) SVOA (8270E)		PAHs (8270E -SIM)		(1) Pest (8081B)		PCBs (8082A)		(3) Metals (6020B)		4 Metals (6020B-UCT-KED)		1 Metals (6020B-UCT-KED)		Hg (7471B)		Dioxins (1613B)		TOC (9060A)		Total Solids (2540G)								
Matrix:	Water/Sediment			W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S
A	21J0131	11/18/21	12/13/21	-	-	-	-	-	-	-	-	0	23	-	-	-	-	0	7	-	-	0	1	0	23	0	23								
B	21J0134	11/18/21	12/13/21	0	2	0	2	0	1	0	1	0	17	0	1	0	1	0	4	0	1	0	3	0	19	0	19								
C	21J0137	11/18/21	12/13/21	-	-	-	-	-	-	-	-	0	24	-	-	-	-	-	-	-	-	0	6	0	24	0	24								
D	21J0142	11/18/21	12/13/21	-	-	0	1	-	-	-	-	0	21	-	-	-	-	0	2	-	-	0	4	0	23	0	23								
E	21K0332	12/01/21	12/22/21	-	-	-	-	-	-	-	-	0	1	-	-	-	-	-	-	-	-	-	-	0	1	0	1								
Total	T/PG			0	2	0	3	0	1	0	1	0	86	0	1	0	1	0	13	0	1	0	14	0	90	0	90	0	0	0	0	0	0	0	303

Shaded cells indicate Stage 4 validation (all other cells are Stage 2B validation). These sample counts do not include MS/MSD, and DUPs

V:\LOGIN\Windward\Duwamish\52703ST.wpd

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Polychlorinated Biphenyls

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila

Sample Delivery Group (SDG): 21J0131

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-SC560F	21J0131-01	Sediment	06/29/21
LDW21-SC509D	21J0131-02	Sediment	07/01/21
LDW21-SC517D	21J0131-03	Sediment	07/01/21
LDW21-SC520A	21J0131-04	Sediment	07/02/21
LDW21-SC527D	21J0131-05	Sediment	07/02/21
LDW21-SC531D	21J0131-06	Sediment	07/02/21
LDW21-SC534D	21J0131-07	Sediment	07/02/21
LDW21-IT601	21J0131-08	Sediment	07/06/21
LDW21-IT592B	21J0131-09	Sediment	07/06/21
LDW21-IT592C	21J0131-10	Sediment	07/06/21
LDW21-IT592D	21J0131-11	Sediment	07/06/21
LDW21-IT592D	21J0131-12	Sediment	07/06/21
LDW21-IT592F	21J0131-13	Sediment	07/06/21
LDW21-IT592G	21J0131-14	Sediment	07/06/21
LDW21-SC510F	21J0131-15	Sediment	07/07/21
LDW21-IT609D	21J0131-16	Sediment	07/07/21
LDW21-SC595	21J0131-18	Sediment	07/08/21
LDW21-SC519B	21J0131-19	Sediment	07/08/21
LDW21-SC519C	21J0131-20	Sediment	07/08/21
LDW21-SC519D	21J0131-21	Sediment	07/08/21
LDW21-SC519E	21J0131-22	Sediment	07/08/21
LDW21-SC519F	21J0131-23	Sediment	07/08/21
LDW21-SC535D	21J0131-24	Sediment	07/08/21
LDW21-SC509DMS	21J0131-02MS	Sediment	07/01/21
LDW21-SC509DMSD	21J0131-02MSD	Sediment	07/01/21
LDW21-IT592CMS	21J0131-10MS	Sediment	07/06/21

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT592CMSD	21J0131-10MSD	Sediment	07/06/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for Organic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Polychlorinated Biphenyls (PCBs) by Environmental Protection Agency (EPA) SW 846 Method 8082A

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

The percent relative standard deviations (%RSD) were less than or equal to 20.0% for all analytes.

Retention time windows were established as required by the method.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 20.0% for all analytes.

III. Continuing Calibration

Continuing calibration was performed at required frequencies.

The percent differences (%D) were less than or equal to 20.0% for all analytes with the following exceptions:

Date	Standard	Column	Analyte	%D	Associated Samples	Flag	A or P
10/27/21	10272103	2C	Aroclor-1260	23.8	LDW21-SC509D	J (all detects)	A

Retention times of all analytes in the calibration standards were within the established retention time windows.

IV. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks.

V. Field Blanks

No field blanks were identified in this SDG.

VI. Surrogates/Internal Standards

Surrogates were added to all samples as required by the method. All surrogate recoveries (%R) were within QC limits.

All internal standard percent recoveries (%R) were within QC limits with the following exceptions:

Sample	Internal Standards	%R (Limits)	Affected Analyte	Flag	A or P
LDW21-IT592B	Hexabromobiphenyl	49 (50-200)	Aroclor-1260	J (all detects)	A

VII. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

VIII. Laboratory Control Samples/Standard Reference Materials

Laboratory control samples (LCS) and laboratory control samples duplicates (LCSD) were analyzed as required by the method. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

Standard reference materials (SRM) were analyzed as required by the method. The results were within QC limits.

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Target Analyte Quantitation

All target analyte quantitations met validation criteria.

The sample results for detected analytes from the two columns were within 40% relative percent difference (RPD) with the following exceptions:

Sample	Analyte	RPD	Flag	A or P
LDW21-SC517D	Aroclor-1248	77.8	J (all detects)	A
LDW21-SC509D	Aroclor-1248 Aroclor-1260	52.9 41.6	J (all detects) J (all detects)	A
LDW21-SC527D	Aroclor-1248	78	J (all detects)	A

XI. Target Analyte Identification

All target analyte identifications met validation criteria.

XII. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

Due to continuing calibration %D, internal standard %R, and RPD between two columns, data were qualified as estimated in four samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable.

Duwamish AOC4
Polychlorinated Biphenyls - Data Qualification Summary - SDG 21J0131

Sample	Analyte	Flag	A or P	Reason
LDW21-SC509D	Aroclor-1260	J (all detects)	A	Continuing calibration (%D)
LDW21-IT592B	Aroclor-1260	J (all detects)	A	Internal standards (%R)
LDW21-SC517D LDW21-SC527D	Aroclor-1248	J (all detects)	A	Target analyte quantitation (RPD between two columns)
LDW21-SC509D	Aroclor-1248 Aroclor-1260	J (all detects) J (all detects)	A	Target analyte quantitation (RPD between two columns)

Duwamish AOC4
Polychlorinated Biphenyls - Laboratory Blank Data Qualification Summary - SDG 21J0131

No Sample Data Qualified in this SDG

Duwamish AOC4
Polychlorinated Biphenyls - Field Blank Data Qualification Summary - SDG 21J0131

No Sample Data Qualified in this SDG

LDC #: 52703A3b
SDG #: 21J0131
Laboratory: Analytical Resources, Inc.

VALIDATION COMPLETENESS WORKSHEET
Stage 4

Date: 7/10/21
Page: 1 of 2
Reviewer: [illegible]
2nd Reviewer: JM

METHOD: GC Polychlorinated Biphenyls (EPA SW846 Method 8082A)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A	
II.	Initial calibration/ICV	A A	RSD ≤ 20% ICV ≤ 20%
III.	Continuing calibration	SW	CCV ≤ 20%
IV.	Laboratory Blanks	A	
V.	Field blanks	N	
VI.	Surrogate spikes / DCB	A/SW	
VII.	Matrix spike/Matrix spike duplicates	A	
VIII.	Laboratory control samples / SRM	A	LCS/D
IX.	Field duplicates	N	
X.	Target analyte quantitation	SW	
XI.	Target analyte identification	A	
XII.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	LDW21-SC560F	21J0131-01	Sediment	06/29/21
2 M	LDW21-SC509D	21J0131-02	Sediment	07/01/21
3	LDW21-SC517D	21J0131-03	Sediment	07/01/21
4	LDW21-SC520A	21J0131-04	Sediment	07/02/21
5	LDW21-SC527D	21J0131-05	Sediment	07/02/21
6	LDW21-SC531D	21J0131-06	Sediment	07/02/21
7	LDW21-SC534D	21J0131-07	Sediment	07/02/21
8	LDW21-IT601	21J0131-08	Sediment	07/06/21
9	LDW21-IT592B	21J0131-09	Sediment	07/06/21
10	LDW21-IT592C	21J0131-10	Sediment	07/06/21
11	LDW21-IT592D	21J0131-11	Sediment	07/06/21
12	LDW21-IT592D	21J0131-12	Sediment	07/06/21
13	LDW21-IT592F	21J0131-13	Sediment	07/06/21
14	LDW21-IT592G	21J0131-14	Sediment	07/06/21
15	LDW21-SC510F	21J0131-15	Sediment	07/07/21
16	LDW21-IT609D	21J0131-16	Sediment	07/07/21
17	LDW21-SC595	21J0131-18	Sediment	07/08/21

LDC #: 52703A3b

SDG #: 21J0131

Laboratory: Analytical Resources, Inc.

VALIDATION COMPLETENESS WORKSHEET

Stage 4

Date: 8/10/21

Reviewer: 9

2nd Reviewer: JVG

METHOD: GC Polychlorinated Biphenyls (EPA SW846 Method 8082A)

	Client ID	Lab ID	Matrix	Date
18	LDW21-SC519B	21J0131-19	Sediment	07/08/21
19	LDW21-SC519C	21J0131-20	Sediment	07/08/21
20	LDW21-SC519D	21J0131-21	Sediment	07/08/21
21 2	LDW21-SC519E	21J0131-22	Sediment	07/08/21
22 2	LDW21-SC519F	21J0131-23	Sediment	07/08/21
23 2	LDW21-SC535D	21J0131-24	Sediment	07/08/21
24	LDW21-SC509DMS	21J0131-02MS	Sediment	07/01/21
25	LDW21-SC509DMSD	21J0131-02MSD	Sediment	07/01/21
26	LDW21-IT592CMS	21J0131-10MS	Sediment	07/06/21
27	LDW21-IT592CMSD	21J0131-10MSD	Sediment	07/06/21
28				
29				
30				

Notes:

	BN0624-BLK1						
	BN0629-BLK1						
	BN0664-BLK1						

LDC #: 52703A3b

VALIDATION FINDINGS CHECKLIST

Page: 1 of 2
Reviewer: Q

Method: /GC __HPLC

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
Were all technical holding times met?	✓			
Was cooler temperature criteria met?	✓			
IIa. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✓			
Were all percent relative standard deviations (%RSD) ≤ 20%?	✓			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥0.990?			✓	
Were the RT windows properly established?	✓			
IIb. Initial calibration verification				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	✓			
Were all percent differences (%D) ≤ 20%?	✓			
III. Continuing calibration				
Was a continuing calibration analyzed daily?	✓			
Were all percent differences (%D) ≤ 20%?		✓		
Were all the retention times within the acceptance windows?	✓			
IV. Laboratory Blanks				
Was a laboratory blank associated with every sample in this SDG?	✓			
Was a laboratory blank analyzed for each matrix and concentration?	✓			
Was there contamination in the laboratory blanks?		✓		
V. Field Blanks				
Were field blanks identified in this SDG?		✓		
Were target compounds detected in the field blanks?			✓	
VI. Surrogate spikes				
Were all surrogate percent recovery (%R) within the QC limits?	✓			
If the percent recovery (%R) of one or more surrogates was outside QC limits, was a reanalysis performed to confirm %R?			✓	
If any %R was less than 10 percent, was a reanalysis performed to confirm %R?			✓	
VII. Matrix spike/Matrix spike duplicates				
Were matrix spike (MS) and matrix spike duplicate (MSD) analyzed in this SDG?	✓			
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?	✓			
VIII. Laboratory control samples				
Was an LCS analyzed per analytical or extraction batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	✓			

Validation Area	Yes	No	NA	Findings/Comments
IX. Field duplicates				
Were field duplicate pairs identified in this SDG?		✓		
Were target compounds detected in the field duplicates?			✓	
X. Compound quantitation				
Did the laboratory LOQs/RLs meet the QAPP LOQs/RLs?	✓			
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
XI. Target compound identification				
Were the retention times of reported detects within the RT windows?	✓			
XIII. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			

LDC #: 52703A3b

VALIDATION FINDINGS WORKSHEET
Continuing Calibration

Page: 1 of 1
Reviewer:

METHOD: ✓ GC __ HPLC

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

[✓ Y] N N/A Were continuing calibration standards analyzed at the required frequencies?

Y [✓ N] N/A Did the continuing calibration standards meet the %D validation criteria of <20.0%?

Level IV Only

[✓ Y] N N/A Were the retention times for all calibrated compounds within their respective acceptance windows?

#	Date	Standard ID	Detector/ Column	Compound	%D (Limit)	RT (limit)	Associated Samples	Qualifications
	10/27/21	10272103	2C	BB	23.8	( )	2, 24-25, MB (dets)	J/UJ/A
						( )		(Ic in)
						( )		
	~~10/28/21~~					( )		
						( )		
						( )		
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LDC #: 52103A3b

VALIDATION FINDINGS WORKSHEET
Internal Standards

Reviewer: Q

METHOD: GC

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y (N) N/A Were all internal standard area counts within -50 to +100% of the ICAL midpoint standard?

(Y) N N/A Were the retention times of the internal standards within +/- 0.05 min seconds of the retention times of the ICAL midpoint standard?

#	Date	Sample ID	Internal Standard	Area (Limits)	RT (Limits)	Qualifications
		3 9 (1,2,5)	HBB (12)	49 (50-200)		J (4) / A (BB)

HBB - Hexabromobiphenyl

LDC #: 52703A36

VALIDATION FINDINGS WORKSHEET
Compound Quantitation and Reported CRQLs

Reviewer: 9

METHOD: / GC __ HPLC

Level IV/D Only

Y N N/A Were CRQLs adjusted for sample dilutions, dry weight factors, etc.?
Y N N/A Did the reported results for detected target compounds agree within 10.0% of the recalculated results?
Y N N/A Did the relative percent differences of detected compounds between two columns/detectors ≤40%?
If no, please see findings bellow.

#	Compound Name	Sample ID	%RPD Between Two Columns/Detectors Limit (≤ 40%)	Qualifications
	Aroclor 1248	3	57.8	Idets/A
	↓			
		2	52.9	↓
	Aroclor 1260		41.6	
	Aroclor 1248	5	T8	Idets/A

LDC #: 52703A36

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Reviewer: 9

METHOD: GC ✓ HPLC ____

The calibration factors (CF) and relative standard deviation (%RSD) were recalculated using the following calculations:

CF = A/C
Average CF = sum of the CF/number of standards
%RSD = 100 * (S/X)

Where: A = Area of compound
C = Concentration of compound
S = Standard deviation of calibration factors
X = Mean of calibration factors

#	Standard ID	Calibration Date	Compound	Reported CF (100 std)	Recalculated CF (100 std)	Reported Ave CF (initial)	Recalculated Ave CF (intial)	Reported %RSD	Recalculated %RSD
1	ICAL	8/13/97	BB-1 (1C)	0.0358713	0.0358713	0.0359933	0.0359923	2.6	2.6
			BB-1 (2C)	0.0687649	0.068764	0.0665038	0.0665038	7.7	7.8
2									
3									
4									

Comments: Refer to Initial Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703A6

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Reviewer: 9

METHOD: ✓ GC_HPLC

The percent difference (%D) of the initial calibration average Calibration Factors (CF) and the continuing calibration CF were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. CF -CF)/ave.CF

Where: ave. CF = initial calibration average CF
CF = continuing calibration CF
A = Area of compound
C = Concentration of compound

#	Standard ID	Calibration Date	Compound	Average CF(Ical)/ CCV Conc.	Reported CF/ Conc. CCV	Recalculated CF/ Conc. CCV	Reported %D	Recalculated %D
1	102303	10/23/21	BB-1 (1c)	0.0359923	0.0328101	0.0328101	8.8	8.8
	1.3-10.26-T		BB-1 (2c)	0.0665032	0.0550927	0.0550927	17.2	17.2
	MT							
2	102320	10/24/21	↓	0.0359923	0.0332095	0.0332094	7.6	7.7
	11-17			0.0665032	0.0556153	0.0556153	16.4	16.4
3	102434	10/25/21 T=40	↓	0.0359923	0.0300082	0.0300081	16.8	16.6
	21.23			0.0665032	0.0534658	0.0534657	19.6	19.6
	MT							
4	102503	10/25/21 20:10	↓	0.0359923	0.0299229	0.0299229	16.8	16.9
	8.18-20			0.0665032	0.0542807	0.0542806	18.4	18.4

LDC #: 50703A36

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Reviewer: 9

METHOD: ✓ GC_HPLC

The percent difference (%D) of the initial calibration average Calibration Factors (CF) and the continuing calibration CF were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. CF -CF)/ave.CF

Where: ave. CF = initial calibration average CF
CF = continuing calibration CF
A = Area of compound
C = Concentration of compound

#	Standard ID	Calibration Date	Compound	Average CF(Ical)/ CCV Conc.	Reported CF/ Conc. CCV	Recalculated CF/ Conc. CCV	Reported %D	Recalculated %D
1	10378103	10/5/61	BB-1 (IC)	0.0359923	0.0288124	0.0288124	20.0	20.0
	MB, 2-24-15	T=30	BB-1 (2C)	0.0665032	0.0486648	0.0486647	26.8	26.8
2	10282113	10/8/61	↓	0.0359923	0.0286022		20.4	
	22	20:27	↓	0.0665032	0.0479189		28.0	
3	10282113	10/8/61	BB-1 (IC)	0.0359923	0.0320735	0.0320734	10.8	10.9
	22		BB-1 (2C)	0.0665032	0.0540579	0.0540578	18.8	18.7
4								

LDC #: 52703A36

VALIDATION FINDINGS WORKSHEET
Surrogate Results Verification

Reviewer: 9

METHOD: ✓ GC ___ HPLC

The percent recoveries (%R) of surrogates were recalculated for the compounds identified below using the following calculation:

% Recovery: SF/SS * 100

Where: SF = Surrogate Found
SS = Surrogate Spiked

Sample ID: 1

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	
DCB	1c	40.0	40.1	100	100	
TCMX	↓	↓	30.3	75.7	75.7	

Sample ID: _____

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	

Sample ID: _____

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	

LDC #: 53703-D

VALIDATION FINDINGS WORKSHEET
Matrix Spike/Matrix Spike Duplicates Results Verification

Reviewer: Q

METHOD: ✓ GC ___ HPLC

The percent recoveries (%R) and relative percent differences (RPD) of the matrix spike and matrix spike duplicate were recalculated for the compounds identified below using the following calculation:

%Recovery = 100 * (SSC - SC)/SA Where SSC = Spiked sample concentration SA = Spike added SC = Sample concentration

RPD =({SSCMS - SSCMSD} * 2) / (SSCMS + SSCMSD))*100 MS = Matrix spike MSD = Matrix spike duplicate

MS/MSD samples: 26a7

Compound	Spike Added (ug/kg)		Sample Conc. (ug/kg)	Spike Sample Concentration (ug/kg)		Matrix spike Percent Recovery		Matrix Spike Duplicate Percent Recovery		MS/MSD RPD	
	MS	MSD	---	MS	MSD	Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
Gasoline (8015)											
Diesel (8015)											
Benzene (8021B)											
Methane (RSK-175)											
2,4-D (8151)											
Dinoseb (8151)											
Naphthalene (8310)											
Anthracene (8310)											
HMX (8330)											
2,4,6-Trinitrotoluene (8330)											
~~BB~~	10.1	10.1	2.0	T5.9	T4.8	T3.4	T3.2	T2.3	T2.1	1.48	1.46

Comments: Refer to Matrix Spike/Matrix Spike Duplicates findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52723A36

VALIDATION FINDINGS WORKSHEET
Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification

Reviewer: 9

METHOD: 1 **GC** __**HPLC**

The percent recoveries (%R) and relative percent differences (RPD) of the laboratory control sample and laboratory control sample duplicate were recalculated for the compounds identified below using the following calculation:

%Recovery = 100 * (SSC - SC)/SA Where SSC = Spiked sample concentration, SA = Spike added, SC = Sample concentration

RPD =(({SSCLCS - SSCLCSD} * 2) / (SSCLCS + SSCLCSD))*100 LCS = Laboratory Control Sample, LCSD = Laboratory Control Sample duplicate

LCS/LCSD samples: BLI0624-BS1/BSD1

Compound	Spike Added (µg/kg)		Spike Sample Concentration (µg/kg)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
Gasoline (8015)										
Diesel (8015)										
Benzene (8021B)										
Methane (RSK-175)										
2,4-D (8151)										
Dinoseb (8151)										
Naphthalene (8310)										
Anthracene (8310)										
HMX (8330)										
2,4,6-Trinitrotoluene (8330)										
BB	101	101	80.0	84.2	81.4	81.1	83.6	83.4	2.67	2.65

Comments: Refer to Laboratory Control Sample/Laboratory Control Sample Duplicate findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703A3b

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: CL

METHOD: / GC __ HPLC

Y N N/A Were all reported results recalculated and verified for all level IV samples?
Y N N/A Were all recalculated results for detected target compounds within 10% of the reported results?

Concentration= (A)(Fv)(Df) / (RF)(Vs or Ws)(%S/100)

A= Area or height of the compound to be measured
Fv= Final Volume of extract
Df= Dilution Factor
RF= Average response factor of the compound In the initial calibration
Vs= Initial volume of the sample
Ws= Initial weight of the sample
%S= Percent Solid

Example:

Sample ID. 1 Compound Name PCB-1260-1

Concentration = $\frac{(14889)\ (80.0)}{(430881)(10.035993)} = 16.8$

conctotal = $\frac{(16.8+16.4+19.1+94.6+88.1)(2.5)}{5 \times 14.39 \times 0.8684} = 16.6$ µg/g

#	Sample ID	Compound	Reported Concentrations (µg/g)	Recalculated Results Concentrations ( )	Qualifications
	1	PCB-1260	16.6		

Comments: _____

SAMPCAL.wpd

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Arsenic

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21J0131

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT601	21J0131-08	Sediment	07/06/21
LDW21-IT592B	21J0131-09	Sediment	07/06/21
LDW21-IT592C	21J0131-10	Sediment	07/06/21
LDW21-IT592D	21J0131-11	Sediment	07/06/21
LDW21-IT592D	21J0131-12	Sediment	07/06/21
LDW21-IT592F	21J0131-13	Sediment	07/06/21
LDW21-IT592G	21J0131-14	Sediment	07/06/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for Inorganic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Arsenic by Environmental Protection Agency (EPA) SW 846 Method 6020B

All sample results were subjected to Stage 4 evaluation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition.

All technical holding time requirements were met.

II. ICPMS Tune

The mass calibration was within 0.1 AMU and the percent relative standard deviation (%RSD) was less than or equal to 5%.

III. Instrument Calibration

Initial and continuing calibrations were performed as required by the method.

The initial calibration verification (ICV) and continuing calibration verification (CCV) standards were within QC limits.

IV. ICP Interference Check Sample Analysis

The frequency of interference check sample (ICS) analysis was met. All criteria were within QC limits.

V. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks.

VI. Field Blanks

No field blanks were identified in this SDG.

VII. Matrix Spike/Matrix Spike Duplicates

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

VIII. Duplicate Sample Analysis

The laboratory has indicated that there were no duplicate (DUP) analyses specified for the samples in this SDG, and therefore duplicate analyses were not performed for this SDG.

IX. Serial Dilution

Serial dilution was not performed for this SDG.

X. Laboratory Control Samples

Laboratory control samples (LCS) were analyzed as required by the method. Percent recoveries (%R) were within QC limits.

XI. Field Duplicates

No field duplicates were identified in this SDG.

XII. Internal Standards (ICP-MS)

All internal standard percent recoveries (%R) were within QC limits.

XIII. Target Analyte Quantitation

All target analyte quantitations were within validation criteria.

XIV. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

The quality control criteria reviewed were met and are considered acceptable.

Duwamish AOC4
Arsenic - Data Qualification Summary - SDG 21J0131

No Sample Data Qualified in this SDG

Duwamish AOC4
Arsenic - Laboratory Blank Data Qualification Summary - SDG 21J0131

No Sample Data Qualified in this SDG

Duwamish AOC4
Arsenic - Field Blank Data Qualification Summary - SDG 21J0131

No Sample Data Qualified in this SDG

LDC #: 52703A4a

SDG #: 21J0131

Laboratory: Analytical Resources, Inc., Tukwila, WA

VALIDATION COMPLETENESS WORKSHEET

Stage 4

Date: 12/9/21

Page: 1 of 1

Reviewer: G

2nd Reviewer: [illegible]

METHOD: Arsenic (EPA SW846 Method 6020B)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A, A	
II.	ICP/MS Tune	A	
III.	Instrument Calibration	A	
IV.	ICP Interference Check Sample (ICS) Analysis	A	
V.	Laboratory Blanks	A	
VI.	Field Blanks	N	
VII.	Matrix Spike/Matrix Spike Duplicates	N	
VIII.	Duplicate sample analysis	N	
IX.	Serial Dilution	N	
X.	Laboratory control samples	A	LCS
XI.	Field Duplicates	N	
XII.	Internal Standard (ICP-MS)	A	
XIII.	Target Analyte Quantitation	A	
XIV	Overall Assessment of Data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	LDW21-IT601	21J0131-08	Sediment	07/06/21
2	LDW21-IT592B	21J0131-09	Sediment	07/06/21
3	LDW21-IT592C	21J0131-10	Sediment	07/06/21
4	LDW21-IT592D	21J0131-11	Sediment	07/06/21
5	LDW21-IT592D	21J0131-12	Sediment	07/06/21
6	LDW21-IT592F	21J0131-13	Sediment	07/06/21
7	LDW21-IT592G	21J0131-14	Sediment	07/06/21
8				
9				
10				
11				
12				
13				

Notes:

METHOD: Trace Metals (EPA SW 846 Methods 6010/6020/7000)				
Validation Area	**Yes**	**No**	**NA**	**Comments**
I. Technical holding times				
Were all technical holding times met?	X			
Were all water samples preserved to a pH of <2?			X	
II. ICP-MS Tune				
Were mass resolutions within 0.1 amu for all isotopes in the tuning solution?	X			
Were %RSDs of isoptoes in the tuning solution ≤5%?	X			
III. Calibration				
Were all instuments calibrated daily?	X			
Were the proper standards used?	X			
Were all initial and continuing calibration verifications within the 90-110% (80-120% for mercury) QC limits?	X			
Were the low level standard checks within 70-130%?			X	
Were all initial calibration correlation coefficients within limits as specifed by the method?	X			
IV. Blanks				
Was a method blank associated with every sample in this SDG?	X			
Was there contamination in the method blanks?		X		
Was there contamination in the initial and continuing calibration blanks?		X		
V. Interference Check Sample				
Were the interference check samples performed daily?	X			
Were the AB solution recoveries within 80-120%?	X			
VI. Matrix Spike/Matrix Spike Duplicates/Laboratory Duplicates				
Were MS/MSD recoveries with the QC limits? (If the sample concentration exceeded the spike concentration by a factor of 4, no action was taken.)			X	
Were the MS/MSD or laboratory duplicate relative percent differences (RPDs) within the QC limits?			X	
VII. Laboratory Control Samples				
Was a LCS analyzed for each batch in the SDG?	X			
Were the LCS recoveries and RPDs (if applicable) within QC limits?	X			

METHOD: Trace Metals (EPA SW 846 Methods 6010/6020/7000)				
Validation Area	**Yes**	**No**	**NA**	**Comments**
VIII. Internal Standards				
Were all percent recoveries within the 30-120% (60-125% for EPA Method 200.8) QC limits?	X			
If the recoveries were outside the limits, was a reanalysis performed?		X		
IX. Serial Dilution				
Were all percent differences <10%?			X	
Was there evidence of negative interference? If yes, professional judgement will be used to qualify the data.			X	
X. Sample Result Verification				
Were all reporting limits adjusted to reflect sample dilutions?	X			
Were all soil samples dry weight corrected?	X			
XI. Overall Assessment of Data				
Was the overall assessment of the data found to be acceptable?	X			
XII. Field Duplicates				
Were field duplicates identifed in this SDG?		X		
Were target analytes detected in the field duplicates?			X	
XIII. Field Blanks				
Were field blanks identified in this SDG?		X		
Were target analytes detected in the field blanks?			X	

METHOD: Trace Metals (EPA SW 846 Methods 6010/6020/7000)

An intial calibration verification (ICV), continuing calibration verification (CCV), low level calibration check (LLCC), and interference check sample (ICSAB) percent recovery (%R) was recalculated for each type of analysis using the following formula:

%R = (Found/True) x 100

Found = concentration of each analyte measured in the analysis
True = concentration of each analyte in the source

Standard ID	Type of Analysis	Element	Found (ug/L)	True (ug/L)	Recalcuated %R	Reported %R	Acceptable (Y/N)
ICV	ICP-MS	As	47.7	50	95.4	95.5	Y
CCV	ICP-MS	Cd 95	49.8	50	99.6	99.6	Y
ICSAB	ICP-MS	As	19.283	20	96.4	96.4	Y

ICP-MS Tune	QC Parameter	Mass	Actual	Required
10/28/2021	Mass Axis	115	114.9	± 0.1 amu
10/28/2021	%RSD	115	1	≤ 5%

METHOD: Trace Metals (EPA SW 846 Methods 6010/6020/7000)

Percent recoveries (%R) for the laboratory control sample (LCS), matrix spike (MS), and post digestion spike (PDS) were recalculated using the following formula:

%R = (Found/True) x 100

Found = concentration of each analyte measured in the analysis. For the MS calculation, Found = SSR (Spiked Sample Result) - SR (Sample Result)

True = concentration of each analyte in the source

The sample and duplicate relative percent difference (RPD) was recalculated using the following formula:

RPD = (Absolute value(S-D)x 200) / (S+D)

S = Original sample concentration

D = Duplicate sample concentration

The serial dilution percent difference (%D) was recalculated using the following formula.

%D = (Absolute value (I - SDR)) x 100 / (I)

I = Initial sample result

SDR = Serial dilution result (with a 5x dilution applied)

Sample ID	Type of Analysis	Element	Found/S/I	True/D/SDR	Recalcuated %R/RPD/%D	Reported %R/RPD/%D	Acceptable (Y/N)
LCS	LCS	As	24.1	25	96.4	96.5	Y
	MS						
	Duplicate						
	PDS						
	Serial dilution						

METHOD: Trace Metals (EPA SW 846 Methods 6010/6020/7000)
Analytes were recalculated and verified using the following equation:
Concentration = (Result from raw data x Final volume x Dilution factor) / (Percent solids x Initial weight)

Sample ID	Analyte	Raw Data (ug/L)	Dilution	Initial Weight/ Volume (g)	Final Volume (mL)	Percent solids (%)	Reported Result (mg/Kg)	Recalcuated Result (mg/Kg)	Acceptable (Y/N)
1	As	6.384	20	1.004	50	65.71	9.68	9.68	Y
2	As	130.145	20	1.028	50	68.11	186	186	Y
3	As	8.584	20	1.043	50	87.46	9.41	9.41	Y
4	As	7.601	20	1.003	50	71.47	10.6	10.6	Y
5	As	3.03	20	1.084	50	73.48	3.8	3.8	Y
6	As	3.874	20	1.049	50	77.4	4.77	4.77	Y
7	As	2.526	20	1.035	50	77.24	3.16	3.16	Y

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Wet Chemistry

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21J0131

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-SC560F	21J0131-01	Sediment	06/29/21
LDW21-SC509D	21J0131-02	Sediment	07/01/21
LDW21-SC517D	21J0131-03	Sediment	07/01/21
LDW21-SC520A	21J0131-04	Sediment	07/02/21
LDW21-SC527D	21J0131-05	Sediment	07/02/21
LDW21-SC531D	21J0131-06	Sediment	07/02/21
LDW21-SC534D	21J0131-07	Sediment	07/02/21
LDW21-IT601	21J0131-08	Sediment	07/06/21
LDW21-IT592B	21J0131-09	Sediment	07/06/21
LDW21-IT592C	21J0131-10	Sediment	07/06/21
LDW21-IT592D	21J0131-11	Sediment	07/06/21
LDW21-IT592D	21J0131-12	Sediment	07/06/21
LDW21-IT592F	21J0131-13	Sediment	07/06/21
LDW21-IT592G	21J0131-14	Sediment	07/06/21
LDW21-SC510F	21J0131-15	Sediment	07/07/21
LDW21-IT609D	21J0131-16	Sediment	07/07/21
LDW21-SC595	21J0131-18	Sediment	07/08/21
LDW21-SC519B	21J0131-19	Sediment	07/08/21
LDW21-SC519C	21J0131-20	Sediment	07/08/21
LDW21-SC519D	21J0131-21	Sediment	07/08/21
LDW21-SC519E	21J0131-22	Sediment	07/08/21
LDW21-SC519F	21J0131-23	Sediment	07/08/21
LDW21-SC535D	21J0131-24	Sediment	07/08/21
LDW21-SC560FMS	21J0131-01MS	Sediment	06/29/21
LDW21-SC560FDUP1	21J0131-01DUP1	Sediment	06/29/21
LDW21-SC560FDUP2	21J0131-01DUP2	Sediment	06/29/21

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-SC519EMS	21J0131-22MS	Sediment	07/08/21
LDW21-SC519EDUP1	21J0131-22DUP1	Sediment	07/08/21
LDW21-SC519EDUP2	21J0131-22DUP2	Sediment	07/08/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for Inorganic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following methods:

Total Organic Carbon by Environmental Protection Agency (EPA) SW 846 Method 9060A
Total Solids by Standard Method 2540G

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition.

All technical holding time requirements were met.

II. Initial Calibration

All criteria for the initial calibration of each method were met.

III. Continuing Calibration

Continuing calibration frequency and analysis criteria were met for each method when applicable.

IV. Laboratory Blanks

Laboratory blanks were analyzed as required by the methods. No contaminants were found in the laboratory blanks.

V. Field Blanks

No field blanks were identified in this SDG.

VI. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits.

VII. Duplicate Sample Analysis

Duplicate (DUP) sample analysis was performed on an associated project sample. Results were within QC limits.

VIII. Laboratory Control Samples

Laboratory control samples (LCS) were analyzed as required by the methods. Percent recoveries (%R) were within QC limits.

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Target Analyte Quantitation

All target analyte quantitations were within validation criteria.

XI. Overall Assessment of Data

The analysis was conducted within all specifications of the methods. No results were rejected in this SDG.

The quality control criteria reviewed were met and are considered acceptable.

Duwamish AOC4
Wet Chemistry - Data Qualification Summary - SDG 21J0131

No Sample Data Qualified in this SDG

Duwamish AOC4
Wet Chemistry - Laboratory Blank Data Qualification Summary - SDG 21J0131

No Sample Data Qualified in this SDG

Duwamish AOC4
Wet Chemistry - Field Blank Data Qualification Summary - SDG 21J0131

No Sample Data Qualified in this SDG

LDC #: 52703A6 **VALIDATION COMPLETENESS WORKSHEET** Date: 12/9/21
SDG #: 21J0131 Stage 4 Page: 1 of 2
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer: [illegible]
2nd Reviewer:

METHOD: (Analyte) TOC (EPA SW846 Method 9060A), Total Solids (SM2540G)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A, A	
II	Initial calibration	A	
III.	Calibration verification	A	
IV	Laboratory Blanks	A	
V	Field blanks	N	
VI.	Matrix Spike/Matrix Spike Duplicates	A	
VII.	Duplicate sample analysis	A	
VIII.	Laboratory control samples	A	LCS
IX.	Field duplicates	N	
X.	Target Analyte Quantitation	A	
XI	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	LDW21-SC560F	21J0131-01	Sediment	06/29/21
2	LDW21-SC509D	21J0131-02	Sediment	07/01/21
3	LDW21-SC517D	21J0131-03	Sediment	07/01/21
4	LDW21-SC520A	21J0131-04	Sediment	07/02/21
5	LDW21-SC527D	21J0131-05	Sediment	07/02/21
6	LDW21-SC531D	21J0131-06	Sediment	07/02/21
7	LDW21-SC534D	21J0131-07	Sediment	07/02/21
8	LDW21-IT601	21J0131-08	Sediment	07/06/21
9	LDW21-IT592B	21J0131-09	Sediment	07/06/21
10	LDW21-IT592C	21J0131-10	Sediment	07/06/21
11	LDW21-IT592D	21J0131-11	Sediment	07/06/21
12	LDW21-IT592D	21J0131-12	Sediment	07/06/21
13	LDW21-IT592F	21J0131-13	Sediment	07/06/21
14	LDW21-IT592G	21J0131-14	Sediment	07/06/21
15	LDW21-SC510F	21J0131-15	Sediment	07/07/21
16	LDW21-IT609D	21J0131-16	Sediment	07/07/21
17	LDW21-SC595	21J0131-18	Sediment	07/08/21

LDC #: 52703A6 **VALIDATION COMPLETENESS WORKSHEET** Date: 2/1/21
SDG #: 21J0131 Stage 4 Page: 2of2
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer:
2nd Reviewer:

METHOD: (Analyte) TOC (EPA SW846 Method 9060A), Total Solids (SM2540G)

	Client ID	Lab ID	Matrix	Date
18	LDW21-SC519B	21J0131-19	Sediment	07/08/21
19	LDW21-SC519C	21J0131-20	Sediment	07/08/21
20	LDW21-SC519D	21J0131-21	Sediment	07/08/21
21	LDW21-SC519E	21J0131-22	Sediment	07/08/21
22	LDW21-SC519F	21J0131-23	Sediment	07/08/21
23	LDW21-SC535D	21J0131-24	Sediment	07/08/21
24	LDW21-SC560FMS	21J0131-01MS	Sediment	06/29/21
25	LDW21-SC560FDUP	21J0131-01DUP	Sediment	06/29/21
26	LDW21-SC560FTRP DW	21J0131-01TRP	Sediment	06/29/21
27	LDW21-SC519EMS	21J0131-22MS	Sediment	07/08/21
28	LDW21-SC519EDUP	21J0131-22DUP	Sediment	07/08/21
29	LDW21-SC519ETRP DW	21J0131-22TRP	Sediment	07/08/21
30				
31				
32				

Notes:

METHOD: Inorganics				
Validation Area	**Yes**	**No**	**NA**	**Comments**
I. Technical holding times				
Were all technical holding times were met?	X			Frozen
II. Calibration				
Were all instuments calibrated at the requried frequency?	X			
Were the proper number of standards used?	X			
Were all initial and continuing calibration verifications within the QC limits?	X			
Were all initial calibration correlation coefficients within limits as specifed by the method?	X			
Were balance checks performed as required?	X			
III. Blanks				
Was a method blank assoicated with every sample in this SDG?	X			
Was there contamination in the method blanks?		X		
Was there contamination in the initial and continuing calibration blanks?		X		
IV. Matrix Spike/Matrix Spike Duplicates/Laboratory Duplicates				
Were MS/MSD recoveries with the QC limits? (If the sample concentration exceeded the spike concentration by a factor of 4, no action was taken.)	X			
Were the MS/MSD or laboratory duplicate relative percent differences (RPDs) within the QC limits?	X			
V. Laboratory Control Samples				
Was a LCS analyzed for each batch in the SDG?	X			
Were the LCS recoveries and RPDs (if applicable) within QC limits?	X			
X. Sample Result Verification				
Were all reproting limits adjusted to reflect sample dilutions?	X			
Were all soil samples dry weight corrected?	X			
XI. Overall Assessment of Data				
Was the overall assessment of the data found to be acceptable?	X			

METHOD: Inorganics				
Validation Area	**Yes**	**No**	**NA**	**Comments**
XII. Field Duplicates				
Were field duplicates identifed in this SDG?		X		
Were target analytes detected in the field duplicates?			X	
XIII. Field Blanks				
Were field blanks identified in this SDG?		X		
Were target analytes detected in the field blanks?			X	

All elements are applicable to each sample as noted below.

Sample ID	Target Analyte List
All	TS, TOC
QC:	
24	TOC
25	TOC, TS
26	TS
27	TOC
28	TOC, TS
29	TS

LDC #: 52703A6

Validation Findings Worksheet
Initial and Continuing Calibration Calculation Verification

Method: Inorganics, Method See Cover

An initial or continuing calibration verification percent recovery (%R) was recalculated for each type of analysis using the following formula:

$$\%R = \frac{\text{Found} \times 100}{\text{True}}$$

Where, Found = concentration of each analyte measured in the analysis of the ICV or CCV solution

True = concentration of each analyte in the ICV or CCV source

Calibration verification	TOC	ICV	44.446	47.154	106	106	Y
Calibration verification	TOC	CCV	44.446	43.275	97	97	Y
Calibration verification	TOC	CCV	44.446	44.823	101	101	Y

Comments:

METHOD: Inorganics

Percent recoveries (%R) for the laboratory control sample (LCS) and matrix spike (MS) were recalcuated using the following formula.
%R = (Found/True) x 100
Found = concentration of each analyte measured in the analysis. For the MS calculation, Found = SSR (Spiked Sample Result) - SR (Sample Result)
True = concentraiton of each analyte in the source
The sample and duplciate relative percent difference (RPD) was recalcuated using the following formula.
RPD = (Absolute value(S-D)x 200) / (S+D)
S = Original sample concentraiton
D = Duplciate sample concentration

Sample ID	Type of Analysis	Element	Found/S	True/D	Recalcuated %R/RPD	Reported %R/RPD	Acceptable (Y/N)
LCS	LCS	TOC	44.1	44.4	99.3	99.3	Y
24	MS	TOC	0.89	0.882	101	101	Y
26	Duplicate	TS	84.21	83.47	0.883	0.883	Y

VALIDATION FINDINGS CHECKLIST
Sample Calculation Verification

METHOD: Inorganics
Analytes were recalcuated and verified using the following equation.
Concentration = (Result from raw data x Final volume x Dilution factor) / (Percent solids (if applicable) x Initial weight or volume)

Sample ID	Analyte	Raw Data (%)	Dry (g)	Sample Dry (g)	Tare (g)	Percent solids (%)	Reported Result (%)	Recalcuated Result (mg/Kg)	Acceptable (Y/N)
1		0.128				84.21	0.15	0.15	Y
2		0.73				68	1.07	1.07	Y
3		1.101				65.61	1.68	1.68	Y
4		0.962				55.89	1.72	1.72	Y
5		1.153				61.77	1.87	1.87	Y
6		0.433				75.55	0.57	0.57	Y
7		0.27				74.3	0.36	0.36	Y
8		0.873				65.71	1.33	1.33	Y
9		1.006				68.11	1.48	1.48	Y
10		0.034				87.46	0.04	0.04	Y
11		2.028				71.47	2.84	2.84	Y
12		0.041				73.48	0.06	0.06	Y
13		0.576				77.4	0.74	0.74	Y
14		0.064				77.24	0.08	0.08	Y
15			4.6601	5.9704	0.7966		74.67	74.67	Y
16			5.3277	6.8056	0.766		75.53	75.53	Y
17			2.8706	4.8457	0.8032		51.15	51.14	Y
18			2.971	4.5351	0.7899		58.24	58.24	Y
19			3.9811	6.0615	0.7954		60.49	60.49	Y
20			4.3143	7.0703	0.7599		56.33	56.33	Y
21			3.6609	5.9743	0.7849		55.42	55.42	Y
22			3.7681	6.0623	0.7894		56.49	56.49	Y
23			4.4567	5.9003	0.7915		71.74	71.74	Y

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Polychlorinated Dioxins/Dibenzofurans

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21J0131

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT627	21J0131-17	Sediment	07/08/21
LDW21-IT627DUP	21J0131-17DUP	Sediment	07/08/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for High Resolution Superfund Methods Data Review (April 2016). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Polychlorinated Dioxins/Dibenzofurans by Environmental Protection Agency (EPA) Method 1613B

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered not detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. HRGC/HRMS Instrument Performance Check

Instrument performance was checked at the required frequency.

