LABORATORY DATA CONSULTANTS, INC.
2701 Loker Ave. West, Suite 220, Carlsbad, CA 92010 Bus: 760-827-1100 Fax: 760-827-1099

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

December 21, 2021

SUBJECT: **Revised** Duwamish AOC4 - Data Validation

Dear Ms. Vandervort,

Enclosed is the revised validation report for the fraction listed below. This SDG was received on October 5, 2021. Attachment 1 is a summary of the samples that were reviewed for the analysis.

Revision: Corrected Sample ID

LDC Project #52219G_RV1:

SDG #	**Fraction**
21G0140	Polychlorinated Dioxins/Dibenzofurans

The data validation was performed under Stage 2B guidelines. The analysis was validated using the following documents, as applicable to the 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 High Resolution Superfund Methods Data Review (April 2016)

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

Sincerely,

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

LABORATORY DATA CONSULTANTS, INC.
2701 Loker Ave. West, Suite 220, Carlsbad, CA 92010 Bus: 760-827-1100 Fax: 760-827-1099

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

November 3, 2021

SUBJECT: Duwamish AOC4 - Data Validation

Dear Ms. Vandervort,

Enclosed are the final validation reports for the fraction listed below. These SDGs were received on October 5, 2021. Attachment 1 is a summary of the samples that were reviewed for each analysis.

LDC Project #52219:

SDG #	Fraction
21G0064, 21G0079, 21G0082, 21G0094 21G0111, 21G0126, 21G0140, 21G0156 21G0211, 21G0283, 21G0286	Polychlorinated Dioxins/Dibenzofurans

The data validation was performed under Stage 2B 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 High Resolution Superfund Methods Data Review (April 2016)

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

Sincerely,

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

73 pages-ADV

Attachment 1

2B/4 (client Select) EDD **LDC# 52219 (Windward Environmental, LLC - Seattle, WA / Duwamish AOC4)**

LDC	SDG#	DATE REC'D	(3) DATE DUE	Dioxins (1613B)																													
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
A	21G0064	10/05/21	10/26/21	0	1																												
B	21G0079	10/05/21	10/26/21	0	1																												
C	21G0082	10/05/21	10/26/21	0	2																												
D	21G0094	10/05/21	10/26/21	0	4																												
E	21G0111	10/05/21	10/26/21	0	2																												
F	21G0126	10/05/21	10/26/21	0	8																												
G	21G0140	10/05/21	10/26/21	0	5																												
H	21G0156	10/05/21	10/26/21	0	5																												
I	21G0211	10/05/21	10/26/21	0	6																												
J	21G0283	10/05/21	10/26/21	0	8																												
K	21G0286	10/05/21	10/26/21	0	1																												
Total	T/PG			0	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43

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

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LDC Report# 52219A21

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: October 25, 2021

Parameters: Polychlorinated Dioxins/Dibenzofurans

Validation Level: Stage 2B

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21G0064

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT507	21G0064-10	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 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 2B data validation, which comprises an evaluation of quality control (QC) summary results.

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 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.

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. 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 (Associated Samples)	Analyte	%R (Limits)	Flag	A or P
BJG0375-SRM2 (All samples in SDG 21G0064)	1,2,3,7,8-PeCDD	161 (50-150)	J (all detects)	A

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Labeled Compounds

All percent recoveries (%R) for labeled compounds used to quantitate target analytes were within QC limits.

XI. Target Analyte Quantitation

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

Sample	Analyte	Flag	A or P
All samples in SDG 21G0064	All compounds reported as estimated maximum possible concentration (EMPC) and greater than the reporting limit.	J (all detects)	A
All samples in SDG 21G0064	All results flagged "X" by the laboratory due to chlorinated diphenyl ether (CDPE) interference.	J (all detects)	A

Raw data were not reviewed for Stage 2B validation.

XII. Target Analyte Identification

Raw data were not reviewed for Stage 2B validation.

XIII. System Performance

Raw data were not reviewed for Stage 2B validation.

XIV. Overall Assessment of Data

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

Due to SRM %R, analytes reported as EMPC, and CDPE interference, 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
Polychlorinated Dioxins/Dibenzofurans - Data Qualification Summary - SDG 21G0064

Sample	Analyte	Flag	A or P	Reason
LDW21-IT507	1,2,3,7,8-PeCDD	J (all detects)	A	Standard reference materials (%R)
LDW21-IT507	All compounds reported as estimated maximum possible concentration (EMPC) and greater than the reporting limit.	J (all detects)	A	Target analyte quantitation (EMPC)
LDW21-IT507	All results flagged "X" by the laboratory 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 21G0064

No Sample Data Qualified in this SDG

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Field Blank Data Qualification Summary - SDG 21G0064

No Sample Data Qualified in this SDG

LDC #: 52219A21 **VALIDATION COMPLETENESS WORKSHEET** Date: 10/20/21
SDG #: 21G0064 Stage 2B Page: 1 of 1
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer: 1
2nd Reviewer: 2

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	A	
VI.	Field blanks	N	
VII.	Matrix spike/Matrix spike duplicates	N	CS
VIII.	Laboratory control samples /SRM	A/N	LCS.
IX.	Field duplicates	N	
X.	Internal standards	A	
XI.	Target analyte quantitation	A/N	
XII.	Target analyte identification	N	
XIII.	System performance	N	
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-IT507	21G0064-10	Sediment	07/06/21
2				
3				
4				
5				
6				
7				
8				
9				
10				

Notes:

	BJF0375						

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:_____

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_____

LDC #: 52219A21

VALIDATION FINDINGS WORKSHEET
Laboratory Control Samples (LCS)

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 Was a LCS required?