Retention time windows were established for all homologues. The chromatographic resolution between 2,3,7,8-TCDD and peaks representing any other unlabeled TCDD isomer was less than or equal to 25%.

The static resolving power was at least 10,000 (10% valley definition).

III. Initial Calibration and Initial Calibration Verification

A five point initial calibration was performed as required by the method.

The percent relative standard deviations (%RSD) were less than or equal to 20.0% for all analytes and less than or equal to 35.0% for labeled compounds.

The ion abundance ratios for all PCDDs and PCDFs were within validation criteria.

The minimum S/N ratio was greater than or equal to 10 for each analyte and labeled compound.

The percent differences (%D) of the initial calibration verification (ICV) standard were within the QC limits for all analytes and labeled compounds.

IV. Continuing Calibration

Continuing calibration was performed at the required frequencies.

All of the continuing calibration results were within the QC limits for all analytes and labeled compounds.

The ion abundance ratios for all PCDDs and PCDFs were within validation criteria.

The minimum S/N ratio was greater than or equal to 10 for each analyte and labeled compound.

V. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks with the following exceptions:

Blank ID	Extraction Date	Analyte	Concentration	Associated Samples
BJJ0500-BLK1	10/19/21	OCDD Total HxCDF	0.981 ng/Kg 0.100 ng/Kg	All samples in SDG 21J0131

Sample concentrations were compared to concentrations detected in the laboratory blanks. The sample concentrations were either not detected or were significantly greater than the concentrations found in the associated laboratory blanks.

VI. Field Blanks

No field blanks were identified in this SDG.

VII. Matrix Spike/Matrix Spike Duplicates/Duplicate Sample Analysis

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

Duplicate (DUP) sample analysis was performed on an associated project sample. Results were within QC limits.

VIII. Laboratory Control Samples/Standard Reference Materials

Laboratory control samples (LCS) were analyzed as required by the method. Percent recoveries (%R) were within QC limits.

Standard reference materials (SRM) were analyzed as required by the method. The results were within QC limits.

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Internal Standards

All internal standard areas and retention times were within QC limits.

XI. Target Analyte Quantitation

All target analyte quantitations met validation criteria with the following exceptions:

Sample	Analyte	Flag	A or P
All samples in SDG 21J0131	All analytes reported as estimated maximum possible concentration (EMPC) and greater than the reporting limit (RL).	J (all detects)	A

XII. Target Analyte Identification

All target analyte identifications met validation criteria.

XIII. System Performance

The system performance was acceptable.

XIV. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

Due to results reported by the laboratory as EMPCs, data were qualified as estimated in two samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable.

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Data Qualification Summary - SDG 21J0131

Sample	Analyte	Flag	A or P	Reason
LDW21-IT627 LDW21-IT627DUP	All analytes reported as estimated maximum possible concentration (EMPC) and greater than the reporting limit (RL).	J (all detects)	A	Target analyte quantitation (EMPC)

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Laboratory Blank Data Qualification Summary - SDG 21J0131

No Sample Data Qualified in this SDG

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Field Blank Data Qualification Summary - SDG 21J0131

No Sample Data Qualified in this SDG

LDC #: 52703A21 **VALIDATION COMPLETENESS WORKSHEET** Date: 4/9/21
SDG #: 21J0131 Stage 4 Page: 1 of 1
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer: Q
2nd Reviewer: JM

METHOD: HRGC/HRMS Polychlorinated Dioxins/Dibenzofurans (EPA Method 1613B)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A	
II.	HRGC/HRMS Instrument performance check	A	
III.	Initial calibration/ICV	A/A	RSD≤ 20/35%. ICV≤ QC limits
IV.	Continuing calibration	A	CCV≤ QC limits
V.	Laboratory Blanks	SW	
VI.	Field blanks	N	
VII.	Matrix spike/Matrix spike duplicates /DUP	N/A	<5xPL
VIII.	Laboratory control samples /SRM	A	LCS
IX.	Field duplicates	N	
X.	Internal standards	A	
XI.	Target analyte quantitation	A/SW	
XII.	Target analyte identification	A	
XIII.	System performance	A	
XIV.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	LDW21-IT627	21J0131-17	Sediment	07/08/21
2	LDW21-IT627DUP	21J0131-17DUP	Sediment	07/08/21
3				
4				
5				
6				
7				
8				
9				
10				

Notes:

	BLN0500-BLK1						

LDC #: 52703A2/ **VALIDATION FINDINGS CHECKLIST** Page: 1 of 3
Reviewer: CL

Method: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
All technical holding times were met.	√			
Cooler temperature criteria were met.	√			
II. GC/MS Instrument performance check				
Was PFK exact mass 380.9760 verified?	√			
Were the retention time windows established for all homologues?	√			
Was the chromatographic resolution between 2,3,7,8-TCDD and peaks representing any other unlabeled TCDD isomers ≤ 25%?	√			
Is the static resolving power at least 10,000 (10% valley definition)?	√			
Was the mass resolution adequately check with PFK?	√			
Was the presence of 1,2,8,9-TCDD and 1,3,4,6,8-PeCDF verified?	√			
III. Initial calibration and Initial calibration verification				
Was the initial calibration performed at 5 concentration levels?	√			
Were all percent relative standard deviations (%RSD) ≤ 20% for unlabeled compounds and ≤ 35% for unlabeled compounds?	√			
Did all calibration standards meet the Ion Abundance Ratio criteria?	√			
Was the signal to noise ratio for each target compound and labeled compound ≥ 10?	√			
Was an initial calibration verification (ICV) standard analyzed after each initial calibration for each instrument?	√			
Were all ICV concentrations for the unlabeled and labeled compounds within QC limits?	√			
IV. Continuing calibration				
Was a continuing calibration performed at the beginning of each 12-hour period?	√			
Were all continuing calibration concentrations for the unlabeled and labeled compounds within QC limits?	√			
Did all continuing calibration standards meet the Ion Abundance Ratio criteria?	√			
V. Blanks				
Was a method blank associated with every sample in this SDG?	√			
Was a method blank performed for each matrix and whenever a sample extraction was performed?	√			
Was there contamination in the method blanks?	V	Q		
VI. Field blanks				
Were field blanks identified in this SDG?		√		
Were target compounds detected in the field blanks?			√	
VII. Matrix spike/Matrix spike duplicates				
Were matrix spike (MS) and matrix spike duplicate (MSD) analyzed in this SDG?		√		
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?			√	

Validation Area	Yes	No	NA	Findings/Comments
VIII. Laboratory control samples				
Was an LCS analyzed per extraction batch?	√			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	√			
IX. Field duplicates				
Were field duplicate pairs identified in this SDG?		√		
Were target compounds detected in the field duplicates?			√	
X. Labeled Compounds				
Were labeled compounds within QC limits?	V	D		
Was the minimum S/N ratio of all labeled compound peaks ≥ 10?	√			
XI. Compound quantitation				
Did the laboratory LOQs/RLs meet the QAPP LOQs/RLs?	√			
Were the correct labeled compound, quantitation ion and relative response factor (RRF) used to quantitate the compound?	√			
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	√			
XII. Target compound identification				
For 2,3,7,8 substituted congeners with associated labeled standards, were the retention times of the two quantitation peaks within -1 to 3 sec. of the RT of the labeled standard?	√			
For 2,3,7,8 substituted congeners without associated labeled standards, were the relative retention times of the two quantitation peaks within 0.005 time units of the RRT measured in the routine calibration?	√			
For non-2,3,7,8 substituted congeners, were the retention times of the two quantitation peaks within RT established in the performance check solution?	√			
Did selected ion current profile (SICP) contain all characteristic ions listed in Method 1613B, Table 8?	√			
Was the Ion Abundance Ratio for the two quantitation ions within criteria?		√		
Was the signal to noise ratio for each target compound ≥2.5 and ≥10 for the labeled compound?	√			
Does the maximum intensity of each specified characteristic ion coincide within ± 2 seconds (includes labeled standards)?	√			
For PCDF identification, was any signal (S/N ≥ 2.5, at ± seconds RT) detected in the corresponding PCDPE channel?			√	
Was an acceptable lock mass recorded and monitored?	√			
XIII. System performance				
System performance was found to be acceptable.	√			
XIV. Overall assessment of data				
Overall assessment of data was found to be acceptable.	√			

VALIDATION FINDINGS WORKSHEET

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

A. 2,3,7,8-TCDD	F. 1,2,3,4,6,7,8-HpCDD	K. 1,2,3,4,7,8-HxCDF	P. 1,2,3,4,7,8,9-HpCDF	U. Total HpCDD
B. 1,2,3,7,8-PeCDD	G. OCDD	L. 1,2,3,6,7,8-HxCDF	Q. OCDF	V. Total TCDF
C. 1,2,3,4,7,8-HxCDD	H. 2,3,7,8-TCDF	M. 2,3,4,6,7,8-HxCDF	R. Total TCDD	W. Total PeCDF
D. 1,2,3,6,7,8-HxCDD	I. 1,2,3,7,8-PeCDF	N. 1,2,3,7,8,9-HxCDF	S. Total PeCDD	X. Total HxCDF
E. 1,2,3,7,8,9-HxCDD	J. 2,3,4,7,8-PeCDF	O. 1,2,3,4,6,7,8-HpCDF	T. Total HxCDD	Y. Total HpCDF

Notes:_____

_____

_____

LDC #: 52703A21

VALIDATION FINDINGS WORKSHEET
Blanks

Reviewer:

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

(Y) N N/A Were all samples associated with a method blank?

(Y) N N/A Was a method blank performed for each matrix and whenever a sample extraction was performed?

(Y) N N/A Was the method blank contaminated?

Blank extraction date: 10/19/21 **Blank analysis date:** 10/25/21 **Associated samples:** All

Conc. units: ng/kg

Compound	Blank ID	Sample Identification								
	BLK0506-BLK1									
4	0.981									
X	0.100									

Blank extraction date: _____ **Blank analysis date:** _____

Conc. units: _____ Associated Samples: _____

Compound	Blank ID	Sample Identification								

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT:
All contaminants within five times the method blank concentration were qualified as not detected, "U".

LDC #: 52703A21

VALIDATION FINDINGS WORKSHEET
Compound Quantitation and Reported RLs

Reviewer: PG

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y N N/A Were the correct labeled compound, quantitation ions and relative response factors (RRF) used to quantitate the compound?
Y N N/A Compound quantitation and RLs were adjusted to reflect all sample dilutions and dry weight factors (if necessary).

#	Date	Sample ID	Finding	Associated Samples	Qualifications
		All	All compounds reported as estimated maximum possible concentration (EMPC) > RL		Jdets/A

Comments: See sample calculation verification worksheet for recalculations

LDC #: 52703A21

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

The Relative Response Factor (RRF), average RRF, and percent relative standard deviation (%RSD) were recalculated for the compounds identified below using the following calculations:

$RRF = (A_x)(C_{is})/(A_{is})(C_x)$
average RRF = sum of the RRFs/number of standards
%RSD = 100 * (S/X)

A_x = Area of compound,
C_x = Concentration of compound,
S = Standard deviation of the RRFs,

A_{is} = Area of associated internal standard
C_{is} = Concentration of internal standard
X = Mean of the RRFs

#	Standard ID	Calibration Date	Compound (Reference Internal Standard)	Reported RRF (10/50 std)	Recalculated RRF (10/50 std)	Reported Average RRF (initial)	Recalculated Average RRF (initial)	Reported %RSD	Recalculated %RSD
1	ICAL	8/11/21	2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)	1.0832006	1.083746	1.107593	1.107593	3.6	3.6
	01		2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)	0.9085186	0.908390	0.9202875	0.9202874	3.1	3.1
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)	1.005616	1.005605	1.00898	1.00898	1.0	1.0
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)	1.051009	1.051062	1.068088	1.068088	6.6	6.6
			OCDF (^{13}C-OCDF)	1.440564	1.44059	1.44690	1.44690	5.7	5.7
2			2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)						
			2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)						
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)						
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)						
			OCDF (^{13}C-OCDD)						
3			2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)						
			2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)						
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)						
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)						
			OCDF (^{13}C-OCDD)						

Comments: Refer to Initial Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703A2

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Reviewer: 9

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

The percent difference (%D) of the initial calibration average Relative Response Factors (RRFs) and the continuing calibration RRFs were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. RRF - RRF)/ave. RRF
$RRF = (A_x)(C_{is})/(A_{is})(C_x)$

Where: ave. RRF = initial calibration average RRF
RRF = continuing calibration RRF
A_x = Area of compound, A_{is} = Area of associated internal standard
C_x = Concentration of compound, C_{is} = Concentration of internal standard

#	Standard ID	Calibration Date	Compound (Reference Internal Standard)	Average RRF (initial)	Reported Conc (CC)	Recalculated Conc (CC)	Reported %D	Recalculated %D
1	211025051A	10/5/21	2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)	1.10T593	1.0T45550	1.0T46175	3.0	3.0
			2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)	0.920287S	1.0081390	1.0081532	9.5	9.5
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)	1.00898	1.0688370	1.0683744	5.9	5.9
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)	1.068088	1.1679010	1.1678182	9.3	9.3
			OCDF (^{13}C-OCDF)	1.44690	1.338=880	1.338548	T.5	T.5
2			2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)					
			2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)					
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)					
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)					
			OCDF (^{13}C-OCDF)					
3			2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)					
			2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)					
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)					
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)					
			OCDF (^{13}C-OCDF)					

Comments: Refer to Routine Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703A21

VALIDATION FINDINGS WORKSHEET
Laboratory Control Sample Results Verification

Page: 1 of 1
Reviewer: 9

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

The percent recoveries (%R) and Relative Percent Difference (RPD) of the laboratoy control sample and laboratory control sample duplicate (if applicable) were recalculated for the compounds identified below using the following calculation:

% Recovery = 100 * SSC/SA Where: SSC = Spiked sample concentration
SA = Spike added

RPD = I LCS - LCSD I * 2/(LCS + LCSD) LCS = Laboraotry control sample percent recovery LCSD = Laboratory control sample duplicate percent recovery

LCS ID: BN0520-BS

Compound	Spike Added (ng/kg)		Spiked Sample Concentration (ng/kg)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc	Reported	Recalc	Reported	Recalculated
2,3,7,8-TCDD	20.0	NA	21.0	NA	105	105				
1,2,3,7,8-PeCDD	100	↓	107	↓	107	107				
1,2,3,4,7,8-HxCDD	↓	↓	99.2	↓	99.2	99.2				
1,2,3,4,7,8,9-HpCDF	↓	↓	95.9	↓	95.9	95.9				
OCDF	200	↓	151	↓	75.5	75.5				

Comments: Refer to Laboratory Control Sample findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 32703A2

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Reviewer: Q

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

Y N N/A Were all reported results recalculated and verified for all level IV samples?
Y N N/A Were all recalculated results for detected target compounds agree within 10.0% of the reported results?

Concentration = $\frac{(A_x)(I_s)(DF)}{(A_{is})(RRF)(V_o)(\%S)}$

A_x = Area of the characteristic ion (EICP) for the compound to be measured

A_{is} = Area of the characteristic ion (EICP) for the specific internal standard

I_s = Amount of internal standard added in nanograms (ng)

V_o = Volume or weight of sample extract in milliliters (ml) or grams (g).

RRF = Relative Response Factor (average) from the initial calibration

Df = Dilution Factor.

%S = Percent solids, applicable to soil and solid matrices only.

Example:

Sample I.D. 1 , F :

Conc. = $\frac{(9.18e4+8.67e4)(100)(20)(1)}{(9.14e4+8.56e4)(1.068088)(14.43)(0.6935)}$

= 183.9 ng/g

#	Sample ID	Compound	Reported Concentration (ng/g)	Calculated Concentration ( )	Acceptable (Y/N)
	1	F	184		

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Semivolatiles

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21J0134

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-SS600	21J0134-11	Sediment	07/12/21
LDW21-SS681	21J0134-12	Sediment	07/12/21
LDW21-SC587A	21J0134-14	Sediment	07/12/21
LDW21-SC587F	21J0134-15	Sediment	07/12/21
LDW21-SS600MS	21J0134-11MS	Sediment	07/12/21
LDW21-SS600MSD	21J0134-11MSD	Sediment	07/12/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for Organic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Semivolatile Organic Compounds (SVOCs) by Environmental Protection Agency (EPA) SW 846 Method 8270E

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. GC/MS Instrument Performance Check

A decafluorotriphenylphosphine (DFTPP) tune was performed at 12 hour intervals.

All ion abundance requirements were met.

III. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

For analytes where average relative response factors (RRFs) were utilized, percent relative standard deviations (%RSD) were less than or equal to 20.0%.

In the case where the laboratory used a calibration curve to evaluate the analytes, all coefficients of determination (r^2) were greater than or equal to 0.990.

Average relative response factors (RRF) for all analytes were within validation criteria.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 30.0% for all analytes.

IV. Continuing Calibration

Continuing calibration was performed at the required frequencies.

The percent differences (%D) were less than or equal to 20.0% for all analytes with the following exceptions:

Date	Analyte	%D	Associated Samples	Flag	A or P
10/30/21	Butylbenzylphthalate	25.7	LDW21-SS600 LDW21-SC587A LDW21-SC587F	J (all detects) UJ (all non-detects)	A

All of the continuing calibration relative response factors (RRF) were within validation criteria.

V. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks.

VI. Field Blanks

No field blanks were identified in this SDG.

VII. Surrogates

Surrogates were added to all samples as required by the method. All surrogate recoveries (%R) were within QC limits.

VIII. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits with the following exceptions:

Spike ID (Associated Samples)	Analyte	MS (%R) (Limits)	MSD (%R) (Limits)	Flag	A or P
LDW21-SS600MS/MSD (LDW21-SS600)	Phenanthrene	122 (49-120)	-	J (all detects)	A
	Fluoranthene	174 (53-145)	-	J (all detects)	
	Pyrene	160 (52-134)	-	J (all detects)	
	Butylbenzylphthalate	204 (45-132)	-	J (all detects)	
	Chrysene	131 (47-120)	-	J (all detects)	

Relative percent differences (RPD) were within QC limits with the following exceptions:

Spike ID (Associated Samples)	Analyte	RPD (Limits)	Flag	A or P
LDW21-SS600MS/MSD (LDW21-SS600)	Phenanthrene	44.0 (≤35)	J (all detects)	A
	Anthracene	35.1 (≤35)	J (all detects)	
	Fluoranthene	65.2 (≤35)	J (all detects)	
	Pyrene	62.7 (≤35)	J (all detects)	
	Butylbenzylphthalate	69.0 (≤35)	J (all detects)	
	Benzo(a)anthracene	47.9 (≤35)	J (all detects)	
	Chrysene	38.2 (≤35)	J (all detects)	
	Benzo(a)pyrene	39.5 (≤35)	J (all detects)	
	Benzofluoranthenes, total	38.6 (≤35)	J (all detects)	

IX. Laboratory Control Samples/Standard Reference Materials

Laboratory control samples (LCS) were analyzed as required by the method. Percent recoveries (%R) were within QC limits.

Standard reference materials (SRM) were analyzed as required by the method. The results were within QC limits with the following exceptions:

SRM ID	Analyte	%R (Limits)	Associated Samples	Flag	A or P
BJJ0826-SRM1	Naphthalene 2-Methylnaphthalene Acenaphthylene Acenaphthene	14.2 (41-159) 26.5 (51-149) 41.6 (57-142) 48.2 (59-141)	LDW21-SS600 LDW21-SS681	J (all detects) UJ (all non-detects)	A

X. Field Duplicates

No field duplicates were identified in this SDG.

XI. Internal Standards

All internal standard areas and retention times were within QC limits.

XII. Target Analyte Quantitation

All target analyte quantitations were within validation criteria.

XIII. Target Analyte Identification

All target analyte identifications were within validation criteria.

XIV. System Performance

The system performance was acceptable.

XV. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

Due to continuing calibration %D, MS/MSD %R and RPD, and SRM %R, data were qualified as estimated in four samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable.

Duwamish AOC4
Semivolatiles - Data Qualification Summary - SDG 21J0134

Sample	Analyte	Flag	A or P	Reason
LDW21-SS600 LDW21-SC587A LDW21-SC587F	Butylbenzylphthalate	J (all detects) UJ (all non-detects)	A	Continuing calibration (%D)
LDW21-SS600	Phenanthrene Fluoranthene Pyrene Butylbenzylphthalate Chrysene	J (all detects) J (all detects) J (all detects) J (all detects) J (all detects)	A	Matrix Spike/Matrix Spike Duplicates (%R)
LDW21-SS600	Phenanthrene Anthracene Fluoranthene Pyrene Butylbenzylphthalate Benzo(a)anthracene Chrysene Benzo(a)pyrene Benzofluoranthenes, total	J (all detects) J (all detects) J (all detects) J (all detects) J (all detects) J (all detects) J (all detects) J (all detects) J (all detects)	A	Matrix Spike/Matrix Spike Duplicates (RPD)
LDW21-SS600 LDW21-SS681	Naphthalene 2-Methylnaphthalene Acenaphthylene Acenaphthene	J (all detects) UJ (all non-detects)	A	Standard reference materials (%R)

Duwamish AOC4
Semivolatiles - Laboratory Blank Data Qualification Summary - SDG 21J0134

No Sample Data Qualified in this SDG

Duwamish AOC4
Semivolatiles - Field Blank Data Qualification Summary - SDG 21J0134

No Sample Data Qualified in this SDG

LDC #: 52703B2a

SDG #: 21J0134

Laboratory: Analytical Resources, Inc., Tukwila, WA

VALIDATION COMPLETENESS WORKSHEET

Stage 4

Date: 12/10/21

Page: 1 of 1

Reviewer: 9

2nd Reviewer: SW

METHOD: GC/MS Semivolatiles (EPA SW 846 Method 8270E)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A	
II.	GC/MS Instrument performance check	A	
III.	Initial calibration/ICV	A/A	RSD ≤ 20%. r² RF ≤ 30%
IV.	Continuing calibration	SW	CCV ≤ 20%
V.	Laboratory Blanks	A	
VI.	Field blanks	N	
VII.	Surrogate spikes	A	
VIII.	Matrix spike/Matrix spike duplicates	SW	
IX.	Laboratory control samples SRM	SW	LCS
X.	Field duplicates	N	
XI.	Internal standards	A	
XII.	Target analyte quantitation	A	
XIII.	Target analyte identification	A	
XIV.	System performance	A	
XV.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	LDW21-SS600	21J0134-11	Sediment	07/12/21
2	LDW21-SS681	21J0134-12	Sediment	07/12/21
3	LDW21-SC587A	21J0134-14	Sediment	07/12/21
4	LDW21-SC587F	21J0134-15	Sediment	07/12/21
5	LDW21-SS600MS	21J0134-11MS	Sediment	07/12/21
6	LDW21-SS600MSD	21J0134-11MSD	Sediment	07/12/21
7				
8				
9				

Notes:

	BW1086-BK1						

LDC #: 52703B29

VALIDATION FINDINGS CHECKLIST

Reviewer: 9
~~2nd Reviewer:~~

Method: Semivolatiles (EPA SW 846 Method 8270D)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
Were all technical holding times met?	✓			
Was cooler temperature criteria met?	✓			
II. GC/MS Instrument performance check				
Were the DFTPP performance results reviewed and found to be within the specified criteria?	✓			
Were all samples analyzed within the 12 hour clock criteria?	✓			
IIIa. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✓			
Were all percent relative standard deviations (%RSD) ≤ 20% and relative response factors (RRF) within method criteria?	✓			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥ 0.990?	✓			
IIIb. Initial Calibration Verification				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	✓			
Were all percent differences (%D) ≤ 30%?	✓			
IV. Continuing calibration				
Was a continuing calibration standard analyzed at least once every 12 hours for each instrument?	✓			
Were all percent differences (%D) ≤ 20% and relative response factors (RRF) within method criteria?		✓		
V. Laboratory Blanks				
Was a laboratory blank associated with every sample in this SDG?	✓			
Was a laboratory blank analyzed at least once every 12 hours for each matrix and concentration?	✓			
Was there contamination in the laboratory blanks? If yes, please see the blanks validation findings worksheet.		✓		
VI. Field blanks				
Were field blanks were identified in this SDG?		✓		
Were target compounds detected in the field blanks?			✓	
VII. Surrogate spikes				
Were all surrogate percent recovery (%R) within QC limits?	✓			
If 2 or more base neutral or acid surrogates were outside QC limits, was a reanalysis performed to confirm %R?			✓	
If any percent recoveries (%R) was less than 10%, was a reanalysis performed to confirm %R ?			✓	
VIII. Matrix spike/Matrix spike duplicates				
Were matrix spike (MS) and matrix spike duplicate (MSD) analyzed in this SDG?	✓			

Validation Area	Yes	No	NA	Findings/Comments
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?		✓		
IX. Laboratory control samples				
Was an LCS analyzed per extraction batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?		✓		
X. Field duplicates				
Were field duplicate pairs identified in this SDG?		✓		
Were target compounds detected in the field duplicates?			✓	
XI. Internal standards				
Were internal standard area counts within -50% to +100% of the associated calibration standard?	✓			
Were retention times within ± 30 seconds of the associated calibration standard?	✓			
XII. Compound quantitation				
Did the laboratory LOQs/RLs meet the QAPP LOQs/RLs?	✓			
Were the correct internal standard (IS), quantitation ion and relative response factor (RRF) used to quantitate the compound?	✓			
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
XIII. Target compound identification				
Were relative retention times (RRT's) within ± 0.06 RRT units of the standard?	✓			
Did compound spectra meet specified EPA "Functional Guidelines" criteria?	✓			
Were chromatogram peaks verified and accounted for?	✓			
XIV. System performance				
System performance was found to be acceptable.	✓			
XV. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			

VALIDATION FINDINGS WORKSHEET

METHOD: GC/MS SVOA

A. Phenol	CC. Dimethylphthalate	EEE. Bis(2-ethylhexyl)phthalate	GGGG. C30-Hopane	I1. Methyl methanesulfonate
B. Bis (2-chloroethyl) ether	DD. Acenaphthylene	FFF. Di-n-octylphthalate	HHHH. 1-Methylphenanthrene	J1. Ethyl methanesulfonate
C. 2-Chlorophenol	EE. 2,6-Dinitrotoluene	GGG. Benzo(b)fluoranthene	IIII. 1,4-Dioxane	K1. o,o',o''-Triethylphosphorothioate
D. 1,3-Dichlorobenzene	FF. 3-Nitroaniline	HHH. Benzo(k)fluoranthene	JJJJ. Acetophenone	L1. n-Phenylene diamine
E. 1,4-Dichlorobenzene	GG. Acenaphthene	III. Benzo(a)pyrene	KKKK. Atrazine	M1. 1,4-Naphthoquinone
F. 1,2-Dichlorobenzene	HH. 2,4-Dinitrophenol	JJJ. Indeno(1,2,3-cd)pyrene	LLLL. Benzaldehyde	N1. N-Nitro-o-toluidine
G. 2-Methylphenol	II. 4-Nitrophenol	KKK. Dibenz(a,h)anthracene	MMMM. Caprolactam	O1. 1,3,5-Trinitrobenzene
H. 2,2'-Oxybis(1-chloropropane)	JJ. Dibenzofuran	LLL. Benzo(g,h,i)perylene	NNNN. 2,6-Dichlorophenol	P1. Pentachlorobenzene
I. 4-Methylphenol	KK. 2,4-Dinitrotoluene	MMM. Bis(2-Chloroisopropyl)ether	OOOO. 1,2-Diphenylhydrazine	Q1. 4-Aminobiphenyl
J. N-Nitroso-di-n-propylamine	LL. Diethylphthalate	NNN. Aniline	PPPP. 3-Methylphenol	R1. 2-Naphthylamine
K. Hexachloroethane	MM. 4-Chlorophenyl-phenyl ether	OOO. N-Nitrosodimethylamine	QQQQ. 3&4-Methylphenol	S1. Triphenylene
L. Nitrobenzene	NN. Fluorene	PPP. Benzoic Acid	RRRR. 4-Dimethyldibenzothiophene (4MDT)	T1. Octachlorostyrene
M. Isophorone	OO. 4-Nitroaniline	QQQ. Benzyl alcohol	SSSS. 2/3-Dimethyldibenzothiophene (4MDT)	U1. Famphur
N. 2-Nitrophenol	PP. 4,6-Dinitro-2-methylphenol	RRR. Pyridine	TTTT. 1-Methyldibenzothiophene (1MDT)	V1. 1,4-phenylenediamine
O. 2,4-Dimethylphenol	QQ. N-Nitrosodiphenylamine	SSS. Benzidine	UUUU.. 2,3,4,6-Tetrachlorophenol	W1. Methapyrilene
P. Bis(2-chloroethoxy)methane	RR. 4-Bromophenyl-phenylether	TTT. 1-Methylnaphthalene	VVVV. 1,2,4,5-Tetrachlorobenzene	X1. Pentachloroethane
Q. 2,4-Dichlorophenol	SS. Hexachlorobenzene	UUU.Benzo(b)thiophene	WWWW.. 2-Picoline	Y1. 3,3'-Dimethylbenzidine
R. 1,2,4-Trichlorobenzene	TT. Pentachlorophenol	VVV.Benzonaphthothiophene	XXXX. 3-Methylcholanthrene	Z1. o-Toluidine
S. Naphthalene	UU. Phenanthrene	WWW.Benzo(e)pyrene	YYYY. a,a-Dimethylphenethylamine	A2. 1-Naphthylamine
T. 4-Chloroaniline	VV. Anthracene	XXX. 2,6-Dimethylnaphthalene	ZZZZ. Hexachloropropene	B2. 4-Aminobiphenyl
U. Hexachlorobutadiene	WW. Carbazole	YYY. 2,3,5-Trimethylnaphthalene	A1. N-Nitrosodiethylamine	C2. 4-Nitroquinoline-1-oxide
V. 4-Chloro-3-methylphenol	XX. Di-n-butylphthalate	ZZZ. Perylene	B1. N-Nitrosodi-n-butylamine	D2. Hexachloropene
W. 2-Methylnaphthalene	YY. Fluoranthene	AAAA. Dibenzothiophene	C1. N-Nitrosomethylethylamine	E2. Bis (2-chloro-1-methylethyl) ether
X. Hexachlorocyclopentadiene	ZZ. Pyrene	BBBB. Benzo(a)fluoranthene	D1. N-Nitrosomorpholine	F2. Bifenthrin
Y. 2,4,6-Trichlorophenol	AAA. Butylbenzylphthalate	CCCC. Benzo(b)fluorene	E1. N-Nitrosopyrrolidine	G2. Cyfluthrin
Z. 2,4,5-Trichlorophenol	BBB. 3,3'-Dichlorobenzidine	DDDD. cis/trans-Decalin	F1. Phenacetin	H2. Cypermethrin
AA. 2-Chloronaphthalene	CCC. Benzo(a)anthracene	EEEE. 1,1'-Biphenyl	G1. 2-Acetylaminofluorene	I2. Permethrin (cis/trans)
BB. 2-Nitroaniline	DDD. Chrysene	FFFF. Retene	H1. Pronamide	J2. 5-Nitro-o-toluidine

LDC #: 52703B29

VALIDATION FINDINGS WORKSHEET
Continuing Calibration

Reviewer: [illegible]
~~2nd Reviewer:~~

METHOD: GC/MS BNA (EPA SW 846 Method 8270D)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

(Y) N N/A Was a continuing calibration standard analyzed at least once every 12 hours for each instrument?

Y (N) N/A Were percent differences (%D) ≤20 % and relative response factors (RRF) within the method criteria?

#	Date	Standard ID	Compound	Finding %D (Limit: ≤20.0%)	Finding RRF (Limit)	Associated Samples	Qualifications
	10/30/21	NT102110300 2	AAA	25.7		1, 3-4, 5-6, MB (Dets+ND)	J/UJ/A

LDC #: 52703B2a

VALIDATION FINDINGS WORKSHEET
Matrix Spike/Matrix Spike Duplicates

Page: 1 of 1
Reviewer: 2nd

METHOD: GC/MS BNA (EPA SW 846 Method 8270D)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

(Y) N N/A Were a matrix spike (MS) and matrix spike duplicate (MSD) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD. Soil / Water.

(Y) N N/A Was a MS/MSD analyzed every 20 samples of each matrix?

Y (N) N/A Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?

#	MS/MSD ID	Compound	MS %R (Limits)	MSD %R (Limits)	RPD (Limits)	Associated Samples	Qualifications
	5/6	UU	122 (49-120)	( )	( )	1 ~~(WO: [illegible])~~	[illegible]/A
		YY	174 (53-145)	( )	( )		
		ZZ	160 (52-134)	( )	( )		
		~~AAA~~	204 (45-132)	( )	( )		
		~~DDD~~	131 (47-120)	( )	( )		
		UU	( )	( )	44.0 (≤ 35)		
		VV	( )	( )	35.1 ( )		
		YY	( )	( )	65.2 ( )		
		ZZ	( )	( )	62.7 ( )		
		~~AAA~~	( )	( )	69.0 ( )		
		~~CCC~~	( )	( )	47.9 ( )		
		DDD	( )	( )	38.2 ( )		
		III	( )	( )	39.5 ( )		
		Benzo[luoranthenes, Total	( )	( )	38.6 ( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		

LDC #: 52723B2a

VALIDATION FINDINGS WORKSHEET
Laboratory Control Samples (LCS)

Page: 1 of 1
Reviewer: 9

METHOD: GC/MS BNA (EPA SW 846 Method 8270D)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".
[✓ Y] N N/A Was a LCS required?
[✓ Y] N N/A Were the LCS/LCSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?

#	Date	LCS/LCSD ID	Compound	LCS %R (Limits)	LCSD %R (Limits)	RPD (Limits)	Associated Samples	Qualifications
		BN0826-SPM1	S	14.2 (41-159)	( )	( )	All (dets+ND)	J/UJ/A
			W	26.5 (51-149)	( )	( )		↓
			DD	41.6 (57-142)	( )	( )		↓
			GG	48.2 (59-141)	( )	( )		↓
				( )	( )	( )		
				( )	( )	( )		
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LDC #: 52T03B9

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Reviewer: 9
~~2nd Reviewer:~~

METHOD: GC/MS BNA (EPA SW 846 Method 8270D)

The Relative Response Factor (RRF), average RRF, and percent relative standard deviation (%RSD) were recalculated for the compounds identified below using the following calculations:

$RRF = (A_x)(C_{is})/(A_{is})(C_x)$
average RRF = sum of the RRFs/number of standards
%RSD = 100 * (S/X)

A_x = Area of compound,
C_x = Concentration of compound,
S = Standard deviation of the RRFs,

A_{is} = Area of associated internal standard
C_{is} = Concentration of internal standard
X = Mean of the RRFs

#	Standard ID	Calibration Date	Compound (Reference Internal Standard)	Reported RRF (5 std)	Recalculated RRF (5 std)	Reported Average RRF (initial)	Recalculated Average RRF (initial)	Reported %RSD	Recalculated %RSD
1	ICAL	10/25/21	Phenol (1st internal standard)	1.964599	1.964599	2.156898	2.156898	10.1	10.1
			Naphthalene (2nd internal standard)	1.135424	1.135424	1.143444	1.143444	2.1	2.1
			Fluorene (3rd internal standard)	2.097977	2.097977	2.077259	2.077259	7.8	7.8
			~~Pentachlorophenol~~ (4th internal standard) UU	1.097528	1.097528	1.103879	1.103879	3.1	3.1
			~~Bis(2-ethylhexyl)phthalate~~ (5th internal standard) AAA	0.9138844	0.9138844	0.9488406	0.9488406	5.3	5.3
			Benzo(a)pyrene (6th internal standard)	1.452654	1.452654	1.473196	1.473196	2.1	2.1
2			Phenol (1st internal standard)						
			Naphthalene (2nd internal standard)						
			Fluorene (3rd internal standard)						
			Pentachlorophenol (4th internal standard)						
			Bis(2-ethylhexyl)phthalate (5th internal standard)						
			Benzo(a)pyrene (6th internal standard)						
3			Phenol (1st internal standard)						
			Naphthalene (2nd internal standard)						
			Fluorene (3rd internal standard)						
			Pentachlorophenol (4th internal standard)						
			Bis(2-ethylhexyl)phthalate (5th internal standard)						
			Benzo(a)pyrene (6th internal standard)						

Comments: Refer to Initial Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703B2A1

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Page: 1 of 1
Reviewer: 9
~~2nd Reviewer:~~

METHOD: GC/MS BNA (EPA SW 846 Method 8270D)

The percent difference (%D) of the initial calibration average Relative Response Factors (RRFs) and the continuing calibration RRFs were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. RRF - RRF)/ave. RRF
$RRF = (A_x)(C_{is})/(A_{is})(C_x)$

Where: ave. RRF = initial calibration average RRF
RRF = continuing calibration RRF
A_x = Area of compound, A_{is} = Area of associated internal standard
C_x = Concentration of compound, C_{is} = Concentration of internal standard

#	Standard ID	Calibration Date	Compound (Reference Internal Standard)	Average RRF (initial)	Reported RRF (CC)	Recalculated RRF (CC)	Reported %D	Recalculated %D
1	WT102102302	10/30/21	Phenol (1st internal standard)	2.156898	2.239T960	2.239T962	3.8	3.8
			Naphthalene (2nd internal standard)	1.143444	1.1092970	1.109296T	3.0	3.0
			Fluorene (3rd internal standard)	2.0TT259	2.066T570	2.066T568	0.5	0.5
			~~Pentachlorophenol~~ (4th internal standard) MM	1.1038T9	1.123TT20	1.123TT2	1.8	1.8
			~~Bis(2-ethylhexyl)phthalate~~ AAA (5th internal standard)	0.9488406	1.1931350	1.193134 8	25.7	25.7
			Benzo(a)pyrene (6th internal standard)	1.4T3196	1.2984050	1.2984052	11.9	11.9
2			Phenol (1st internal standard)					
			Naphthalene (2nd internal standard)					
			Fluorene (3rd internal standard)					
			Pentachlorophenol (4th internal standard)					
			Bis(2-ethylhexyl)phthalate (5th internal standard)					
			Benzo(a)pyrene (6th internal standard)					
3			Phenol (1st internal standard)					
			Naphthalene (2nd internal standard)					
			Fluorene (3rd internal standard)					
			Pentachlorophenol (4th internal standard)					
			Bis(2-ethylhexyl)phthalate (5th internal standard)					
			Benzo(a)pyrene (6th internal standard)					

Comments: Refer to Continuing Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 55703B29

VALIDATION FINDINGS WORKSHEET
Surrogate Results Verification

Page: 1 of 1
Reviewer: a
2nd reviewer:

METHOD: GC/MS Semivolatiles (EPA SW 846 Method 8270D)

The percent recoveries (%R) of surrogates were recalculated for the compounds identified below using the following calculation:

% Recovery: SF/SS * 100

Where: SF = Surrogate Found
SS = Surrogate Spiked

Sample ID: 1

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5	5.0	3.621	72.4	72.4	
2-Fluorobiphenyl	↓	3.848	77.0	77.0	
Terphenyl-d14	↓	3.860	77.2	77.2	
Phenol-d5	7.5	4.372	58.3	58.3	
2-Fluorophenol	↓	4.098	54.6	54.6	
2,4,6-Tribromophenol	↓	7.028	93.7	93.7	
2-Chlorophenol-d4	↓	5.203	69.4	69.4	
1,2-Dichlorobenzene-d4	5.0	3.358	67.2	67.2	

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14					
Phenol-d5					
2-Fluorophenol					
2,4,6-Tribromophenol					
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14					
Phenol-d5					
2-Fluorophenol					
2,4,6-Tribromophenol					
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

LDC #: 52703B29

VALIDATION FINDINGS WORKSHEET
Matrix Spike/Matrix Spike Duplicates Results Verification

Reviewer: 9
~~2nd Reviewer:~~

METHOD: GC/MS BNA (EPA SW 846 Method 8270D)

The percent recoveries (%R) and Relative Percent Difference (RPD) of the matrix spike and matrix spike duplicate were recalculated for the compounds identified below using the following calculation:

% Recovery = 100 * (SSC - SC)/SA Where: SSC = Spiked sample concentration; SA = Spike added; SC = Sample concentation

RPD = I MSC - MSC I * 2/(MSC + MSDC) MSC = Matrix spike concentration MSDC = Matrix spike duplicate concentration

MS/MSD samples: 5/6

Compound	Spike Added (~~MS/MSD~~)		Sample Concentration (~~MS/MSD~~)	Spiked Sample Concentration (~~MS/MSD~~)		Matrix Spike Percent Recovery		Matrix Spike Duplicate Percent Recovery		MS/MSD RPD	
	MS	MSD	------	MS	MSD	Reported	Recalc	Reported	Recalc	Reported	Recalculated
Phenol	49T	495	16.T	45T	421	82.T	82.6	T5.T	T5.6	8.19	8.2
N-Nitroso-di-n-propylamine											
4-Chloro-3-methylphenol											
Acenaphthene	↓	↓	11.8	45T	411	89.T	89.6	80.T	80T	10.T	10.6
Pentachlorophenol											
Pyrene	↓	↓	150	243	493	160	160	69.2	69.3	62.T	62.T

Comments: Refer to Matrix Spike/Matrix Spike Duplicates findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 32703B29

VALIDATION FINDINGS WORKSHEET
Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification

Reviewer: 9
~~2nd Reviewer:~~

METHOD: GC/MS Semivolatiles (EPA SW 846 Method 8270D)

The percent recoveries (%R) and Relative Percent Difference (RPD) of the laboratory control sample and laboratory control sample duplicate were recalculated for the compounds identified below using the following calculation:

% Recovery = 100 * (SC/SA) Where: SSC = Spike concentration
SA = Spike added

RPD = I LCSC - LCSDC I * 2/(LCSC + LCSDC) LCSC = Laboratory control sample concentration LCSDC = Laboratory control sample duplicate concentration

LCS/LCSD samples: ~~BH0826-BS1~~

Compound	Spike Added (~~MG/KG~~)		Spike Concentration (~~MG/KG~~)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc	Reported	Recalc	Reported	Recalculated
Phenol	500	NA	380	NA	76.1	76.0				
N-Nitroso-di-n-propylamine										
4-Chloro-3-methylphenol										
Acenaphthene	V	V	321	V	64.3	64.2				
Pentachlorophenol										
Pyrene	V	V	366	V	73.2	73.2				

Comments: Refer to Laboratory Control Sample/Laboratory Control Sample Duplicates findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703B29

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: 9
~~2nd reviewer:~~

METHOD: GC/MS SVOA (EPA SW 846 Method 8270D)

Y N N/A Were all reported results recalculated and verified for all level IV samples?
Y N N/A Were all recalculated results for detected target compounds agree within 10.0% of the reported results?

Concentration = $\frac{(A_x)(I_s)(V_t)(DF)(2.0)}{(A_{is})(RRF)(V_o)(V_i)(\%S)}$

A_x	=	Area of the characteristic ion (EICP) for the compound to be measured
A_{is}	=	Area of the characteristic ion (EICP) for the specific internal standard
I_s	=	Amount of internal standard added in nanograms (ng)
V_o	=	Volume or weight of sample extract in milliliters (ml) or grams (g).
V_i	=	Volume of extract injected in microliters (ul)
V_t	=	Volume of the concentrated extract in microliters (ul)
Df	=	Dilution Factor.
%S	=	Percent solids, applicable to soil and solid matrices only.
2.0	=	Factor of 2 to account for GPC cleanup

Example:

Sample I.D. 1 , S :

Conc. = $\frac{(11949)(4.0)(1000)(1)(\quad)}{(40518)(1.143444)(1604)(0.67)(\quad)}$

= 10.3 ~~MEAS~~

#	Sample ID	Compound	Reported Concentration ~~(MEAS)~~	Calculated Concentration ( )	Qualification
	1	S	10.3		

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Polynuclear Aromatic Hydrocarbons

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21J0134

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-SS600	21J0134-11	Sediment	07/12/21
LDW21-SS600MS	21J0134-11MS	Sediment	07/12/21
LDW21-SS600MSD	21J0134-11MSD	Sediment	07/12/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for Organic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Polynuclear Aromatic Hydrocarbons (PAHs) by Environmental Protection Agency (EPA) SW 846 Method 8270E in Selected Ion Monitoring (SIM) mode

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. GC/MS Instrument Performance Check

A decafluorotriphenylphosphine (DFTPP) tune was performed at 12 hour intervals.

All ion abundance requirements were met.

III. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

For analytes where average relative response factors (RRFs) were utilized, percent relative standard deviations (%RSD) were less than or equal to 20.0%.

In the case where the laboratory used a calibration curve to evaluate the analytes, all coefficients of determination (r^2) were greater than or equal to 0.990.

Average relative response factors (RRF) for all analytes were within validation criteria.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 30.0% for all analytes.

IV. Continuing Calibration

Continuing calibration was performed at the required frequencies.

The percent differences (%D) were less than or equal to 20.0% for all analytes with the following exceptions:

Date	Analyte	%D	Associated Samples	Flag	A or P
10/30/21	Benzoic acid N-Nitrosodiphenylamine Pentachlorophenol	32.7 20.6 36.8	All samples in SDG 21J0134	J (all detects) J (all detects) J (all detects)	A

All of the continuing calibration relative response factors (RRF) were within validation criteria.

V. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks.

VI. Field Blanks

No field blanks were identified in this SDG.

VII. Surrogates

Surrogates were added to all samples as required by the method. All surrogate recoveries (%R) were within QC limits.

VIII. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits with the following exceptions:

Spike ID (Associated Samples)	Analyte	MS (%R) (Limits)	MSD (%R) (Limits)	Flag	A or P
LDW21-SS600MS/MSD (LDW21-SS600)	N-Nitrosodiphenylamine	122 (27-120)	-	J (all detects)	A

Relative percent differences (RPD) were within QC limits.

IX. Laboratory Control Samples/Standard Reference Materials

Laboratory control samples (LCS) were analyzed as required by the method. Percent recoveries (%R) were within QC limits.

Standard reference materials (SRM) were analyzed as required by the method. The results were within QC limits with the following exceptions:

SRM ID	Analyte	%R (Limits)	Associated Samples	Flag	A or P
BJJ0826-SRM2	1,4-Dichlorobenzene 1,2-Dichlorobenzene	10.2 (12-188) 10.2 (17-184)	All samples in SDG 21J0134	J (all detects) J (all detects)	A

X. Field Duplicates

No field duplicates were identified in this SDG.

XI. Internal Standards

All internal standard areas and retention times were within QC limits.

XII. Target Analyte Quantitation

All target analyte quantitations were within validation criteria.

XIII. Target Analyte Identification

All target analyte identifications were within validation criteria.

XIV. System Performance

The system performance was acceptable.

XV. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

Due to continuing calibration %D, MS/MSD %R, and SRM %R, data were qualified as estimated in one sample.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable.

Duwamish AOC4
Polynuclear Aromatic Hydrocarbons - Data Qualification Summary - SDG 21J0134

Sample	Analyte	Flag	A or P	Reason
LDW21-SS600	Benzoic acid N-Nitrosodiphenylamine Pentachlorophenol	J (all detects) J (all detects) J (all detects)	A	Continuing calibration (%D)
LDW21-SS600	N-Nitrosodiphenylamine	J (all detects)	A	Matrix spike/Matrix spike duplicate (%R)
LDW21-SS600	1,4-Dichlorobenzene 1,2-Dichlorobenzene	J (all detects) J (all detects)	A	Standard reference materials (%R)

Duwamish AOC4
Polynuclear Aromatic Hydrocarbons - Laboratory Blank Data Qualification Summary - SDG 21J0134

No Sample Data Qualified in this SDG

Duwamish AOC4
Polynuclear Aromatic Hydrocarbons - Field Blank Data Qualification Summary - SDG 21J0134

No Sample Data Qualified in this SDG

LDC #: 52703B2b
SDG #: 21J0134
Laboratory: Analytical Resources, Inc., Tukwila, WA

VALIDATION COMPLETENESS WORKSHEET
Stage 4

Date: 12/10/21
Page: 1 of 1
Reviewer:
2nd Reviewer: JVC

METHOD: GC/MS Polynuclear Aromatic Hydrocarbons (EPA SW 846 Method 8270E-SIM)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A	
II.	GC/MS Instrument performance check	A	
III.	Initial calibration/ICV	A/A	RSD ≤ 20% · r^2 ICV ≤ 30%
IV.	Continuing calibration	SW	CCV ≤ 20%
V.	Laboratory Blanks	A	
VI.	Field blanks	N	
VII.	Surrogate spikes	A	
VIII.	Matrix spike/Matrix spike duplicates	SW	
IX.	Laboratory control samples / SRM	SW	LCS
X.	Field duplicates	N	
XI.	Internal standards	A	
XII.	Target analyte quantitation	A	
XIII.	Target analyte identification	A	
XIV.	System performance	A	
XV.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	LDW21-SS600	21J0134-11	Sediment	07/12/21
2	LDW21-SS600MS	21J0134-11MS	Sediment	07/12/21
3	LDW21-SS600MSD	21J0134-11MSD	Sediment	07/12/21
4				
5				
6				
7				
8				
9				

Notes:

	BW0826						

LDC #: 32708B2b

VALIDATION FINDINGS CHECKLIST

Reviewer: 9

Method: PAH (EPA SW 846 Method 8270D-SIM)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
Were all technical holding times met?	✓			
Was cooler temperature criteria met?	✓			
II. GC/MS Instrument performance check (Not required)				
Were the DFTPP performance results reviewed and found to be within the specified criteria?	✓			
Were all samples analyzed within the 12 hour clock criteria?	✓			
IIIa. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✓			
Were all percent relative standard deviations (%RSD) ≤ 20% and relative response factors (RRF) ≥ 0.05?	✓			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥ 0.990?	✓			
IIIb. Initial Calibration Verification				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	✓			
Were all percent differences (%D) ≤30%?	✓			
IV. Continuing calibration				
Was a continuing calibration standard analyzed at least once every 12 hours for each instrument?	✓			
Were all percent differences (%D) ≤ 20% and relative response factors (RRF) ≥ 0.05?		✓		
V. Laboratory Blanks				
Was a laboratory blank associated with every sample in this SDG?	✓			
Was a laboratory blank analyzed for each matrix and concentration?	✓			
Was there contamination in the laboratory blanks?		✓		
VI. Field blanks				
Were field blanks identified in this SDG?		✓		
Were target compounds detected in the field blanks?			✓	
VII. Surrogate spikes				
Were all surrogate percent differences (%R) within QC limits?	✓			
If 2 or more base neutral or acid surrogates were outside QC limits, was a reanalysis performed to confirm %R?			✓	
If any percent recoveries (%R) was less than 10 percent, was a reanalysis performed to confirm %R?			✓	
VIII. Matrix spike/Matrix spike duplicates				
Were matrix spike (MS) and matrix spike duplicate (MSD) analyzed in this SDG?	✓			
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?		✓		

Validation Area	Yes	No	NA	Findings/Comments
IX. Laboratory control samples				
Was an LCS analyzed per extraction batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	✓			
X. Field duplicates				
Were field duplicate pairs identified in this SDG?		✓		
Were target compounds detected in the field duplicates?			✓	
XI. Internal standards				
Were internal standard area counts within -50% or +100% of the associated calibration standard?	✓			
Were retention times within ± 30 seconds of the associated calibration standard?	✓			
XII. Compound quantitation				
Did the laboratory LOQs/RLs meet the QAPP LOQs/RLs?	✓			
Were the correct internal standard (IS), quantitation ion and relative response factor (RRF) used to quantitate the compound?	✓			
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
XIII. Target compound identification				
Were relative retention times (RRT's) within ± 0.06 RRT units of the standard?	✓			
Did compound spectra meet specified EPA "Functional Guidelines" criteria?	✓			
Were chromatogram peaks verified and accounted for?	✓			
XIV. System performance				
System performance was found to be acceptable.	✓			
XV. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			

VALIDATION FINDINGS WORKSHEET

METHOD: GC/MS SVOA

A. Phenol	AA. 2-Chloronaphthalene	AAA. Butylbenzylphthalate	AAAA. Dibenzothiophene	A1. N-Nitrosodiethylamine
B. Bis (2-chloroethyl) ether	BB. 2-Nitroaniline	BBB. 3,3'-Dichlorobenzidine	BBBB. Benzo(a)fluoranthene	B1. N-Nitrosodi-n-butylamine
C. 2-Chlorophenol	CC. Dimethylphthalate	CCC. Benzo(a)anthracene	CCCC. Benzo(b)fluorene	C1. N-Nitrosomethylethylamine
D. 1,3-Dichlorobenzene	DD. Acenaphthylene	DDD. Chrysene	DDDD. cis/trans-Decalin	D1. N-Nitrosomorpholine
E. 1,4-Dichlorobenzene	EE. 2,6-Dinitrotoluene	EEE. Bis(2-ethylhexyl)phthalate	EEEE. Biphenyl	E1. N-Nitrosopyrrolidine
F. 1,2-Dichlorobenzene	FF. 3-Nitroaniline	FFF. Di-n-octylphthalate	FFFF. Retene	F1. Phenacetin
G. 2-Methylphenol	GG. Acenaphthene	GGG. Benzo(b)fluoranthene	GGGG. C30-Hopane	G1. 2-Acetylaminofluorene
H. 2,2'-Oxybis(1-chloropropane)	HH. 2,4-Dinitrophenol	HHH. Benzo(k)fluoranthene	HHHH. 1-Methylphenanthrene	H1. Pronamide
I. 4-Methylphenol	II. 4-Nitrophenol	III. Benzo(a)pyrene	IIII. 1,4-Dioxane	I1. Methyl methanesulfonate
J. N-Nitroso-di-n-propylamine	JJ. Dibenzofuran	JJJ. Indeno(1,2,3-cd)pyrene	JJJJ. Acetophenone	J1. Ethyl methanesulfonate
K. Hexachloroethane	KK. 2,4-Dinitrotoluene	KKK. Dibenz(a,h)anthracene	KKKK. Atrazine	K1. o,o',o''-Triethylphosphorothioate
L. Nitrobenzene	LL. Diethylphthalate	LLL. Benzo(g,h,i)perylene	LLLL. Benzaldehyde	L1. n-Phenylene diamine
M. Isophorone	MM. 4-Chlorophenyl-phenyl ether	MMM. Bis(2-Chloroisopropyl)ether	MMMM. Caprolactam	M1. 1,4-Naphthoquinone
N. 2-Nitrophenol	NN. Fluorene	NNN. Aniline	NNNN. 2,6-Dichlorophenol	N1. N-Nitro-o-toluidine
O. 2,4-Dimethylphenol	OO. 4-Nitroaniline	OOO. N-Nitrosodimethylamine	OOOO. 1,2-Diphenylhydrazine	O1. 1,3,5-Trinitrobenzene
P. Bis(2-chloroethoxy)methane	PP. 4,6-Dinitro-2-methylphenol	PPP. Benzoic Acid	PPPP. 3-Methylphenol	P1. Pentachlorobenzene
Q. 2,4-Dichlorophenol	QQ. N-Nitrosodiphenylamine	QQQ. Benzyl alcohol	QQQQ. 3&4-Methylphenol	Q1. 4-Aminobiphenyl
R. 1,2,4-Trichlorobenzene	RR. 4-Bromophenyl-phenylether	RRR. Pyridine	RRRR. 4-Dimethyldibenzothiophene (4MDT)	R1. 2-Naphthylamine
S. Naphthalene	SS. Hexachlorobenzene	SSS. Benzidine	SSSS. 2/3-Dimethyldibenzothiophene (4MDT)	S1. Triphenylene
T. 4-Chloroaniline	TT. Pentachlorophenol	TTT. 1-Methylnaphthalene	TTTT. 1-Methyldibenzothiophene (1MDT)	T1. Octachlorostyrene
U. Hexachlorobutadiene	UU. Phenanthrene	UUU.Benzo(b)thiophene	UUUU.. 2,3,4,6-Tetrachlorophenol	U1. Famphur
V. 4-Chloro-3-methylphenol	VV. Anthracene	VVV.Benzonaphthothiophene	VVVV. 1,2,4,5-Tetrachlorobenzene	V1. 1,4-phenylenediamine
W. 2-Methylnaphthalene	WW. Carbazole	WWW.Benzo(e)pyrene	WWWW.. 2-Picoline	W1. Methapyrilene
X. Hexachlorocyclopentadiene	XX. Di-n-butylphthalate	XXX. 2,6-Dimethylnaphthalene	XXXX. 3-Methylcholanthrene	X1. Pentachloroethane
Y. 2,4,6-Trichlorophenol	YY. Fluoranthene	YYY. 2,3,5-Trimethylnaphthalene	YYYY. a,a-Dimethylphenethylamine	Y1. 3,3'-Dimethylbenzidine
Z. 2,4,5-Trichlorophenol	ZZ. Pyrene	ZZZ. Perylene	ZZZZ. Hexachloropropene	Z1. o-Toluidine

LDC #: 52703B29

VALIDATION FINDINGS WORKSHEET
Continuing Calibration

METHOD: GC/MS BNA (EPA SW 846 Method 8270D)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

(Y) N N/A Was a continuing calibration standard analyzed at least once every 12 hours for each instrument?

Y (N) N/A Were percent differences (%D) ≤20 % and relative response factors (RRF) within the method criteria?

#	Date	Standard ID	Compound	Finding %D (Limit: <20.0%)	Finding RRF (Limit)	Associated Samples	Qualifications
	10/30/21	NT102103003S	PPP	32.7		All (dets)	J/UJ/A
			QQ	20.6			↓
			TT	36.8			↓

LDC #: 52703B3b

VALIDATION FINDINGS WORKSHEET
Matrix Spike/Matrix Spike Duplicates

Page: 1 of 1
Reviewer: 9

METHOD: GC/MS BNA (EPA SW 846 Method 8270D)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

[✓ Y] N N/A Were a matrix spike (MS) and matrix spike duplicate (MSD) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD. Soil / Water.

[✓ Y] N N/A Was a MS/MSD analyzed every 20 samples of each matrix?

Y [✓ N] N/A Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?

#	MS/MSD ID	Compound	MS %R (Limits)	MSD %R (Limits)	RPD (Limits)	Associated Samples	Qualifications
	2/3	QQ	122 (27-120)	( )	( )	1 (dets)	J dets/A
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
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			( )	( )	( )		
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			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		

LDC #: 52703B6

VALIDATION FINDINGS WORKSHEET
Laboratory Control Samples (LCS)

Page: 1 of 1
Reviewer: 9

METHOD: GC/MS BNA (EPA SW 846 Method 8270D)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".
[✓ Y] N N/A Was a LCS required?
Y [✓ N] N/A Were the LCS/LCSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?

#	Date	LCS/LCSD ID	Compound	LCS %R (Limits)	LCSD %R (Limits)	RPD (Limits)	Associated Samples	Qualifications
		BJJ0826-BS1/2	E	10.2 (12-188)	( )	( )	All (dets)	J/UJ/A
			F	10.2 (17-184)	( )	( )		↓
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
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				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		

LDC #: 52703B2b

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Reviewer: 9

METHOD: GC/MS PCB (EPA SW 846 Method 8270DSIM)

The Relative Response Factor (RRF), average RRF, and percent relative standard deviation (%RSD) were recalculated for the compounds identified below using the following calculations:

$RRF = (A_x)(C_{is})/(A_{is})(C_x)$
average RRF = sum of the RRFs/number of standards
%RSD = 100 * (S/X)

A_x = Area of compound,
C_x = Concentration of compound,
S = Standard deviation of the RRFs,

A_{is} = Area of associated internal standard
C_{is} = Concentration of internal standard
X = Mean of the RRFs

#	Standard ID	Calibration Date	Compound (Reference Internal Standard)	Reported RRF	Recalculated RRF	Reported Average RRF (initial)	Recalculated Average RRF (initial)	Reported %RSD	Recalculated %RSD
1	ICAL	10/5/21	E (1st internal standard)	1.26600T	1.26600T	1.32508T	1.32508T	11.5	11.5
			O (2nd internal standard)	0.4T62963	0.4T62963	0.4T3TTT8	0.4T3TTT8	14.2	14.2
			QQ (3rd internal standard)	0.T81438I	0.T81438	0.T96401=	0.T96401=	14.4	14.4
			(4th internal standard)						
			(5th internal standard)						
			(6th internal standard)						
2			(1st internal standard)						
			(2nd internal standard)						
			(3rd internal standard)						
			(4th internal standard)						
			(5th internal standard)						
			(6th internal standard)						
3			(1st internal standard)						
			(2nd internal standard)						
			(3rd internal standard)						
			(4th internal standard)						
			(5th internal standard)						
			(6th internal standard)						

Comments: Refer to Initial Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703B2b

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Reviewer: 2

METHOD: GC/MS PCB (EPA SW 846 Method 8270DSIM)

The percent difference (%D) of the initial calibration average Relative Response Factors (RRFs) and the continuing calibration RRFs were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. RRF - RRF)/ave. RRF
$RRF = (A_x)(C_{is})/(A_{is})(C_x)$

Where: ave. RRF = initial calibration average RRF
RRF = continuing calibration RRF
A_x = Area of compound, A_{is} = Area of associated internal standard
C_x = Concentration of compound, C_{is} = Concentration of internal standard

#	Standard ID	Calibration Date	Compound (Reference Internal Standard)	Average RRF (initial)	Reported RRF (CC)	Recalculated RRF (CC)	Reported %D	Recalculated %D
1	NT102103039	10/30/-1	E (1st internal standard)	1.32508T	1.2890450	1.2890448	2.T	2.T
			O (2nd internal standard)	0.4T3TT8	0.4562324	0.4562322	3.T	3.T
			QR (3rd internal standard)	0.T96401Z	0.9602963	0.960296	20.6	20.6
			(4th internal standard)					
			(5th internal standard)					
			(6th internal standard)					
2			(1st internal standard)					
			(2nd internal standard)					
			(3rd internal standard)					
			(4th internal standard)					
			(5th internal standard)					
			(6th internal standard)					
3			(1st internal standard)					
			(2nd internal standard)					
			(3rd internal standard)					
			(4th internal standard)					
			(5th internal standard)					
			(6th internal standard)					

Comments: Refer to Continuing Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 53702B6

VALIDATION FINDINGS WORKSHEET
Surrogate Results Verification

Page: 1 of 1
Reviewer: 9

METHOD: GC/MS Semivolatiles (EPA SW 846 Method 8270D-SIM)

The percent recoveries (%R) of surrogates were recalculated for the compounds identified below using the following calculation:

% Recovery: SF/SS * 100

Where: SF = Surrogate Found
SS = Surrogate Spiked

Sample ID: 1

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14	5.0	2.828	56.6	56.6	
Phenol-d5					
2-Fluorophenol	7.5	3.961	52.8	52.8	
2,4,6-Tribromophenol					
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14					
Phenol-d5					
2-Fluorophenol					
2,4,6-Tribromophenol					
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14					
Phenol-d5					
2-Fluorophenol					
2,4,6-Tribromophenol					
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

LDC #: 52703B26

VALIDATION FINDINGS WORKSHEET
Matrix Spike/Matrix Spike Duplicates Results Verification

Reviewer: 9

METHOD: GC/MS PAHs (EPA SW 846 Method 8270D-SIM)

The percent recoveries (%R) and Relative Percent Difference (RPD) of the matrix spike and matrix spike duplicate were recalculated for the compounds identified below using the following calculation:

% Recovery = 100 * (SSC - SC)/SA Where: SSC = Spiked sample concentration; SA = Spike added; SC = Sample concentation

RPD = I MSC - MSC I * 2/(MSC + MSDC) MSC = Matrix spike concentration MSDC = Matrix spike duplicate concentration

MS/MSD samples: 2/3

Compound	Spike Added (ug/kg)		Sample Concentration (ug/kg)	Spiked Sample Concentration (ug/kg)		Matrix Spike Percent Recovery		Matrix Spike Duplicate Percent Recovery		MS/MSD RPD	
	MS	MSD	------	MS	MSD	Reported	Recalc	Reported	Recalc	Reported	Recalculated
Acenaphthene											
Pyrene											
E	497	495	2.4	427	404	85.4	85.4	81.1	81.1	5.56	5.54
TT	1290	1290	2.7	1320	1130	102	102	87.3	87.4	15.6	15.5

Comments: Refer to Matrix Spike/Matrix Spike Duplicates findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52723B6

VALIDATION FINDINGS WORKSHEET
Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification

METHOD: GC/MS PAHs (EPA SW 846 Method 8270D-SIM)

The percent recoveries (%R) and Relative Percent Difference (RPD) of the laboratory control sample and laboratory control sample duplicate were recalculated for the compounds identified below using the following calculation:

% Recovery = 100 * (SC/SA) Where: SSC = Spike concentration
SA = Spike added

RPD = I LCSC - LCSDC I * 2/(LCSC + LCSDC) LCSC = Laboratory control sample concentration LCSDC = Laboratory control sample duplicate concentration

LCS/LCSD samples: BN0826-BS2

Compound	Spike Added (ug/kg)		Spike Concentration (ug/kg)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc	Reported	Recalc	Reported	Recalculated
Acenaphthene										
Pyrene										
E	500	500	387	385	77.4	77.4	76.9	77	0.569	0.39
TT	1300	1300	1140	1180	87.3	87.7	90.7	90.8	3.82	3.45

Comments: Refer to Laboratory Control Sample/Laboratory Control Sample Duplicates findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52103B-b

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: Q

METHOD: GC/MS PAHs (EPA SW 846 Method 8270D-SIM)

Y N N/A Were all reported results recalculated and verified for all level IV samples?
Y N N/A Were all recalculated results for detected target compounds agree within 10.0% of the reported results?

Concentration = $\frac{(A_x)(I_s)(V_t)(DF)(2.0)}{(A_{is})(RRF)(V_o)(V_i)(\%S)}$

A_x = Area of the characteristic ion (EICP) for the compound to be measured

A_{is} = Area of the characteristic ion (EICP) for the specific internal standard

I_s = Amount of internal standard added in nanograms (ng)

V_o = Volume or weight of sample extract in milliliters (ml) or grams (g).

V_i = Volume of extract injected in microliters (ul)

V_t = Volume of the concentrated extract in microliters (ul)

Df = Dilution Factor.

%S = Percent solids, applicable to soil and solid matrices only.

2.0 = Factor of 2 to account for GPC cleanup

Example:

Sample I.D. 1, E:

Conc. = $\frac{(837)(4.0)(1000)(1)(\quad)}{(102620)(1.3508)(16.04)(0.662)(\quad)}$

= 2.42 ng/kg

#	Sample ID	Compound	Reported Concentration (ng/kg)	Calculated Concentration ( )	Qualification
	1	E	2.4		

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Hexachlorobenzene

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21J0134

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-SS600	21J0134-11	Sediment	07/12/21
LDW21-SS600MS	21J0134-11MS	Sediment	07/12/21
LDW21-SS600MSD	21J0134-11MSD	Sediment	07/12/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for Organic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Hexachlorobenzene by Environmental Protection Agency (EPA) SW 846 Method 8081B

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. GC Instrument Performance Check

Instrument performance was checked at 12 hour intervals.

The individual 4,4'-DDT and Endrin breakdowns (%BD) were less than or equal to 15.0%.

III. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

The percent relative standard deviations (%RSD) were less than or equal to 20.0%.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 20.0%.

IV. Continuing Calibration

Continuing calibration was performed at required frequencies.

The percent differences (%D) were less than or equal to 20.0%.

V. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks.

VI. Field Blanks

No field blanks were identified in this SDG.

VII. Surrogates/Internal Standards

Surrogates were added to all samples as required by the method. All surrogate recoveries (%R) were within QC limits.

All internal standard areas and retention times were within QC limits.

VIII. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

IX. Laboratory Control Samples

Laboratory control samples (LCS) and laboratory control samples duplicates (LCSD) were analyzed as required by the method. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

X. Field Duplicates

No field duplicates were identified in this SDG.

XI. Target Analyte Quantitation

All target analyte quantitations met validation criteria.

XII. Target Analyte Identification

All target analyte identifications met validation criteria.

XIII. System Performance

The system performance was acceptable.

XIV. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

The quality control criteria reviewed were met and are considered acceptable.

Duwamish AOC4
Hexachlorobenzene - Data Qualification Summary - SDG 21J0134

No Sample Data Qualified in this SDG

Duwamish AOC4
Hexachlorobenzene - Laboratory Blank Data Qualification Summary - SDG 21J0134

No Sample Data Qualified in this SDG

Duwamish AOC4
Hexachlorobenzene - Field Blank Data Qualification Summary - SDG 21J0134

No Sample Data Qualified in this SDG

LDC #: 52703B3a
SDG #: 21J0134
Laboratory: Analytical Resources, Inc., Tukwila, WA

VALIDATION COMPLETENESS WORKSHEET
Stage 4

Date: 12/10/21
Page: 1 of 1
Reviewer:
2nd Reviewer: MC

METHOD: GC Hexachlorobenzene (EPA SW846 Method 8081B)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A	
II.	GC Instrument Performance Check	A	
III.	Initial calibration/ICV	A/A	RSD≤ 20% ICV≤ 20%
IV.	Continuing calibration	A	CCV≤ 20%
V.	Laboratory Blanks	A	
VI.	Field blanks	N	
VII.	Surrogate spikes /IS	A/A	
VIII.	Matrix spike/Matrix spike duplicates	A	
IX.	Laboratory control samples	A	LCS/D
X.	Field duplicates	N	
XI.	Target analyte quantitation	A	
XII.	Target analyte identification	A	
XIII.	System Performance	A	
XIV.	Overall assessment of data	D	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	LDW21-SS600	21J0134-11	Sediment	07/12/21
2	LDW21-SS600MS	21J0134-11MS	Sediment	07/12/21
3	LDW21-SS600MSD	21J0134-11MSD	Sediment	07/12/21
4				
5				
6				
7				
8				
9				
10				
11				

Notes:

	BJ0629						

LDC #: 52703B31

VALIDATION FINDINGS CHECKLIST

Page: 1 of 2
Reviewer: 9

Method: Pesticides (EPA SW 846 Method 8081A)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
Were all technical holding times met?	✓			
Was cooler temperature criteria met?	✓			
II. GC/ECD Instrument performance check				
Was the instrument performance found to be acceptable?	✓			
Were Evaluation mix standards analyzed prior to the initial calibration and at beginning of each 12-hour shift?	✓			
Were endrin and 4,4'-DDT breakdowns ≤ 15% for individual breakdown in the Evaluation mix standards?			✓	
IIIa. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✓			
Were all percent relative standard deviations (%RSD) ≤ 20%?	✓			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥ 0.990?			✓	
Were the RT windows properly established?	✓			
IIIb. Initial calibration verification				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	✓			
Were all percent differences (%D) ≤ 20%?	✓			
IV. Continuing calibration				
Was a continuing calibration analyzed daily?	✓			
Were all percent differences (%D) ≤ 20%?	✓			
Were all the retention times within the acceptance windows?	✓			
V. Laboratory Blanks				
Was a laboratory blank associated with every sample in this SDG?	✓			
Was a laboratory blank analyzed for each matrix and concentration?	✓			
Was there contamination in the laboratory blanks?		✓		
VI. Field blanks				
Were field blanks identified in this SDG?		✓		
Were target compounds detected in the field blanks?			✓	
VII. ***Surrogate spikes/Internal Standards***				
Were all surrogate percent recovery (%R) within the QC limits?	✓			
If the percent recovery (%R) of one or more surrogates was outside QC limits, was a reanalysis performed to confirm %R?			✓	

Validation Area	Yes	No	NA	Findings/Comments
If any percent recovery (%R) was less than 10 percent, was a reanalysis performed to confirm %R?			✓	
Were internal standard area counts within ± 50% of the average area calculated during calibration?	✓			
VII. Matrix spike/Matrix spike duplicates				
Were a matrix spike (MS) and matrix spike duplicate (MSD) analyzed for each matrix in this SDG?	✓			
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?	✓			
IX. Laboratory control samples				
Was an LCS analyzed per extraction batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	✓			
X. Field duplicates				
Were field duplicate pairs identified in this SDG?		✓		
Were target compounds detected in the field duplicates?			✓	
XI. Compound quantitation				
Did the laboratory LOQs/RLs meet the QAPP LOQs/RLs?	✓			
Were compound quantitation and RLs adjusted to reflect all sample dilutions, dry weight factors, and clean-up activities applicable to level IV validation?	✓			
Were relative percent difference (RPD) of the results between two columns ≤ 40%?			✓	
XII. Target compound identification				
Were the retention times of reported detects within the RT windows?	✓			
XIII. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			

VALIDATION FINDINGS WORKSHEET

METHOD: Pesticides

A. alpha-BHC	K. Endrin	U. Toxaphene	EE. 2,4'-DDT	OO. oxy-Chlordane
B. beta-BHC	L. Endosulfan II	V. Aroclor-1016	FF. Hexachlorobenzene	PP. cis-Nonachlor
C. delta-BHC	M. 4,4'-DDD	W. Aroclor-1221	GG. Chlordane	QQ. trans-Nonachlor
D. gamma-BHC	N. Endosulfan sulfate	X. Aroclor-1232	HH. Chlordane (Technical)	RR. cis-Chlordane
E. Heptachlor	O. 4,4'-DDT	Y. Aroclor-1242	II. p,p'-DDE	SS. trans-Chlordane
F. Aldrin	P. Methoxychlor	Z. Aroclor-1248	JJ. p,p'-DDD	TT. alpha-Endosulphan
G. Heptachlor epoxide	Q. Endrin ketone	AA. Aroclor-1254	KK. p,p'-DDT	UU. beta-Endosulphan
H. Endosulfan I	R. Endrin aldehyde	BB. Aroclor-1260	LL. o,p'-DDT	VV. Endosulphan Sulphate
I. Dieldrin	S. alpha-Chlordane	CC. 2,4'-DDD	MM. o,p'-DDE	WW. Mirex
J. 4,4'-DDE	T. gamma-Chlordane	DD. 2,4'-DDE	NN. o,p'-DDD	

Notes:_____

LDC #: 52703B3A

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Reviewer: 9

METHOD: GC Pesticides (EPA SW 846 Method 8081A)

The calibration factors (CF) and relative standard deviation (%RSD) were recalculated using the following calculations:

CF = A/C
Average CF = sum of the CF/number of standards
%RSD = 100 * (S/X)

Where: A = Area of compound
C = Concentration of compound
S = Standard deviation of calibration factors
X = Mean of calibration factors

#	Standard ID	Calibration Date	Compound	Reported CF (10 std)	Recalculated CF (10 std)	Reported Ave CF (initial)	Recalculated Ave CF (intial)	Reported %RSD	Recalculated %RSD
1	ICAL	6/24/21	FF (1C)	1.292649	1.292649	1.29694	1.29694	12.7	12.7
			FF (2C)	1.247978	1.247978	1.240281	1.240281	12.5	12.5
2									
3									
4									

Comments: Refer to Initial Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703B3A

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Reviewer: PG

METHOD: GC Pesticides (EPA SW 846 Method 8081B)

Percent difference (%D) = 100 * (N - C)/N

Where: N = Initial Calibration Factor or Nominal Amount (ng)
C = Calibration Factor from Continuing Calibration Standard or Calculated Amount (ng)

Standard ID	Calibration Date/Time	Compound	Average CF/ CCV Conc	Reported CF/Conc CCV	Recalculated CF/Conc CCV	Reported %D	Recalculated %D
21102805	10/28/21	FF (1<)	1.29694	1.4131260	1.4131260	9.0	9.0
		FF (2<)	1.240281	1.181927O	1.181927T	5.0	4.T

Comments: Refer to Continuing Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 50703B3a

VALIDATION FINDINGS WORKSHEET
Surrogate Results Verification

Page: 1 of 1
Reviewer: a

METHOD: GC Pesticides (EPA SW 846 Method 8081~~B~~A)

The percent recoveries (%R) of surrogates were recalculated for the compounds identified below using the following calculation:

% Recovery: SF/SS * 100

Where: SF = Surrogate Found
SS = Surrogate Spiked

Sample ID: 1

Surrogate	Column	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	
Tetrachloro-m-xylene	STX-CLP	40.0	30.40	76.0	76.0	
Decachlorobiphenyl	↓	↓	37.17	92.9	92.9	
Tetrachloro-m-xylene						
Decachlorobiphenyl						

Sample ID:

Surrogate	Column	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	
Tetrachloro-m-xylene						
Decachlorobiphenyl						
Tetrachloro-m-xylene						
Decachlorobiphenyl						

Sample ID:

Surrogate	Column	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	
Tetrachloro-m-xylene						
Decachlorobiphenyl						
Tetrachloro-m-xylene						
Decachlorobiphenyl						

Sample ID:

Surrogate	Column	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	
Tetrachloro-m-xylene						
Decachlorobiphenyl						
Tetrachloro-m-xylene						
Decachlorobiphenyl						

Notes:

LDC #: 52703B31

VALIDATION FINDINGS WORKSHEET
Matrix Spike/Matrix Spike Duplicates Results Verification

METHOD: GC Pesticides (EPA SW 846 Method 8081B)

The percent recoveries (%R) and Relative Percent difference (RPD) of the matrix spike and matrix spike duplicate were recalculated for the compounds identified below using the following calculation:

% Recovery = 100* (SSC-SC)/SA

Where: SSC = Spiked sample concentration
SA = Spike added
SC = Concentration

RPD = I SSCMS - SSCMSD I * 2/(SSCMS + SSCMSD)

MS = Matrix spike percent recovery

MSD = Matrix spike duplicate percent recovery

MS/MSD samples: 2/3

Compound	Spike Added (ug/kg)		Sample Concentration (ug/kg)	Spiked Sample Concentration (ug/kg)		Matrix Spike Percent Recovery		Matrix Spike Duplicate Percent Recovery		MS/MSD RPD	
	MS	MSD	--	MS	MSD	Reported	Recalc.	Reported	Recalc.	Reported	Recalculated
gamma-BHC											
4,4'-DDT											
Aroclor 1260											
FF	3.99	3.99	ND	3.74	3.38	93.7	93.7	84.7	84.7	10.3	10.1

Comments: Refer ot Matrix Spike/Matrix Spike Duplicates findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703B39

VALIDATION FINDINGS WORKSHEET
Laboratory Control Sample/Laboratory Control Sample Duplicate Results Verification

Reviewer: 9

METHOD: GC Pesticides (EPA SW 846 Method 8081A)

The percent recoveries (%R) and Relative Percent difference (RPD) of the laboratory control sample and laboratory control sample duplicate were recalculated for the compounds identified below using the following calculation:

% Recovery = 100* (SSC-SC)/SA

Where: SSC = Spiked sample concentration; SA = Spike added; SC = Concentration

RPD = I LCS - LCSD I * 2/(LCS + LCSD)

LCS = Laboratory control sample percent recovery; LCSD = Laboratory control sample duplicate percent recovery

LCS/LCSD samples: BJJ0639-BS1/-BSD1

Compound	Spike Added (µg/kg)		Spiked Sample Concentration (µg/kg)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
gamma-BHC										
4,4'-DDT										
FF	4.00	4.00	3.88	35.1	97.0	97.0	87.8	87.8	9.90	10.0

Comments: Refer to Laboratory Control Sample/Laboratory Control Sample Duplicate findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703B39

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: 9r

METHOD: GC Pesticides (EPA SW 846 Method 8081~~B~~)

Y N N/A Were all reported results recalculated and verified for all level IV samples?
Y N N/A Were all recalculated results for detected target compounds agree within 10.0% of the reported results?

Concentration = $\frac{(A_x)(I_s)(V_t)(DF)(2.0)}{(A_{is})(RRF)(V_o)(V_i)(\%S)}$

A_x	=	Area of the characteristic ion (EICP) for the compound to be measured
A_{is}	=	Area of the characteristic ion (EICP) for the specific internal standard
I_s	=	Amount of internal standard added in nanograms (ng)
V_o	=	Volume or weight of sample extract in milliliters (ml) or grams (g).
V_i	=	Volume of extract injected in microliters (ul)
V_t	=	Volume of the concentrated extract in microliters (ul)
Df	=	Dilution Factor.
%S	=	Percent solids, applicable to soil and solid matrices only.
2.0	=	Factor of 2 to account for GPC cleanup

Example:

Sample I.D. NO, FF:
BH0639-BS1

Conc. = $\frac{(618819)(80.0)(2.5)(1)(\quad)}{(196778)(1.2968)(12.5)(\quad)(\quad)}$

= 3.88 ug/kg

#	Sample ID	Compound	Reported Concentration (ug/kg)	Calculated Concentration ( )	Qualification
	BH0639-BS1	FF	3.88		

LDC Report# 52703B3b

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Polychlorinated Biphenyls

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila

Sample Delivery Group (SDG): 21J0134

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT669D	21J0134-01	Sediment	07/08/21
LDW21-IT598B	21J0134-02	Sediment	07/08/21
LDW21-IT598C	21J0134-03	Sediment	07/08/21
LDW21-IT598D	21J0134-04	Sediment	07/08/21
LDW21-IT598E	21J0134-05	Sediment	07/08/21
LDW21-IT598F	21J0134-06	Sediment	07/08/21
LDW21-IT598G	21J0134-07	Sediment	07/08/21
LDW21-IT598H	21J0134-08	Sediment	07/08/21
LDW21-SC553D	21J0134-09	Sediment	07/09/21
LDW21-SC554D	21J0134-10	Sediment	07/09/21
LDW21-SS600	21J0134-11	Sediment	07/12/21
LDW21-SS641	21J0134-13	Sediment	07/09/21
LDW21-SC587A	21J0134-14	Sediment	07/12/21
LDW21-SC587F	21J0134-15	Sediment	07/12/21
LDW21-IT660C	21J0134-16	Sediment	07/14/21
LDW21-IT588F	21J0134-17	Sediment	07/14/21
LDW21-SC568F	21J0134-19	Sediment	07/14/21
LDW21-IT598CMS	21J0134-03MS	Sediment	07/08/21
LDW21-IT598CMSD	21J0134-03MSD	Sediment	07/08/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for Organic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Polychlorinated Biphenyls (PCBs) by Environmental Protection Agency (EPA) SW 846 Method 8082A

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

The percent relative standard deviations (%RSD) were less than or equal to 20.0% for all analytes.