(Y) N N/A Was a LCS analyzed every 20 samples for each matrix or whenever a sample extraction was performed?

(Y) N N/A Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?

#	Date	Lab ID/Reference	Compound	LCS %R (Limits)	LCSD %R (Limits)	RPD (Limits)	Associated Samples	Qualifications
		BJG0375-SRM/2	B	161 (50-150)	( )	( )	All (dets)	J dets/A
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
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				( )	( )	( )		
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				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		

LDC #: 52219A21

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
		All	All compounds flagged "X" due to chlorinated diphenyl either interference		Jdets/A

Comments: See sample calculation verification worksheet for recalculations

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: October 25, 2021

Parameters: Polychlorinated Dioxins/Dibenzofurans

Validation Level: Stage 2B

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21G0079

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT603	21G0079-10	Sediment	07/06/21
LDW21-IT603DUP	21G0079-10DUP	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 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 2B data validation, which comprises an evaluation of quality control (QC) summary results.

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 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.

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/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 with the following exceptions:

DUP ID (Associated Samples)	Analyte	RPD (Limits)	Flag	A or P
LDW21-IT603DUP (LDW21-IT603 LDW21-IT603DUP)	1,2,3,4,6,7,8-HpCDF 1,2,3,4,6,7,8-HpCDD OCDF OCDD	34.8 (≤25) 31.6 (≤25) 27.2 (≤25) 34.4 (≤25)	J (all detects) J (all detects) J (all detects) J (all detects)	A

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 with the following exceptions:

SRM ID (Associated Samples)	Analyte	%R (Limits)	Flag	A or P
BJG0375-SRM2 (All samples in SDG 21G0079)	1,2,3,7,8-PeCDD	161 (50-150)	J (all detects)	A

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Labeled Compounds

All percent recoveries (%R) for labeled compounds used to quantitate target analytes were within QC limits.

XI. Target Analyte Quantitation

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

Sample	Analyte	Flag	A or P
All samples in SDG 21G0079	All analytes reported as estimated maximum possible concentration (EMPC) and greater than the reporting limit (RL).	J (all detects)	A
All samples in SDG 21G0079	All results flagged "X" by the laboratory due to chlorinated diphenyl ether (CDPE) interference.	J (all detects)	A

Raw data were not reviewed for Stage 2B validation.

XII. Target Analyte Identification

Raw data were not reviewed for Stage 2B validation.

XIII. System Performance

Raw data were not reviewed for Stage 2B validation.

XIV. Overall Assessment of Data

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

Due to DUP RPD, SRM %R, analytes reported as EMPC, and CDPE interference, 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 21G0079

Sample	Analyte	Flag	A or P	Reason
LDW21-IT603 LDW21-IT603DUP	1,2,3,4,6,7,8-HpCDF 1,2,3,4,6,7,8-HpCDD OCDF OCDD	J (all detects) J (all detects) J (all detects) J (all detects)	A	Duplicate sample analysis (RPD)
LDW21-IT603 LDW21-IT603DUP	1,2,3,7,8-PeCDD	J (all detects)	A	Standard reference materials (%R)
LDW21-IT603 LDW21-IT603DUP	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-IT603 LDW21-IT603DUP	All results flagged "X" by the laboratory 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 21G0079

No Sample Data Qualified in this SDG

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Field Blank Data Qualification Summary - SDG 21G0079

No Sample Data Qualified in this SDG

LDC #: 52219B21
SDG #: 21G0079
Laboratory: Analytical Resources, Inc., Tukwila, WA

VALIDATION COMPLETENESS WORKSHEET
Stage 2B

Date: 10/20/21
Page: 1 of 1
Reviewer:
2nd Reviewer:

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≤20/25% ICV≤QC Limits
IV.	Continuing calibration	A	CCV≤QC Limits
V.	Laboratory Blanks	A	
VI.	Field blanks	N	
VII.	Matrix spike/Matrix spike duplicates /DUP	N/SW	
VIII.	Laboratory control samples /SRM	A/SW	LCS
IX.	Field duplicates	N	
X.	Internal standards	A	
XI.	Target analyte quantitation	SW	
XII.	Target analyte identification	N	
XIII.	System performance	N	
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-IT603	21G0079-10	Sediment	07/06/21
2	LDW21-IT603DUP	21G0079-10DUP	Sediment	07/06/21
3				
4				
5				
6				
7				
8				
9				
10				

Notes:

	BKF0375						

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 #: 52298B21

VALIDATION FINDINGS WORKSHEET
Matrix Spike/Matrix Spike Duplicates

Page: 1 of 1
Reviewer: Q

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 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?