Retention time windows were established as required by the method.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 20.0% for all analytes.

III. Continuing Calibration

Continuing calibration was performed at required frequencies.

The percent differences (%D) were less than or equal to 20.0% for all analytes with the following exceptions:

Date	Standard	Column	Analyte	%D	Associated Samples	Flag	A or P
10/27/21	10272115	2C	Aroclor-1260	24.6	LDW21-IT598G	J (all detects)	A

Retention times of all analytes in the calibration standards were within the established retention time windows.

IV. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks.

V. Field Blanks

No field blanks were identified in this SDG.

VI. Surrogates/Internal Standards

Surrogates were added to all samples as required by the method. Surrogate recoveries (%R) were not within QC limits for sample LDW21-IT598B. No data were qualified for samples analyzed at greater than or equal to 5X dilution.

All internal standard percent recoveries (%R) were within QC limits with the following exceptions:

Sample	Internal Standards	%R (Limits)	Affected Analyte	Flag	A or P
LDW21-IT598F	Hexabromobiphenyl	41 (50-200)	Aroclor-1260	J (all detects)	A
LDW21-SC553D	Hexabromobiphenyl	47 (50-200)	Aroclor-1260	UJ (all non-detects)	A
LDW21-SC587A	Hexabromobiphenyl	45 (50-200)	Aroclor-1260	J (all detects)	A
LDW21-SC587F	Hexabromobiphenyl	40 (50-200)	Aroclor-1260	J (all detects)	A
LDW21-SC568F	Hexabromobiphenyl	49 (50-200)	Aroclor-1260	J (all detects)	A

VII. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

VIII. Laboratory Control Samples/Standard Reference Materials

Laboratory control samples (LCS) and laboratory control samples duplicates (LCSD) were analyzed as required by the method. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

Standard reference materials (SRM) were analyzed as required by the method. The results were within QC limits.

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Target Analyte Quantitation

All target analyte quantitations met validation criteria.

The sample results for detected analytes from the two columns were within 40% relative percent difference (RPD) with the following exceptions:

Sample	Analyte	RPD	Flag	A or P
LDW21-IT598D	Aroclor-1260	42.6	J (all detects)	A
LDW21-SC587F	Aroclor-1260	45.1	J (all detects)	A

Sample	Analyte	RPD	Flag	A or P
LDW21-SC568F	Aroclor-1260	40.8	J (all detects)	A

XI. Target Analyte Identification

All target analyte identifications met validation criteria.

XII. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

Due to continuing calibration %D, internal standard %R, and RPD between two columns, data were qualified as estimated in seven samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable.

Duwamish AOC4
Polychlorinated Biphenyls - Data Qualification Summary - SDG 21J0134

Sample	Analyte	Flag	A or P	Reason
LDW21-IT598G	Aroclor-1260	J (all detects)	A	Continuing calibration (%D)
LDW21-IT598F LDW21-SC553D LDW21-SC587A LDW21-SC587F LDW21-SC568F	Aroclor-1260	J (all detects) UJ (all non-detects)	A	Internal standards (%R)
LDW21-IT598D LDW21-SC587F LDW21-SC568F	Aroclor-1260	J (all detects)	A	Target analyte quantitation (RPD between two columns)

Duwamish AOC4
Polychlorinated Biphenyls - Laboratory Blank Data Qualification Summary - SDG 21J0134

No Sample Data Qualified in this SDG

Duwamish AOC4
Polychlorinated Biphenyls - Field Blank Data Qualification Summary - SDG 21J0134

No Sample Data Qualified in this SDG

LDC #: 52703B3b
SDG #: 21J0134
Laboratory: Analytical Resources, Inc.

VALIDATION COMPLETENESS WORKSHEET
Stage 4

Date: 12/10/21
Page: 1 of 3
Reviewer: 9
2nd Reviewer: JVG

METHOD: GC Polychlorinated Biphenyls (EPA SW846 Method 8082A)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A	
II.	Initial calibration/ICV	A / A	RSD ≤ 20% ICV ≤ 20%
III.	Continuing calibration	SW	CCV ≤ 20%
IV.	Laboratory Blanks	A	
V.	Field blanks	N	
VI.	Surrogate spikes /IS	SW / SW	
VII.	Matrix spike/Matrix spike duplicates	A	
VIII.	Laboratory control samples /SRM	A	LCS/3
IX.	Field duplicates	N	
X.	Target analyte quantitation	SW	
XI.	Target analyte identification	A	
XII.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	LDW21-IT669D	21J0134-01	Sediment	07/08/21
2	LDW21-IT598B	21J0134-02	Sediment	07/08/21
3	LDW21-IT598C	21J0134-03	Sediment	07/08/21
4	LDW21-IT598D	21J0134-04	Sediment	07/08/21
5	LDW21-IT598E	21J0134-05	Sediment	07/08/21
6	LDW21-IT598F	21J0134-06	Sediment	07/08/21
7	LDW21-IT598G	21J0134-07	Sediment	07/08/21
8	LDW21-IT598H	21J0134-08	Sediment	07/08/21
9	LDW21-SC553D	21J0134-09	Sediment	07/09/21
10	LDW21-SC554D	21J0134-10	Sediment	07/09/21
11	LDW21-SS600	21J0134-11	Sediment	07/12/21
12	LDW21-SS641	21J0134-13	Sediment	07/09/21
13	LDW21-SC587A	21J0134-14	Sediment	07/12/21
14	LDW21-SC587F	21J0134-15	Sediment	07/12/21
15	LDW21-IT660C	21J0134-16	Sediment	07/14/21
16	LDW21-IT588F	21J0134-17	Sediment	07/14/21
17	LDW21-SC568F	21J0134-19	Sediment	07/14/21

LDC #: 52703B3b

SDG #: 21J0134

Laboratory: Analytical Resources, Inc.

VALIDATION COMPLETENESS WORKSHEET

Stage 4

Date: 12/10/21

Page: 2 of 2

Reviewer: 9

2nd Reviewer: SVG

METHOD: GC Polychlorinated Biphenyls (EPA SW846 Method 8082A)

	Client ID	Lab ID	Matrix	Date
18	LDW21-IT598CMS	21J0134-03MS	Sediment	07/08/21
19	LDW21-IT598CMSD	21J0134-03MSD	Sediment	07/08/21
20				
21				
22				

Notes:

	BW6609-BK1						

LDC #: 52703B36

VALIDATION FINDINGS CHECKLIST

Method: ✓ GC __ HPLC

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
Were all technical holding times met?	✓			
Was cooler temperature criteria met?	✓			
IIa. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✓			
Were all percent relative standard deviations (%RSD) ≤ 20%?	✓			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥0.990?			✓	
Were the RT windows properly established?	✓			
IIb. Initial calibration verification				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	✓			
Were all percent differences (%D) ≤ 20%?	✓			
III. Continuing calibration				
Was a continuing calibration analyzed daily?	✓			
Were all percent differences (%D) ≤ 20%?		✓		
Were all the retention times within the acceptance windows?	✓			
IV. Laboratory Blanks				
Was a laboratory blank associated with every sample in this SDG?	✓			
Was a laboratory blank analyzed for each matrix and concentration?	✓			
Was there contamination in the laboratory blanks?		✓		
V. Field Blanks				
Were field blanks identified in this SDG?		✓		
Were target compounds detected in the field blanks?			✓	
VI. Surrogate spikes				
Were all surrogate percent recovery (%R) within the QC limits?		✓		
If the percent recovery (%R) of one or more surrogates was outside QC limits, was a reanalysis performed to confirm %R?			✓	
If any %R was less than 10 percent, was a reanalysis performed to confirm %R?			✓	
VII. Matrix spike/Matrix spike duplicates				
Were matrix spike (MS) and matrix spike duplicate (MSD) analyzed in this SDG?	✓			
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?	✓			
VIII. Laboratory control samples				
Was an LCS analyzed per analytical or extraction batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	✓			

Validation Area	Yes	No	NA	Findings/Comments
IX. Field duplicates				
Were field duplicate pairs identified in this SDG?		✓		
Were target compounds detected in the field duplicates?			✓	
X. Compound quantitation				
Did the laboratory LOQs/RLs meet the QAPP LOQs/RLs?	✓			
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
XI. Target compound identification				
Were the retention times of reported detects within the RT windows?	✓			
XIII. Overall assessment of data	✓			
Overall assessment of data was found to be acceptable.				

LDC #: 52703B3b

VALIDATION FINDINGS WORKSHEET

Continuing Calibration

Page: 1 of 1
Reviewer: 9

METHOD: ✓ **GC** __ **HPLC**

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

[✓ Y] N N/A Were continuing calibration standards analyzed at the required frequencies?

Y [✓ N] N/A Did the continuing calibration standards meet the %D validation criteria of ≤20.0%?

Level IV Only

[✓ Y] N N/A Were the retention times for all calibrated compounds within their respective acceptance windows?

#	Date	Standard ID	Detector/ Column	Compound	%D (Limit)	RT (limit)	Associated Samples	Qualifications
	~~10/27/21~~	~~10272115~~	~~2C~~	~~BB~~	~~23.4~~	( )	~~T.~~	~~J/UJ/A~~
						( )		
						( )		
	10/27/21	10272115	2C	BB	24.6	( )	T (dets)	J/UJ/A
						( )		(1C in)
						( )		
						( )		
						( )		
						( )		
						( )		
						( )		
						( )		
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						( )		
						( )		
						( )		
						( )		
						( )		

LDC #: 53703B3b

VALIDATION FINDINGS WORKSHEET
Surrogate Recovery

Reviewer: 9r

METHOD: ✓ **GC** __ **HPLC**

Are surrogates required by the method? Yes____ or No____.

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

(Y) N N/A Were surrogates spiked into all samples and blanks?

Y (N) N/A Did all surrogate recoveries (%R) meet the QC limits?

#	Sample ID	Detector/ Column	Surrogate Compound	%R (Limits)	Qualifications
	2	1c	O	138 (40-126)	No Qual (10x)
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	

	Surrogate Compound		Surrogate Compound		Surrogate Compound		Surrogate Compound		Surrogate Compound
A	Chlorobenzene (CBZ)	G	Octacosane	M	Benzo(e)Pyrene	S	1-Chloro-3-Nitrobenzene	Y	Tetrachloro-m- xylene
B	4-Bromofluorobenzene (BFB)	H	Ortho-Terphenyl	N	Terphenyl-D14	T	3,4-Dinitrotoluene	Z	1,2-Dinitrobenzene
C	a,a,a-Trifluorotoluene	I	Fluorobenzene (FBZ)	O	Decachlorobiphenyl (DCB)	U	Tripentyltin		
D	Bromochlorobenene	J	n-Triacontane	P	1-methylnaphthalene	V	Tri-n-propyltin		
E	1,4-Dichlorobutane	K	Hexacosane	Q	Dichlorophenyl Acetic Acid (DCAA)	W	Tributyl Phosphate		
F	1,4-Difluorobenzene (DFB)	L	Bromobenzene	R	4-Nitrophenol	X	Triphenyl Phosphate		

LDC #: 52703B3D

VALIDATION FINDINGS WORKSHEET
Internal Standards

Reviewer: CT

METHOD: GC

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y (N) N/A Were all internal standard area counts within -50 to +100% of the ICAL midpoint standard?

(Y) N N/A Were the retention times of the internal standards within +/- 0.05 min seconds of the retention times of the ICAL midpoint standard?

#	Date	Sample ID	Internal Standard	Area (Limits)	RT (Limits)	Qualifications
		6 (dets)	HBB (1C)	41 (50 - 200)		J/UJ/R (BB)
		9 (ND)		47		
		13 (dets)		45		
		14 (dets)		40		
		17 (dets)		49		

HBB - Hexabromobiphenyl

LDC #: 53703B36

VALIDATION FINDINGS WORKSHEET
Compound Quantitation and Reported CRQLs

METHOD: / GC __ HPLC

Level IV/D Only

Y (N) N/A Were CRQLs adjusted for sample dilutions, dry weight factors, etc.?
Y N N/A Did the reported results for detected target compounds agree within 10.0% of the recalculated results?
Y (N) N/A Did the relative percent differences of detected compounds between two columns/detectors ≤40%?
If no, please see findings bellow.

#	Compound Name	Sample ID	%RPD Between Two Columns/Detectors Limit (≤ 40%)	Qualifications
	Aroclor-1260	4	42.6	Note 3/A
	↓			↓
		14	45.1	
	↓	17	40.8	↓

LDC #: 37033B3b

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Page: 1 of 1
Reviewer: 9

METHOD: GC ✓ HPLC _____

The calibration factors (CF) and relative standard deviation (%RSD) were recalculated using the following calculations:

CF = A/C
Average CF = sum of the CF/number of standards
%RSD = 100 * (S/X)

Where: A = Area of compound
C = Concentration of compound
S = Standard deviation of calibration factors
X = Mean of calibration factors

#	Standard ID	Calibration Date	Compound	Reported CF (100 std)	Recalculated CF (100 std)	Reported Ave CF (initial)	Recalculated Ave CF (intial)	Reported %RSD	Recalculated %RSD
1	ICAL	8/13/21	BB-1 (1C)	0.03587713	0.03587713	0.03599333	0.03599333	2.6	2.6
	7		BB-1 (2C)	0.06812649	0.06812649	0.06650318	0.06650318	7.7	7.8
2									
3									
4									

Comments: Refer to Initial Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52T03336

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Reviewer:

METHOD: ✓ GC_HPLC

The percent difference (%D) of the initial calibration average Calibration Factors (CF) and the continuing calibration CF were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. CF -CF)/ave.CF

Where: ave. CF = initial calibration average CF
CF = continuing calibration CF
A = Area of compound
C = Concentration of compound

#	Standard ID	Calibration Date	Compound	Average CF(Ical)/ CCV Conc.	Reported CF/ Conc. CCV	Recalculated CF/ Conc. CCV	Reported %D	Recalculated %D
1	1024281	10/25/21 2:53	BB1 (1C)	0.03599233	0.0304758	0.0304757	15.2	15.2
	1-2. MB		BB1 (2C)	0.06650318	0.0539459	0.0539459	18.8	18.8
2	1024284	10/25 12:06	↓	0.0359923	0.0298223	0.0298223	17.2	17.2
	3-6.8-10			0.06650318	0.0524275	0.0524275	21.2	21.2
3	1024285	10/25/21 15:31	↓	0.0359923	0.0330805	0.0330804	8.0	8.0
	11-17			0.06650318	0.0552499	0.0552498	16.8	16.8
4	1027212	10/27/21 10:55	↓	0.0359923	0.0286261	0.028626	20.4	20.5
	T			0.06650318	0.0488190	0.0488189	26.4	26.5

LDC #: 52703B3b

VALIDATION FINDINGS WORKSHEET
Surrogate Results Verification

METHOD: ✓ GC ___ HPLC

The percent recoveries (%R) of surrogates were recalculated for the compounds identified below using the following calculation:

% Recovery: SF/SS * 100

Where: SF = Surrogate Found
SS = Surrogate Spiked

Sample ID: 1

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
DCB	1C	40.0	36.9	92.2	92.2	
TCMX	↓	↓	27.7	69.4	69.4	

Sample ID: _____

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference

Sample ID: _____

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference

LDC #: 35703B36

VALIDATION FINDINGS WORKSHEET
Matrix Spike/Matrix Spike Duplicates Results Verification

Page: 1 of 1
Reviewer: 9

METHOD: ✓ GC __HPLC

The percent recoveries (%R) and relative percent differences (RPD) of the matrix spike and matrix spike duplicate were recalculated for the compounds identified below using the following calculation:

%Recovery = 100 * (SSC - SC)/SA Where SSC = Spiked sample concentration SC = Sample concentration
SA = Spike added
RPD =(({SSCMS - SSCMSD} * 2) / (SSCMS + SSCMSD))*100 MS = Matrix spike MSD = Matrix spike duplicate

MS/MSD samples: 18/19

Compound	Spike Added (ug/kg)		Sample Conc. (ug/kg)	Spike Sample Concentration (ug/kg)		Matrix spike Percent Recovery		Matrix Spike Duplicate Percent Recovery		MS/MSD RPD	
	MS	MSD	---	MS	MSD	Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
Gasoline (8015)											
Diesel (8015)											
Benzene (8021B)											
Methane (RSK-175)											
2,4-D (8151)											
Dinoseb (8151)											
Naphthalene (8310)											
Anthracene (8310)											
HMX (8330)											
2,4,6-Trinitrotoluene (8330)											
PCB-1260	101	101	4.2	86.3	93.8	81.3	81.3	88.7	88.7	8.37	8.3

Comments: Refer to Matrix Spike/Matrix Spike Duplicates findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52723B36

VALIDATION FINDINGS WORKSHEET
Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification

Page: 1 of 1
Reviewer: 2

METHOD: ✓ GC __HPLC

The percent recoveries (%R) and relative percent differences (RPD) of the laboratory control sample and laboratory control sample duplicate were recalculated for the compounds identified below using the following calculation:

%Recovery = 100 * (SSC - SC)/SA

Where SSC = Spiked sample concentration; SA = Spike added; SC = Sample concentration

RPD =(({SSCLCS - SSCLCSD} * 2) / (SSCLCS + SSCLCSD))*100

LCS = Laboratory Control Sample; LCSD = Laboratory Control Sample duplicate

LCS/LCSD samples: 472629-BS1/-BS01

Compound	Spike Added (ug/kg)		Spike Sample Concentration (ug/kg)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
Gasoline (8015)										
Diesel (8015)										
Benzene (8021B)										
Methane (RSK-175)										
2,4-D (8151)										
Dinoseb (8151)										
Naphthalene (8310)										
Anthracene (8310)										
HMX (8330)										
2,4,6-Trinitrotoluene (8330)										
PCB-1260	101	101	84.4	87.4	83.7	83.6	82.9	82.8	1.02	1.0

Comments: Refer to Laboratory Control Sample/Laboratory Control Sample Duplicate findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 53703B6

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: 9

METHOD: ✓ GC __ HPLC

Y N N/A Were all reported results recalculated and verified for all level IV samples?
Y N N/A Were all recalculated results for detected target compounds within 10% of the reported results?

Concentration= $\frac{(A)(Fv)(Df)}{(RF)(Vs \text{ or } Ws)(\%S/100)}$

A= Area or height of the compound to be measured
Fv= Final Volume of extract
Df= Dilution Factor
RF= Average response factor of the compound In the initial calibration
Vs= Initial volume of the sample
Ws= Initial weight of the sample
%S= Percent Solid

Example:

Sample ID. 1 Compound Name PCB-1260-1

Concentration = $\frac{(3T659)(80)}{(356030)(0.03599233)} = 235.1$

conc total = $\frac{(235.1^{1} + 180.1^{1} + 191.6^{1} + 202.1^{1} + 225.4^{4})(2.5)}{5 \times 18.28 \times 0.6844} = 41.T$ µg/g

#	Sample ID	Compound	Reported Concentrations (µg/g)	Recalculated Results Concentrations ( )	Qualifications
	1	PCB-1260	41.T		

Comments: _____

LDC Report# 52703B4a

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Metals

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21J0134

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-SS600	21J0134-11	Sediment	07/12/21
LDW21-SC587A	21J0134-14	Sediment	07/12/21
LDW21-SC587F	21J0134-15	Sediment	07/12/21
LDW21-IT588F	21J0134-17	Sediment	07/14/21
LDW21-IT585F	21J0134-18	Sediment	07/14/21
LDW21-SS600MS	21J0134-11MS	Sediment	07/12/21
LDW21-SS600MSD	21J0134-11MSD	Sediment	07/12/21
LDW21-SS600DUP	21J0134-11DUP	Sediment	07/12/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for Inorganic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following methods:

Arsenic, Cadmium, Chromium, Copper, Lead, Silver, and Zinc by Environmental Protection Agency (EPA) SW 846 Method 6020B
Mercury by EPA SW 846 Method 7471B

All sample results were subjected to Stage 4 evaluation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition.

All technical holding time requirements were met with the following exceptions:

Sample	Analyte	Total Days From Sample Collection Until Analysis	Required Holding Time (in Days) From Sample Collection Until Analysis	Flag	A or P
LDW21-SS600 LDW21-SS600DUP	Mercury	106	28	J (all detects)	P

II. ICPMS Tune

The mass calibration was within 0.1 AMU and the percent relative standard deviation (%RSD) was less than or equal to 5%.

III. Instrument Calibration

Initial and continuing calibrations were performed as required by the methods.

The initial calibration verification (ICV) and continuing calibration verification (CCV) standards were within QC limits.

IV. ICP Interference Check Sample Analysis

The frequency of interference check sample (ICS) analysis was met. All criteria were within QC limits.

V. Laboratory Blanks

Laboratory blanks were analyzed as required by the methods. No contaminants were found in the laboratory blanks.

VI. Field Blanks

No field blanks were identified in this SDG.

VII. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

VIII. Duplicate Sample Analysis

Duplicate (DUP) sample analysis was performed on an associated project sample. Results were within QC limits.

IX. Serial Dilution

Serial dilution was not performed for this SDG.

X. Laboratory Control Samples

Laboratory control samples (LCS) were analyzed as required by the methods. Percent recoveries (%R) were within QC limits.

XI. Field Duplicates

No field duplicates were identified in this SDG.

XII. Internal Standards (ICP-MS)

All internal standard percent recoveries (%R) were within QC limits.

XIII. Target Analyte Quantitation

All target analyte quantitations were within validation criteria.

XIV. Overall Assessment of Data

The analysis was conducted within all specifications of the methods. No results were rejected in this SDG.

Due to technical holding time, data were qualified as estimated in two samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable.

Duwamish AOC4
Metals - Data Qualification Summary - SDG 21J0134

Sample	Analyte	Flag	A or P	Reason
LDW21-SS600 LDW21-SS600DUP	Mercury	J (all detects)	P	Technical holding times

Duwamish AOC4
Metals - Laboratory Blank Data Qualification Summary - SDG 21J0134

No Sample Data Qualified in this SDG

Duwamish AOC4
Metals - Field Blank Data Qualification Summary - SDG 21J0134

No Sample Data Qualified in this SDG

LDC #: 52703B4a

SDG #: 21J0134

Laboratory: Analytical Resources, Inc., Tukwila, WA

VALIDATION COMPLETENESS WORKSHEET

Stage 4

Date: 12/1/21

Page: 1 of 1

Reviewer:

2nd Reviewer:

METHOD: Metals (EPA SW846 Method 6020B/7471B)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A AS W	
II.	ICP/MS Tune	A	
III.	Instrument Calibration	A	
IV.	ICP Interference Check Sample (ICS) Analysis	A	
V.	Laboratory Blanks	A	
VI.	Field Blanks	N	
VII.	Matrix Spike/Matrix Spike Duplicates	A	
VIII.	Duplicate sample analysis	A	
IX.	Serial Dilution	N	
X.	Laboratory control samples	A	LCS
XI.	Field Duplicates	N	
XII.	Internal Standard (ICP-MS)	A	
XIII.	Target Analyte Quantitation	A	
XIV	Overall Assessment of Data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	LDW21-SS600	21J0134-11	Sediment	07/12/21
2	LDW21-SC587A	21J0134-14	Sediment	07/12/21
3	LDW21-SC587F	21J0134-15	Sediment	07/12/21
4	LDW21-IT588F	21J0134-17	Sediment	07/14/21
5	LDW21-IT585F	21J0134-18	Sediment	07/14/21
6	LDW21-SS600MS	21J0134-11MS	Sediment	07/12/21
7	LDW21-SS600MSD	21J0134-11MSD	Sediment	07/12/21
8	LDW21-SS600DUP	21J0134-11DUP	Sediment	07/12/21
9				
10				
11				
12				
13				

Notes:

METHOD: Trace Metals (EPA SW 846 Methods 6010/6020/7000)				
Validation Area	**Yes**	**No**	**NA**	**Comments**
I. Technical holding times				
Were all technical holding times met?		X		
Were all water samples preserved to a pH of <2?			X	
II. ICP-MS Tune				
Were mass resolutions within 0.1 amu for all isotopes in the tuning solution?	X			
Were %RSDs of isoptoes in the tuning solution ≤5%?	X			
III. Calibration				
Were all instuments calibrated daily?	X			
Were the proper standards used?	X			
Were all initial and continuing calibration verifications within the 90-110% (80-120% for mercury) QC limits?	X			
Were the low level standard checks within 70-130%?			X	
Were all initial calibration correlation coefficients within limits as specifed by the method?	X			
IV. Blanks				
Was a method blank associated with every sample in this SDG?	X			
Was there contamination in the method blanks?		X		
Was there contamination in the initial and continuing calibration blanks?		X		
V. Interference Check Sample				
Were the interference check samples performed daily?	X			
Were the AB solution recoveries within 80-120%?	X			
VI. Matrix Spike/Matrix Spike Duplicates/Laboratory Duplicates				
Were MS/MSD recoveries with the QC limits? (If the sample concentration exceeded the spike concentration by a factor of 4, no action was taken.)	X			
Were the MS/MSD or laboratory duplicate relative percent differences (RPDs) within the QC limits?	X			
VII. Laboratory Control Samples				
Was a LCS analyzed for each batch in the SDG?	X			
Were the LCS recoveries and RPDs (if applicable) within QC limits?	X			

METHOD: Trace Metals (EPA SW 846 Methods 6010/6020/7000)				
Validation Area	**Yes**	**No**	**NA**	**Comments**
VIII. Internal Standards				
Were all percent recoveries within the 30-120% (60-125% for EPA Method 200.8) QC limits?	X			
If the recoveries were outside the limits, was a reanalysis performed?		X		
IX. Serial Dilution				
Were all percent differences <10%?			X	
Was there evidence of negative interference? If yes, professional judgement will be used to qualify the data.			X	
X. Sample Result Verification				
Were all reporting limits adjusted to reflect sample dilutions?	X			
Were all soil samples dry weight corrected?	X			
XI. Overall Assessment of Data				
Was the overall assessment of the data found to be acceptable?	X			
XII. Field Duplicates				
Were field duplicates identifed in this SDG?		X		
Were target analytes detected in the field duplicates?			X	
XIII. Field Blanks				
Were field blanks identified in this SDG?		X		
Were target analytes detected in the field blanks?			X	

All elements are applicable to each sample as noted below.

Sample ID	Target Analyte List
1	As, Cd, Cr, Cu, Pb, Ag, Zn, Hg
2 to 5	As
QC: 6-8	As, Cd, Cr, Cu, Pb, Ag, Zn, Hg

Analysis Method

ICP	
ICP-MS	As, Cd, Cr, Cu, Pb, Ag , Zn
CVAA	Hg

VALIDATION FINDINGS WORKSHEETS
Holding Time

METHOD: Trace Metals (EPA SW 846 Methods 6010/6020/7000)
All samples were properly preserved (water samples to a pH of <2) and analyzed within the required holding time with the following exceptions.

Method:		Mercury by 7470A, HT = 28 days			
Sample ID	Sampling Date	Analysis Date	Total Time from Collection to Analysis	Qualifier	Det/ND
1, 8	7/12/2021	10/26/2021	106	J/R/P	Det

METHOD: Trace Metals (EPA SW 846 Methods 6010/6020/7000)

An intial calibration verification (ICV), continuing calibration verification (CCV), low level calibration check (LLCC), and interference check sample (ICSAB) percent recovery (%R) was recalculated for each type of analysis using the following formula:

%R = (Found/True) x 100

Found = concentration of each analyte measured in the analysis

True = concentration of each analyte in the source

Standard ID	Type of Analysis	Element	Found (ug/L)	True (ug/L)	Recalcuated %R	Reported %R	Acceptable (Y/N)
ICV	ICP-MS	As	47.7	50	95.4	95.5	Y
CCV	ICP-MS	As	50.2	50	100	100	Y
ICSAB	ICP-MS	As	19.283	20	96.4	96.4	Y
ICV	CVAA	Hg	4.1178	4	103	103	Y
CCV	CVAA	Hg	4.0688	4	102	102	Y

ICP-MS Tune	QC Parameter	Mass	Actual	Required
10/28/2021	Mass Axis	115	114.9	± 0.1 amu
10/28/2021	%RSD	115	1	≤ 5%

METHOD: Trace Metals (EPA SW 846 Methods 6010/6020/7000)

Percent recoveries (%R) for the laboratory control sample (LCS), matrix spike (MS), and post digestion spike (PDS) were recalculated using the following formula:

%R = (Found/True) x 100

Found = concentration of each analyte measured in the analysis. For the MS calculation, Found = SSR (Spiked Sample Result) - SR (Sample Result)

True = concentration of each analyte in the source

The sample and duplicate relative percent difference (RPD) was recalculated using the following formula:

RPD = (Absolute value(S-D)x 200) / (S+D)

S = Original sample concentration

D = Duplicate sample concentration

The serial dilution percent difference (%D) was recalculated using the following formula.

%D = (Absolute value (I - SDR)) x 100 / (I)

I = Initial sample result

SDR = Serial dilution result (with a 5x dilution applied)

Sample ID	Type of Analysis	Element	Found/S/I	True/D/SDR	Recalcuated %R/RPD/%D	Reported %R/RPD/%D	Acceptable (Y/N)
LCS	LCS	As	24.1	25	96.4	96.5	Y
6	MS	Cd	39.66	39.5	100	100	
8	Duplicate	Cu	28.3	29	2.44	2.54	
	PDS						
	Serial dilution						

METHOD: Trace Metals (EPA SW 846 Methods 6010/6020/7000)
Analytes were recalculated and verified using the following equation:
Concentration = (Result from raw data x Final volume x Dilution factor) / (Percent solids x Initial weight)

Sample ID	Analyte	Raw Data (ug/L)	Dilution	Initial Weight/ Volume (g)	Final Volume (mL)	Percent solids (%)	Reported Result (mg/Kg)	Recalcuated Result (mg/Kg)	Acceptable (Y/N)
1	Hg	0.2515	1	0.267	50	59.74	0.0788	0.0788	Y
2	As	6.06	20	1.032	50	54.31	10.8	10.8	Y
3	As	15.709	20	1.051	50	61.72	24.2	24.2	Y
4	As	26.952	20	1.072	50	73.77	34.1	34.1	Y
5	As	252.68	20	1.056	50	77.89	307	307	Y

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Wet Chemistry

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21J0134

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT669D	21J0134-01	Sediment	07/08/21
LDW21-IT598B	21J0134-02	Sediment	07/08/21
LDW21-IT598C	21J0134-03	Sediment	07/08/21
LDW21-IT598D	21J0134-04	Sediment	07/08/21
LDW21-IT598E	21J0134-05	Sediment	07/08/21
LDW21-IT598F	21J0134-06	Sediment	07/08/21
LDW21-IT598G	21J0134-07	Sediment	07/08/21
LDW21-IT598H	21J0134-08	Sediment	07/08/21
LDW21-SC553D	21J0134-09	Sediment	07/09/21
LDW21-SC554D	21J0134-10	Sediment	07/09/21
LDW21-SS600	21J0134-11	Sediment	07/12/21
LDW21-SS681	21J0134-12	Sediment	07/12/21
LDW21-SS641	21J0134-13	Sediment	07/09/21
LDW21-SC587A	21J0134-14	Sediment	07/12/21
LDW21-SC587F	21J0134-15	Sediment	07/12/21
LDW21-IT660C	21J0134-16	Sediment	07/14/21
LDW21-IT588F	21J0134-17	Sediment	07/14/21
LDW21-IT585F	21J0134-18	Sediment	07/14/21
LDW21-SC568F	21J0134-19	Sediment	07/14/21
LDW21-IT585FMS	21J0134-18MS	Sediment	07/14/21
LDW21-IT585FDUP1	21J0134-18DUP1	Sediment	07/14/21
LDW21-IT585FDUP2	21J0134-18DUP2	Sediment	07/14/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for Inorganic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following methods:

Total Organic Carbon by Environmental Protection Agency (EPA) SW 846 Method 9060A
Total Solids by Standard Method 2540G

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition.

All technical holding time requirements were met.

II. Initial Calibration

All criteria for the initial calibration of each method were met.

III. Continuing Calibration

Continuing calibration frequency and analysis criteria were met for each method when applicable.

IV. Laboratory Blanks

Laboratory blanks were analyzed as required by the methods. No contaminants were found in the laboratory blanks.

V. Field Blanks

No field blanks were identified in this SDG.

VI. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits.

VII. Duplicate Sample Analysis

Duplicate (DUP) sample analysis was performed on an associated project sample. Results were within QC limits with the following exceptions:

DUP ID (Associated Samples)	Analyte	RPD (Limits)	Difference (Limits)	Flag	A or P
LDW21-IT585FDUP1 (All samples in SDG 21J0134)	Total organic carbon	22.1 (≤20)	-	J (all detects)	A

VIII. Laboratory Control Samples

Laboratory control samples (LCS) were analyzed as required by the methods. Percent recoveries (%R) were within QC limits.

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Target Analyte Quantitation

All target analyte quantitations were within validation criteria.

XI. Overall Assessment of Data

The analysis was conducted within all specifications of the methods. No results were rejected in this SDG.

Due to DUP RPD, data were qualified as estimated in twenty-one samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable.

Duwamish AOC4
Wet Chemistry - Data Qualification Summary - SDG 21J0134

Sample	Analyte	Flag	A or P	Reason
LDW21-IT669D LDW21-IT598B LDW21-IT598C LDW21-IT598D LDW21-IT598E LDW21-IT598F LDW21-IT598G LDW21-IT598H LDW21-SC553D LDW21-SC554D LDW21-SS600 LDW21-SS681 LDW21-SS641 LDW21-SC587A LDW21-SC587F LDW21-IT660C LDW21-IT588F LDW21-IT585F LDW21-SC568F LDW21-IT585FDUP1 LDW21-IT585FDUP2	Total organic carbon	J (all detects)	A	Duplicate sample analysis (RPD)

Duwamish AOC4
Wet Chemistry - Laboratory Blank Data Qualification Summary - SDG 21J0134

No Sample Data Qualified in this SDG

Duwamish AOC4
Wet Chemistry - Field Blank Data Qualification Summary - SDG 21J0134

No Sample Data Qualified in this SDG

LDC #: 52703B6 **VALIDATION COMPLETENESS WORKSHEET** Date: 12/9/21
SDG #: 21J0134 Stage 4 Page: 1 of 2
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer:
2nd Reviewer:

METHOD: (Analyte) TOC (EPA SW846 Method 9060A), Total Solids (SM2540G)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A+A	
II	Initial calibration	A	
III.	Calibration verification	A	
IV	Laboratory Blanks	A	
V	Field blanks	N	
VI.	Matrix Spike/Matrix Spike Duplicates	A	
VII.	Duplicate sample analysis	SW	
VIII.	Laboratory control samples	A	LCS
IX.	Field duplicates	N	
X.	Target Analyte Quantitation	A	
XI	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	LDW21-IT669D	21J0134-01	Sediment	07/08/21
2	LDW21-IT598B	21J0134-02	Sediment	07/08/21
3	LDW21-IT598C	21J0134-03	Sediment	07/08/21
4	LDW21-IT598D	21J0134-04	Sediment	07/08/21
5	LDW21-IT598E	21J0134-05	Sediment	07/08/21
6	LDW21-IT598F	21J0134-06	Sediment	07/08/21
7	LDW21-IT598G	21J0134-07	Sediment	07/08/21
8	LDW21-IT598H	21J0134-08	Sediment	07/08/21
9	LDW21-SC553D	21J0134-09	Sediment	07/09/21
10	LDW21-SC554D	21J0134-10	Sediment	07/09/21
11	LDW21-SS600	21J0134-11	Sediment	07/12/21
12	LDW21-SS681	21J0134-12	Sediment	07/12/21
13	LDW21-SS641	21J0134-13	Sediment	07/09/21
14	LDW21-SC587A	21J0134-14	Sediment	07/12/21
15	LDW21-SC587F	21J0134-15	Sediment	07/12/21
16	LDW21-IT660C	21J0134-16	Sediment	07/14/21
17	LDW21-IT588F	21J0134-17	Sediment	07/14/21

LDC #: 52703B6 **VALIDATION COMPLETENESS WORKSHEET** Date: 12/9/21
SDG #: 21J0134 Stage 4 Page: 2 of 2
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer:
2nd Reviewer:

METHOD: (Analyte) TOC (EPA SW846 Method 9060A), Total Solids (SM2540G)

	Client ID	Lab ID	Matrix	Date
18	LDW21-IT585F	21J0134-18	Sediment	07/14/21
19	LDW21-SC568F	21J0134-19	Sediment	07/14/21
20	LDW21-IT585FMS	21J0134-18MS	Sediment	07/14/21
21	LDW21-IT585FDUP	21J0134-18DUP	Sediment	07/14/21
22	LDW21-IT585F~~TRP~~ DUP	21J0134-18TRP	Sediment	07/14/21
23				
24				
25				

Notes:

METHOD: Inorganics				
Validation Area	**Yes**	**No**	**NA**	**Comments**
I. Technical holding times				
Were all technical holding times were met?	X			Frozen
II. Calibration				
Were all instuments calibrated at the requried frequency?	X			
Were the proper number of standards used?	X			
Were all initial and continuing calibration verifications within the QC limits?	X			
Were all initial calibration correlation coefficients within limits as specifed by the method?	X			
Were balance checks performed as required?	X			
III. Blanks				
Was a method blank assoicated with every sample in this SDG?	X			
Was there contamination in the method blanks?		X		
Was there contamination in the initial and continuing calibration blanks?		X		
IV. Matrix Spike/Matrix Spike Duplicates/Laboratory Duplicates				
Were MS/MSD recoveries with the QC limits? (If the sample concentration exceeded the spike concentration by a factor of 4, no action was taken.)	X			
Were the MS/MSD or laboratory duplicate relative percent differences (RPDs) within the QC limits?		X		
V. Laboratory Control Samples				
Was a LCS analyzed for each batch in the SDG?	X			
Were the LCS recoveries and RPDs (if applicable) within QC limits?	X			
X. Sample Result Verification				
Were all reproting limits adjusted to reflect sample dilutions?	X			
Were all soil samples dry weight corrected?	X			
XI. Overall Assessment of Data				
Was the overall assessment of the data found to be acceptable?	X			

METHOD: Inorganics				
Validation Area	**Yes**	**No**	**NA**	**Comments**
XII. Field Duplicates				
Were field duplicates identifed in this SDG?		X		
Were target analytes detected in the field duplicates?			X	
XIII. Field Blanks				
Were field blanks identified in this SDG?		X		
Were target analytes detected in the field blanks?			X	

All elements are applicable to each sample as noted below.

Sample ID	Target Analyte List
All	TS, TOC
QC:	
20	TOC
21	TS, TOC
22	TS

METHOD: Inorganics

Laboratory duplicate analysis was performed by the laboratory. All laboratory duplicates were with the relative percent difference (RPD) for samples >5X the reporting limits with the exceptions listed below. If samples were <5X the reproting limits, the difference was with 1X the reporting limit for water samples and within 2X the reporting limit for soil samples for all samples with the exceptions listed below.

Duplicate ID	Matrix	Analyte	RPD	RPD Limit	Difference (units)	Difference Limit	Assocaited Samples	Qualification	Det/ND
21	s	TOC	22.1	20			All	J/UJ/A	Det

Comments:

LDC #: 52703B6

Validation Findings Worksheet
Initial and Continuing Calibration Calculation Verification

Method: Inorganics, Method See Cover

An initial or continuing calibration verification percent recovery (%R) was recalculated for each type of analysis using the following formula:

$$\%R = \frac{\text{Found} \times 100}{\text{True}}$$

Where, Found = concentration of each analyte measured in the analysis of the ICV or CCV solution

True = concentration of each analyte in the ICV or CCV source

Calibration verification	TOC	ICV	44.446	44.742	101	101	Y
Calibration verification	TOC	CCV	44.446	44.325	100	100	Y
Calibration verification	TOC	CCV	44.446	44.814	101	101	Y

Comments:

METHOD: Inorganics

Percent recoveries (%R) for the laboratory control sample (LCS) and matrix spike (MS) were recalcuated using the following formula.
%R = (Found/True) x 100
Found = concentration of each analyte measured in the analysis. For the MS calculation, Found = SSR (Spiked Sample Result) - SR (Sample Result)
True = concentraiton of each analyte in the source
The sample and duplciate relative percent difference (RPD) was recalcuated using the following formula.
RPD = (Absolute value(S-D)x 200) / (S+D)
S = Original sample concentraiton
D = Duplciate sample concentration

Sample ID	Type of Analysis	Element	Found/S	True/D	Recalcuated %R/RPD	Reported %R/RPD	Acceptable (Y/N)
LCS	LCS	TOC	44.6	44.4	100	100	Y
24	MS	TOC	0.88	0.876	100	101	Y
21	Duplicate	TS	77.89	77.29	0.773	0.775	Y

METHOD: Inorganics

Analytes were recalcuated and verified using the following equation.

Concentration = (Result from raw data x Final volume x Dilution factor) / (Percent solids (if applicable) x Initial weight or volume)

Sample ID	Analyte	Raw Data (%)	Dry (g)	Sample Dry (g)	Tare (g)	Percent solids (%)	Reported Result (%)	Recalcuated Result (mg/Kg)	Acceptable (Y/N)
1	TOC	0.814				68.87	1.18	1.18	Y
2	TOC	2.048				74.29	2.76	2.76	Y
3	TOC	0.621				75.79	0.82	0.82	Y
4	TOC	2.876				75.76	3.05	3.80	Y
5	TOC	0.171				78.33	0.22	0.22	Y
6	TOC	1.191				64.87	1.84	1.84	Y
7	TOC	1.453				59.79	2.43	2.43	Y
8	TOC	0.089				79.59	0.11	0.11	Y
9	TOC	1.504				62.06	2.42	2.42	Y
10	TOC	1				64.47	1.55	1.55	Y
11	TOC	2.737				59.74	4.58	4.58	Y
12	TOC	0.891				62.99	1.41	1.41	Y
13	TOC	0.71				61.12	1.16	1.16	Y
14	TOC	0.872				54.31	1.61	1.61	Y
15	TS		3.5611	5.2717	0.8034		61.72	61.72	Y
16	TS		5.2397	6.367	0.7893		79.79	79.79	Y
17	TS		5.4367	7.0785	0.8181		73.77	73.77	Y
18	TS		3.8765	4.7504	0.7979		77.89	77.89	Y
19	TS		2.8574	4.1357	0.7862		61.84	61.84	Y

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Polychlorinated Dioxins/Dibenzofurans

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21J0134

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT669D	21J0134-01	Sediment	07/08/21
LDW21-SS641	21J0134-13	Sediment	07/09/21
LDW21-IT660C	21J0134-16	Sediment	07/14/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for High Resolution Superfund Methods Data Review (April 2016). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Polychlorinated Dioxins/Dibenzofurans by Environmental Protection Agency (EPA) Method 1613B

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered not detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. HRGC/HRMS Instrument Performance Check

Instrument performance was checked at the required frequency.

Retention time windows were established for all homologues. The chromatographic resolution between 2,3,7,8-TCDD and peaks representing any other unlabeled TCDD isomer was less than or equal to 25%.

The static resolving power was at least 10,000 (10% valley definition).

III. Initial Calibration and Initial Calibration Verification

A five point initial calibration was performed as required by the method.

The percent relative standard deviations (%RSD) were less than or equal to 20.0% for all analytes and less than or equal to 35.0% for labeled compounds.

The ion abundance ratios for all PCDDs and PCDFs were within validation criteria.

The minimum S/N ratio was greater than or equal to 10 for each analyte and labeled compound.

The percent differences (%D) of the initial calibration verification (ICV) standard were within the QC limits for all analytes and labeled compounds.

IV. Continuing Calibration

Continuing calibration was performed at the required frequencies.

All of the continuing calibration results were within the QC limits for all analytes and labeled compounds.

The ion abundance ratios for all PCDDs and PCDFs were within validation criteria.

The minimum S/N ratio was greater than or equal to 10 for each analyte and labeled compound.

V. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks with the following exceptions:

Blank ID	Extraction Date	Analyte	Concentration	Associated Samples
BJJ0500-BLK1	10/19/21	OCDD Total HxCDF	0.981 ng/Kg 0.100 ng/Kg	All samples in SDG 21J0134

Sample concentrations were compared to concentrations detected in the laboratory blanks. The sample concentrations were either not detected or were significantly greater than the concentrations found in the associated laboratory blanks.

VI. Field Blanks

No field blanks were identified in this SDG.

VII. Matrix Spike/Matrix Spike Duplicates

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

VIII. Laboratory Control Samples/Standard Reference Materials

Laboratory control samples (LCS) were analyzed as required by the method. Percent recoveries (%R) were within QC limits.

Standard reference materials (SRM) were analyzed as required by the method. The results were within QC limits.

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Internal Standards

All internal standard areas and retention times were within QC limits.

XI. Target Analyte Quantitation

All target analyte quantitations met validation criteria with the following exceptions:

Sample	Analyte	Flag	A or P
All samples in SDG 21J0134	All analytes reported as estimated maximum possible concentration (EMPC) and greater than the reporting limit (RL).	J (all detects)	A

Sample	Analyte	Flag	A or P
All samples in SDG 21J0134	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U	A

Sample	Analyte	Finding	Criteria	Flag	A or P
LDW21-IT669D	OCDD	Sample result exceeded calibration range.	Reported result should be within calibration range.	J (all detects)	P

XII. Target Analyte Identification

All target analyte identifications met validation criteria.

XIII. System Performance

The system performance was acceptable.

XIV. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

Due to results reported by the laboratory as EMPCs and results exceeding calibration range, data were qualified as estimated in three samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable.

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Data Qualification Summary - SDG 21J0134

Sample	Analyte	Flag	A or P	Reason
LDW21-IT669D LDW21-SS641 LDW21-IT660C	All analytes reported as estimated maximum possible concentration (EMPC) and greater than the reporting limit (RL).	J (all detects)	A	Target analyte quantitation (EMPC)
LDW21-IT669D LDW21-SS641 LDW21-IT660C	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U	A	Target analyte quantitation (EMPC)
LDW21-IT669D	OCDD	J (all detects)	P	Target analyte quantitation (exceeding range)

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Laboratory Blank Data Qualification Summary - SDG 21J0134

No Sample Data Qualified in this SDG

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Field Blank Data Qualification Summary - SDG 21J0134

No Sample Data Qualified in this SDG

LDC #: 52703B21

SDG #: 21J0134

Laboratory: Analytical Resources, Inc., Tukwila, WA

VALIDATION COMPLETENESS WORKSHEET

Stage 4

Date: 1-19-22

Page: 1 of 1

Reviewer: [illegible]

2nd Reviewer: SM

METHOD: HRGC/HRMS Polychlorinated Dioxins/Dibenzofurans (EPA Method 1613B)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A	
II.	HRGC/HRMS Instrument performance check	A	
III.	Initial calibration/ICV	A/A	RSD ≤ 20/35% ICV ≤ QC limits
IV.	Continuing calibration	A	CCV ≤ QC limits
V.	Laboratory Blanks	SW	
VI.	Field blanks	N	
VII.	Matrix spike/Matrix spike duplicates	N	CS
VIII.	Laboratory control samples /SRM	A	LCS
IX.	Field duplicates	N	
X.	Internal standards	A	
XI.	Target analyte quantitation	SW	
XII.	Target analyte identification	A	
XIII.	System performance	A	
XIV.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	LDW21-IT669D	21J0134-01	Sediment	07/08/21
2	LDW21-SS641	21J0134-13	Sediment	07/09/21
3	LDW21-IT660C	21J0134-16	Sediment	07/14/21
4				
5				
6				
7				
8				
9				
10				

Notes:

	BN0500-BK1						

LDC #: 52703B2

VALIDATION FINDINGS CHECKLIST

Page: 1 of 2
Reviewer: 9

Method: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
All technical holding times were met.	√			
Cooler temperature criteria were met.	√			
II. GC/MS Instrument performance check				
Was PFK exact mass 380.9760 verified?	√			
Were the retention time windows established for all homologues?	√			
Was the chromatographic resolution between 2,3,7,8-TCDD and peaks representing any other unlabeled TCDD isomers ≤ 25%?	√			
Is the static resolving power at least 10,000 (10% valley definition)?	√			
Was the mass resolution adequately check with PFK?	√			
Was the presence of 1,2,8,9-TCDD and 1,3,4,6,8-PeCDF verified?	√			
III. Initial calibration and Initial calibration verification				
Was the initial calibration performed at 5 concentration levels?	√			
Were all percent relative standard deviations (%RSD) ≤ 20% for unlabeled compounds and ≤ 35% for unlabeled compounds?	√			
Did all calibration standards meet the Ion Abundance Ratio criteria?	√			
Was the signal to noise ratio for each target compound and labeled compound ≥ 10?	√			
Was an initial calibration verification (ICV) standard analyzed after each initial calibration for each instrument?	√			
Were all ICV concentrations for the unlabeled and labeled compounds within QC limits?	√			
IV. Continuing calibration				
Was a continuing calibration performed at the beginning of each 12-hour period?	√			
Were all continuing calibration concentrations for the unlabeled and labeled compounds within QC limits?	√			
Did all continuing calibration standards meet the Ion Abundance Ratio criteria?	√			
V. Blanks				
Was a method blank associated with every sample in this SDG?	√			
Was a method blank performed for each matrix and whenever a sample extraction was performed?	√			
Was there contamination in the method blanks?	✓	✓		
VI. Field blanks				
Were field blanks identified in this SDG?		√		
Were target compounds detected in the field blanks?			√	
VII. Matrix spike/Matrix spike duplicates				
Were matrix spike (MS) and matrix spike duplicate (MSD) analyzed in this SDG?		√		
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?			√	

Validation Area	Yes	No	NA	Findings/Comments
VIII. Laboratory control samples				
Was an LCS analyzed per extraction batch?	√			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	√			
IX. Field duplicates				
Were field duplicate pairs identified in this SDG?		√		
Were target compounds detected in the field duplicates?			√	
X. Labeled Compounds				
Were labeled compounds within QC limits?	✓	Ø		
Was the minimum S/N ratio of all labeled compound peaks ≥ 10?	√			
XI. Compound quantitation				
Did the laboratory LOQs/RLs meet the QAPP LOQs/RLs?	√			
Were the correct labeled compound, quantitation ion and relative response factor (RRF) used to quantitate the compound?	√			
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	√			
XII. Target compound identification				
For 2,3,7,8 substituted congeners with associated labeled standards, were the retention times of the two quantitation peaks within -1 to 3 sec. of the RT of the labeled standard?	√			
For 2,3,7,8 substituted congeners without associated labeled standards, were the relative retention times of the two quantitation peaks within 0.005 time units of the RRT measured in the routine calibration?	√			
For non-2,3,7,8 substituted congeners, were the retention times of the two quantitation peaks within RT established in the performance check solution?	√			
Did selected ion current profile (SICP) contain all characteristic ions listed in Method 1613B, Table 8?	√			
Was the Ion Abundance Ratio for the two quantitation ions within criteria?		√		
Was the signal to noise ratio for each target compound ≥2.5 and ≥10 for the labeled compound?	√			
Does the maximum intensity of each specified characteristic ion coincide within ± 2 seconds (includes labeled standards)?	√			
For PCDF identification, was any signal (S/N ≥ 2.5, at ± seconds RT) detected in the corresponding PCDPE channel?			√	
Was an acceptable lock mass recorded and monitored?	√			
XIII. System performance				
System performance was found to be acceptable.	√			
XIV. Overall assessment of data				
Overall assessment of data was found to be acceptable.	√			

VALIDATION FINDINGS WORKSHEET

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

A. 2,3,7,8-TCDD	F. 1,2,3,4,6,7,8-HpCDD	K. 1,2,3,4,7,8-HxCDF	P. 1,2,3,4,7,8,9-HpCDF	U. Total HpCDD
B. 1,2,3,7,8-PeCDD	G. OCDD	L. 1,2,3,6,7,8-HxCDF	Q. OCDF	V. Total TCDF
C. 1,2,3,4,7,8-HxCDD	H. 2,3,7,8-TCDF	M. 2,3,4,6,7,8-HxCDF	R. Total TCDD	W. Total PeCDF
D. 1,2,3,6,7,8-HxCDD	I. 1,2,3,7,8-PeCDF	N. 1,2,3,7,8,9-HxCDF	S. Total PeCDD	X. Total HxCDF
E. 1,2,3,7,8,9-HxCDD	J. 2,3,4,7,8-PeCDF	O. 1,2,3,4,6,7,8-HpCDF	T. Total HxCDD	Y. Total HpCDF

Notes:_____

_____

_____

LDC #: 52703B2-1

VALIDATION FINDINGS WORKSHEET
Blanks

Page: 1 of 1
Reviewer: 9

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

(Y) N N/A Were all samples associated with a method blank?
(Y) N N/A Was a method blank performed for each matrix and whenever a sample extraction was performed?
(Y) N N/A Was the method blank contaminated?

Blank extraction date: 10/19/21 **Blank analysis date:** 10/25/21 **Associated samples:** All

Conc. units: ng/Ks

Compound	Blank ID	Sample Identification								
BLK	500-BLK1	8								
G	0.981									
X	0.100									

Blank extraction date: _____ **Blank analysis date:** _____

Conc. units: _____ Associated Samples: _____

Compound	Blank ID	Sample Identification								

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT:
All contaminants within five times the method blank concentration were qualified as not detected, "U".

LDC #: 52703B21

VALIDATION FINDINGS WORKSHEET
Compound Quantitation and Reported RLs

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y N N/A Were the correct labeled compound, quantitation ions and relative response factors (RRF) used to quantitate the compound?
Y N N/A Compound quantitation and RLs were adjusted to reflect all sample dilutions and dry weight factors (if necessary).

#	Date	Sample ID	Finding	Associated Samples	Qualifications
		All	All compounds reported as estimated maximum		Jdets/A
			possible concentration (EMPC) > RL		
		1	G > calibration range		Jdets/P
		All	All compounds reported as estimated maximum		U/A
			possible concentration (EMPC) < RL		

Comments: See sample calculation verification worksheet for recalculations

LDC #: 52703A21

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Reviewer: PG

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

The Relative Response Factor (RRF), average RRF, and percent relative standard deviation (%RSD) were recalculated for the compounds identified below using the following calculations:

$RRF = (A_x)(C_{is})/(A_{is})(C_x)$
average RRF = sum of the RRFs/number of standards
%RSD = 100 * (S/X)

A_x = Area of compound,
C_x = Concentration of compound,
S = Standard deviation of the RRFs,

A_{is} = Area of associated internal standard
C_{is} = Concentration of internal standard
X = Mean of the RRFs

#	Standard ID	Calibration Date	Compound (Reference Internal Standard)	Reported RRF (10/50 std)	Recalculated RRF (10/50 std)	Reported Average RRF (initial)	Recalculated Average RRF (initial)	Reported %RSD	Recalculated %RSD
1	ICAL	8/11/21	2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)	1.0832006	1.083746	1.107593	1.107593	3.6	3.6
	01		2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)	0.9085186	0.908390	0.9202875	0.9202874	3.1	3.1
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)	1.005616	1.005605	1.00898	1.00898	1.0	1.0
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)	1.051009	1.051062	1.068088	1.068088	6.6	6.6
			OCDF (^{13}C-OCDD)	1.440564	1.44059	1.44690	1.44690	5.7	5.7
2			2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)						
			2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)						
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)						
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)						
			OCDF (^{13}C-OCDD)						
3			2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)						
			2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)						
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)						
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)						
			OCDF (^{13}C-OCDD)						

Comments: Refer to Initial Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703B2

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Reviewer: 9

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

The percent difference (%D) of the initial calibration average Relative Response Factors (RRFs) and the continuing calibration RRFs were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. RRF - RRF)/ave. RRF
$RRF = (A_x)(C_{is})/(A_{is})(C_x)$

Where: ave. RRF = initial calibration average RRF
RRF = continuing calibration RRF
A_x = Area of compound, A_{is} = Area of associated internal standard
C_x = Concentration of compound, C_{is} = Concentration of internal standard

#	Standard ID	Calibration Date	Compound (Reference Internal Standard)	Average RRF (initial)	Reported Conc (CC)	Recalculated Conc (CC)	Reported %D	Recalculated %D
1	211050SA	10/25/21	2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)	1.10T593	1.0745550	1.0746175	3.0	3.0
			2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)	0.920285T5	1.0081390	1.0081532	9.5	9.5
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)	1.00898	1.0688370	1.0683744	5.9	5.9
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)	1.068088	1.16T9010	1.16T8182	9.3	9.3
			OCDF (^{13}C-OCDF)	1.44690	1.338=880	1.338548	T.5	7.5
2			2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)					
			2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)					
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)					
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)					
			OCDF (^{13}C-OCDF)					
3			2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)					
			2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)					
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)					
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)					
			OCDF (^{13}C-OCDF)					

Comments: Refer to Routine Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703B2/

VALIDATION FINDINGS WORKSHEET
Laboratory Control Sample Results Verification

Reviewer: 9

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

The percent recoveries (%R) and Relative Percent Difference (RPD) of the laboratoy control sample and laboratory control sample duplicate (if applicable) were recalculated for the compounds identified below using the following calculation:

% Recovery = 100 * SSC/SA Where: SSC = Spiked sample concentration
SA = Spike added

RPD = I LCS - LCSD I * 2/(LCS + LCSD) LCS = Laboraotry control sample percent recovery LCSD = Laboratory control sample duplicate percent recovery

LCS ID: BN0500-BS

Compound	Spike Added (ng/L)		Spiked Sample Concentration (ng/L)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc	Reported	Recalc	Reported	Recalculated
2,3,7,8-TCDD	20.0	NA	21.0	NA	105	105				
1,2,3,7,8-PeCDD	100	↓	107	↓	107	107				
1,2,3,4,7,8-HxCDD	↓	↓	99.2	↓	99.2	99.2				
1,2,3,4,7,8,9-HpCDF	↓	↓	95.9	↓	95.9	95.9				
OCDF	200	↓	151	↓	75.5	75.5				

Comments: Refer to Laboratory Control Sample findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703B2-1

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: 9

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

Y N N/A Were all reported results recalculated and verified for all level IV samples?
Y N N/A Were all recalculated results for detected target compounds agree within 10.0% of the reported results?

Concentration = $\frac{(A_x)(I_s)(DF)}{(A_{is})(RRF)(V_o)(\%S)}$

A_x = Area of the characteristic ion (EICP) for the compound to be measured

A_{is} = Area of the characteristic ion (EICP) for the specific internal standard

I_s = Amount of internal standard added in nanograms (ng)

V_o = Volume or weight of sample extract in milliliters (ml) or grams (g).

RRF = Relative Response Factor (average) from the initial calibration

Df = Dilution Factor.

%S = Percent solids, applicable to soil and solid matrices only.

Example:

Sample I.D. 1, A:

Conc. = $\frac{(9.498e2+1.372e3)(100)(20)(1)}{(3.198e5+4.143e5)(14.36)(0.6983)(0.92028TS)}$

= 0.6855 ng/kg

#	Sample ID	Compound	Reported Concentration (ng/kg)	Calculated Concentration ( )	Acceptable (Y/N)
	1	A	0.686		

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Polychlorinated Biphenyls

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila

Sample Delivery Group (SDG): 21J0137

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT653D	21J0137-01	Sediment	07/12/21
LDW21-IT652A	21J0137-02	Sediment	07/12/21
LDW21-IT632D	21J0137-03	Sediment	07/12/21
LDW21-IT644B	21J0137-04	Sediment	07/12/21
LDW21-IT644C	21J0137-05	Sediment	07/12/21
LDW21-IT644D	21J0137-06	Sediment	07/12/21
LDW21-IT644E	21J0137-07	Sediment	07/12/21
LDW21-SC529B	21J0137-08	Sediment	07/14/21
LDW21-SC529C	21J0137-09	Sediment	07/14/21
LDW21-SC529D	21J0137-10	Sediment	07/14/21
LDW21-SC529E	21J0137-11	Sediment	07/14/21
LDW21-SC529F	21J0137-12	Sediment	07/14/21
LDW21-IT608B	21J0137-13	Sediment	07/13/21
LDW21-IT662A	21J0137-14	Sediment	07/13/21
LDW21-IT658A	21J0137-15	Sediment	07/13/21
LDW21-IT648D	21J0137-16	Sediment	07/13/21
LDW21-IT648E	21J0137-17	Sediment	07/13/21
LDW21-SC596A	21J0137-18	Sediment	07/13/21
LDW21-SC596B	21J0137-19	Sediment	07/13/21
LDW21-SC596C	21J0137-20	Sediment	07/13/21
LDW21-SC596D	21J0137-21	Sediment	07/13/21
LDW21-SC596E	21J0137-22	Sediment	07/13/21
LDW21-SC596F	21J0137-23	Sediment	07/13/21
LDW21-SC562C	21J0137-24	Sediment	07/13/21
LDW21-IT653DMS	21J0137-01MS	Sediment	07/12/21
LDW21-IT653DMSD	21J0137-01MSD	Sediment	07/12/21

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-SC562CMS	21J0137-24MS	Sediment	07/13/21
LDW21-SC562CMSD	21J0137-24MSD	Sediment	07/13/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for Organic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Polychlorinated Biphenyls (PCBs) by Environmental Protection Agency (EPA) SW 846 Method 8082A

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

The percent relative standard deviations (%RSD) were less than or equal to 20.0% for all analytes.

Retention time windows were established as required by the method.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 20.0% for all analytes.

III. Continuing Calibration

Continuing calibration was performed at required frequencies.

The percent differences (%D) were less than or equal to 20.0% for all analytes with the following exceptions:

Date	Standard	Column	Analyte	%D	Associated Samples	Flag	A or P
10/27/21	10272115	2C	Aroclor-1260	24.6	LDW21-IT653D LDW21-SC596E	J (all detects)	A

Retention times of all analytes in the calibration standards were within the established retention time windows.

IV. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks.

V. Field Blanks

No field blanks were identified in this SDG.

VI. Surrogates/Internal Standards

Surrogates were added to all samples as required by the method. Surrogate recoveries (%R) were not within QC limits for sample LDW21-IT652A. No data were qualified for samples analyzed at greater than or equal to 5X dilution.

All internal standard percent recoveries (%R) were within QC limits with the following exceptions:

Sample	Internal Standards	%R (Limits)	Affected Analyte	Flag	A or P
LDW21-IT644B	Hexabromobiphenyl	45 (50-200)	Aroclor-1260	J (all detects)	A
LDW21-IT644C	Hexabromobiphenyl	48 (50-200)	Aroclor-1260	J (all detects)	A
LDW21-SC596A	Hexabromobiphenyl	48 (50-200)	Aroclor-1260	J (all detects)	A

VII. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) samples were reviewed for each matrix as applicable. Percent recoveries (%R) were not within the QC limits for LDW21-IT653DMS/MSD. No data were qualified for MS/MSD samples analyzed greater than or equal to a 5X dilution. Relative percent differences (RPD) were within the QC limits.

VIII. Laboratory Control Samples/Standard Reference Materials

Laboratory control samples (LCS) and laboratory control samples duplicates (LCSD) were analyzed as required by the method. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

Standard reference materials (SRM) were analyzed as required by the method. The results were within QC limits.

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Target Analyte Quantitation

All target analyte quantitations met validation criteria.

The sample results for detected analytes from the two columns were within 40% relative percent difference (RPD) with the following exceptions:

Sample	Analyte	RPD	Flag	A or P
LDW21-IT644C	Aroclor-1260	41.9	J (all detects)	A
LDW21-IT644D	Aroclor-1260 Aroclor-1248	44.8 41.4	J (all detects) J (all detects)	A
LDW21-SC596A	Aroclor-1260	40.5	J (all detects)	A

Sample	Analyte	RPD	Flag	A or P
LDW21-SC596B	Aroclor-1254	49.4	J (all detects)	A
LDW21-SC596D	Aroclor-1260	41.3	J (all detects)	A
LDW21-SC562C	Aroclor-1248	44.6	J (all detects)	A
LDW21-SC529F	Aroclor-1248	58.3	J (all detects)	A

XI. Target Analyte Identification

All target analyte identifications met validation criteria.

XII. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

Due to continuing calibration %D, internal standard %R, and RPD between two columns, data were qualified as estimated in ten samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable.

Duwamish AOC4
Polychlorinated Biphenyls - Data Qualification Summary - SDG 21J0137

Sample	Analyte	Flag	A or P	Reason
LDW21-IT653D LDW21-SC596E	Aroclor-1260	J (all detects)	A	Continuing calibration (%D)
LDW21-IT644B LDW21-IT644C LDW21-SC596A	Aroclor-1260	J (all detects)	A	Internal standards (%R)
LDW21-IT644C LDW21-SC596A LDW21-SC596D	Aroclor-1260	J (all detects)	A	Target analyte quantitation (RPD between two columns)
LDW21-IT644D	Aroclor-1260 Aroclor-1248	J (all detects) J (all detects)	A	Target analyte quantitation (RPD between two columns)
LDW21-SC596B	Aroclor-1254	J (all detects)	A	Target analyte quantitation (RPD between two columns)
LDW21-SC562C LDW21-SC529F	Aroclor-1248	J (all detects)	A	Target analyte quantitation (RPD between two columns)

Duwamish AOC4
Polychlorinated Biphenyls - Laboratory Blank Data Qualification Summary - SDG 21J0137

No Sample Data Qualified in this SDG

Duwamish AOC4
Polychlorinated Biphenyls - Field Blank Data Qualification Summary - SDG 21J0137

No Sample Data Qualified in this SDG

LDC #: 52703C3b
SDG #: 21J0137
Laboratory: Analytical Resources, Inc.

VALIDATION COMPLETENESS WORKSHEET
Stage 4

Date: 1/10/21
Page: 1 of 2
Reviewer: [illegible]
2nd Reviewer: JVG

METHOD: GC Polychlorinated Biphenyls (EPA SW846 Method 8082A)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A	
II.	Initial calibration/ICV	A/A	RSD ≤ 20% ICV ≤ 20%
III.	Continuing calibration	SW	CCV ≤ 20%
IV.	Laboratory Blanks	A	
V.	Field blanks	N	
VI.	Surrogate spikes /IS	SW/SW	
VII.	Matrix spike/Matrix spike duplicates	SW	
VIII.	Laboratory control samples /SRM	A	LCS/D
IX.	Field duplicates	N	
X.	Target analyte quantitation	SW	
XI.	Target analyte identification	A	
XII.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	LDW21-IT653D	21J0137-01	Sediment	07/12/21
2	LDW21-IT652A	21J0137-02	Sediment	07/12/21
3	LDW21-IT632D	21J0137-03	Sediment	07/12/21
4	LDW21-IT644B	21J0137-04	Sediment	07/12/21
5	LDW21-IT644C	21J0137-05	Sediment	07/12/21
6	LDW21-IT644D	21J0137-06	Sediment	07/12/21
7	LDW21-IT644E	21J0137-07	Sediment	07/12/21
8	LDW21-SC529B	21J0137-08	Sediment	07/14/21
9	LDW21-SC529C	21J0137-09	Sediment	07/14/21
10	LDW21-SC529D	21J0137-10	Sediment	07/14/21
11	LDW21-SC529E	21J0137-11	Sediment	07/14/21
12	LDW21-SC529F	21J0137-12	Sediment	07/14/21
13	LDW21-IT608B	21J0137-13	Sediment	07/13/21
14	LDW21-IT662A	21J0137-14	Sediment	07/13/21
15	LDW21-IT658A	21J0137-15	Sediment	07/13/21
16	LDW21-IT648D	21J0137-16	Sediment	07/13/21
17	LDW21-IT648E	21J0137-17	Sediment	07/13/21

LDC #: 52703C3b

SDG #: 21J0137

Laboratory: Analytical Resources, Inc.

VALIDATION COMPLETENESS WORKSHEET

Stage 4

Date: 12/16/21

Reviewer: Q

2nd Reviewer: JVG

METHOD: GC Polychlorinated Biphenyls (EPA SW846 Method 8082A)

	Client ID	Lab ID	Matrix	Date
18	LDW21-SC596A	21J0137-18	Sediment	07/13/21
19	LDW21-SC596B	21J0137-19	Sediment	07/13/21
20	LDW21-SC596C	21J0137-20	Sediment	07/13/21
21	LDW21-SC596D	21J0137-21	Sediment	07/13/21
22	LDW21-SC596E	21J0137-22	Sediment	07/13/21
23	LDW21-SC596F	21J0137-23	Sediment	07/13/21
24	LDW21-SC562C	21J0137-24	Sediment	07/13/21
25	LDW21-IT653DMS	21J0137-01MS	Sediment	07/12/21
26	LDW21-IT653DMSD	21J0137-01MSD	Sediment	07/12/21
27	LDW21-SC562CMS	21J0137-24MS	Sediment	07/13/21
28	LDW21-SC562CMSD	21J0137-24MSD	Sediment	07/13/21
29				
30				
31				

Notes:

LDC #: 50703C2b

VALIDATION FINDINGS CHECKLIST

Reviewer: 9

Method: ✓ GC __ HPLC

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
Were all technical holding times met?	✓			
Was cooler temperature criteria met?	✓			
IIa. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✓			
Were all percent relative standard deviations (%RSD) ≤ 20%?	✓			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥0.990?			✓	
Were the RT windows properly established?	✓			
IIb. Initial calibration verification				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	✓			
Were all percent differences (%D) ≤ 20%?	✓			
III. Continuing calibration				
Was a continuing calibration analyzed daily?	✓			
Were all percent differences (%D) ≤ 20%?		✓		
Were all the retention times within the acceptance windows?	✓			
IV. Laboratory Blanks				
Was a laboratory blank associated with every sample in this SDG?	✓			
Was a laboratory blank analyzed for each matrix and concentration?	✓			
Was there contamination in the laboratory blanks?		✓		
V. Field Blanks				
Were field blanks identified in this SDG?		✓		
Were target compounds detected in the field blanks?			✓	
VI. Surrogate spikes				
Were all surrogate percent recovery (%R) within the QC limits?		✓		
If the percent recovery (%R) of one or more surrogates was outside QC limits, was a reanalysis performed to confirm %R?		✓		
If any %R was less than 10 percent, was a reanalysis performed to confirm %R?			✓	
VII. Matrix spike/Matrix spike duplicates				
Were matrix spike (MS) and matrix spike duplicate (MSD) analyzed in this SDG?	✓			
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?		✓		
VIII. Laboratory control samples				
Was an LCS analyzed per analytical or extraction batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	✓			

Validation Area	Yes	No	NA	Findings/Comments
IX. Field duplicates				
Were field duplicate pairs identified in this SDG?		✓		
Were target compounds detected in the field duplicates?			✓	
X. Compound quantitation				
Did the laboratory LOQs/RLs meet the QAPP LOQs/RLs?	✓			
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
XI. Target compound identification				
Were the retention times of reported detects within the RT windows?	✓			
XIII. Overall assessment of data	✓			
Overall assessment of data was found to be acceptable.				

LDC #: 52703036

VALIDATION FINDINGS WORKSHEET
Continuing Calibration

Page: 1 of 1
Reviewer: 9

METHOD: ✓ GC __ HPLC

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

[✓ Y] N N/A Were continuing calibration standards analyzed at the required frequencies?

Y [✓ N] N/A Did the continuing calibration standards meet the %D validation criteria of ≤20.0%?

Level IV Only

[✓ Y] N N/A Were the retention times for all calibrated compounds within their respective acceptance windows?

#	Date	Standard ID	Detector/ Column	Compound	%D (Limit)	RT (limit)	Associated Samples	Qualifications
	10/5/21	102T2115	2C	BB	24.6	( )	1, 22 (dets)	J/UJ/A
						( )		(1Cm)
						( )		
						( )		
						( )		
						( )		
						( )		
						( )		
						( )		
						( )		
						( )		
						( )		
						( )		
						( )		
						( )		
						( )		
						( )		
						( )		
						( )		
						( )		
						( )		
						( )		
						( )		
						( )		
						( )		

LDC #: 52T0336

VALIDATION FINDINGS WORKSHEET
Surrogate Recovery

Page: 1 of 1
Reviewer: 9

METHOD: / **GC** __ **HPLC**

Are surrogates required by the method? Yes____ or No____.

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

(Y) N N/A Were surrogates spiked into all samples and blanks?

Y (N) N/A Did all surrogate recoveries (%R) meet the QC limits?

#	Sample ID	Detector/ Column	Surrogate Compound	%R (Limits)	Qualifications
	2 ~~Tbtbs~~	1c	O	133 (40-126)	~~Tbtbs~~ No Qual (1X)
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	

	Surrogate Compound		Surrogate Compound		Surrogate Compound		Surrogate Compound		Surrogate Compound
A	Chlorobenzene (CBZ)	G	Octacosane	M	Benzo(e)Pyrene	S	1-Chloro-3-Nitrobenzene	Y	Tetrachloro-m- xylene
B	4-Bromofluorobenzene (BFB)	H	Ortho-Terphenyl	N	Terphenyl-D14	T	3,4-Dinitrotoluene	Z	1,2-Dinitrobenzene
C	a,a,a-Trifluorotoluene	I	Fluorobenzene (FBZ)	O	Decachlorobiphenyl (DCB)	U	Tripentyltin		
D	Bromochlorobenene	J	n-Triacontane	P	1-methylnaphthalene	V	Tri-n-propyltin		
E	1,4-Dichlorobutane	K	Hexacosane	Q	Dichlorophenyl Acetic Acid (DCAA)	W	Tributyl Phosphate		
F	1,4-Difluorobenzene (DFB)	L	Bromobenzene	R	4-Nitrophenol	X	Triphenyl Phosphate		

LDC #: 5-70306

VALIDATION FINDINGS WORKSHEET
Internal Standards

Reviewer: 9

METHOD: GC

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y (N) N/A Were all internal standard area counts within -50 to +100% of the ICAL midpoint standard?

(Y) N N/A Were the retention times of the internal standards within +/- 0.05 min seconds of the retention times of the ICAL midpoint standard?

#	Date	Sample ID	Internal Standard	%R Area (Limits)	RT (Limits)	Qualifications
		4 (dots)	HBB (1C)	45 (50-200)		J/UJ/A (BB)
		5 (dots)		48		
		18 (dots)		48		

LDC #: 53703C3b

VALIDATION FINDINGS WORKSHEET

Matrix Spike/Matrix Spike Duplicates

Page: 1 of 1

Reviewer: 9

METHOD: ✓ GC __ HPLC

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

[✓ Y] N N/A Were a matrix spike (MS) and matrix spike duplicate (MSD) analyzed for each matrix in this SDG?

[✓ Y] N N/A Was an MS/MSD analyzed every 20 samples for each matrix or whenever a sample extraction was performed?

Y [✓ N] N/A Were the MS/MSD percent recoveries (%R) and relative percent differences (RPD) within QC limits?

#	MS/MSD ID	Compound	MS %R (Limits)	MSD %R (Limits)	RPD (Limits)	Associated Samples	Qualifications
	25/26	%R out	( )	( )	( )	1 (5x)	~~NR~~ No Qual
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		

LDC #: 52036b

VALIDATION FINDINGS WORKSHEET
Compound Quantitation and Reported CRQLs

Reviewer: 9

METHOD: / GC __ HPLC

Level IV/D Only

Y N N/A Were CRQLs adjusted for sample dilutions, dry weight factors, etc.?
Y N N/A Did the reported results for detected target compounds agree within 10.0% of the recalculated results?
Y N N/A Did the relative percent differences of detected compounds between two columns/detectors ≤40%?
If no, please see findings bellow.

#	Compound Name	Sample ID	%RPD Between Two Columns/Detectors Limit (≤ 40%)	Qualifications
	Aroclor 1260	5	41.9	dets/A
	↓	6	44.8	
	Aroclor 1248		41.4	
	Aroclor 1260	18	40.5	
	1254	19	49.4	
	1260	21	41.3	
	↓ 1248	24	44.6	↓
	↓ 1248	12	58.3	dets/A

LDC #: 5-703C3b

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Page: 1 of 1
Reviewer: Q

METHOD: GC ✓ HPLC _____

The calibration factors (CF) and relative standard deviation (%RSD) were recalculated using the following calculations:

CF = A/C
Average CF = sum of the CF/number of standards
%RSD = 100 * (S/X)

Where: A = Area of compound
C = Concentration of compound
S = Standard deviation of calibration factors
X = Mean of calibration factors

#	Standard ID	Calibration Date	Compound	Reported CF (100 std)	Recalculated CF (100 std)	Reported Ave CF (initial)	Recalculated Ave CF (intial)	Reported %RSD	Recalculated %RSD
1	KAc	8/3/21	BB-1 (1C)	0.0758TT13	0.0758TT13	0.0359933	0.0599 23	26	2.6
			BB-1 (2C)	0.068T2649	0.068T264	0.06650318	0.0665032	T.T	T.8
2									
3									
4									

Comments: Refer to Initial Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703C3b

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Reviewer: 9

METHOD: ✓ GC_HPLC

The percent difference (%D) of the initial calibration average Calibration Factors (CF) and the continuing calibration CF were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. CF -CF)/ave.CF

Where: ave. CF = initial calibration average CF
CF = continuing calibration CF
A = Area of compound
C = Concentration of compound

#	Standard ID	Calibration Date	Compound	Average CF(Ical)/ CCV Conc.	Reported CF/ Conc. CCV	Recalculated CF/ Conc. CCV	Reported %D	Recalculated %D
1	102404	10/24/21	BB-1 (1c)	0.035993	0.030845	0.030845	16.0	16.1
	2-9.413		BB-1 (2c)	0.066503	0.053140T	0.053140T	20.0	20.1
2	102421	10/25/21 3:14	↓	0.035993	0.030458	0.030457	15.2	15.3
	10-20		↓	0.066503	0.053959	0.053959	18.8	18.9
3	102503	10/25/21 20:10	↓	0.035993	0.029929	0.029929	16.8	16.9
	21,23-24		↓	0.066503	0.054280T	0.054280G	18.4	18.4
4	102715	10/27/21 18:25	↓	0.035993	0.028410T	0.028410G	21.2	21.1
	1.22		↓	0.066503	0.048295	0.048294	27.6	27.5

LDC #: 52703A36

VALIDATION FINDINGS WORKSHEET
Surrogate Results Verification

Reviewer: 9

METHOD: ✓ GC ___ HPLC

The percent recoveries (%R) of surrogates were recalculated for the compounds identified below using the following calculation:

% Recovery: SF/SS * 100

Where: SF = Surrogate Found
SS = Surrogate Spiked

Sample ID: 1

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	
DCB	1C	~~10.0~~ 8.0	9.1	113	113	
TCMX	↓	↓	6.2	78.0	78	
DCB	2C		6.5	80.7	81	
TCMX	↓	↓	6.1	76.3	76.3	

Sample ID: _____

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	

Sample ID: _____

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	

LDC #: 52703B6

VALIDATION FINDINGS WORKSHEET
Matrix Spike/Matrix Spike Duplicates Results Verification

METHOD: / GC __HPLC

The percent recoveries (%R) and relative percent differences (RPD) of the matrix spike and matrix spike duplicate were recalculated for the compounds identified below using the following calculation:

%Recovery = 100 * (SSC - SC)/SA Where SSC = Spiked sample concentration SC = Sample concentration
SA = Spike added
RPD =(({SSCMS - SSCMSD} * 2) / (SSCMS + SSCMSD))*100 MS = Matrix spike MSD = Matrix spike duplicate

MS/MSD samples: 25/26

Compound	Spike Added (ug/kg)		Sample Conc. (ug/kg)	Spike Sample Concentration (ug/kg)		Matrix spike Percent Recovery		Matrix Spike Duplicate Percent Recovery		MS/MSD RPD	
	MS	MSD	---	MS	MSD	Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
Gasoline (8015)											
Diesel (8015)											
Benzene (8021B)											
Methane (RSK-175)											
2,4-D (8151)											
Dinoseb (8151)											
Naphthalene (8310)											
Anthracene (8310)											
HMX (8330)											
2,4,6-Trinitrotoluene (8330)											
BB	101	101	255	273	297	17.8	17.8	41.6	41.6	8.16	8.4

Comments: Refer to Matrix Spike/Matrix Spike Duplicates findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52T03c36

VALIDATION FINDINGS WORKSHEET
Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification

Page: 1 of 1
Reviewer: 9

METHOD: ✓ GC __ HPLC

The percent recoveries (%R) and relative percent differences (RPD) of the laboratory control sample and laboratory control sample duplicate were recalculated for the compounds identified below using the following calculation:

%Recovery = 100 * (SSC - SC)/SA Where SSC = Spiked sample concentration, SA = Spike added, SC = Sample concentration

RPD =(({SSCLCS - SSCLCSD} * 2) / (SSCLCS + SSCLCSD))*100 LCS = Laboratory Control Sample, LCSD = Laboratory Control Sample duplicate

LCS/LCSD samples: BN0548

Compound	Spike Added (ug/kg)		Spike Sample Concentration (ug/kg)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
Gasoline (8015)										
Diesel (8015)										
Benzene (8021B)										
Methane (RSK-175)										
2,4-D (8151)										
Dinoseb (8151)										
Naphthalene (8310)										
Anthracene (8310)										
HMX (8330)										
2,4,6-Trinitrotoluene (8330)										
BB	101	101	81.7	85.5	81.0	81.0	84.9	84.7	4.61	4.5

Comments: Refer to Laboratory Control Sample/Laboratory Control Sample Duplicate findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703c36

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: [illegible]

METHOD: / GC __ HPLC

(Y) N N/A Were all reported results recalculated and verified for all level IV samples?
Y N N/A Were all recalculated results for detected target compounds within 10% of the reported results?

Concentration= $\frac{(A)(Fv)(Df)}{(RF)(Vs \text{ or } Ws)(\%S/100)}$

A= Area or height of the compound to be measured
Fv= Final Volume of extract
Df= Dilution Factor
RF= Average response factor of the compound In the initial calibration
Vs= Initial volume of the sample
Ws= Initial weight of the sample
%S= Percent Solid

Example:

Sample ID. 1 Compound Name PCB-1260-1

Concentration = $\frac{(50353)(80.0)}{(384769)(0.035993)} = 290.9$

$\text{con-total} = \frac{(290.9 + 182.1 + 253.1 + 208.7 + 342.3)(2.5)(5)}{5 \times 20.03 \times 0.6243} = 255.3$ µg/kg

#	Sample ID	Compound	Reported Concentrations (µg/kg)	Recalculated Results Concentrations ( )	Qualifications
	1	PCB-1260	255		

Comments: _____

SAMPCAL.wpd

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Wet Chemistry

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21J0137

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT653D	21J0137-01	Sediment	07/12/21
LDW21-IT652A	21J0137-02	Sediment	07/12/21
LDW21-IT632D	21J0137-03	Sediment	07/12/21
LDW21-IT644B	21J0137-04	Sediment	07/12/21
LDW21-IT644C	21J0137-05	Sediment	07/12/21
LDW21-IT644D	21J0137-06	Sediment	07/12/21
LDW21-IT644E	21J0137-07	Sediment	07/12/21
LDW21-SC529B	21J0137-08	Sediment	07/14/21
LDW21-SC529C	21J0137-09	Sediment	07/14/21
LDW21-SC529D	21J0137-10	Sediment	07/14/21
LDW21-SC529E	21J0137-11	Sediment	07/14/21
LDW21-SC529F	21J0137-12	Sediment	07/14/21
LDW21-IT608B	21J0137-13	Sediment	07/13/21
LDW21-IT662A	21J0137-14	Sediment	07/13/21
LDW21-IT658A	21J0137-15	Sediment	07/13/21
LDW21-IT648D	21J0137-16	Sediment	07/13/21
LDW21-IT648E	21J0137-17	Sediment	07/13/21
LDW21-SC596A	21J0137-18	Sediment	07/13/21
LDW21-SC596B	21J0137-19	Sediment	07/13/21
LDW21-SC596C	21J0137-20	Sediment	07/13/21
LDW21-SC596D	21J0137-21	Sediment	07/13/21
LDW21-SC596E	21J0137-22	Sediment	07/13/21
LDW21-SC596F	21J0137-23	Sediment	07/13/21
LDW21-SC562C	21J0137-24	Sediment	07/13/21
LDW21-IT653DMS	21J0137-01MS	Sediment	07/12/21
LDW21-IT653DDUP1	21J0137-01DUP1	Sediment	07/12/21

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT653DDUP2	21J0137-01DUP2	Sediment	07/12/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for Inorganic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following methods:

Total Organic Carbon by Environmental Protection Agency (EPA) SW 846 Method 9060A
Total Solids by Standard Method 2540G

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition.