#	Date	MS/MSD ID	Compound	MS %R (Limits)	MSD %R (Limits)	RPD (Limits)	Associated Samples	Qualifications
		2	O	( )	( )	34.8 (≤25)	1-2 (dets)	dets/A
			F	( )	( )	31.6 (↓)		↓
			R	( )	( )	27.2 (↓)		↓
			4	( )	( )	34.4 (↓)		↓
			others <RL		( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
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				( )	( )	( )		
				( )	( )	( )		

LDC #: 52219B21

VALIDATION FINDINGS WORKSHEET
Laboratory Control Samples (LCS)

Reviewer: q

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 Was a LCS required?
(Y) N N/A Was a LCS analyzed every 20 samples for each matrix or whenever a sample extraction was performed?
(Y) N N/A Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?

#	Date	Lab ID/Reference	Compound	LCS %R (Limits)	LCSD %R (Limits)	RPD (Limits)	Associated Samples	Qualifications
		BK40375-SRM2	B	161 (50-150)	( )	( )	1-2 (dets)	J dets/A
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
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				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		

LDC #: 52219B21

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
		All	All compounds flagged "X" due to chlorinated diphenyl either interference		Jdets/A

Comments: See sample calculation verification worksheet for recalculations

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: October 25, 2021

Parameters: Polychlorinated Dioxins/Dibenzofurans

Validation Level: Stage 2B

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21G0082

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW-21-IT647	21G0082-12	Sediment	07/07/21
LDW-21-IT647-FD	21G0082-13	Sediment	07/07/21

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 2B data validation, which comprises an evaluation of quality control (QC) summary results.

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 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.

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. 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 (Associated Samples)	Analyte	%R (Limits)	Flag	A or P
BJG0375-SRM2 (All samples in SDG 21G0082)	1,2,3,7,8-PeCDD	161 (50-150)	J (all detects)	A

IX. Field Duplicates

Samples LDW-21-IT647 and LDW-21-IT647-FD were identified as field duplicates. No results were detected in any of the samples with the following exceptions:

Analyte	Concentration (ng/Kg)		RPD
	LDW-21-IT647	LDW-21-IT647-FD	
2,3,7,8-TCDF	0.701	0.615	13
1,2,3,7,8-PeCDF	0.700	0.456	42
2,3,4,7,8-PeCDF	2.49	0.646	118
1,2,3,7,8-PeCDD	1.05	1.03	2
1,2,3,4,7,8-HxCDF	13.8	1.90	152
1,2,3,6,7,8-HxCDF	2.65	0.913	98
2,3,4,6,7,8-HxCDF	2.93	0.644	128
1,2,3,7,8,9-HxCDF	2.55	0.453	140
1,2,3,4,7,8-HxCDD	1.37	1.09	23

Analyte	Concentration (ng/Kg)		RPD
	LDW-21-IT647	LDW-21-IT647-FD	
1,2,3,6,7,8-HxCDD	6.21	3.77	49
1,2,3,7,8,9-HxCDD	3.22	2.64	20
1,2,3,4,6,7,8-HpCDF	28.9	159	138
1,2,3,4,7,8,9-HpCDF	3.18	1.44	75
1,2,3,4,6,7,8-HpCDD	164	105	44
OCDF	49.2	47.6	3
OCDD	1560	807	64
Total TCDF	2.05	4.35	72
Total TCDD	1.10	1.00U	Not calculable
Total PeCDF	21.8	6.88	104
Total PeCDD	1.62	1.58	3
Total HxCDF	70.3	23.6	99
Total HxCDD	41.3	32.8	23
Total HpCDF	96.7	53.0	58
Total HpCDD	359	270	28

X. Labeled Compounds

All percent recoveries (%R) for labeled compounds used to quantitate target analytes were within QC limits.

XI. Target Analyte Quantitation

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

Sample	Analyte	Flag	A or P
All samples in SDG 21G0082	All analytes reported as estimated maximum possible concentration (EMPC) and greater than the reporting limit (RL).	J (all detects)	A
All samples in SDG 21G0082	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U (all non-detects)	A

Raw data were not reviewed for Stage 2B validation.

XII. Target Analyte Identification

Raw data were not reviewed for Stage 2B validation.

XIII. System Performance

Raw data were not reviewed for Stage 2B validation.

XIV. Overall Assessment of Data

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

Due to SRM %R and analytes reported as EMPC, 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 21G0082

Sample	Analyte	Flag	A or P	Reason
LDW-21-IT647 LDW-21-IT647-FD	1,2,3,7,8-PeCDD	J (all detects)	A	Standard reference materials (%R)
LDW-21-IT647 LDW-21-IT647-FD	All analytes reported as estimated maximum possible concentration (EMPC) and greater than the reporting limit (RL).	J (all detects)	A	Target analyte quantitation (EMPC)
LDW-21-IT647 LDW-21-IT647-FD	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U (all non-detects)	A	Target analyte quantitation (EMPC)

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Laboratory Blank Data Qualification Summary - SDG 21G0082

No Sample Data Qualified in this SDG

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Field Blank Data Qualification Summary - SDG 21G0082

No Sample Data Qualified in this SDG

LDC #: 52219C21 **VALIDATION COMPLETENESS WORKSHEET** Date: 10/30/21
SDG #: 21G0082 Stage 2B Page: 1 of 1
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer:
2nd Reviewer:

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≤20/25% QC limits
IV.	Continuing calibration	A	QC limits
V.	Laboratory Blanks	A	
VI.	Field blanks	N	
VII.	Matrix spike/Matrix spike duplicates	N	CS
VIII.	Laboratory control samples	A/SW	LCS
IX.	Field duplicates	SW	D=1+2
X.	Internal standards	A	
XI.	Target analyte quantitation	SW	
XII.	Target analyte identification	N	
XIII.	System performance	N	
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	LDW-21-IT647	21G0082-12	Sediment	07/07/21
2	LDW-21-IT647-FD	21G0082-13	Sediment	07/07/21
3				
4				
5				
6				
7				
8				
9				
10				

Notes:

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 #: 52219C21

Reviewer: [illegible]

VALIDATION FINDINGS WORKSHEET
Laboratory Control Samples (LCS)

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 Was a LCS required?

(Y) N N/A Was a LCS analyzed every 20 samples for each matrix or whenever a sample extraction was performed?

Y (N) N/A Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?

#	Date	Lab ID/Reference	Compound	LCS %R (Limits)	LCSD %R (Limits)	RPD (Limits)	Associated Samples	Qualifications
		BJ40375-BS1/2	B	161 (50-150)	( )	( )	All (dets)	J dets/A
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
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				( )	( )	( )		
				( )	( )	( )		

LDC#: 52219C21

VALIDATION FINDINGS WORKSHEET
Field Duplicates

Page: 1 of 1
Reviewer: PG

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

Compound	Concentration (ng/kg)		RPD
	1	2	
H	0.701	0.615	13
I	0.700	0.456	42
J	2.49	0.646	118
B	1.05	1.03	2
K	13.8	1.90	152
L	2.65	0.913	98
M	2.93	0.644	128
N	2.55	0.453	140
C	1.37	1.09	23
D	6.21	3.77	49
E	3.22	2.64	20
O	28.9	159	138
P	3.18	1.44	75
F	164	105	44
Q	49.2	47.6	3
G	1560	807	64
V	2.05	4.35	72
R	1.10	1.00U	NC
W	21.8	6.88	104
S	1.62	1.58	3
X	70.3	23.6	99
T	41.3	32.8	23
Y	96.7	53.0	58
U	359	270	28

LDC #: 52219B21

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
		All	All compounds reported as estimated maximum possible concentration (EMPC) < RL		U/A

Comments: See sample calculation verification worksheet for recalculations

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: October 25, 2021

Parameters: Polychlorinated Dioxins/Dibenzofurans

Validation Level: Stage 2B

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21G0094

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT651	21G0094-07	Sediment	07/08/21
LDW21-IT651-FD	21G0094-08	Sediment	07/08/21
LDW21-IT656	21G0094-10	Sediment	07/08/21
LDW21-IT668	21G0094-15	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 2B data validation, which comprises an evaluation of quality control (QC) summary results.

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 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.

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. 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 (Associated Samples)	Analyte	%R (Limits)	Flag	A or P
BJG0375-SRM2 (All samples in SDG 21G0094)	1,2,3,7,8-PeCDD	161 (50-150)	J (all detects)	A

IX. Field Duplicates

Samples LDW21-IT651 and LDW21-IT651-FD were identified as field duplicates. No results were detected in any of the samples with the following exceptions:

Analyte	Concentration (ng/Kg)		RPD
	LDW21-IT651	LDW21-IT651-FD	
2,3,7,8-TCDF	0.832	0.652	24
2,3,7,8-TCDD	1.00U	0.518	Not calculable
1,2,3,7,8-PeCDF	0.500	0.473	6
2,3,4,7,8-PeCDF	0.802	0.788	2
1,2,3,7,8-PeCDD	1.29	1.33	3
1,2,3,4,7,8-HxCDF	2.43	2.54	4
1,2,3,6,7,8-HxCDF	1.30	1.18	10
2,3,4,6,7,8-HxCDF	0.860	0.774	11
1,2,3,7,8,9-HxCDF	0.450	0.466	3

Analyte	Concentration (ng/Kg)		RPD
	LDW21-IT651	LDW21-IT651-FD	
1,2,3,4,7,8-HxCDD	1.43	1.40	2
1,2,3,6,7,8-HxCDD	6.01	5.81	3
1,2,3,7,8,9-HxCDD	3.98	3.81	4
1,2,3,4,6,7,8-HpCDF	21.7	22.3	3
1,2,3,4,7,8,9-HpCDF	1.89	1.96	4
1,2,3,4,6,7,8-HpCDD	135	142	5
OCDF	56.6	60.2	6
OCDD	1030	1090	6
Total TCDF	4.77	3.59	28
Total TCDD	1.73	1.39	22
Total PeCDF	6.06	8.79	37
Total PeCDD	1.53	3.23	71
Total HxCDF	31.2	31.3	0
Total HxCDD	49.9	36.1	32
Total HpCDF	49.6	72.3	37
Total HpCDD	313	323	3

X. Labeled Compounds

All percent recoveries (%R) for labeled compounds used to quantitate target analytes were within QC limits.