All technical holding time requirements were met.

II. Initial Calibration

All criteria for the initial calibration of each method were met.

III. Continuing Calibration

Continuing calibration frequency and analysis criteria were met for each method when applicable.

IV. Laboratory Blanks

Laboratory blanks were analyzed as required by the methods. No contaminants were found in the laboratory blanks.

V. Field Blanks

No field blanks were identified in this SDG.

VI. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits.

VII. Duplicate Sample Analysis

Duplicate (DUP) sample analysis was performed on an associated project sample. Results were within QC limits.

VIII. Laboratory Control Samples

Laboratory control samples (LCS) were analyzed as required by the methods. Percent recoveries (%R) were within QC limits.

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Target Analyte Quantitation

All target analyte quantitations were within validation criteria.

XI. Overall Assessment of Data

The analysis was conducted within all specifications of the methods. No results were rejected in this SDG.

The quality control criteria reviewed were met and are considered acceptable.

Duwamish AOC4
Wet Chemistry - Data Qualification Summary - SDG 21J0137

No Sample Data Qualified in this SDG

Duwamish AOC4
Wet Chemistry - Laboratory Blank Data Qualification Summary - SDG 21J0137

No Sample Data Qualified in this SDG

Duwamish AOC4
Wet Chemistry - Field Blank Data Qualification Summary - SDG 21J0137

No Sample Data Qualified in this SDG

LDC #: 52703C6
SDG #: 21J0137
Laboratory: Analytical Resources, Inc., Tukwila, WA

VALIDATION COMPLETENESS WORKSHEET
Stage 4

Date: 12/9/21
Page: 1 of 2
Reviewer:
2nd Reviewer:

METHOD: (Analyte) TOC (EPA SW846 Method 9060A), Total Solids (SM2540G)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A,A	
II	Initial calibration	A	
III.	Calibration verification	A	
IV	Laboratory Blanks	A	
V	Field blanks	N	
VI.	Matrix Spike/Matrix Spike Duplicates	A	
VII.	Duplicate sample analysis	A	
VIII.	Laboratory control samples	A	LCS
IX.	Field duplicates	N	
X.	Target Analyte Quantitation	A	
XI	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	LDW21-IT653D	21J0137-01	Sediment	07/12/21
2	LDW21-IT652A	21J0137-02	Sediment	07/12/21
3	LDW21-IT632D	21J0137-03	Sediment	07/12/21
4	LDW21-IT644B	21J0137-04	Sediment	07/12/21
5	LDW21-IT644C	21J0137-05	Sediment	07/12/21
6	LDW21-IT644D	21J0137-06	Sediment	07/12/21
7	LDW21-IT644E	21J0137-07	Sediment	07/12/21
8	LDW21-SC529B	21J0137-08	Sediment	07/14/21
9	LDW21-SC529C	21J0137-09	Sediment	07/14/21
10	LDW21-SC529D	21J0137-10	Sediment	07/14/21
11	LDW21-SC529E	21J0137-11	Sediment	07/14/21
12	LDW21-SC529F	21J0137-12	Sediment	07/14/21
13	LDW21-IT608B	21J0137-13	Sediment	07/13/21
14	LDW21-IT662A	21J0137-14	Sediment	07/13/21
15	LDW21-IT658A	21J0137-15	Sediment	07/13/21
16	LDW21-IT648D	21J0137-16	Sediment	07/13/21
17	LDW21-IT648E	21J0137-17	Sediment	07/13/21

LDC #: 52703C6 **VALIDATION COMPLETENESS WORKSHEET** Date: 12/9/21
SDG #: 21J0137 Stage 4 Page: 2 of 2
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer: [illegible]
2nd Reviewer: [illegible]

METHOD: (Analyte) TOC (EPA SW846 Method 9060A), Total Solids (SM2540G)

	Client ID	Lab ID	Matrix	Date
18	LDW21-SC596A	21J0137-18	Sediment	07/13/21
19	LDW21-SC596B	21J0137-19	Sediment	07/13/21
20	LDW21-SC596C	21J0137-20	Sediment	07/13/21
21	LDW21-SC596D	21J0137-21	Sediment	07/13/21
22	LDW21-SC596E	21J0137-22	Sediment	07/13/21
23	LDW21-SC596F	21J0137-23	Sediment	07/13/21
24	LDW21-SC562C	21J0137-24	Sediment	07/13/21
25	LDW21-IT653DMS	21J0137-01MS	Sediment	07/12/21
26	LDW21-IT653DDUP \	21J0137-01DUP \	Sediment	07/12/21
27	LDW21-IT653D~~TRP~~ DUP	21J0137-01~~TRP~~ DUP	Sediment	07/12/21
28				
29				
30				

Notes:

METHOD: Inorganics				
Validation Area	**Yes**	**No**	**NA**	**Comments**
I. Technical holding times				
Were all technical holding times were met?	X			Frozen
II. Calibration				
Were all instuments calibrated at the requried frequency?	X			
Were the proper number of standards used?	X			
Were all initial and continuing calibration verifications within the QC limits?	X			
Were all initial calibration correlation coefficients within limits as specifed by the method?	X			
Were balance checks performed as required?	X			
III. Blanks				
Was a method blank assoicated with every sample in this SDG?	X			
Was there contamination in the method blanks?		X		
Was there contamination in the initial and continuing calibration blanks?		X		
IV. Matrix Spike/Matrix Spike Duplicates/Laboratory Duplicates				
Were MS/MSD recoveries with the QC limits? (If the sample concentration exceeded the spike concentration by a factor of 4, no action was taken.)	X			
Were the MS/MSD or laboratory duplicate relative percent differences (RPDs) within the QC limits?	X			
V. Laboratory Control Samples				
Was a LCS analyzed for each batch in the SDG?	X			
Were the LCS recoveries and RPDs (if applicable) within QC limits?	X			
X. Sample Result Verification				
Were all reproting limits adjusted to reflect sample dilutions?	X			
Were all soil samples dry weight corrected?	X			
XI. Overall Assessment of Data				
Was the overall assessment of the data found to be acceptable?	X			

METHOD: Inorganics				
Validation Area	**Yes**	**No**	**NA**	**Comments**
XII. Field Duplicates				
Were field duplicates identifed in this SDG?		X		
Were target analytes detected in the field duplicates?			X	
XIII. Field Blanks				
Were field blanks identified in this SDG?		X		
Were target analytes detected in the field blanks?			X	

All elements are applicable to each sample as noted below.

Sample ID	Target Analyte List
All	TS, TOC
QC:	
25	TOC
26	TS, TOC
27	TS

LDC #: 52703C6

Validation Findings Worksheet
Initial and Continuing Calibration Calculation Verification

Reviewer: CR

Method: Inorganics, Method See Cover

An initial or continuing calibration verification percent recovery (%R) was recalculated for each type of analysis using the following formula:

$$\%R = \frac{\text{Found} \times 100}{\text{True}}$$

Where, Found = concentration of each analyte measured in the analysis of the ICV or CCV solution

True = concentration of each analyte in the ICV or CCV source

Calibration verification	TOC	ICV	44.446	47.154	106	106	Y
Calibration verification	TOC	CCV	44.446	44.629	100	100	Y
Calibration verification	TOC	CCV	44.446	44.357	100	100	Y

Comments:

VALIDATION FINDINGS CHECKLIST
Quality Control Sample Recalculations

METHOD: Inorganics

Percent recoveries (%R) for the laboratory control sample (LCS) and matrix spike (MS) were recalcuated using the following formula.
%R = (Found/True) x 100
Found = concentration of each analyte measured in the analysis. For the MS calculation, Found = SSR (Spiked Sample Result) - SR (Sample Result)
True = concentraiton of each analyte in the source
The sample and duplciate relative percent difference (RPD) was recalcuated using the following formula.
RPD = (Absolute value(S-D)x 200) / (S+D)
S = Original sample concentraiton
D = Duplciate sample concentration

Sample ID	Type of Analysis	Element	Found/S	True/D	Recalcuated %R/RPD	Reported %R/RPD	Acceptable (Y/N)
LCS	LCS	TOC	45.3	44.4	102	102	Y
24	MS	TOC	1.31	1.16	113	112	Y
26	Duplicate	TS	64.1	63.39	1.11	1.11	Y

METHOD: Inorganics

Analytes were recalcuated and verified using the following equation.

Concentration = (Result from raw data x Final volume x Dilution factor) / (Percent solids (if applicable) x Initial weight or volume)

Sample ID	Analyte	Raw Data (%)	Dry (g)	Sample Dry (g)	Tare (g)	Percent solids (%)	Reported Result (%)	Recalcuated Result (mg/Kg)	Acceptable (Y/N)
1	TOC	1.75				64.1	2.73	2.73	Y
2	TOC	0.919				60.23	1.53	1.53	Y
3	TOC	0.027				81.62	0.03	0.03	Y
4	TOC	1.48				65.21	2.27	2.27	Y
5	TOC	1.556				62.73	2.48	2.48	Y
6	TOC	1.055				66.96	1.58	1.58	Y
7	TOC	0.038				91.18	0.04	0.04	Y
8	TOC	1.117				58.44	1.91	1.91	Y
9	TOC	1.01				60.68	1.66	1.66	Y
10	TOC	0.871				64.17	1.36	1.36	Y
11	TOC	0.617				67.65	0.91	0.91	Y
12	TOC	0.961				63.19	1.52	1.52	Y
13	TOC	0.523				69.94	0.75	0.75	Y
14	TOC	1.067				55.34	1.93	1.93	Y
15	TS		3.936	5.7969	0.8112		62.68	62.68	Y
16	TS		3.4649	4.8347	0.8033		66.02	66.02	Y
17	TS		3.8553	4.1942	0.8078		89.4	89.99	Y
18	TS		3.2583	4.8916	0.7968		60.11	60.11	Y
19	TS		3.4221	4.4786	0.7955		71.31	71.31	Y
20	TS		5.4429	7.0638	0.7986		74.13	74.13	Y
21	TS		4.0123	5.7007	0.7972		65.57	65.57	Y
22	TS		2.8332	4.2395	0.8143		58.94	58.94	Y
23	TS		3.7536	5.2064	0.8098		66.96	66.96	Y
24	TS		4.4018	6.7354	0.7919		60.74	60.74	Y

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Polychlorinated Dioxins/Dibenzofurans

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21J0137

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT653D	21J0137-01	Sediment	07/12/21
LDW21-IT652A	21J0137-02	Sediment	07/12/21
LDW21-IT662A	21J0137-14	Sediment	07/13/21
LDW21-IT658A	21J0137-15	Sediment	07/13/21
LDW21-IT648D	21J0137-16	Sediment	07/13/21
LDW21-IT648E	21J0137-17	Sediment	07/13/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for High Resolution Superfund Methods Data Review (April 2016). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Polychlorinated Dioxins/Dibenzofurans by Environmental Protection Agency (EPA) Method 1613B

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered not detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. HRGC/HRMS Instrument Performance Check

Instrument performance was checked at the required frequency.

Retention time windows were established for all homologues. The chromatographic resolution between 2,3,7,8-TCDD and peaks representing any other unlabeled TCDD isomer was less than or equal to 25%.

The static resolving power was at least 10,000 (10% valley definition).

III. Initial Calibration and Initial Calibration Verification

A five point initial calibration was performed as required by the method.

The percent relative standard deviations (%RSD) were less than or equal to 20.0% for all analytes and less than or equal to 35.0% for labeled compounds.

The ion abundance ratios for all PCDDs and PCDFs were within validation criteria.

The minimum S/N ratio was greater than or equal to 10 for each analyte and labeled compound.

The percent differences (%D) of the initial calibration verification (ICV) standard were within the QC limits for all analytes and labeled compounds.

IV. Continuing Calibration

Continuing calibration was performed at the required frequencies.

All of the continuing calibration results were within the QC limits for all analytes and labeled compounds.

The ion abundance ratios for all PCDDs and PCDFs were within validation criteria.

The minimum S/N ratio was greater than or equal to 10 for each analyte and labeled compound.

V. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks with the following exceptions:

Blank ID	Extraction Date	Analyte	Concentration	Associated Samples
BJJ0500-BLK1	10/19/21	OCDD Total HxCDF	0.981 ng/Kg 0.100 ng/Kg	All samples in SDG 21J0137

Sample concentrations were compared to concentrations detected in the laboratory blanks. The sample concentrations were either not detected or were significantly greater than the concentrations found in the associated laboratory blanks.

VI. Field Blanks

No field blanks were identified in this SDG.

VII. Matrix Spike/Matrix Spike Duplicates

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

VIII. Laboratory Control Samples/Standard Reference Materials

Laboratory control samples (LCS) were analyzed as required by the method. Percent recoveries (%R) were within QC limits.

Standard reference materials (SRM) were analyzed as required by the method. The results were within QC limits.

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Internal Standards

All internal standard areas and retention times were within QC limits.

XI. Target Analyte Quantitation

All target analyte quantitations met validation criteria with the following exceptions:

Sample	Analyte	Flag	A or P
All samples in SDG 21J0137	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U	A
All samples in SDG 21J0137	All analytes flagged "X" due to chlorinated diphenyl ether (CDPE) interference.	J (all detects)	A

XII. Target Analyte Identification

All target analyte identifications met validation criteria.

XIII. System Performance

The system performance was acceptable.

XIV. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

Due to results reported by the laboratory as EMPCs and CDPE interference, data were qualified as estimated in six samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable.

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Data Qualification Summary - SDG 21J0137

Sample	Analyte	Flag	A or P	Reason
LDW21-IT653D LDW21-IT652A LDW21-IT662A LDW21-IT658A LDW21-IT648D LDW21-IT648E	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U	A	Target analyte quantitation (EMPC)
LDW21-IT653D LDW21-IT652A LDW21-IT662A LDW21-IT658A LDW21-IT648D LDW21-IT648E	All analytes flagged "X" due to chlorinated diphenyl ether (CDPE) interference.	J (all detects)	A	Target analyte quantitation (CDPE interference)

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Laboratory Blank Data Qualification Summary - SDG 21J0137

No Sample Data Qualified in this SDG

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Field Blank Data Qualification Summary - SDG 21J0137

No Sample Data Qualified in this SDG

LDC #: 52703C21 **VALIDATION COMPLETENESS WORKSHEET** Date: 2/9/21
SDG #: 21J0137 Stage 4 Page: 1 of 1
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer:
2nd Reviewer: JM

METHOD: HRGC/HRMS Polychlorinated Dioxins/Dibenzofurans (EPA Method 1613B)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A	
II.	HRGC/HRMS Instrument performance check	A	
III.	Initial calibration/ICV	A/A	RSD ≤ 20/35% ICV ≤ QC limits
IV.	Continuing calibration	A	CCV ≤ QC limits
V.	Laboratory Blanks	SW	
VI.	Field blanks	N	
VII.	Matrix spike/Matrix spike duplicates	N	CS
VIII.	Laboratory control samples / SRM	A	LCS
IX.	Field duplicates	N	
X.	Internal standards	A	
XI.	Target analyte quantitation	SW/A	
XII.	Target analyte identification	A	
XIII.	System performance	A	
XIV.	Overall assessment of data	A	

Note: A = Acceptable; ND = No compounds detected; D = Duplicate; SB=Source blank
N = Not provided/applicable; R = Rinsate; TB = Trip blank; OTHER:
SW = See worksheet; FB = Field blank; EB = Equipment blank

	Client ID	Lab ID	Matrix	Date
1	LDW21-IT653D	21J0137-01	Sediment	07/12/21
2	LDW21-IT652A	21J0137-02	Sediment	07/12/21
3	LDW21-IT662A	21J0137-14	Sediment	07/13/21
4	LDW21-IT658A	21J0137-15	Sediment	07/13/21
5	LDW21-IT648D	21J0137-16	Sediment	07/13/21
6	LDW21-IT648E	21J0137-17	Sediment	07/13/21
7				
8				
9				
10				

Notes:

	BN0500-BK1						

LDC #: 52703C21 **VALIDATION FINDINGS CHECKLIST** Page: 1 of 2
Reviewer: 4

Method: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
All technical holding times were met.	√			
Cooler temperature criteria were met.	√			
II. GC/MS Instrument performance check				
Was PFK exact mass 380.9760 verified?	√			
Were the retention time windows established for all homologues?	√			
Was the chromatographic resolution between 2,3,7,8-TCDD and peaks representing any other unlabeled TCDD isomers ≤ 25%?	√			
Is the static resolving power at least 10,000 (10% valley definition)?	√			
Was the mass resolution adequately check with PFK?	√			
Was the presence of 1,2,8,9-TCDD and 1,3,4,6,8-PeCDF verified?	√			
III. Initial calibration and Initial calibration verification				
Was the initial calibration performed at 5 concentration levels?	√			
Were all percent relative standard deviations (%RSD) ≤ 20% for unlabeled compounds and ≤ 35% for unlabeled compounds?	√			
Did all calibration standards meet the Ion Abundance Ratio criteria?	√			
Was the signal to noise ratio for each target compound and labeled compound ≥ 10?	√			
Was an initial calibration verification (ICV) standard analyzed after each initial calibration for each instrument?	√			
Were all ICV concentrations for the unlabeled and labeled compounds within QC limits?	√			
IV. Continuing calibration				
Was a continuing calibration performed at the beginning of each 12-hour period?	√			
Were all continuing calibration concentrations for the unlabeled and labeled compounds within QC limits?	√			
Did all continuing calibration standards meet the Ion Abundance Ratio criteria?	√			
V. Blanks				
Was a method blank associated with every sample in this SDG?	√			
Was a method blank performed for each matrix and whenever a sample extraction was performed?	√			
Was there contamination in the method blanks?	✓	0		
VI. Field blanks				
Were field blanks identified in this SDG?		√		
Were target compounds detected in the field blanks?			√	
VII. Matrix spike/Matrix spike duplicates				
Were matrix spike (MS) and matrix spike duplicate (MSD) analyzed in this SDG?		√		
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?			√	

LDC #: 52823C2

VALIDATION FINDINGS CHECKLIST

Page: 2 of 2
Reviewer: 2

Validation Area	Yes	No	NA	Findings/Comments
VIII. Laboratory control samples				
Was an LCS analyzed per extraction batch?	√			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	√			
IX. Field duplicates				
Were field duplicate pairs identified in this SDG?		√		
Were target compounds detected in the field duplicates?			√	
X. Labeled Compounds				
Were labeled compounds within QC limits?	√	D		
Was the minimum S/N ratio of all labeled compound peaks ≥ 10?	√			
XI. Compound quantitation				
Did the laboratory LOQs/RLs meet the QAPP LOQs/RLs?	√			
Were the correct labeled compound, quantitation ion and relative response factor (RRF) used to quantitate the compound?	√			
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	√			
XII. Target compound identification				
For 2,3,7,8 substituted congeners with associated labeled standards, were the retention times of the two quantitation peaks within -1 to 3 sec. of the RT of the labeled standard?	√			
For 2,3,7,8 substituted congeners without associated labeled standards, were the relative retention times of the two quantitation peaks within 0.005 time units of the RRT measured in the routine calibration?	√			
For non-2,3,7,8 substituted congeners, were the retention times of the two quantitation peaks within RT established in the performance check solution?	√			
Did selected ion current profile (SICP) contain all characteristic ions listed in Method 1613B, Table 8?	√			
Was the Ion Abundance Ratio for the two quantitation ions within criteria?		√		
Was the signal to noise ratio for each target compound ≥2.5 and ≥10 for the labeled compound?	√			
Does the maximum intensity of each specified characteristic ion coincide within ± 2 seconds (includes labeled standards)?	√			
For PCDF identification, was any signal (S/N ≥ 2.5, at ± seconds RT) detected in the corresponding PCDPE channel?			√	
Was an acceptable lock mass recorded and monitored?	√			
XIII. System performance				
System performance was found to be acceptable.	√			
XIV. Overall assessment of data				
Overall assessment of data was found to be acceptable.	√			

VALIDATION FINDINGS WORKSHEET

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

A. 2,3,7,8-TCDD	F. 1,2,3,4,6,7,8-HpCDD	K. 1,2,3,4,7,8-HxCDF	P. 1,2,3,4,7,8,9-HpCDF	U. Total HpCDD
B. 1,2,3,7,8-PeCDD	G. OCDD	L. 1,2,3,6,7,8-HxCDF	Q. OCDF	V. Total TCDF
C. 1,2,3,4,7,8-HxCDD	H. 2,3,7,8-TCDF	M. 2,3,4,6,7,8-HxCDF	R. Total TCDD	W. Total PeCDF
D. 1,2,3,6,7,8-HxCDD	I. 1,2,3,7,8-PeCDF	N. 1,2,3,7,8,9-HxCDF	S. Total PeCDD	X. Total HxCDF
E. 1,2,3,7,8,9-HxCDD	J. 2,3,4,7,8-PeCDF	O. 1,2,3,4,6,7,8-HpCDF	T. Total HxCDD	Y. Total HpCDF

Notes:_____

LDC #: 53703C2/

VALIDATION FINDINGS WORKSHEET
Blanks

Page: 1 of 1
Reviewer: CA

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)
Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

(Y) N N/A Were all samples associated with a method blank?
Y N N/A Was a method blank performed for each matrix and whenever a sample extraction was performed?
Y (N) N/A Was the method blank contaminated?

Blank extraction date: 10/19/21 **Blank analysis date:** 10/25/21 **Associated samples:** All

Conc. units: pg/Kg

Compound	Blank ID	Sample Identification								
BK	0900-BLK1									
4F	0.981									
X	0.100									

Blank extraction date: _____ **Blank analysis date:** _____

Conc. units: _____ Associated Samples: _____

Compound	Blank ID	Sample Identification								

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT:
All contaminants within five times the method blank concentration were qualified as not detected, "U".

VALIDATION FINDINGS WORKSHEET
Compound Quantitation and Reported RLs

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y N N/A Were the correct labeled compound, quantitation ions and relative response factors (RRF) used to quantitate the compound?
Y N N/A Compound quantitation and RLs were adjusted to reflect all sample dilutions and dry weight factors (if necessary).

#	Date	Sample ID	Finding	Associated Samples	Qualifications
		All	All compounds reported as estimated maximum possible concentration (EMPC) < RL		U/A
		All	All compounds flagged "X" due to chlorinated diphenyl ~~ether~~ ether interference		Jdets/A

Comments: See sample calculation verification worksheet for recalculations

LDC #: 52703C21

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

The Relative Response Factor (RRF), average RRF, and percent relative standard deviation (%RSD) were recalculated for the compounds identified below using the following calculations:

$RRF = (A_x)(C_{is})/(A_{is})(C_x)$
average RRF = sum of the RRFs/number of standards
%RSD = 100 * (S/X)

A_x = Area of compound,
C_x = Concentration of compound,
S = Standard deviation of the RRFs,

A_{is} = Area of associated internal standard
C_{is} = Concentration of internal standard
X = Mean of the RRFs

#	Standard ID	Calibration Date	Compound (Reference Internal Standard)	Reported RRF (10/50 std)	Recalculated RRF (10/50 std)	Reported Average RRF (initial)	Recalculated Average RRF (initial)	Reported %RSD	Recalculated %RSD
1	ICAL	8/11/21	2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)	1.0832006	1.083746	1.107593	1.107593	3.6	3.6
	01		2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)	0.9085186	0.908390	0.9202875	0.9202874	3.1	3.1
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)	1.005616	1.005605	1.00898	1.00898	1.0	1.0
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)	1.051009	1.051062	1.068088	1.068088	6.6	6.6
			OCDF (^{13}C-OCDD)	1.440564	1.44059	1.44690	1.44690	5.7	5.7
2			2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)						
			2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)						
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)						
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)						
			OCDF (^{13}C-OCDD)						
3			2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)						
			2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)						
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)						
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)						
			OCDF (^{13}C-OCDD)						

Comments: Refer to Initial Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703C2

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Reviewer: 9

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

The percent difference (%D) of the initial calibration average Relative Response Factors (RRFs) and the continuing calibration RRFs were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. RRF - RRF)/ave. RRF
RRF = $(A_x)(C_{is})/(A_{is})(C_x)$

Where: ave. RRF = initial calibration average RRF
RRF = continuing calibration RRF
A_x = Area of compound, A_{is} = Area of associated internal standard
C_x = Concentration of compound, C_{is} = Concentration of internal standard

#	Standard ID	Calibration Date	Compound (Reference Internal Standard)	Average RRF (initial)	Reported Conc (CC)	Recalculated Conc (CC)	Reported %D	Recalculated %D
1	2110250SA	10/25/21	2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)	1.10T593	1.0T45550	1.0T46T5	3.0	3.0
			2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)	0.9208T5	1.0081390	1.0081532	9.5	9.5
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)	1.00898	1.06883T0	1.0683T44	5.9	5.9
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)	1.068088	1.16T9010	1.16T8182	9.3	9.3
			OCDF (^{13}C-OCDF)	1.44690	1.338=880	1.33854 8	T.5	T.5
2	2110251 8	10/26/21	2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)	1.10T593	1.0T13550	1.0T13484	3.3	3.3
			2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)	0.9208T5	1.0205990	1.0206664	10.9	10.9
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)	1.00898	1.0288T00	1.028884	2.0	2.0
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)	1.068088	1.1328670	1.1328398	6.1	6.1
			OCDF (^{13}C-OCDF)	1.44690	1.3304=60	1.330458	8.0	8.0
3			2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)					
			2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)					
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)					
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)					
			OCDF (^{13}C-OCDF)					

Comments: Refer to Routine Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52032

VALIDATION FINDINGS WORKSHEET
Laboratory Control Sample Results Verification

Page: 1 of 1
Reviewer: A

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

The percent recoveries (%R) and Relative Percent Difference (RPD) of the laboratoy control sample and laboratory control sample duplicate (if applicable) were recalculated for the compounds identified below using the following calculation:

% Recovery = 100 * SSC/SA Where: SSC = Spiked sample concentration
SA = Spike added

RPD = | LCS - LCSD | * 2/(LCS + LCSD) LCS = Laboraotry control sample percent recovery LCSD = Laboratory control sample duplicate percent recovery

LCS ID: BH0500-BS

Compound	Spike Added (ng/kg)		Spiked Sample Concentration (ng/kg)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc	Reported	Recalc	Reported	Recalculated
2,3,7,8-TCDD	20.0	NA	21.0	NA	105	105				
1,2,3,7,8-PeCDD	100	↓	101	↓	101	101				
1,2,3,4,7,8-HxCDD	↓	↓	99.2	↓	99.2	99.2				
1,2,3,4,7,8,9-HpCDF	↓	↓	95.9	↓	95.9	95.9				
OCDF	200	↓	151	↓	75.5	75.5				

Comments: Refer to Laboratory Control Sample findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703C21

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Reviewer: 9

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

Y N N/A Were all reported results recalculated and verified for all level IV samples?
Y N N/A Were all recalculated results for detected target compounds agree within 10.0% of the reported results?

Concentration = $\frac{(A_x)(I_s)(DF)}{(A_{is})(RRF)(V_o)(\%S)}$

A_x = Area of the characteristic ion (EICP) for the compound to be measured

A_{is} = Area of the characteristic ion (EICP) for the specific internal standard

I_s = Amount of internal standard added in nanograms (ng)

V_o = Volume or weight of sample extract in milliliters (ml) or grams (g).

RRF = Relative Response Factor (average) from the initial calibration

Df = Dilution Factor.

%S = Percent solids, applicable to soil and solid matrices only.

Example:

Sample I.D. 1, 8:

Conc. = $\frac{(1.597e4+1.802e4)(200)(20)(1)}{(3.101e5+3.345e5)(1.4469)(15.87)(0.6390)}$

= 14.56 ng/g

#	Sample ID	Compound	Reported Concentration (ng/g)	Calculated Concentration ( )	Acceptable (Y/N)
	1	4	14.6		

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Semivolatiles

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21J0142

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT621B	21J0142-23	Sediment	08/02/21
LDW21-IT621BMS	21J0142-23MS	Sediment	08/02/21
LDW21-IT621BMSD	21J0142-23MSD	Sediment	08/02/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for Organic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Semivolatile Organic Compounds (SVOCs) by Environmental Protection Agency (EPA) SW 846 Method 8270E

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. GC/MS Instrument Performance Check

A decafluorotriphenylphosphine (DFTPP) tune was performed at 12 hour intervals.

All ion abundance requirements were met.

III. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

The percent relative standard deviations (%RSD) were less than or equal to 20.0% for all analytes.

Average relative response factors (RRF) for all analytes were within validation criteria.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 30.0% for all analytes.

IV. Continuing Calibration

Continuing calibration was performed at the required frequencies.

The percent differences (%D) were less than or equal to 20.0% for all analytes with the following exceptions:

Date	Analyte	%D	Associated Samples	Flag	A or P
10/30/21	Butylbenzylphthalate	25.7	All samples in SDG 21J0142	UJ (all non-detects)	A

All of the continuing calibration relative response factors (RRF) were within validation criteria.

V. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks.

VI. Field Blanks

No field blanks were identified in this SDG.

VII. Surrogates

Surrogates were added to all samples as required by the method. All surrogate recoveries (%R) were within QC limits.

VIII. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

IX. Laboratory Control Samples

Laboratory control samples (LCS) and laboratory control samples duplicates (LCSD) were analyzed as required by the method. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

X. Field Duplicates

No field duplicates were identified in this SDG.

XI. Internal Standards

All internal standard areas and retention times were within QC limits.

XII. Target Analyte Quantitation

All target analyte quantitations were within validation criteria.

XIII. Target Analyte Identification

All target analyte identifications were within validation criteria.

XIV. System Performance

The system performance was acceptable.

XV. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

Due to continuing calibration %D, data were qualified as estimated in one sample.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable.

Duwamish AOC4
Semivolatiles - Data Qualification Summary - SDG 21J0142

Sample	Analyte	Flag	A or P	Reason
LDW21-IT621B	Butylbenzylphthalate	UJ (all non-detects)	A	Continuing calibration (%D)

Duwamish AOC4
Semivolatiles - Laboratory Blank Data Qualification Summary - SDG 21J0142

No Sample Data Qualified in this SDG

Duwamish AOC4
Semivolatiles - Field Blank Data Qualification Summary - SDG 21J0142

No Sample Data Qualified in this SDG

LDC #: 52703D2a
SDG #: 21J0142
Laboratory: Analytical Resources, Inc., Tukwila, WA

VALIDATION COMPLETENESS WORKSHEET
Stage 4

Date: 1/19/21
Page: 1 of 1
Reviewer: A
2nd Reviewer: JM

METHOD: GC/MS Butylbenzylphthalate (EPA SW 846 Method 8270E)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A	
II.	GC/MS Instrument performance check	A	
III.	Initial calibration/ICV	A/A	RSD ≤ 20% ICV ≤ 30%
IV.	Continuing calibration	AW	CCV ≤ 20%
V.	Laboratory Blanks	A	
VI.	Field blanks	N	
VII.	Surrogate spikes	A	
VIII.	Matrix spike/Matrix spike duplicates	A	
IX.	Laboratory control samples	A	LCS/D
X.	Field duplicates	N	
XI.	Internal standards	A	
XII.	Target analyte quantitation	A	
XIII.	Target analyte identification	A	
XIV.	System performance	A	
XV.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	LDW21-IT621B	21J0142-23	Sediment	08/02/21
2	LDW21-IT621BMS	21J0142-23MS	Sediment	08/02/21
3	LDW21-IT621BMSD	21J0142-23MSD	Sediment	08/02/21
4				
5				
6				
7				
8				
9				

Notes:

	BN0794 BK1						

LDC #: 52703D29

VALIDATION FINDINGS CHECKLIST

Page: 1 of 2
Reviewer: Q
~~2nd Reviewer:~~

Method: Semivolatiles (EPA SW 846 Method 8270D)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
Were all technical holding times met?	✓			
Was cooler temperature criteria met?	✓			
II. GC/MS Instrument performance check				
Were the DFTPP performance results reviewed and found to be within the specified criteria?	✓			
Were all samples analyzed within the 12 hour clock criteria?	✓			
IIIa. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✓			
Were all percent relative standard deviations (%RSD) ≤ 20% and relative response factors (RRF) within method criteria?	✓			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥ 0.990?			✓	
IIIb. Initial Calibration Verification				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	✓			
Were all percent differences (%D) ≤ 30%?	✓			
IV. Continuing calibration				
Was a continuing calibration standard analyzed at least once every 12 hours for each instrument?	✓			
Were all percent differences (%D) ≤ 20% and relative response factors (RRF) within method criteria?		✓		
V. Laboratory Blanks				
Was a laboratory blank associated with every sample in this SDG?	✓			
Was a laboratory blank analyzed at least once every 12 hours for each matrix and concentration?	✓			
Was there contamination in the laboratory blanks? If yes, please see the blanks validation findings worksheet.		✓		
VI. Field blanks				
Were field blanks were identified in this SDG?		✓		
Were target compounds detected in the field blanks?			✓	
VII. Surrogate spikes				
Were all surrogate percent recovery (%R) within QC limits?	✓			
If 2 or more base neutral or acid surrogates were outside QC limits, was a reanalysis performed to confirm %R?			✓	
If any percent recoveries (%R) was less than 10%, was a reanalysis performed to confirm %R ?			✓	
VIII. Matrix spike/Matrix spike duplicates				
Were matrix spike (MS) and matrix spike duplicate (MSD) analyzed in this SDG?	✓			

LDC #: 52703B2A

VALIDATION FINDINGS CHECKLIST

Reviewer: Q
~~2nd Reviewer:~~

Validation Area	Yes	No	NA	Findings/Comments
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?	✓			
IX. Laboratory control samples				
Was an LCS analyzed per extraction batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	✓			
X. Field duplicates				
Were field duplicate pairs identified in this SDG?		✓		
Were target compounds detected in the field duplicates?			✓	
XI. Internal standards				
Were internal standard area counts within -50% to +100% of the associated calibration standard?	✓			
Were retention times within ± 30 seconds of the associated calibration standard?	✓			
XII. Compound quantitation				
Did the laboratory LOQs/RLs meet the QAPP LOQs/RLs?	✓			
Were the correct internal standard (IS), quantitation ion and relative response factor (RRF) used to quantitate the compound?	✓			
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
XIII. Target compound identification				
Were relative retention times (RRT's) within ± 0.06 RRT units of the standard?	✓			
Did compound spectra meet specified EPA "Functional Guidelines" criteria?	✓			
Were chromatogram peaks verified and accounted for?	✓			
XIV. System performance				
System performance was found to be acceptable.	✓			
XV. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			

VALIDATION FINDINGS WORKSHEET

METHOD: GC/MS SVOA

A. Phenol	CC. Dimethylphthalate	EEE. Bis(2-ethylhexyl)phthalate	GGGG. C30-Hopane	I1. Methyl methanesulfonate
B. Bis (2-chloroethyl) ether	DD. Acenaphthylene	FFF. Di-n-octylphthalate	HHHH. 1-Methylphenanthrene	J1. Ethyl methanesulfonate
C. 2-Chlorophenol	EE. 2,6-Dinitrotoluene	GGG. Benzo(b)fluoranthene	IIII. 1,4-Dioxane	K1. o,o',o''-Triethylphosphorothioate
D. 1,3-Dichlorobenzene	FF. 3-Nitroaniline	HHH. Benzo(k)fluoranthene	JJJJ. Acetophenone	L1. n-Phenylene diamine
E. 1,4-Dichlorobenzene	GG. Acenaphthene	III. Benzo(a)pyrene	KKKK. Atrazine	M1. 1,4-Naphthoquinone
F. 1,2-Dichlorobenzene	HH. 2,4-Dinitrophenol	JJJ. Indeno(1,2,3-cd)pyrene	LLLL. Benzaldehyde	N1. N-Nitro-o-toluidine
G. 2-Methylphenol	II. 4-Nitrophenol	KKK. Dibenz(a,h)anthracene	MMMM. Caprolactam	O1. 1,3,5-Trinitrobenzene
H. 2,2'-Oxybis(1-chloropropane)	JJ. Dibenzofuran	LLL. Benzo(g,h,i)perylene	NNNN. 2,6-Dichlorophenol	P1. Pentachlorobenzene
I. 4-Methylphenol	KK. 2,4-Dinitrotoluene	MMM. Bis(2-Chloroisopropyl)ether	OOOO. 1,2-Diphenylhydrazine	Q1. 4-Aminobiphenyl
J. N-Nitroso-di-n-propylamine	LL. Diethylphthalate	NNN. Aniline	PPPP. 3-Methylphenol	R1. 2-Naphthylamine
K. Hexachloroethane	MM. 4-Chlorophenyl-phenyl ether	OOO. N-Nitrosodimethylamine	QQQQ. 3&4-Methylphenol	S1. Triphenylene
L. Nitrobenzene	NN. Fluorene	PPP. Benzoic Acid	RRRR. 4-Dimethyldibenzothiophene (4MDT)	T1. Octachlorostyrene
M. Isophorone	OO. 4-Nitroaniline	QQQ. Benzyl alcohol	SSSS. 2/3-Dimethyldibenzothiophene (4MDT)	U1. Famphur
N. 2-Nitrophenol	PP. 4,6-Dinitro-2-methylphenol	RRR. Pyridine	TTTT. 1-Methyldibenzothiophene (1MDT)	V1. 1,4-phenylenediamine
O. 2,4-Dimethylphenol	QQ. N-Nitrosodiphenylamine	SSS. Benzidine	UUUU.. 2,3,4,6-Tetrachlorophenol	W1. Methapyrilene
P. Bis(2-chloroethoxy)methane	RR. 4-Bromophenyl-phenylether	TTT. 1-Methylnaphthalene	VVVV. 1,2,4,5-Tetrachlorobenzene	X1. Pentachloroethane
Q. 2,4-Dichlorophenol	SS. Hexachlorobenzene	UUU.Benzo(b)thiophene	WWWW.. 2-Picoline	Y1. 3,3'-Dimethylbenzidine
R. 1,2,4-Trichlorobenzene	TT. Pentachlorophenol	VVV.Benzonaphthothiophene	XXXX. 3-Methylcholanthrene	Z1. o-Toluidine
S. Naphthalene	UU. Phenanthrene	WWW.Benzo(e)pyrene	YYYY. a,a-Dimethylphenethylamine	A2. 1-Naphthylamine
T. 4-Chloroaniline	VV. Anthracene	XXX. 2,6-Dimethylnaphthalene	ZZZZ. Hexachloropropene	B2. 4-Aminobiphenyl
U. Hexachlorobutadiene	WW. Carbazole	YYY. 2,3,5-Trimethylnaphthalene	A1. N-Nitrosodiethylamine	C2. 4-Nitroquinoline-1-oxide
V. 4-Chloro-3-methylphenol	XX. Di-n-butylphthalate	ZZZ. Perylene	B1. N-Nitrosodi-n-butylamine	D2. Hexachloropene
W. 2-Methylnaphthalene	YY. Fluoranthene	AAAA. Dibenzothiophene	C1. N-Nitrosomethylethylamine	E2. Bis (2-chloro-1-methylethyl) ether
X. Hexachlorocyclopentadiene	ZZ. Pyrene	BBBB. Benzo(a)fluoranthene	D1. N-Nitrosomorpholine	F2. Bifenthrin
Y. 2,4,6-Trichlorophenol	AAA. Butylbenzylphthalate	CCCC. Benzo(b)fluorene	E1. N-Nitrosopyrrolidine	G2. Cyfluthrin
Z. 2,4,5-Trichlorophenol	BBB. 3,3'-Dichlorobenzidine	DDDD. cis/trans-Decalin	F1. Phenacetin	H2. Cypermethrin
AA. 2-Chloronaphthalene	CCC. Benzo(a)anthracene	EEEE. 1,1'-Biphenyl	G1. 2-Acetylaminofluorene	I2. Permethrin (cis/trans)
BB. 2-Nitroaniline	DDD. Chrysene	FFFF. Retene	H1. Pronamide	J2. 5-Nitro-o-toluidine

LDC #: 52703D29

VALIDATION FINDINGS WORKSHEET
Continuing Calibration

Reviewer: 9
~~2nd Reviewer:~~

METHOD: GC/MS BNA (EPA SW 846 Method 8270D)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

(Y) N N/A Was a continuing calibration standard analyzed at least once every 12 hours for each instrument?

Y (N) N/A Were percent differences (%D) ≤20 % and relative response factors (RRF) within the method criteria?