XI. Target Analyte Quantitation

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

Sample	Analyte	Flag	A or P
All samples in SDG 21G0094	All analytes reported as estimated maximum possible concentration (EMPC) and greater than the reporting limit (RL).	J (all detects)	A
All samples in SDG 21G0094	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U (all non-detects)	A

Raw data were not reviewed for Stage 2B validation.

XII. Target Analyte Identification

Raw data were not reviewed for Stage 2B validation.

XIII. System Performance

Raw data were not reviewed for Stage 2B validation.

XIV. Overall Assessment of Data

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

Due to SRM %R and analytes reported as EMPC, 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 Dioxins/Dibenzofurans - Data Qualification Summary - SDG 21G0094

Sample	Analyte	Flag	A or P	Reason
LDW21-IT651 LDW21-IT651-FD LDW21-IT656 LDW21-IT668	1,2,3,7,8-PeCDD	J (all detects)	A	Standard reference materials (%R)
LDW21-IT651 LDW21-IT651-FD LDW21-IT656 LDW21-IT668	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-IT651 LDW21-IT651-FD LDW21-IT656 LDW21-IT668	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U (all non-detects)	A	Target analyte quantitation (EMPC)

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Laboratory Blank Data Qualification Summary - SDG 21G0094

No Sample Data Qualified in this SDG

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Field Blank Data Qualification Summary - SDG 21G0094

No Sample Data Qualified in this SDG

LDC #: 52219D21 **VALIDATION COMPLETENESS WORKSHEET** Date: 10/30/21
SDG #: 21G0094 Stage 2B Page: 1 of 1
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer: 1
2nd Reviewer: 2

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	A	
VI.	Field blanks	N	
VII.	Matrix spike/Matrix spike duplicates	N	CS
VIII.	Laboratory control samples / SRM	A/SW	LCS
IX.	Field duplicates	SW	D = 1+2
X.	Internal standards	A	
XI.	Target analyte quantitation	SW	
XII.	Target analyte identification	N	
XIII.	System performance	N	
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-IT651	21G0094-07	Sediment	07/08/21
2	LDW21-IT651-FD	21G0094-08	Sediment	07/08/21
3	LDW21-IT656	21G0094-10	Sediment	07/08/21
4	LDW21-IT668	21G0094-15	Sediment	07/08/21
5				
6				
7				
8				
9				
10				

Notes:

	B/F0375						

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 #: 52219D-21

VALIDATION FINDINGS WORKSHEET
Laboratory Control Samples (LCS)

Reviewer: Q

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 Was a LCS required?
Y (N) N/A Was a LCS analyzed every 20 samples for each matrix or whenever a sample extraction was performed?
(Y) N N/A Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?

#	Date	Lab ID/Reference	Compound	LCS %R (Limits)	LCSD %R (Limits)	RPD (Limits)	Associated Samples	Qualifications
		BKF0375-SRM2	B	161 (50-150)	( )	( )	All (dets)	J dets/A
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
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				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
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				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		

LDC#: 52219D21

VALIDATION FINDINGS WORKSHEET
Field Duplicates

Reviewer: PG

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

Compound	Concentration (ng/kg)		RPD
	1	2	
H	0.832	0.652	24
A	1.00U	0.518	NC
I	0.500	0.473	6
J	0.802	0.788	2
B	1.29	1.33	3
K	2.43	2.54	4
L	1.30	1.18	10
M	0.860	0.774	11
N	0.450	0.466	3
C	1.43	1.40	2
D	6.01	5.81	3
E	3.98	3.81	4
O	21.7	22.3	3
P	1.89	1.96	4
F	135	142	5
Q	56.6	60.2	6
G	1030	1090	6
V	4.77	3.59	28
R	1.73	1.39	22
W	6.06	8.79	37
S	1.53	3.23	71
X	31.2	31.3	0
T	49.9	36.1	32
Y	49.6	72.3	37
U	313	323	3

LDC #: 52219D21

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
		All	All compounds reported as estimated maximum possible concentration (EMPC) < RL		U/A

Comments: See sample calculation verification worksheet for recalculations

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: October 25, 2021

Parameters: Polychlorinated Dioxins/Dibenzofurans

Validation Level: Stage 2B

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21G0111

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-SS603	21G0111-06	Sediment	07/09/21
LDW21-SS661	21G0111-12	Sediment	07/09/21
LDW21-SS603DUP	21G0111-06DUP	Sediment	07/09/21

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 2B data validation, which comprises an evaluation of quality control (QC) summary results.

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 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.

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
BJG0572-BK3	07/30/21	OCDD	7.14 ng/Kg	All samples in SDG 21G0111

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 with the following exceptions:

SRM ID (Associated Samples)	Analyte	%R (Limits)	Flag	A or P
BJG0572-SRM1 (All samples in SDG 21G0111)	2,3,7,8-TCDF 2,3,7,8-TCDD 1,2,3,7,8-PeCDF 2,3,4,7,8-PeCDF 1,2,3,7,8-PeCDD 2,3,4,6,7,8-HxCDF 1,2,3,7,8,9-HxCDF	0 (50-150) 0 (50-150) 0 (50-150) 0 (50-150) 0 (50-150) 0 (50-150) 0 (50-150)	J (all detects)* UJ (all non-detects)	A
BJG0572-SRM1 (All samples in SDG 21G0111)	1,2,3,6,7,8-HxCDF	176 (50-150)	J (all detects)	P

*Due to the laboratory using smaller aliquots, the LCS is within QC limits.

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Labeled Compounds

All percent recoveries (%R) for labeled compounds used to quantitate target analytes were within QC limits with the exception of sample LDW21-SS603DUP. No data were qualified since there were no associated samples in this SDG.

XI. Target Analyte Quantitation

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

Sample	Analyte	Flag	A or P
All samples in SDG 21G0111	All compounds reported as estimated maximum possible concentration (EMPC) and greater than the reporting limit.	J (all detects)	A
All samples in SDG 21G0111	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U (all non-detects)	A

Raw data were not reviewed for Stage 2B validation.

XII. Target Analyte Identification

Raw data were not reviewed for Stage 2B validation.

XIII. System Performance

Raw data were not reviewed for Stage 2B validation.

XIV. Overall Assessment of Data

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

Due to SRM %R and analytes reported as EMPC, 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 21G0111

Sample	Analyte	Flag	A or P	Reason
LDW21-SS603 LDW21-SS661 LDW21-SS603DUP	2,3,7,8-TCDF 2,3,7,8-TCDD 1,2,3,7,8-PeCDF 2,3,4,7,8-PeCDF 1,2,3,7,8-PeCDD 2,3,4,6,7,8-HxCDF 1,2,3,7,8,9-HxCDF	J (all detects) UJ (all non-detects)	A	Standard reference materials (%R)
LDW21-SS603 LDW21-SS661 LDW21-SS603DUP	1,2,3,6,7,8-HxCDF	J (all detects)	P	Standard reference materials (%R)
LDW21-SS603 LDW21-SS661 LDW21-SS603DUP	All compounds reported as estimated maximum possible concentration (EMPC) and greater than the reporting limit.	J (all detects)	A	Target analyte quantitation (EMPC)
LDW21-SS603 LDW21-SS661 LDW21-SS603DUP	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U (all non-detects)	A	Target analyte quantitation (EMPC)

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Laboratory Blank Data Qualification Summary - SDG 21G0111

No Sample Data Qualified in this SDG

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Field Blank Data Qualification Summary - SDG 21G0111

No Sample Data Qualified in this SDG

LDC #: 52219E21 **VALIDATION COMPLETENESS WORKSHEET** Date: 10/20/21
SDG #: 21G0111 Stage 2B Page: 1 of 1
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer:
2nd Reviewer:

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 ≤ 20/25% ICV ≤ QC limits
IV.	Continuing calibration	A	CCV ≤ QC limits
V.	Laboratory Blanks	A	
VI.	Field blanks	N	
VII.	Matrix spike/Matrix spike duplicates/DUP	N/A	>RL
VIII.	Laboratory control samples/SRM	A/SW	LCS
IX.	Field duplicates	N	
X.	Internal standards	SW	
XI.	Target analyte quantitation	SW	
XII.	Target analyte identification	N	
XIII.	System performance	N	
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-SS603	21G0111-06	Sediment	07/09/21
2	LDW21-SS661	21G0111-12	Sediment	07/09/21
3	LDW21-SS603DUP	21G0111-06DUP	Sediment	07/09/21
4				
5				
6				
7				
8				
9				
10				

Notes:

	B1605/2						

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 #: 52219E21

VALIDATION FINDINGS WORKSHEET
Blanks

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 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: 7/30/21 **Blank analysis date:** 8/18/21

Conc. units: ng/kg **Associated samples:** All

Compound	Blank ID	Sample Identification								
	BJG0572-BK3									
G	7.14									

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 #: 52219C2

VALIDATION FINDINGS WORKSHEET
Laboratory Control Samples (LCS)

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 Was a LCS required?

Y N N/A Was a LCS analyzed every 20 samples for each matrix or whenever a sample extraction was performed?

Y N N/A Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?

#	Date	Lab ID/Reference	Compound	~~LCS SRM~~ %R (Limits)	LCSD %R (Limits)	RPD (Limits)	Associated Samples	Qualifications
		BJG057/2-SRM1	H	0 (50-150)	( )	( )	All (dets+ND)	J/NJ/A *
			A	0 ( )	( )	( )		
			I	0 ( )	( )	( )		
			J	0 ( )	( )	( )		
			B	0 ( )	( )	( )		
			M	0 ( )	( )	( )		
			N	0 ( )	( )	( )		
			L	176 ( )	( )	( )	(dets)	J dets/A
				( )	( )	( )		
			* due to lab using smaller aliquots. LCS is within QC limits.					
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
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				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		

LDC #: 52019E2/

VALIDATION FINDINGS WORKSHEET
Labeled Compounds

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 labeled compound recoveries within the QC criteria?