#	Date	Standard ID	Compound	Finding %D (Limit: ≤20.0%)	Finding RRF (Limit)	Associated Samples	Qualifications
	10/20/21	NT1021103002	AAA	25.7		All (ND)	J/UJ/A

LDC #: 52703B29

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Page: 1 of 1
Reviewer: a
~~2nd Reviewer:~~

METHOD: GC/MS BNA (EPA SW 846 Method 8270D)

The Relative Response Factor (RRF), average RRF, and percent relative standard deviation (%RSD) were recalculated for the compounds identified below using the following calculations:

$RRF = (A_x)(C_{is})/(A_{is})(C_x)$
average RRF = sum of the RRFs/number of standards
%RSD = 100 * (S/X)

A_x = Area of compound,
C_x = Concentration of compound,
S = Standard deviation of the RRFs,

A_{is} = Area of associated internal standard
C_{is} = Concentration of internal standard
X = Mean of the RRFs

#	Standard ID	Calibration Date	Compound (Reference Internal Standard)	Reported RRF (5 std)	Recalculated RRF (5 std)	Reported Average RRF (initial)	Recalculated Average RRF (initial)	Reported %RSD	Recalculated %RSD
1	ICAL	10/25/21	~~Phenol (1st internal standard)~~ AAA	0.9138844	0.9138844	0.9488406	0.9488406	5.3	5.3
			Naphthalene (2nd internal standard)						
			Fluorene (3rd internal standard)						
			Pentachlorophenol (4th internal standard)						
			Bis(2-ethylhexyl)phthalate (5th internal standard)						
			~~Benzo(a)pyrene (6th internal standard)~~						
2			Phenol (1st internal standard)						
			Naphthalene (2nd internal standard)						
			Fluorene (3rd internal standard)						
			Pentachlorophenol (4th internal standard)						
			Bis(2-ethylhexyl)phthalate (5th internal standard)						
			Benzo(a)pyrene (6th internal standard)						
3			Phenol (1st internal standard)						
			Naphthalene (2nd internal standard)						
			Fluorene (3rd internal standard)						
			Pentachlorophenol (4th internal standard)						
			Bis(2-ethylhexyl)phthalate (5th internal standard)						
			Benzo(a)pyrene (6th internal standard)						

Comments: Refer to Initial Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52783D2A

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Page: 1 of 1
Reviewer: Q
~~2nd Reviewer:~~

METHOD: GC/MS BNA (EPA SW 846 Method 8270D)

The percent difference (%D) of the initial calibration average Relative Response Factors (RRFs) and the continuing calibration RRFs were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. RRF - RRF)/ave. RRF
RRF = $(A_x)(C_{is})/(A_{is})(C_x)$

Where: ave. RRF = initial calibration average RRF
RRF = continuing calibration RRF
A_x = Area of compound, A_{is} = Area of associated internal standard
C_x = Concentration of compound, C_{is} = Concentration of internal standard

#	Standard ID	Calibration Date	Compound (Reference Internal Standard)	Average RRF (initial)	Reported RRF (CC)	Recalculated RRF (CC)	Reported %D	Recalculated %D
1	NT102110300 2	10/30/21	~~Phenol (1st internal standard)~~ AAA	0.9488406	1.1931350	1.1931348	25.7	25.7
			Naphthalene (2nd internal standard)					
			Fluorene (3rd internal standard)					
			Pentachlorophenol (4th internal standard)					
			~~Bis~~(2-ethylhexyl)phthalate (5th internal standard)					
			~~Benzo(a)pyrene (6th internal standard)~~					
2			Phenol (1st internal standard)					
			Naphthalene (2nd internal standard)					
			Fluorene (3rd internal standard)					
			Pentachlorophenol (4th internal standard)					
			Bis(2-ethylhexyl)phthalate (5th internal standard)					
			~~Benzo(a)pyrene (6th internal standard)~~					
3			Phenol (1st internal standard)					
			Naphthalene (2nd internal standard)					
			Fluorene (3rd internal standard)					
			Pentachlorophenol (4th internal standard)					
			Bis(2-ethylhexyl)phthalate (5th internal standard)					
			Benzo(a)pyrene (6th internal standard)					

Comments: Refer to Continuing Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703B29

VALIDATION FINDINGS WORKSHEET
Surrogate Results Verification

Page: 1 of 1
Reviewer: 9
~~2nd reviewer:~~

METHOD: GC/MS Semivolatiles (EPA SW 846 Method 8270D)

The percent recoveries (%R) of surrogates were recalculated for the compounds identified below using the following calculation:

% Recovery: SF/SS * 100

Where: SF = Surrogate Found
SS = Surrogate Spiked

Sample ID: 1

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14	5.0	3.94505	78.9	78.9	
Phenol-d5					
2-Fluorophenol					
2,4,6-Tribromophenol					
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14					
Phenol-d5					
2-Fluorophenol					
2,4,6-Tribromophenol					
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14					
Phenol-d5					
2-Fluorophenol					
2,4,6-Tribromophenol					
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

LDC #: 5-7031029

VALIDATION FINDINGS WORKSHEET
Matrix Spike/Matrix Spike Duplicates Results Verification

Reviewer: 9
~~2nd Reviewer:~~

METHOD: GC/MS BNA (EPA SW 846 Method 8270D)

The percent recoveries (%R) and Relative Percent Difference (RPD) of the matrix spike and matrix spike duplicate were recalculated for the compounds identified below using the following calculation:

% Recovery = 100 * (SSC - SC)/SA

Where: SSC = Spiked sample concentration; SA = Spike added; SC = Sample concentation

RPD = I MSC - MSC I * 2/(MSC + MSDC)

MSC = Matrix spike concentration; MSDC = Matrix spike duplicate concentration

MS/MSD samples: 2/3

Compound	Spike Added (~~UG/KG~~)		Sample Concentration (UG/KG)	Spiked Sample Concentration (UG/KG)		Matrix Spike Percent Recovery		Matrix Spike Duplicate Percent Recovery		MS/MSD RPD	
	MS	MSD	------	MS	MSD	Reported	Recalc	Reported	Recalc	Reported	Recalculated
Phenol											
N-Nitroso-di-n-propylamine											
4-Chloro-3-methylphenol											
Acenaphthene											
Pentachlorophenol											
Pyrene											
~~AAA~~	500	500	ND	405	430	81.0	81.0	85.9	86.0	5.93	5.8

Comments: Refer to Matrix Spike/Matrix Spike Duplicates findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703D29

VALIDATION FINDINGS WORKSHEET

Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification

Page: 1 of 1
Reviewer: 2
2nd Reviewer: ~~2nd Reviewer~~

METHOD: GC/MS Semivolatiles (EPA SW 846 Method 8270D)

The percent recoveries (%R) and Relative Percent Difference (RPD) of the laboratory control sample and laboratory control sample duplicate were recalculated for the compounds identified below using the following calculation:

% Recovery = 100 * (SC/SA) Where: SSC = Spike concentration
SA = Spike added

RPD = | LCSC - LCSDC | * 2/(LCSC + LCSDC) LCSC = Laboratory control sample concentration LCSDC = Laboratory control sample duplicate concentration

LCS/LCSD samples: BJN0794-BS1/-BSD1

Compound	Spike Added (ug/kg)		Spike Concentration (ug/kg)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc	Reported	Recalc	Reported	Recalculated
Phenol										
N-Nitroso-di-n-propylamine										
4-Chloro-3-methylphenol										
Acenaphthene										
Pentachlorophenol										
Pyrene										
AAA	500	500	458	472	91.5	91.5	94.3	94.3	3.01	2.9

Comments: Refer to Laboratory Control Sample/Laboratory Control Sample Duplicates findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703D29

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: 9
~~2nd reviewer:~~

METHOD: GC/MS SVOA (EPA SW 846 Method 8270D)

(Y) N N/A Were all reported results recalculated and verified for all level IV samples?
(Y) N N/A Were all recalculated results for detected target compounds agree within 10.0% of the reported results?

Concentration = $\frac{(A_x)(I_s)(V_t)(DF)(2.0)}{(A_{is})(RRF)(V_o)(V_i)(\%S)}$

A_x	=	Area of the characteristic ion (EICP) for the compound to be measured
A_{is}	=	Area of the characteristic ion (EICP) for the specific internal standard
I_s	=	Amount of internal standard added in nanograms (ng)
V_o	=	Volume or weight of sample extract in milliliters (ml) or grams (g).
V_i	=	Volume of extract injected in microliters (ul)
V_t	=	Volume of the concentrated extract in microliters (ul)
Df	=	Dilution Factor.
%S	=	Percent solids, applicable to soil and solid matrices only.
2.0	=	Factor of 2 to account for GPC cleanup

Example:

Sample I.D. NO, AAA: BN0794-BS01

Conc. = $\frac{(219041)(4.0)(1000)(1)(\quad)}{(195770)(0.9488406)(10)(\quad)}$

= 471.6 ng/g

#	Sample ID	Compound	Reported Concentration ng/g	Calculated Concentration ( )	Qualification
	BN0794-BS01	AAA	472		

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Polychlorinated Biphenyls

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila

Sample Delivery Group (SDG): 21J0142

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-SC525	21J0142-01	Sediment	07/15/21
LDW21-SS500	21J0142-02	Sediment	07/16/21
LDW21-SS501	21J0142-03	Sediment	07/16/21
LDW21-SS502	21J0142-04	Sediment	07/16/21
LDW21-IT579C	21J0142-06	Sediment	07/16/21
LDW21-IT597A	21J0142-07	Sediment	07/16/21
LDW21-IT597D	21J0142-08	Sediment	07/16/21
LDW21-SC673A	21J0142-09	Sediment	07/19/21
LDW21-IT600	21J0142-10	Sediment	07/19/21
LDW21-IT665D	21J0142-11	Sediment	07/19/21
LDW21-IT666D	21J0142-12	Sediment	07/19/21
LDW21-SS541	21J0142-13	Sediment	07/21/21
LDW21-IT512	21J0142-14	Sediment	07/19/21
LDW21-IT663D	21J0142-15	Sediment	07/19/21
LDW21-SC500	21J0142-16	Sediment	07/20/21
LDW21-SC501	21J0142-17	Sediment	07/20/21
LDW21-SC502	21J0142-18	Sediment	07/20/21
LDW21-SC563A	21J0142-19	Sediment	07/20/21
LDW21-SC628A	21J0142-20	Sediment	07/20/21
LDW21-IT670A	21J0142-22	Sediment	07/20/21
LDW21-IT621B	21J0142-23	Sediment	08/02/21
LDW21-SC628AMS	21J0142-20MS	Sediment	07/20/21
LDW21-SC628AMSD	21J0142-20MSD	Sediment	07/20/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for Organic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Polychlorinated Biphenyls (PCBs) by Environmental Protection Agency (EPA) SW 846 Method 8082A

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

The percent relative standard deviations (%RSD) were less than or equal to 20.0% for all analytes.

Retention time windows were established as required by the method.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 20.0% for all analytes.

III. Continuing Calibration

Continuing calibration was performed at required frequencies.

The percent differences (%D) were less than or equal to 20.0% for all analytes with the following exceptions:

Date	Standard	Column	Analyte	%D	Associated Samples	Flag	A or P
10/27/21	10272115	2C	Aroclor-1260	24.6	LDW21-SC525	J (all detects)	A

Retention times of all analytes in the calibration standards were within the established retention time windows.

IV. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks.

V. Field Blanks

No field blanks were identified in this SDG.

VI. Surrogates/Internal Standards

Surrogates were added to all samples as required by the method. Surrogate recoveries (%R) were within QC limits.

All internal standard percent recoveries (%R) were within QC limits.

VII. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits with the following exceptions:

Spike ID (Associated Samples)	Analyte	MS (%R) (Limits)	MSD (%R) (Limits)	Flag	A or P
LDW21-SC628AMS/MSD (LDW21-SC628A)	Aroclor-1260	49.5 (58-120)	-	J (all detects)	A

Relative percent differences (RPD) were within QC limits.

VIII. Laboratory Control Samples/Standard Reference Materials

Laboratory control samples (LCS) and laboratory control samples duplicates (LCSD) were analyzed as required by the method. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

Standard reference materials (SRM) were analyzed as required by the method. The results were within QC limits.

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Target Analyte Quantitation

All target analyte quantitations met validation criteria.

The sample results for detected analytes from the two columns were within 40% relative percent difference (RPD) with the following exceptions:

Sample	Analyte	RPD	Flag	A or P
LDW21-IT512	Aroclor-1260	42.3	J (all detects)	A
LDW21-SC563A	Aroclor-1254	41.5	J (all detects)	A

XI. Target Analyte Identification

All target analyte identifications met validation criteria.

XII. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

Due to continuing calibration %D, MS/MSD %R, and RPD between two columns, data were qualified as estimated in four samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable.

Duwamish AOC4
Polychlorinated Biphenyls - Data Qualification Summary - SDG 21J0142

Sample	Analyte	Flag	A or P	Reason
LDW21-SC525	Aroclor-1260	J (all detects)	A	Continuing calibration (%D)
LDW21-SC628A	Aroclor-1260	J (all detects)	A	Matrix spike/Matrix spike duplicate (%R)
LDW21-IT512	Aroclor-1260	J (all detects)	A	Target analyte quantitation (RPD between two columns)
LDW21-SC563A	Aroclor-1254	J (all detects)	A	Target analyte quantitation (RPD between two columns)

Duwamish AOC4
Polychlorinated Biphenyls - Laboratory Blank Data Qualification Summary - SDG 21J0142

No Sample Data Qualified in this SDG

Duwamish AOC4
Polychlorinated Biphenyls - Field Blank Data Qualification Summary - SDG 21J0142

No Sample Data Qualified in this SDG

LDC #: 52703D3b

SDG #: 21J0142

Laboratory: Analytical Resources, Inc.

VALIDATION COMPLETENESS WORKSHEET

Stage 4

Date: 12/10/21

Page: 1 of 2

Reviewer: CJ

2nd Reviewer: JVG

METHOD: GC Polychlorinated Biphenyls (EPA SW846 Method 8082A)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A	
II.	Initial calibration/ICV	A/A	RSD ≤ 20% ICV ≤ 20%
III.	Continuing calibration	SW	CCV ≤ 20%
IV.	Laboratory Blanks	A	
V.	Field blanks	N	
VI.	Surrogate spikes /IS	A/A	
VII.	Matrix spike/Matrix spike duplicates	SW	
VIII.	Laboratory control samples /LCSD	A	LCS/D
IX.	Field duplicates	N	
X.	Target analyte quantitation	SW	
XI.	Target analyte identification	A	
XII	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	LDW21-SC525	21J0142-01	Sediment	07/15/21
2	LDW21-SS500	21J0142-02	Sediment	07/16/21
3	LDW21-SS501	21J0142-03	Sediment	07/16/21
4	LDW21-SS502	21J0142-04	Sediment	07/16/21
5	LDW21-IT579C	21J0142-06	Sediment	07/16/21
6	LDW21-IT597A	21J0142-07	Sediment	07/16/21
7	LDW21-IT597D	21J0142-08	Sediment	07/16/21
8	LDW21-SC673A	21J0142-09	Sediment	07/19/21
9	LDW21-IT600	21J0142-10	Sediment	07/19/21
10	LDW21-IT665D	21J0142-11	Sediment	07/19/21
11	LDW21-IT666D	21J0142-12	Sediment	07/19/21
12	LDW21-SS541	21J0142-13	Sediment	07/21/21
13	LDW21-IT512	21J0142-14	Sediment	07/19/21
14	LDW21-IT663D	21J0142-15	Sediment	07/19/21
15	LDW21-SC500	21J0142-16	Sediment	07/20/21
16	LDW21-SC501	21J0142-17	Sediment	07/20/21
17	LDW21-SC502	21J0142-18	Sediment	07/20/21

LDC #: 52703D3b

SDG #: 21J0142

Laboratory: Analytical Resources, Inc.

VALIDATION COMPLETENESS WORKSHEET

Stage 4

Date: 1/10/22

Reviewer: 9

2nd Reviewer: M

METHOD: GC Polychlorinated Biphenyls (EPA SW846 Method 8082A)

	Client ID	Lab ID	Matrix	Date
18	LDW21-SC563A	21J0142-19	Sediment	07/20/21
19	LDW21-SC628A	21J0142-20	Sediment	07/20/21
20	LDW21-IT670A	21J0142-22	Sediment	07/20/21
21	LDW21-IT621B	21J0142-23	Sediment	08/02/21
22	LDW21-SC628AMS	21J0142-20MS	Sediment	07/20/21
23	LDW21-SC628AMSD	21J0142-20MSD	Sediment	07/20/21
24				
25				
26				

Notes:

	BW0633						
	BW0636						

LDC #: 52703836

VALIDATION FINDINGS CHECKLIST

Method: ✓ GC __ HPLC

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
Were all technical holding times met?	✓			
Was cooler temperature criteria met?	✓			
IIa. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✓			
Were all percent relative standard deviations (%RSD) ≤ 20%?	✓			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥0.990?			✓	
Were the RT windows properly established?	✓			
IIb. Initial calibration verification				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	✓			
Were all percent differences (%D) ≤ 20%?	✓			
III. Continuing calibration				
Was a continuing calibration analyzed daily?	✓			
Were all percent differences (%D) ≤ 20%?	✓	✓		
Were all the retention times within the acceptance windows?	✓			
IV. Laboratory Blanks				
Was a laboratory blank associated with every sample in this SDG?	✓			
Was a laboratory blank analyzed for each matrix and concentration?	✓			
Was there contamination in the laboratory blanks?		✓		
V. Field Blanks				
Were field blanks identified in this SDG?		✓		
Were target compounds detected in the field blanks?			✓	
VI. Surrogate spikes				
Were all surrogate percent recovery (%R) within the QC limits?	✓			
If the percent recovery (%R) of one or more surrogates was outside QC limits, was a reanalysis performed to confirm %R?			✓	
If any %R was less than 10 percent, was a reanalysis performed to confirm %R?			✓	
VII. Matrix spike/Matrix spike duplicates				
Were matrix spike (MS) and matrix spike duplicate (MSD) analyzed in this SDG?	✓			
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?		✓		
VIII. Laboratory control samples				
Was an LCS analyzed per analytical or extraction batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	✓			

Validation Area	Yes	No	NA	Findings/Comments
IX. Field duplicates				
Were field duplicate pairs identified in this SDG?		✓		
Were target compounds detected in the field duplicates?			✓	
X. Compound quantitation				
Did the laboratory LOQs/RLs meet the QAPP LOQs/RLs?	✓			
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
XI. Target compound identification				
Were the retention times of reported detects within the RT windows?	✓			
XIII. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			

LDC #: 52703D3b

VALIDATION FINDINGS WORKSHEET
Continuing Calibration

Page: 1 of 1
Reviewer:

METHOD: ✓ **GC** __ **HPLC**

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

[✓ Y] N N/A Were continuing calibration standards analyzed at the required frequencies?

Y [✓ N] N/A Did the continuing calibration standards meet the %D validation criteria of ≤20.0%?

Level IV Only

[✓ Y] N N/A Were the retention times for all calibrated compounds within their respective acceptance windows?

#	Date	Standard ID	Detector/ Column	Compound	%D (Limit)	RT (limit)	Associated Samples	Qualifications
	10/27/21	10272115	2C	BB	24.6	( )	1, MB (dets)	J/UJ/A
						( )		(1C in)
						( )		
						( )		
						( )		
						( )		
						( )		
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LDC #: 52703D3b

VALIDATION FINDINGS WORKSHEET
Matrix Spike/Matrix Spike Duplicates

Page: 1 of 1
Reviewer:

METHOD: ✓ GC __ HPLC

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

[✓ Y] N N/A Were a matrix spike (MS) and matrix spike duplicate (MSD) analyzed for each matrix in this SDG?

[✓ Y] N N/A Was an MS/MSD analyzed every 20 samples for each matrix or whenever a sample extraction was performed?

Y [✓ N] N/A Were the MS/MSD percent recoveries (%R) and relative percent differences (RPD) within QC limits?

#	MS/MSD ID	Compound	MS %R (Limits)	MSD %R (Limits)	RPD (Limits)	Associated Samples	Qualifications
	22/23	BB	49.5 (58-120)	( )	( )	19 (dets)	J/UJ/A
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
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			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		

LDC #: 52703D3b

VALIDATION FINDINGS WORKSHEET
Compound Quantitation and Reported CRQLs

Reviewer: 9

METHOD: ___ GC ___ HPLC

Level IV/D Only

Y N N/A Were CRQLs adjusted for sample dilutions, dry weight factors, etc.?
Y N N/A Did the reported results for detected target compounds agree within 10.0% of the recalculated results?
Y N N/A Did the relative percent differences of detected compounds between two columns/detectors ≤40%?
If no, please see findings bellow.

#	Compound Name	Sample ID	%RPD Between Two Columns/Detectors Limit (≤ 40%)	Qualifications
	Aroclor 1260	13	42.3	Jdets/A
	Aroclor 1254	18	41.5	Jdets/A

LDC #: 52703D30

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Page: 1 of 1
Reviewer: 9

METHOD: GC ✓ HPLC _____

The calibration factors (CF) and relative standard deviation (%RSD) were recalculated using the following calculations:

CF = A/C
Average CF = sum of the CF/number of standards
%RSD = 100 * (S/X)

Where: A = Area of compound
C = Concentration of compound
S = Standard deviation of calibration factors
X = Mean of calibration factors

#	Standard ID	Calibration Date	Compound	Reported CF (100 std)	Recalculated CF (100 std)	Reported Ave CF (initial)	Recalculated Ave CF (intial)	Reported %RSD	Recalculated %RSD
1	LAC	8/13/21	BB-1 (1C)	0.0358713	0.0358713	0.0359933	0.0359933	2.6	2.6
			BB-1 (10C)	0.0687649	0.0687664	0.0665038	0.0665032	T.T	T.8
2									
3									
4									

Comments: Refer to Initial Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703D36

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Reviewer: 9

METHOD: ✓ GC_HPLC

The percent difference (%D) of the initial calibration average Calibration Factors (CF) and the continuing calibration CF were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. CF -CF)/ave.CF

Where: ave. CF = initial calibration average CF
CF = continuing calibration CF
A = Area of compound
C = Concentration of compound

#	Standard ID	Calibration Date	Compound	Average CF(Ical)/ CCV Conc.	Reported CF/ Conc. CCV	Recalculated CF/ Conc. CCV	Reported %D	Recalculated %D
1	102521	10/26/21	BB-1 (1C)	0.0359923	0.0317367	0.0317366	12.0	11.8
	~~3-4.6-13~~	2=19	BB-1 (2C)	0.0665032	0.0543594	0.0543593	18.4	18.3
	7-12							
2	10521133	10/26/21	↓	0.0359923	0.0307250	0.0307249	14.8	14.6
	~~14-20.22-23~~	6=24		0.0665032	0.0539980	0.0539979	18.8	18.8
	13-23.MB							
3	102521S	10/27/21	↓	0.0359923	0.0284107	0.0284106	21.2	21.1
	1	18=25		0.0665032	0.0482295	0.0482294	27.6	27.5
4	10521103	10/25/21	↓	0.0359923	0.0299229	0.0299229	16.8	16.9
	2	20=10		0.0665032	0.0547807	0.0547806	18.4	18.4

LDC #: 52703D36

VALIDATION FINDINGS WORKSHEET
Surrogate Results Verification

Reviewer: 9

METHOD: / GC __ HPLC

The percent recoveries (%R) of surrogates were recalculated for the compounds identified below using the following calculation:

% Recovery: SF/SS * 100

Where: SF = Surrogate Found
SS = Surrogate Spiked

Sample ID: 1

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	
DCB	1C	8.0	8.3	104	104	
TCMX	↓	↓	6.3	78.9	78.8	

Sample ID: _____

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	

Sample ID: _____

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	

LDC #: 52703D36

VALIDATION FINDINGS WORKSHEET
Matrix Spike/Matrix Spike Duplicates Results Verification

Reviewer: 9

METHOD: 1 GC __HPLC

The percent recoveries (%R) and relative percent differences (RPD) of the matrix spike and matrix spike duplicate were recalculated for the compounds identified below using the following calculation:

%Recovery = 100 * (SSC - SC)/SA Where SSC = Spiked sample concentration SC = Sample concentration
SA = Spike added

RPD =(({SSCMS - SSCMSD} * 2) / (SSCMS + SSCMSD))*100 MS = Matrix spike MSD = Matrix spike duplicate

MS/MSD samples: 22/23

Compound	Spike Added (ug/kg)		Sample Conc. (ug/kg)	Spike Sample Concentration (ug/kg)		Matrix spike Percent Recovery		Matrix Spike Duplicate Percent Recovery		MS/MSD RPD	
	MS	MSD	---	MS	MSD	Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
Gasoline (8015)											
Diesel (8015)											
Benzene (8021B)											
Methane (RSK-175)											
2,4-D (8151)											
Dinoseb (8151)											
Naphthalene (8310)											
Anthracene (8310)											
HMX (8330)											
2,4,6-Trinitrotoluene (8330)											
FB	101	101	15.4	65.4	67.1	49.5	49.5	51.2	51.2	2.50	2.57

Comments: Refer to Matrix Spike/Matrix Spike Duplicates findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 53603b36

VALIDATION FINDINGS WORKSHEET
Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification

Page: 1 of 1
Reviewer: Q

METHOD: ✓ GC __HPLC

The percent recoveries (%R) and relative percent differences (RPD) of the laboratory control sample and laboratory control sample duplicate were recalculated for the compounds identified below using the following calculation:

%Recovery = 100 * (SSC - SC)/SA Where SSC = Spiked sample concentration, SA = Spike added, SC = Sample concentration

RPD =(({SSCLCS - SSCLCSD} * 2) / (SSCLCS + SSCLCSD))*100 LCS = Laboratory Control Sample, LCSD = Laboratory Control Sample duplicate

LCS/LCSD samples: BN0633

Compound	Spike Added (mg/kg)		Spike Sample Concentration (mg/kg)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
Gasoline (8015)										
Diesel (8015)										
Benzene (8021B)										
Methane (RSK-175)										
2,4-D (8151)										
Dinoseb (8151)										
Naphthalene (8310)										
Anthracene (8310)										
HMX (8330)										
2,4,6-Trinitrotoluene (8330)										
BD	101	101	84.8	83.3	84.1	84.0	82.6	82.5	1.8	1.8

Comments: Refer to Laboratory Control Sample/Laboratory Control Sample Duplicate findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703D36

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: a

METHOD: 1 **GC** __ **HPLC**

Y N N/A Were all reported results recalculated and verified for all level IV samples?
Y N N/A Were all recalculated results for detected target compounds within 10% of the reported results?

Concentration= $\frac{(A)(Fv)(Df)}{(RF)(Vs \text{ or } Ws)(\%S/100)}$

A= Area or height of the compound to be measured
Fv= Final Volume of extract
Df= Dilution Factor
RF= Average response factor of the compound In the initial calibration
Vs= Initial volume of the sample
Ws= Initial weight of the sample
%S= Percent Solid

Example:

Sample ID. 1 Compound Name PCB-1260-1

Concentration = $\frac{(20224)(80.0)}{(398163)(0.0359933)} = 112.9$

conctotal= $\frac{(112.9+102.0+107.5+110.6+96.9)(2.5)(5)}{5 \times 20.93 \times 0.6001} = 111.4$ ug/kg

#	Sample ID	Compound	Reported Concentrations (ug/kg)	Recalculated Results Concentrations ( )	Qualifications
	1	PCB-1260	111		

Comments: _____

SAMPCAL.wpd

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Arsenic

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21J0142

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT582F	21J0142-05	Sediment	07/16/21
LDW21-IT600	21J0142-10	Sediment	07/19/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for Inorganic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Arsenic by Environmental Protection Agency (EPA) SW 846 Method 6020B

All sample results were subjected to Stage 4 evaluation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition.

All technical holding time requirements were met.

II. ICPMS Tune

The mass calibration was within 0.1 AMU and the percent relative standard deviation (%RSD) was less than or equal to 5%.

III. Instrument Calibration

Initial and continuing calibrations were performed as required by the method.

The initial calibration verification (ICV) and continuing calibration verification (CCV) standards were within QC limits.

IV. ICP Interference Check Sample Analysis

The frequency of interference check sample (ICS) analysis was met. All criteria were within QC limits.

V. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks.

VI. Field Blanks

No field blanks were identified in this SDG.

VII. Matrix Spike/Matrix Spike Duplicates

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

VIII. Duplicate Sample Analysis

The laboratory has indicated that there were no duplicate (DUP) analyses specified for the samples in this SDG, and therefore duplicate analyses were not performed for this SDG.

IX. Serial Dilution

Serial dilution was not performed for this SDG.

X. Laboratory Control Samples

Laboratory control samples (LCS) were analyzed as required by the method. Percent recoveries (%R) were within QC limits.

XI. Field Duplicates

No field duplicates were identified in this SDG.

XII. Internal Standards (ICP-MS)

All internal standard percent recoveries (%R) were within QC limits.

XIII. Target Analyte Quantitation

All target analyte quantitations were within validation criteria.

XIV. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

The quality control criteria reviewed were met and are considered acceptable.

Duwamish AOC4
Arsenic - Data Qualification Summary - SDG 21J0142

No Sample Data Qualified in this SDG

Duwamish AOC4
Arsenic - Laboratory Blank Data Qualification Summary - SDG 21J0142

No Sample Data Qualified in this SDG

Duwamish AOC4
Arsenic - Field Blank Data Qualification Summary - SDG 21J0142

No Sample Data Qualified in this SDG

LDC #: 52703D4a **VALIDATION COMPLETENESS WORKSHEET** Date: 12/9/21
SDG #: 21J0142 Stage 4 Page: 1 of 1
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer: [illegible]
2nd Reviewer: [illegible]

METHOD: Arsenic (EPA SW846 Method 6020B)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A-lA	
II.	ICP/MS Tune	A	
III.	Instrument Calibration	A	
IV.	ICP Interference Check Sample (ICS) Analysis	A	
V.	Laboratory Blanks	A	
VI.	Field Blanks	N	
VII.	Matrix Spike/Matrix Spike Duplicates	N	
VIII.	Duplicate sample analysis	N	
IX.	Serial Dilution	N	
X.	Laboratory control samples	A	LCS
XI.	Field Duplicates	N	
XII.	Internal Standard (ICP-MS)	A	
XIII.	Target Analyte Quantitation	A	
XIV.	Overall Assessment of Data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	LDW21-IT582F	21J0142-05	Sediment	07/16/21
2	LDW21-IT600	21J0142-10	Sediment	07/19/21
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				

Notes:

METHOD: Trace Metals (EPA SW 846 Methods 6010/6020/7000)				
Validation Area	**Yes**	**No**	**NA**	**Comments**
I. Technical holding times				
Were all technical holding times met?	X			
Were all water samples preserved to a pH of <2?			X	
II. ICP-MS Tune				
Were mass resolutions within 0.1 amu for all isotopes in the tuning solution?	X			
Were %RSDs of isoptoes in the tuning solution ≤5%?	X			
III. Calibration				
Were all instuments calibrated daily?	X			
Were the proper standards used?	X			
Were all initial and continuing calibration verifications within the 90-110% (80-120% for mercury) QC limits?	X			
Were the low level standard checks within 70-130%?			X	
Were all initial calibration correlation coefficients within limits as specifed by the method?	X			
IV. Blanks				
Was a method blank associated with every sample in this SDG?	X			
Was there contamination in the method blanks?		X		
Was there contamination in the initial and continuing calibration blanks?		X		
V. Interference Check Sample				
Were the interference check samples performed daily?	X			
Were the AB solution recoveries within 80-120%?	X			
VI. Matrix Spike/Matrix Spike Duplicates/Laboratory Duplicates				
Were MS/MSD recoveries with the QC limits? (If the sample concentration exceeded the spike concentration by a factor of 4, no action was taken.)			X	
Were the MS/MSD or laboratory duplicate relative percent differences (RPDs) within the QC limits?			X	
VII. Laboratory Control Samples				
Was a LCS analyzed for each batch in the SDG?	X			
Were the LCS recoveries and RPDs (if applicable) within QC limits?	X			

METHOD: Trace Metals (EPA SW 846 Methods 6010/6020/7000)				
Validation Area	**Yes**	**No**	**NA**	**Comments**
VIII. Internal Standards				
Were all percent recoveries within the 30-120% (60-125% for EPA Method 200.8) QC limits?	X			
If the recoveries were outside the limits, was a reanalysis performed?		X		
IX. Serial Dilution				
Were all percent differences <10%?			X	
Was there evidence of negative interference? If yes, professional judgement will be used to qualify the data.			X	
X. Sample Result Verification				
Were all reporting limits adjusted to reflect sample dilutions?	X			
Were all soil samples dry weight corrected?	X			
XI. Overall Assessment of Data				
Was the overall assessment of the data found to be acceptable?	X			
XII. Field Duplicates				
Were field duplicates identifed in this SDG?		X		
Were target analytes detected in the field duplicates?			X	
XIII. Field Blanks				
Were field blanks identified in this SDG?		X		
Were target analytes detected in the field blanks?			X	

METHOD: Trace Metals (EPA SW 846 Methods 6010/6020/7000)

An intial calibration verification (ICV), continuing calibration verification (CCV), low level calibration check (LLCC), and interference check sample (ICSAB) percent recovery (%R) was recalculated for each type of analysis using the following formula:

%R = (Found/True) x 100

Found = concentration of each analyte measured in the analysis

True = concentration of each analyte in the source

Standard ID	Type of Analysis	Element	Found (ug/L)	True (ug/L)	Recalcuated %R	Reported %R	Acceptable (Y/N)
ICV	ICP-MS	As	47.7	50	95.4	95.5	Y
CCV	ICP-MS	Cd	49.8	50	99.6	99.6	Y
ICSAB	ICP-MS	As	19.283	20	96.4	96.4	Y

ICP-MS Tune	QC Parameter	Mass	Actual	Required
10/28/2021	Mass Axis	115	114.9	± 0.1 amu
10/28/2021	%RSD	115	1	≤ 5%

METHOD: Trace Metals (EPA SW 846 Methods 6010/6020/7000)

Percent recoveries (%R) for the laboratory control sample (LCS), matrix spike (MS), and post digestion spike (PDS) were recalculated using the following formula:

%R = (Found/True) x 100

Found = concentration of each analyte measured in the analysis. For the MS calculation, Found = SSR (Spiked Sample Result) - SR (Sample Result)

True = concentration of each analyte in the source

The sample and duplicate relative percent difference (RPD) was recalculated using the following formula:

RPD = (Absolute value(S-D)x 200) / (S+D)

S = Original sample concentration

D = Duplicate sample concentration

The serial dilution percent difference (%D) was recalculated using the following formula.

%D = (Absolute value (I - SDR)) x 100 / (I)

I = Initial sample result

SDR = Serial dilution result (with a 5x dilution applied)

Sample ID	Type of Analysis	Element	Found/S/I	True/D/SDR	Recalcuated %R/RPD/%D	Reported %R/RPD/%D	Acceptable (Y/N)
LCS	LCS	As	24.1	25	96.4	96.5	Y
	MS						
	Duplicate						
	PDS						
	Serial dilution						

VALIDATION FINDINGS CHECKLIST
Sample Calculation Verification

METHOD: Trace Metals (EPA SW 846 Methods 6010/6020/7000)
Analytes were recalculated and verified using the following equation:
Concentration = (Result from raw data x Final volume x Dilution factor) / (Percent solids x Initial weight)

Sample ID	Analyte	Raw Data (ug/L)	Dilution	Initial Weight/ Volume (g)	Final Volume (mL)	Percent solids (%)	Reported Result (mg/Kg)	Recalcuated Result (mg/Kg)	Acceptable (Y/N)
1	As	145.395	20	1.095	50	77.33	172	172	Y
2	As	9.383	20	1.039	50	63.97	14.1	14.1	Y

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Wet Chemistry

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21J0142

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-SC525	21J0142-01	Sediment	07/15/21
LDW21-SS500	21J0142-02	Sediment	07/16/21
LDW21-SS501	21J0142-03	Sediment	07/16/21
LDW21-SS502	21J0142-04	Sediment	07/16/21
LDW21-IT582F	21J0142-05	Sediment	07/16/21
LDW21-IT579C	21J0142-06	Sediment	07/16/21
LDW21-IT597A	21J0142-07	Sediment	07/16/21
LDW21-IT597D	21J0142-08	Sediment	07/16/21
LDW21-SC673A	21J0142-09	Sediment	07/19/21
LDW21-IT600	21J0142-10	Sediment	07/19/21
LDW21-IT665D	21J0142-11	Sediment	07/19/21
LDW21-IT666D	21J0142-12	Sediment	07/19/21
LDW21-SS541	21J0142-13	Sediment	07/21/21
LDW21-IT512	21J0142-14	Sediment	07/19/21
LDW21-IT663D	21J0142-15	Sediment	07/19/21
LDW21-SC500	21J0142-16	Sediment	07/20/21
LDW21-SC501	21J0142-17	Sediment	07/20/21
LDW21-SC502	21J0142-18	Sediment	07/20/21
LDW21-SC563A	21J0142-19	Sediment	07/20/21
LDW21-SC628A	21J0142-20	Sediment	07/20/21
LDW21-IT664A	21J0142-21	Sediment	07/20/21
LDW21-IT670A	21J0142-22	Sediment	07/20/21
LDW21-IT621B	21J0142-23	Sediment	08/02/21
LDW21-IT665DMS	21J0142-11MS	Sediment	07/19/21
LDW21-IT665DDUP	21J0142-11DUP	Sediment	07/19/21
LDW21-SC563ADUP1	21J0142-19DUP1	Sediment	07/20/21

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-SC563ADUP2	21J0142-19DUP2	Sediment	07/20/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for Inorganic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following methods:

Total Organic Carbon by Environmental Protection Agency (EPA) SW 846 Method 9060A
Total Solids by Standard Method 2540G

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition.

All technical holding time requirements were met.

II. Initial Calibration

All criteria for the initial calibration of each method were met.

III. Continuing Calibration

Continuing calibration frequency and analysis criteria were met for each method when applicable.

IV. Laboratory Blanks

Laboratory blanks were analyzed as required by the methods. No contaminants were found in the laboratory blanks.

V. Field Blanks

No field blanks were identified in this SDG.

VI. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits.

VII. Duplicate Sample Analysis

Duplicate (DUP) sample analysis was performed on an associated project sample. Results were within QC limits.

VIII. Laboratory Control Samples

Laboratory control samples (LCS) were analyzed as required by the methods. Percent recoveries (%R) were within QC limits.

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Target Analyte Quantitation

All target analyte quantitations were within validation criteria.

XI. Overall Assessment of Data

The analysis was conducted within all specifications of the methods. No results were rejected in this SDG.

The quality control criteria reviewed were met and are considered acceptable.

Duwamish AOC4
Wet Chemistry - Data Qualification Summary - SDG 21J0142

No Sample Data Qualified in this SDG

Duwamish AOC4
Wet Chemistry - Laboratory Blank Data Qualification Summary - SDG 21J0142

No Sample Data Qualified in this SDG

Duwamish AOC4
Wet Chemistry - Field Blank Data Qualification Summary - SDG 21J0142

No Sample Data Qualified in this SDG

LDC #: 52703D6 **VALIDATION COMPLETENESS WORKSHEET** Date: 12/9/21
SDG #: 21J0142 Stage 4 Page: 1 of 2
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer: CA
2nd Reviewer: CA

METHOD: (Analyte) TOC (EPA SW846 Method 9060A), Total Solids (SM2540G)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A/A	
II	Initial calibration	A	
III.	Calibration verification	A	
IV	Laboratory Blanks	A	
V	Field blanks	N	
VI.	Matrix Spike/Matrix Spike Duplicates	A	
VII.	Duplicate sample analysis	A	
VIII.	Laboratory control samples	A	LCS
IX.	Field duplicates	N	
X.	Target Analyte Quantitation	A	
XI	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	LDW21-SC525	21J0142-01	Sediment	07/15/21
2	LDW21-SS500	21J0142-02	Sediment	07/16/21
3	LDW21-SS501	21J0142-03	Sediment	07/16/21
4	LDW21-SS502	21J0142-04	Sediment	07/16/21
5	LDW21-IT582F	21J0142-05	Sediment	07/16/21
6	LDW21-IT579C	21J0142-06	Sediment	07/16/21
7	LDW21-IT597A	21J0142-07	Sediment	07/16/21
8	LDW21-IT597D	21J0142-08	Sediment	07/16/21
9	LDW21-SC673A	21J0142-09	Sediment	07/19/21
10	LDW21-IT600	21J0142-10	Sediment	07/19/21
11	LDW21-IT665D	21J0142-11	Sediment	07/19/21
12	LDW21-IT666D	21J0142-12	Sediment	07/19/21
13	LDW21-SS541	21J0142-13	Sediment	07/21/21
14	LDW21-IT512	21J0142-14	Sediment	07/19/21
15	LDW21-IT663D	21J0142-15	Sediment	07/19/21
16	LDW21-SC500	21J0142-16	Sediment	07/20/21
17	LDW21-SC501	21J0142-17	Sediment	07/20/21

LDC #: 52703D6 **VALIDATION COMPLETENESS WORKSHEET** Date: 12/9/21
SDG #: 21J0142 Stage 4 Page: 2 of 2
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer: [illegible]
2nd Reviewer: [illegible]

METHOD: (Analyte) TOC (EPA SW846 Method 9060A), Total Solids (SM2540G)

	Client ID	Lab ID	Matrix	Date
18	LDW21-SC502	21J0142-18	Sediment	07/20/21
19	LDW21-SC563A	21J0142-19	Sediment	07/20/21
20	LDW21-SC628A	21J0142-20	Sediment	07/20/21
21	LDW21-IT664A	21J0142-21	Sediment	07/20/21
22	LDW21-IT670A	21J0142-22	Sediment	07/20/21
23	LDW21-IT621B	21J0142-23	Sediment	08/02/21
24	LDW21-IT665DMS	21J0142-11MS	Sediment	07/19/21
25	LDW21-IT665DDUP	21J0142-11DUP	Sediment	07/19/21
26	LDW21-SC563ADUP \	21J0142-19DUP \	Sediment	07/20/21
27	LDW21-SC563ATRP DUP	21J0142-19TRP DUP	Sediment	07/20/21
28				
29				
30				

Notes:

METHOD: Inorganics				
Validation Area	**Yes**	**No**	**NA**	**Comments**
I. Technical holding times				
Were all technical holding times were met?	X			Frozen
II. Calibration				
Were all instuments calibrated at the requried frequency?	X			
Were the proper number of standards used?	X			
Were all initial and continuing calibration verifications within the QC limits?	X			
Were all initial calibration correlation coefficients within limits as specifed by the method?	X			
Were balance checks performed as required?	X			
III. Blanks				
Was a method blank assoicated with every sample in this SDG?	X			
Was there contamination in the method blanks?		X		
Was there contamination in the initial and continuing calibration blanks?		X		
IV. Matrix Spike/Matrix Spike Duplicates/Laboratory Duplicates				
Were MS/MSD recoveries with the QC limits? (If the sample concentration exceeded the spike concentration by a factor of 4, no action was taken.)	X			
Were the MS/MSD or laboratory duplicate relative percent differences (RPDs) within the QC limits?	X			
V. Laboratory Control Samples				
Was a LCS analyzed for each batch in the SDG?	X			
Were the LCS recoveries and RPDs (if applicable) within QC limits?	X			
X. Sample Result Verification				
Were all reproting limits adjusted to reflect sample dilutions?	X			
Were all soil samples dry weight corrected?	X			
XI. Overall Assessment of Data				
Was the overall assessment of the data found to be acceptable?	X			

METHOD: Inorganics				
Validation Area	**Yes**	**No**	**NA**	**Comments**
XII. Field Duplicates				
Were field duplicates identifed in this SDG?		X		
Were target analytes detected in the field duplicates?			X	
XIII. Field Blanks				
Were field blanks identified in this SDG?		X		
Were target analytes detected in the field blanks?			X	

All elements are applicable to each sample as noted below.