(Y) N N/A Were all labeled compound ion abundance ratios (IAR) within the QC criteria?

(Y) N N/A Was the S/N ratio all internal standard peaks ≥ 10?

#	Date	Lab ID/Reference	Labeled Compound	% Recovery (Limit)	Qualifications
		3	37Cl4-A	27.5 (79-121)	No Qual (no associated)

LDC #: 52219E21

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
		All	All compounds reported as estimated maximum possible concentration (EMPC) < RL		U/A

Comments: See sample calculation verification worksheet for recalculations

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: October 25, 2021

Parameters: Polychlorinated Dioxins/Dibenzofurans

Validation Level: Stage 2B

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21G0126

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT653B	21G0126-07	Sediment	07/12/21
LDW21-IT653C	21G0126-08	Sediment	07/12/21
LDW21-IT653E	21G0126-09	Sediment	07/12/21
LDW21-IT652B	21G0126-10	Sediment	07/12/21
LDW21-IT652C	21G0126-11	Sediment	07/12/21
LDW21-IT652E	21G0126-12	Sediment	07/12/21
LDW21-IT632B	21G0126-13	Sediment	07/12/21
LDW21-IT632C	21G0126-14	Sediment	07/12/21
LDW21-IT653BDUP	21G0126-07DUP	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 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 2B data validation, which comprises an evaluation of quality control (QC) summary results.

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 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 with the following exceptions:

Date	Analyte	Concentration (Limits)	Associated Samples	Affected Analyte	Flag	A or P
09/20/21	13C-1,2,3,4,7,8,9-HpCDF	73.8 ng/mL (77-129)	LDW21-IT653B LDW21-IT653C LDW21-IT653E LDW21-IT652B LDW21-IT653BDUP	1,2,3,4,7,8,9-HpCDF	J (all detects)	P
09/21/21	13C-1,2,3,4,6,7,8-HpCDF 13C-1,2,3,4,7,8,9-HpCDF	73.6 ng/mL (78-129) 70.3 ng/mL (77-129)	LDW21-IT652C LDW21-IT652E LDW21-IT632B LDW21-IT632C	1,2,3,4,6,7,8-HpCDF 1,2,3,4,7,8,9-HpCDF	J (all detects) J (all detects)	P

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

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
BJH0152-BLK1	09/06/21	1,2,3,4,6,7,8-HpCDD OCDD Total HpCDD	0.346 ng/Kg 2.70 ng/Kg 0.346 ng/Kg	All samples in SDG 21G0126

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 with the following exceptions:

DUP ID (Associated Samples)	Analyte	RPD (Limits)	Flag	A or P
LDW21-IT653BDUP (LDW21-IT653B LDW21-IT653BDUP)	OCDF	27.8 (≤25)	J (all detects)	A

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. Labeled Compounds

All percent recoveries (%R) for labeled compounds used to quantitate target analytes were within QC limits with the following exceptions:

Sample	Labeled Compound	%R (Limits)	Affected Analyte	Flag	A or P
LDW21-IT653C	13C-2,3,7,8-TCDF	21.3 (24-169)	2,3,7,8-TCDF Total TCDF	J (all detects) J (all detects)	P

XI. Target Analyte Quantitation

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

Sample	Analyte	Flag	A or P
All samples in SDG 21G0126	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U (all non-detects)	A
All samples in SDG 21G0126	All results flagged "X" by the laboratory due to chlorinated diphenyl ether (CDPE) interference.	J (all detects)	A
All samples in SDG 21G0126	All compounds reported as estimated maximum possible concentration (EMPC) and greater than the reporting limit.	J (all detects)	A

Sample	Analyte	Finding	Criteria	Flag	A or P
LDW21-IT653B LDW21-IT653C LDW21-IT652B LDW21-IT652C LDW21-IT632B	OCDD	Sample result exceeded calibration range.	Reported result should be within calibration range.	J (all detects)	P

Raw data were not reviewed for Stage 2B validation.

XII. Target Analyte Identification

Raw data were not reviewed for Stage 2B validation.

XIII. System Performance

Raw data were not reviewed for Stage 2B validation.

XIV. 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 concentration, DUP RPD, labeled compound %R, analytes reported as EMPC, CDPE interference, and results exceeding calibration range, data were qualified as estimated in nine 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 21G0126