Sample ID	Target Analyte List
All	TS, TOC
QC:	
24, 25	TOC
26, 27	TS

LDC #: 52703D6

Validation Findings Worksheet
Initial and Continuing Calibration Calculation Verification

Method: Inorganics, Method See Cover

An initial or continuing calibration verification percent recovery (%R) was recalculated for each type of analysis using the following formula:

%R = Found X 100 / True

Where, Found = concentration of each analyte measured in the analysis of the ICV or CCV solution

True = concentration of each analyte in the ICV or CCV source

Calibration verification	TOC	ICV	44.446	47.154	106	106	Y
Calibration verification	TOC	CCV	44.446	45.03	101	101	Y
Calibration verification	TOC	CCV	44.446	46.741	105	105	Y

Comments:

METHOD: Inorganics

Percent recoveries (%R) for the laboratory control sample (LCS) and matrix spike (MS) were recalcuated using the following formula.
%R = (Found/True) x 100
Found = concentration of each analyte measured in the analysis. For the MS calculation, Found = SSR (Spiked Sample Result) - SR (Sample Result)
True = concentraiton of each analyte in the source
The sample and duplciate relative percent difference (RPD) was recalcuated using the following formula.
RPD = (Absolute value(S-D)x 200) / (S+D)
S = Original sample concentraiton
D = Duplciate sample concentration

Sample ID	Type of Analysis	Element	Found/S	True/D	Recalcuated %R/RPD	Reported %R/RPD	Acceptable (Y/N)
LCS	LCS	TOC	44.8	44.4	101	101	Y
24	MS	TOC	1.03	1.04	99	99	Y
26	Duplicate	TS	64	63.25	1.18	1.18	Y

METHOD: Inorganics

Analytes were recalcuated and verified using the following equation.

Concentration = (Result from raw data x Final volume x Dilution factor) / (Percent solids (if applicable) x Initial weight or volume)

Sample ID	Analyte	Raw Data (%)	Dry (g)	Sample Dry (g)	Tare (g)	Percent solids (%)	Reported Result (%)	Recalcuated Result (mg/Kg)	Acceptable (Y/N)
1	TOC	0.824				61.55	1.34	1.34	Y
2	TOC	0.847				53.6	1.58	1.58	Y
3	TOC	0.907				56.93	1.59	1.59	Y
4	TOC	0.874				54.59	1.6	1.60	Y
5	TOC	0.041				77.33	0.05	0.05	Y
7	TOC	0.921				61.82	1.49	1.49	Y
8	TOC	0.128				78.88	0.16	0.16	Y
9	TOC	1.411				40.37	3.5	3.50	Y
10	TOC	1.764				63.97	2.76	2.76	Y
11	TOC	1.552				67.65	2.29	2.29	Y
12	TOC	0.118				76.2	0.15	0.15	Y
13	TOC	0.862				60.03	1.44	1.44	Y
14	TOC	0.749				57.81	1.3	1.30	Y
15	TS		4.7093	5.7781	0.8102		78.49	78.49	Y
16	TS		3.3018	5.1603	0.785		57.52	57.52	Y
17	TS		2.9912	4.6706	0.7811		56.82	56.82	Y
18	TS		3.5492	5.5482	0.8018		57.88	57.88	Y
19	TS		2.7745	3.887	0.797		64	64.00	Y
20	TS		3.1444	4.5128	0.7922		63.22	63.22	Y
21	TS		2.5591	3.4678	0.8036		65.89	65.89	Y
22	TS		4.2175	5.3601	0.7958		74.97	74.97	Y
23	TS		3.8543	4.3906	0.8028		85.05	85.05	Y

LDC Report# 52703D21

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Polychlorinated Dioxins/Dibenzofurans

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21J0142

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT665D	21J0142-11	Sediment	07/19/21
LDW21-IT663D	21J0142-15	Sediment	07/19/21
LDW21-IT664A	21J0142-21	Sediment	07/20/21
LDW21-IT621B	21J0142-23	Sediment	08/02/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for High Resolution Superfund Methods Data Review (April 2016). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Polychlorinated Dioxins/Dibenzofurans by Environmental Protection Agency (EPA) Method 1613B

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered not detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. HRGC/HRMS Instrument Performance Check

Instrument performance was checked at the required frequency.

Retention time windows were established for all homologues. The chromatographic resolution between 2,3,7,8-TCDD and peaks representing any other unlabeled TCDD isomer was less than or equal to 25%.

The static resolving power was at least 10,000 (10% valley definition).

III. Initial Calibration and Initial Calibration Verification

A five point initial calibration was performed as required by the method.

The percent relative standard deviations (%RSD) were less than or equal to 20.0% for all analytes and less than or equal to 35.0% for labeled compounds.

The ion abundance ratios for all PCDDs and PCDFs were within validation criteria.

The minimum S/N ratio was greater than or equal to 10 for each analyte and labeled compound.

The percent differences (%D) of the initial calibration verification (ICV) standard were within the QC limits for all analytes and labeled compounds.

IV. Continuing Calibration

Continuing calibration was performed at the required frequencies.

All of the continuing calibration results were within the QC limits for all analytes and labeled compounds.

The ion abundance ratios for all PCDDs and PCDFs were within validation criteria.

The minimum S/N ratio was greater than or equal to 10 for each analyte and labeled compound.

V. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks with the following exceptions:

Blank ID	Extraction Date	Analyte	Concentration	Associated Samples
BJJ0500-BLK1	10/19/21	OCDD Total HxCDF	0.981 ng/Kg 0.100 ng/Kg	All samples in SDG 21J0142

Sample concentrations were compared to concentrations detected in the laboratory blanks. The sample concentrations were either not detected or were significantly greater than the concentrations found in the associated laboratory blanks with the following exceptions:

Sample	Analyte	Reported Concentration	Modified Final Concentration
LDW21-IT621B	Total HxCDF	0.184 ng/Kg	0.184J ng/Kg

VI. Field Blanks

No field blanks were identified in this SDG.

VII. Matrix Spike/Matrix Spike Duplicates

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

VIII. Laboratory Control Samples/Standard Reference Materials

Laboratory control samples (LCS) were analyzed as required by the method. Percent recoveries (%R) were within QC limits.

Standard reference materials (SRM) were analyzed as required by the method. The results were within QC limits.

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Internal Standards

All internal standard areas and retention times were within QC limits.

XI. Target Analyte Quantitation

All target analyte quantitations met validation criteria with the following exceptions:

Sample	Analyte	Flag	A or P
All samples in SDG 21J0142	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U	A
All samples in SDG 21J0142	All analytes flagged "X" due to chlorinated diphenyl ether (CDPE) interference.	J (all detects)	A

XII. Target Analyte Identification

All target analyte identifications met validation criteria.

XIII. System Performance

The system performance was acceptable.

XIV. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

Due to results reported by the laboratory as EMPCs and CDPE interference, data were qualified as estimated in four samples.

Due to laboratory blank contamination, data were qualified as not detected in one sample.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable.

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Data Qualification Summary - SDG 21J0142

Sample	Analyte	Flag	A or P	Reason
LDW21-IT665D LDW21-IT663D LDW21-IT664A LDW21-IT621B	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U	A	Target analyte quantitation (EMPC)
LDW21-IT665D LDW21-IT663D LDW21-IT664A LDW21-IT621B	All analytes flagged "X" due to chlorinated diphenyl ether (CDPE) interference.	J (all detects)	A	Target analyte quantitation (CDPE interference)

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Laboratory Blank Data Qualification Summary - SDG 21J0142

Sample	Analyte	Modified Final Concentration	A or P
LDW21-IT621B	Total HxCDF	0.184J ng/Kg	A

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Field Blank Data Qualification Summary - SDG 21J0142

No Sample Data Qualified in this SDG

LDC #: 52703D21
SDG #: 21J0142
Laboratory: Analytical Resources, Inc., Tukwila, WA

VALIDATION COMPLETENESS WORKSHEET
Stage 4

Date: 1/9/21
Page: 1 of 1
Reviewer: [illegible]
2nd Reviewer: JMB

METHOD: HRGC/HRMS Polychlorinated Dioxins/Dibenzofurans (EPA Method 1613B)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A	
II.	HRGC/HRMS Instrument performance check	A	
III.	Initial calibration/ICV	A/A	RSD ≤ 20/35% ICV ≤ QC limits
IV.	Continuing calibration	A	CCV ≤ QC limits
V.	Laboratory Blanks	SW	
VI.	Field blanks	N	
VII.	Matrix spike/Matrix spike duplicates	N	CS
VIII.	Laboratory control samples / SRM	A	LCS
IX.	Field duplicates	N	
X.	Internal standards	A	
XI.	Target analyte quantitation	A	
XII.	Target analyte identification	A	
XIII.	System performance	A	
XIV.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	LDW21-IT665D	21J0142-11	Sediment	07/19/21
2	LDW21-IT663D	21J0142-15	Sediment	07/19/21
3	LDW21-IT664A	21J0142-21	Sediment	07/20/21
4	LDW21-IT621B	21J0142-23	Sediment	08/02/21
5				
6				
7				
8				
9				
10				

Notes:

	BH0500-BK1						

LDC #: 52703D2

VALIDATION FINDINGS CHECKLIST

Page: 1 of 2
Reviewer: 9

Method: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
All technical holding times were met.	√			
Cooler temperature criteria were met.	√			
II. GC/MS Instrument performance check				
Was PFK exact mass 380.9760 verified?	√			
Were the retention time windows established for all homologues?	√			
Was the chromatographic resolution between 2,3,7,8-TCDD and peaks representing any other unlabeled TCDD isomers ≤ 25%?	√			
Is the static resolving power at least 10,000 (10% valley definition)?	√			
Was the mass resolution adequately check with PFK?	√			
Was the presence of 1,2,8,9-TCDD and 1,3,4,6,8-PeCDF verified?	√			
III. Initial calibration and Initial calibration verification				
Was the initial calibration performed at 5 concentration levels?	√			
Were all percent relative standard deviations (%RSD) ≤ 20% for unlabeled compounds and ≤ 35% for unlabeled compounds?	√			
Did all calibration standards meet the Ion Abundance Ratio criteria?	√			
Was the signal to noise ratio for each target compound and labeled compound ≥ 10?	√			
Was an initial calibration verification (ICV) standard analyzed after each initial calibration for each instrument?	√			
Were all ICV concentrations for the unlabeled and labeled compounds within QC limits?	√			
IV. Continuing calibration				
Was a continuing calibration performed at the beginning of each 12-hour period?	√			
Were all continuing calibration concentrations for the unlabeled and labeled compounds within QC limits?	√			
Did all continuing calibration standards meet the Ion Abundance Ratio criteria?	√			
V. Blanks				
Was a method blank associated with every sample in this SDG?	√			
Was a method blank performed for each matrix and whenever a sample extraction was performed?	√			
Was there contamination in the method blanks?	V	D		
VI. Field blanks				
Were field blanks identified in this SDG?		√		
Were target compounds detected in the field blanks?			√	
VII. Matrix spike/Matrix spike duplicates				
Were matrix spike (MS) and matrix spike duplicate (MSD) analyzed in this SDG?		√		
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?			√	

Validation Area	Yes	No	NA	Findings/Comments
VIII. Laboratory control samples				
Was an LCS analyzed per extraction batch?	√			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	√			
IX. Field duplicates				
Were field duplicate pairs identified in this SDG?		√		
Were target compounds detected in the field duplicates?			√	
X. Labeled Compounds				
Were labeled compounds within QC limits?	V	D		
Was the minimum S/N ratio of all labeled compound peaks ≥ 10?	√			
XI. Compound quantitation				
Did the laboratory LOQs/RLs meet the QAPP LOQs/RLs?	√			
Were the correct labeled compound, quantitation ion and relative response factor (RRF) used to quantitate the compound?	√			
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	√			
XII. Target compound identification				
For 2,3,7,8 substituted congeners with associated labeled standards, were the retention times of the two quantitation peaks within -1 to 3 sec. of the RT of the labeled standard?	√			
For 2,3,7,8 substituted congeners without associated labeled standards, were the relative retention times of the two quantitation peaks within 0.005 time units of the RRT measured in the routine calibration?	√			
For non-2,3,7,8 substituted congeners, were the retention times of the two quantitation peaks within RT established in the performance check solution?	√			
Did selected ion current profile (SICP) contain all characteristic ions listed in Method 1613B, Table 8?	√			
Was the Ion Abundance Ratio for the two quantitation ions within criteria?		√		
Was the signal to noise ratio for each target compound ≥2.5 and ≥10 for the labeled compound?	√			
Does the maximum intensity of each specified characteristic ion coincide within ± 2 seconds (includes labeled standards)?	√			
For PCDF identification, was any signal (S/N ≥ 2.5, at ± seconds RT) detected in the corresponding PCDPE channel?			√	
Was an acceptable lock mass recorded and monitored?	√			
XIII. System performance				
System performance was found to be acceptable.	√			
XIV. Overall assessment of data				
Overall assessment of data was found to be acceptable.	√			

VALIDATION FINDINGS WORKSHEET

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

A. 2,3,7,8-TCDD	F. 1,2,3,4,6,7,8-HpCDD	K. 1,2,3,4,7,8-HxCDF	P. 1,2,3,4,7,8,9-HpCDF	U. Total HpCDD
B. 1,2,3,7,8-PeCDD	G. OCDD	L. 1,2,3,6,7,8-HxCDF	Q. OCDF	V. Total TCDF
C. 1,2,3,4,7,8-HxCDD	H. 2,3,7,8-TCDF	M. 2,3,4,6,7,8-HxCDF	R. Total TCDD	W. Total PeCDF
D. 1,2,3,6,7,8-HxCDD	I. 1,2,3,7,8-PeCDF	N. 1,2,3,7,8,9-HxCDF	S. Total PeCDD	X. Total HxCDF
E. 1,2,3,7,8,9-HxCDD	J. 2,3,4,7,8-PeCDF	O. 1,2,3,4,6,7,8-HpCDF	T. Total HxCDD	Y. Total HpCDF

Notes:_____

LDC #: 57037

VALIDATION FINDINGS WORKSHEET
Blanks

Reviewer: VL

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

(Y) N N/A Were all samples associated with a method blank?
(Y) N N/A Was a method blank performed for each matrix and whenever a sample extraction was performed?
(Y) N N/A Was the method blank contaminated?

Blank extraction date: 10/19/21 **Blank analysis date:** 10/25/21 **Associated samples:** All

Conc. units: pg/g

Compound	Blank ID	Sample Identification								
BLK	500-BLK1	A								
4	0.981									
X	0.100		0.184 J							

Blank extraction date: _____ **Blank analysis date:** _____

Conc. units: _____ Associated Samples: _____

Compound	Blank ID	Sample Identification								

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT:
All contaminants within five times the method blank concentration were qualified as not detected, "U".

LDC #: 52703D21

VALIDATION FINDINGS WORKSHEET
Compound Quantitation and Reported RLs

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y N N/A Were the correct labeled compound, quantitation ions and relative response factors (RRF) used to quantitate the compound?
Y N N/A Compound quantitation and RLs were adjusted to reflect all sample dilutions and dry weight factors (if necessary).

#	Date	Sample ID	Finding	Associated Samples	Qualifications
		All	All compounds reported as estimated maximum possible concentration (EMPC) < RL		U/A
		All	All compounds flagged "X" due to chlorinated diphenyl ether interference		Jdets/A

Comments: See sample calculation verification worksheet for recalculations

LDC #: 52703D21

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Reviewer: PG

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

The Relative Response Factor (RRF), average RRF, and percent relative standard deviation (%RSD) were recalculated for the compounds identified below using the following calculations:

$RRF = (A_x)(C_{is})/(A_{is})(C_x)$
average RRF = sum of the RRFs/number of standards
%RSD = 100 * (S/X)

A_x = Area of compound,
C_x = Concentration of compound,
S = Standard deviation of the RRFs,

A_{is} = Area of associated internal standard
C_{is} = Concentration of internal standard
X = Mean of the RRFs

#	Standard ID	Calibration Date	Compound (Reference Internal Standard)	Reported RRF (10/50 std)	Recalculated RRF (10/50 std)	Reported Average RRF (initial)	Recalculated Average RRF (initial)	Reported %RSD	Recalculated %RSD
1	ICAL	8/11/21	2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)	1.0832006	1.083746	1.107593	1.107593	3.6	3.6
	01		2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)	0.9085186	0.908390	0.9202875	0.9202874	3.1	3.1
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)	1.005616	1.005605	1.00898	1.00898	1.0	1.0
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)	1.051009	1.051062	1.068088	1.068088	6.6	6.6
			OCDF (^{13}C-OCDD)	1.440564	1.44059	1.44690	1.44690	5.7	5.7
2			2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)						
			2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)						
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)						
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)						
			OCDF (^{13}C-OCDD)						
3			2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)						
			2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)						
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)						
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)						
			OCDF (^{13}C-OCDD)						

Comments: Refer to Initial Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703C2

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Page: 1 of 1
Reviewer: 9

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

The percent difference (%D) of the initial calibration average Relative Response Factors (RRFs) and the continuing calibration RRFs were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. RRF - RRF)/ave. RRF
$RRF = (A_x)(C_{is})/(A_{is})(C_x)$

Where: ave. RRF = initial calibration average RRF
RRF = continuing calibration RRF
A_x = Area of compound, A_{is} = Area of associated internal standard
C_x = Concentration of compound, C_{is} = Concentration of internal standard

#	Standard ID	Calibration Date	Compound (Reference Internal Standard)	Average RRF (initial)	Reported Conc (CC)	Recalculated Conc (CC)	Reported %D	Recalculated %D
1	2110505A	10/25/21	2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)	1.10T593	1.0T45550	1.0T46175	3.0	3.0
			2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)	0.9T028T5	1.0081390	1.0081532	9.5	9.5
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)	1.00898	1.06883T0	1.0683T44	5.9	5.9
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)	1.068088	1.1679010	1.16T8182	9.3	9.3
			OCDF (^{13}C-OCDF)	1.44690	1.338=880	1.338548	T.5	T.5
2	2110518	10/26/21	2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)	1.10T593	1.0T13550	1.0T13484	3.3	3.3
			2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)	0.9=0=8T5	1.0205990	1.0206664	10.9	10.9
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)	1.00898	1.0288T00	1.0=8884	2.0	2.0
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)	1.068088	1.13=86T0	1.13=8398	6.1	6.1
			OCDF (^{13}C-OCDF)	1.44690	1.3304=60	1.330458	8.0	8.0
3			2,3,7,8-TCDF (^{13}C-2,3,7,8-TCDF)					
			2,3,7,8-TCDD (^{13}C-2,3,7,8-TCDD)					
			1,2,3,6,7,8-HxCDD (^{13}C-1,2,3,6,7,8-HxCDD)					
			1,2,3,4,6,7,8-HpCDD (^{13}C-1,2,4,6,7,8,-HpCDD)					
			OCDF (^{13}C-OCDF)					

Comments: Refer to Routine Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703D2

VALIDATION FINDINGS WORKSHEET
Laboratory Control Sample Results Verification

Reviewer: A

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

The percent recoveries (%R) and Relative Percent Difference (RPD) of the laboratoy control sample and laboratory control sample duplicate (if applicable) were recalculated for the compounds identified below using the following calculation:

% Recovery = 100 * SSC/SA Where: SSC = Spiked sample concentration
SA = Spike added

RPD = | LCS - LCSD | * 2/(LCS + LCSD) LCS = Laboraotry control sample percent recovery LCSD = Laboratory control sample duplicate percent recovery

LCS ID: BH0500-BS

Compound	Spike Added (ng/kg)		Spiked Sample Concentration (ng/kg)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc	Reported	Recalc	Reported	Recalculated
2,3,7,8-TCDD	20.0	NA	21.0	NA	105	105 NA				
1,2,3,7,8-PeCDD	100		101		101	101				
1,2,3,4,7,8-HxCDD			99.2		99.2	99.2				
1,2,3,4,7,8,9-HpCDF			95.9		95.9	95.9				
OCDF	200		151		T5.5	T5.5				

Comments: Refer to Laboratory Control Sample findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703D2

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

METHOD: HRGC/HRMS Dioxins/Dibenzofurans (EPA Method 1613B)

Y N N/A Were all reported results recalculated and verified for all level IV samples?
Y N N/A Were all recalculated results for detected target compounds agree within 10.0% of the reported results?

Concentration = $\frac{(A_x)(I_s)(DF)}{(A_{is})(RRF)(V_o)(\%S)}$

A_x = Area of the characteristic ion (EICP) for the compound to be measured

A_{is} = Area of the characteristic ion (EICP) for the specific internal standard

I_s = Amount of internal standard added in nanograms (ng)

V_o = Volume or weight of sample extract in milliliters (ml) or grams (g).

RRF = Relative Response Factor (average) from the initial calibration

Df = Dilution Factor.

%S = Percent solids, applicable to soil and solid matrices only.

Example:

Sample I.D. 1 , D :

Conc. = $\frac{(3.004e3+3.68e3)(\quad)}{(2.743e5+2.205e5)(1.00898)(\quad)}$

= 2.26 NS/kg

#	Sample ID	Compound	Reported Concentration (NS/kg)	Calculated Concentration ( )	Acceptable (Y/N)
	1	D	2.26		

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Polychlorinated Biphenyls

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila

Sample Delivery Group (SDG): 21K0332

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT637A	21K0332-01	Sediment	07/06/21
LDW21-IT637AMS	21K0332-01MS	Sediment	07/06/21
LDW21-IT637AMSD	21K0332-01MSD	Sediment	07/06/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for Organic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Polychlorinated Biphenyls (PCBs) by Environmental Protection Agency (EPA) SW 846 Method 8082A

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

The percent relative standard deviations (%RSD) were less than or equal to 20.0% for all analytes.

Retention time windows were established as required by the method.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 20.0% for all analytes.

III. Continuing Calibration

Continuing calibration was performed at required frequencies.

The percent differences (%D) were less than or equal to 20.0% for all analytes.

Retention times of all analytes in the calibration standards were within the established retention time windows.

IV. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks.

V. Field Blanks

No field blanks were identified in this SDG.

VI. Surrogates/Internal Standards

Surrogates were added to all samples as required by the method. Surrogate recoveries (%R) were within QC limits.

All internal standard percent recoveries (%R) were within QC limits.

VII. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

VIII. Laboratory Control Samples/Standard Reference Materials

Laboratory control samples (LCS) and laboratory control samples duplicates (LCSD) were analyzed as required by the method. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

Standard reference materials (SRM) were analyzed as required by the method. The results were within QC limits.

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Target Analyte Quantitation

All target analyte quantitations met validation criteria.

XI. Target Analyte Identification

All target analyte identifications met validation criteria.

XII. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

The quality control criteria reviewed were met and are considered acceptable.

Duwamish AOC4
Polychlorinated Biphenyls - Data Qualification Summary - SDG 21K0332

No Sample Data Qualified in this SDG

Duwamish AOC4
Polychlorinated Biphenyls - Laboratory Blank Data Qualification Summary - SDG 21K0332

No Sample Data Qualified in this SDG

Duwamish AOC4
Polychlorinated Biphenyls - Field Blank Data Qualification Summary - SDG 21K0332

No Sample Data Qualified in this SDG

LDC #: 52703E3b **VALIDATION COMPLETENESS WORKSHEET** Date: 12/10/21
SDG #: 21K0332 Stage 4 Page: 1 of 1
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer: PG
2nd Reviewer: JM

METHOD: GC Polychlorinated Biphenyls (EPA SW846 Method 8082A)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A	
II.	Initial calibration/ICV	A / A	RSD < 20 % ICV < 20 %
III.	Continuing calibration	A	CCV < 20 %
IV.	Laboratory Blanks	A	
V.	Field blanks	N	
VI.	Surrogate spikes / IS	A / A	
VII.	Matrix spike/Matrix spike duplicates	A	
VIII.	Laboratory control samples / SRM	A	LCS / LCSD
IX.	Field duplicates	N	
X.	Target analyte quantitation	A	
XI.	Target analyte identification	A	
XII.	Overall assessment of data	A	

Note: A = Acceptable ND = No compounds detected D = Duplicate SB=Source blank
N = Not provided/applicable R = Rinsate TB = Trip blank OTHER:
SW = See worksheet FB = Field blank EB = Equipment blank

	Client ID	Lab ID	Matrix	Date
1	LDW21-IT637A	21K0332-01	Sediment	07/06/21
2	LDW21-IT637AMS	21K0332-01MS	Sediment	07/06/21
3	LDW21-IT637AMSD	21K0332-01MSD	Sediment	07/06/21
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				

Notes:

LDC #: 52703E3b

VALIDATION FINDINGS CHECKLIST

Reviewer: PG
2nd Reviewer:

Method: ✓ GC ___ HPLC

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
Were all technical holding times met?	✔			
Was cooler temperature criteria met?	✔			
IIa. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✔			
Were all percent relative standard deviations (%RSD) ≤ 20%?	✔			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥0.990?		✔		
Were the RT windows properly established?	✔			
IIb. Initial calibration verification				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	✔			
Were all percent differences (%D) ≤ 20%?	✔			
III. Continuing calibration				
Was a continuing calibration analyzed daily?	✔			
Were all percent differences (%D) ≤ 20%?	✔			
Were all the retention times within the acceptance windows?	✔			
IV. Laboratory Blanks				
Was a laboratory blank associated with every sample in this SDG?	✔			
Was a laboratory blank analyzed for each matrix and concentration?	✔			
Was there contamination in the laboratory blanks? If yes, please see the Blanks validation completeness worksheet.		✔		
V. Field Blanks				
Were field blanks identified in this SDG?		✔		
Were target compounds detected in the field blanks?			✔	
VI. Surrogate spikes				
Were all surrogate percent recovery (%R) within the QC limits?	✔			
If the percent recovery (%R) of one or more surrogates was outside QC limits, was a reanalysis performed to confirm %R?			✔	
If any %R was less than 10 percent, was a reanalysis performed to confirm %R?			✔	
VII. Matrix spike/Matrix spike duplicates				
Were a matrix spike (MS) and matrix spike duplicate (MSD) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD. Soil / Water.	✔			
Was a MS/MSD analyzed every 20 samples of each matrix?	✔			
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?	✔			

Validation Area	Yes	No	NA	Findings/Comments
VIII. Laboratory control samples				
Was an LCS analyzed for this SDG?	✔			
Was an LCS analyzed per extraction batch?	✔			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	✔			
IX. Field duplicates				
Were field duplicate pairs identified in this SDG?		✔		
Were target compounds detected in the field duplicates?			✔	
X. Compound quantitation				
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✔			
XI. Target compound identification				
Were the retention times of reported detects within the RT windows?	✔			
XIII. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✔			

LDC #: 52T3336

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Page: 1 of 1
Reviewer: 9

METHOD: GC ✓ HPLC _____

The calibration factors (CF) and relative standard deviation (%RSD) were recalculated using the following calculations:

CF = A/C
Average CF = sum of the CF/number of standards
%RSD = 100 * (S/X)

Where: A = Area of compound
C = Concentration of compound
S = Standard deviation of calibration factors
X = Mean of calibration factors

#	Standard ID	Calibration Date	Compound	Reported CF (100 std)	Recalculated CF (100 std)	Reported Ave CF (initial)	Recalculated Ave CF (intial)	Reported %RSD	Recalculated %RSD
1	KAL	11/26/21	BB-1 (1C)	0.056378047	0.05637847	0.055327	0.055327	6.1	6.1
			BB-1 (2C)	0.058690477	0.05869047	0.057580	0.057580	3.1	3.1
2									
3									
4									

Comments: Refer to Initial Calibration findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703236

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Page: 1 of 1
Reviewer: G

METHOD: √ GC_HPLC

The percent difference (%D) of the initial calibration average Calibration Factors (CF) and the continuing calibration CF were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. CF -CF)/ave.CF

Where: ave. CF = initial calibration average CF
CF = continuing calibration CF
A = Area of compound
C = Concentration of compound

#	Standard ID	Calibration Date	Compound	Average CF(Ical)/ CCV Conc.	Reported	Recalculated	Reported	Recalculated
					CF/ Conc. CCV	CF/ Conc. CCV	%D	%D
1	~~ICAL~~	11/~~27~~/21	BB-1 (1c)	0.055327	0.052816	0.052816	4.4	4.5
	112703		BB-1 (2c)	0.057580	0.054650	0.054694	5.2	5.1
2								
3								
4								

LDC #: 52703E2b

VALIDATION FINDINGS WORKSHEET
Surrogate Results Verification

Reviewer: 9

METHOD: / GC __ HPLC

The percent recoveries (%R) of surrogates were recalculated for the compounds identified below using the following calculation:

% Recovery: SF/SS * 100

Where: SF = Surrogate Found
SS = Surrogate Spiked

Sample ID: 1

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
DCB	1C	40.0	39.4	98.5	98.5	
TCMX	↓	↓	34.5	86.2	86.2	

Sample ID: _____

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference

Sample ID: _____

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference

LDC #: 57033B6

VALIDATION FINDINGS WORKSHEET
Matrix Spike/Matrix Spike Duplicates Results Verification

Reviewer: 9

METHOD: ✓ GC __HPLC

The percent recoveries (%R) and relative percent differences (RPD) of the matrix spike and matrix spike duplicate were recalculated for the compounds identified below using the following calculation:

%Recovery = 100 * (SSC - SC)/SA Where SSC = Spiked sample concentration SC = Sample concentration
SA = Spike added
RPD =(({SSCMS - SSCMSD} * 2) / (SSCMS + SSCMSD))*100 MS = Matrix spike MSD = Matrix spike duplicate

MS/MSD samples: 2/3

Compound	Spike Added ( )		Sample Conc. ( )	Spike Sample Concentration ( )		Matrix spike Percent Recovery		Matrix Spike Duplicate Percent Recovery		MS/MSD RPD	
	MS	MSD	---	MS	MSD	Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
Gasoline (8015)											
Diesel (8015)											
Benzene (8021B)											
Methane (RSK-175)											
2,4-D (8151)											
Dinoseb (8151)											
Naphthalene (8310)											
Anthracene (8310)											
HMX (8330)											
2,4,6-Trinitrotoluene (8330)											
PCB-1260	101	101	5.0	73.8	75.1	68.1	68.1	69.4	69.4	1.75	1.75

Comments: Refer to Matrix Spike/Matrix Spike Duplicates findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703236

VALIDATION FINDINGS WORKSHEET
Laboratory Control Sample/Laboratory Control Sample Duplicate Results Verification

Reviewer: 9

METHOD: GC ~~Resticides (EPA SW 846 Method 8081A)~~

The percent recoveries (%R) and Relative Percent difference (RPD) of the laboratory control sample and laboratory control sample duplicate were recalculated for the compounds identified below using the following calculation:

% Recovery = 100* (SSC-SC)/SA

Where: SSC = Spiked sample concentration; SA = Spike added; SC = Concentration

RPD = | LCS - LCSD | * 2/(LCS + LCSD)

LCS = Laboratory control sample percent recovery; LCSD = Laboratory control sample duplicate percent recovery

LCS/LCSD samples: BLK0603

Compound	Spike Added (ug/kg)		Spiked Sample Concentration (ug/kg)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
gamma-BHC										
4,4'-DDT										
BB	101	NA	80.4	NA	81.7	81.5				

Comments: Refer to Laboratory Control Sample/Laboratory Control Sample Duplicate findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 52703E3b

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

METHOD: ___ GC ___ HPLC

Y N N/A Were all reported results recalculated and verified for all level IV samples?
Y N N/A Were all recalculated results for detected target compounds within 10% of the reported results?

Concentration= $\frac{(A)(Fv)(Df)}{(RF)(Vs \text{ or } Ws)(\%S/100)}$

A= Area or height of the compound to be measured
Fv= Final Volume of extract
Df= Dilution Factor
RF= Average response factor of the compound
In the initial calibration
Vs= Initial volume of the sample
Ws= Initial weight of the sample
%S= Percent Solid

Example:

Sample ID. 1 Compound Name PCB-1260-1
LCS, Methane

Concentration = $\frac{(5818)(80.0)}{(335270)(0.0553271)} = 25.1$

Concentration(total) = $\frac{(25.1+19.3+26.9+24.1+29.6)(2.5)(1)}{5 \times 15.93 \times 0.785}$ = 5.0 ug kg

#	Sample ID	Compound	Reported Concentrations (Ug/kg)	Recalculated Results Concentrations ( )	Qualifications
	1	PCB - 1260	5.0		

Comments: _____

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 15, 2021

Parameters: Wet Chemistry

Validation Level: Stage 4

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21K0332

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT637A	21K0332-01	Sediment	07/06/21
LDW21-IT637AMS	21K0332-01MS	Sediment	07/06/21
LDW21-IT637ADUP1	21K0332-01DUP1	Sediment	07/06/21
LDW21-IT637ADUP2	21K0332-01DUP2	Sediment	07/06/21

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Final Lower Duwamish Waterway Quality Assurance Project Plan for Remedial Design of Upper Reach: Pre-Design Investigation (May 2020) and a modified outline of the USEPA National Functional Guidelines (NFG) for Inorganic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following methods:

Total Organic Carbon by Environmental Protection Agency (EPA) SW 846 Method 9060A
Total Solids by Standard Method 2540G

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition.

All technical holding time requirements were met.

II. Initial Calibration

All criteria for the initial calibration of each method were met.

III. Continuing Calibration

Continuing calibration frequency and analysis criteria were met for each method when applicable.

IV. Laboratory Blanks

Laboratory blanks were analyzed as required by the methods. No contaminants were found in the laboratory blanks.

V. Field Blanks

No field blanks were identified in this SDG.

VI. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits.

VII. Duplicate Sample Analysis

Duplicate (DUP) sample analysis was performed on an associated project sample. Results were within QC limits with the following exceptions:

DUP ID (Associated Samples)	Analyte	RPD (Limits)	Difference (Limits)	Flag	A or P
LDW21-IT637ADUP1 (All samples in SDG 21K0332)	Total organic carbon	29.6 (≤20)	-	J (all detects)	A

VIII. Laboratory Control Samples

Laboratory control samples (LCS) were analyzed as required by the methods. Percent recoveries (%R) were within QC limits.

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Target Analyte Quantitation

All target analyte quantitations were within validation criteria.

XI. Overall Assessment of Data

The analysis was conducted within all specifications of the methods. No results were rejected in this SDG.

Due to DUP RPD, data were qualified as estimated in three samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable.

Duwamish AOC4
Wet Chemistry - Data Qualification Summary - SDG 21K0332

Sample	Analyte	Flag	A or P	Reason
LDW21-IT637A LDW21-IT637ADUP1 LDW21-IT637ADUP2	Total organic carbon	J (all detects)	A	Duplicate sample analysis (RPD)

Duwamish AOC4
Wet Chemistry - Laboratory Blank Data Qualification Summary - SDG 21K0332

No Sample Data Qualified in this SDG

Duwamish AOC4
Wet Chemistry - Field Blank Data Qualification Summary - SDG 21K0332

No Sample Data Qualified in this SDG

LDC #: 52703E6 **VALIDATION COMPLETENESS WORKSHEET** Date: 12/13/21
SDG #: 21K0332 Stage 4 Page: 1 of 1
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer: [illegible]
2nd Reviewer: [illegible]

METHOD: (Analyte) TOC (EPA SW846 Method 9060A), Total Solids (SM2540G)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A,A	
II	Initial calibration	A	
III.	Calibration verification	A	
IV	Laboratory Blanks	A	
V	Field blanks	N	
VI.	Matrix Spike/Matrix Spike Duplicates	A	
VII.	Duplicate sample analysis	SW	
VIII.	Laboratory control samples	A	LCS
IX.	Field duplicates	N	
X.	Target Analyte Quantitation	A	
XI	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	LDW21-IT637A	21K0332-01	Sediment	07/06/21
2	LDW21-IT637AMS	21K0332-01MS	Sediment	07/06/21
3	LDW21-IT637ADUP	21K0332-01DUP	Sediment	07/06/21
4	LDW21-IT637A~~TRP~~DUP	21K0332-01TRP	Sediment	07/06/21
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				

Notes:

METHOD: Inorganics				
Validation Area	**Yes**	**No**	**NA**	**Comments**
I. Technical holding times				
Were all technical holding times were met?	X			Frozen
II. Calibration				
Were all instuments calibrated at the requried frequency?	X			
Were the proper number of standards used?	X			
Were all initial and continuing calibration verifications within the QC limits?	X			
Were all initial calibration correlation coefficients within limits as specifed by the method?	X			
Were balance checks performed as required?	X			
III. Blanks				
Was a method blank assoicated with every sample in this SDG?	X			
Was there contamination in the method blanks?		X		
Was there contamination in the initial and continuing calibration blanks?		X		
IV. Matrix Spike/Matrix Spike Duplicates/Laboratory Duplicates				
Were MS/MSD recoveries with the QC limits? (If the sample concentration exceeded the spike concentration by a factor of 4, no action was taken.)	X			
Were the MS/MSD or laboratory duplicate relative percent differences (RPDs) within the QC limits?		X		
V. Laboratory Control Samples				
Was a LCS analyzed for each batch in the SDG?	X			
Were the LCS recoveries and RPDs (if applicable) within QC limits?	X			
X. Sample Result Verification				
Were all reproting limits adjusted to reflect sample dilutions?	X			
Were all soil samples dry weight corrected?	X			
XI. Overall Assessment of Data				
Was the overall assessment of the data found to be acceptable?	X			

METHOD: Inorganics				
Validation Area	**Yes**	**No**	**NA**	**Comments**
XII. Field Duplicates				
Were field duplicates identifed in this SDG?		X		
Were target analytes detected in the field duplicates?			X	
XIII. Field Blanks				
Were field blanks identified in this SDG?		X		
Were target analytes detected in the field blanks?			X	

All elements are applicable to each sample as noted below.

Sample ID	Target Analyte List
All	TS, TOC
QC:	
2	TOC
3	TOC, TS
4	TS

METHOD: Inorganics

Laboratory duplicate analysis was performed by the laboratory. All laboratory duplicates were with the relative percent difference (RPD) for samples >5X the reporting limits with the exceptions listed below. If samples were <5X the reproting limits, the difference was with 1X the reporting limit for water samples and within 2X the reporting limit for soil samples for all samples with the exceptions listed below.

Duplicate ID	Matrix	Analyte	RPD	RPD Limit	Difference (units)	Difference Limit	Assocaited Samples	Qualification	Det/ND
3	s	TOC	29.6	20			All	J/UJ/A	Det

Comments:

LDC #: 52703E6

Validation Findings Worksheet
Initial and Continuing Calibration Calculation Verification

Method: Inorganics, Method See Cover

An initial or continuing calibration verification percent recovery (%R) was recalculated for each type of analysis using the following formula:

$$\%R = \frac{Found \times 100}{True}$$

Where, Found = concentration of each analyte measured in the analysis of the ICV or CCV solution

True = concentration of each analyte in the ICV or CCV source

Calibration verification	TOC	ICV	44.446	45.388	102	102	Y
Calibration verification	TOC	CCV	44.446	43.406	98	98	Y
Calibration verification							

Comments:

METHOD: Inorganics

Percent recoveries (%R) for the laboratory control sample (LCS) and matrix spike (MS) were recalcuated using the following formula.
%R = (Found/True) x 100
Found = concentration of each analyte measured in the analysis. For the MS calculation, Found = SSR (Spiked Sample Result) - SR (Sample Result)
True = concentraiton of each analyte in the source
The sample and duplciate relative percent difference (RPD) was recalcuated using the following formula.
RPD = (Absolute value(S-D)x 200) / (S+D)
S = Original sample concentraiton
D = Duplciate sample concentration

Sample ID	Type of Analysis	Element	Found/S	True/D	Recalcuated %R/RPD	Reported %R/RPD	Acceptable (Y/N)
LCS	LCS	TOC	45.5	44.4	102	102	Y
24	MS	TOC	1.03	1.04	99	99	Y
26	Duplicate	TS	64	63.25	1.18	1.18	Y

VALIDATION FINDINGS CHECKLIST
Sample Calculation Verification

METHOD: Inorganics

Analytes were recalcuated and verified using the following equation.

Concentration = (Result from raw data x Final volume x Dilution factor) / (Percent solids (if applicable) x Initial weight or volume)

Sample ID	Analyte	Raw Data (%)	Dry (g)	Sample Dry (g)	Tare (g)	Percent solids (%)	Reported Result (%)	Recalcuated Result (mg/Kg)	Acceptable (Y/N)
1	TOC	0.818				76.76	1.07	1.07	Y
	TS		5.3841	6.7644	0.8261		76.76	76.76	Y