Sample	Analyte	Flag	A or P	Reason
LDW21-IT653B LDW21-IT653C LDW21-IT653E LDW21-IT652B LDW21-IT653BDUP	1,2,3,4,7,8,9-HpCDF	J (all detects)	P	Continuing calibration (concentration)
LDW21-IT652C LDW21-IT652E LDW21-IT632B LDW21-IT632C	1,2,3,4,6,7,8-HpCDF 1,2,3,4,7,8,9-HpCDF	J (all detects) J (all detects)	P	Continuing calibration (concentration)
LDW21-IT653B LDW21-IT653BDUP	OCDF	J (all detects)	A	Duplicate sample analysis (RPD)
LDW21-IT653C	2,3,7,8-TCDF Total TCDF	J (all detects) J (all detects)	P	Labeled compounds (%R)
LDW21-IT653B LDW21-IT653C LDW21-IT653E LDW21-IT652B LDW21-IT652C LDW21-IT652E LDW21-IT632B LDW21-IT632C LDW21-IT653BDUP	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U (all non-detects)	A	Target analyte quantitation (EMPC)
LDW21-IT653B LDW21-IT653C LDW21-IT653E LDW21-IT652B LDW21-IT652C LDW21-IT652E LDW21-IT632B LDW21-IT632C LDW21-IT653BDUP	All results flagged "X" by the laboratory due to chlorinated diphenyl ether (CDPE) interference.	J (all detects)	A	Target analyte quantitation (CDPE interference)
LDW21-IT653B LDW21-IT653C LDW21-IT653E LDW21-IT652B LDW21-IT652C LDW21-IT652E LDW21-IT632B LDW21-IT632C LDW21-IT653BDUP	All compounds reported as estimated maximum possible concentration (EMPC) and greater than the reporting limit.	J (all detects)	A	Target analyte quantitation (EMPC)
LDW21-IT653B LDW21-IT653C LDW21-IT652B LDW21-IT652C LDW21-IT632B	OCDD	J (all detects)	P	Target analyte quantitation (exceeded range)

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Laboratory Blank Data Qualification Summary - SDG 21G0126

No Sample Data Qualified in this SDG

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Field Blank Data Qualification Summary - SDG 21G0126

No Sample Data Qualified in this SDG

LDC #: 52219F21 **VALIDATION COMPLETENESS WORKSHEET** Date: 10/20/21
SDG #: 21G0126 Stage 2B Page: 1 of 1
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer: Q
2nd Reviewer: A

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≤20/25% ICV=QC limits
IV.	Continuing calibration	SW	CCV=QC limits
V.	Laboratory Blanks	SW	
VI.	Field blanks	N	
VII.	Matrix spike/Matrix spike duplicates /DUP	N/SW	
VIII.	Laboratory control samples /SRM	A	LCS
IX.	Field duplicates	N	
X.	Internal standards	SW	
XI.	Target analyte quantitation	SW	
XII.	Target analyte identification	N	
XIII.	System performance	N	
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-IT653B	21G0126-07	Sediment	07/12/21
2	LDW21-IT653C	21G0126-08	Sediment	07/12/21
3	LDW21-IT653E	21G0126-09	Sediment	07/12/21
4	LDW21-IT652B	21G0126-10	Sediment	07/12/21
5	LDW21-IT652C	21G0126-11	Sediment	07/12/21
6	LDW21-IT652E	21G0126-12	Sediment	07/12/21
7	LDW21-IT632B	21G0126-13	Sediment	07/12/21
8	LDW21-IT632C	21G0126-14	Sediment	07/12/21
9	LDW21-IT653BDUP	21G0126-07DUP	Sediment	07/12/21
10				

Notes:

	BJH0152						

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 #: 52219F21

VALIDATION FINDINGS WORKSHEET

Continuing Calibration

Page: 1 of 1

Reviewer: Q

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 Was a continuing calibration performed at the beginning of each 12 hour period?

Y (N) N/A Were all concentrations within method QC limits for unlabeled and labeled compounds?

(Y) N N/A Did all continuing calibration standards meet the Ion Abundance Ratio criteria?

#	Date	Standard ID	Compound	conc (ng/mL) ~~Finding %D~~	Finding Ion Abundance Ratio	Associated Samples	Qualifications
	9/20/21	21092002A	13C-P	73.8 (77-129)		1-4, 9, MB (dets)	J/UJ/P (qual P)
	9/21/21	21092012	13C-O	73.6 (78-129)		5-8 (dets)	J/UJ/P (qual O, P)
			↓ P	70.3 (77-129)			↓

LDC #: 52219F2

VALIDATION FINDINGS WORKSHEET
Blanks

Reviewer: 2

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: 9/6/21
Conc. units: ng/kg Associated Samples: All

Compound	Blank ID	Sample Identification								
	BLH0152-BLK1									
F	0.346									
F	2.70									
U	0.346									

Blank extraction 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 #: 52197F4

VALIDATION FINDINGS WORKSHEET
Matrix Spike/Matrix Spike Duplicates

Reviewer: Q

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 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?

#	Date	MS/MSD ID	Compound	MS %R (Limits)	MSD %R (Limits)	RPD (Limits)	Associated Samples	Qualifications
		9	Q	( )	( )	27.8 (≤25)	1, 9 (dets)	J dets/A
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
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				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		

LDC #: 52219F21

VALIDATION FINDINGS WORKSHEET
Labeled Compounds

Reviewer: Q

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 labeled compound recoveries within the QC criteria?

(Y) N N/A Were all labeled compound ion abundance ratios (IAR) within the QC criteria?

(Y) N N/A Was the S/N ratio all internal standard peaks ≥ 10?

#	Date	Lab ID/Reference	Labeled Compound	% Recovery (Limit)	Qualifications
		2 (dets)	13C-H	21.3 (24-169)	J/UJ/P (H, B)

LDC #: 51090F21

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		U/A
		All	All compounds flagged "X" due to chlorinated diphenyl either interference		Jdets/A
		All	All compounds reported as estimated maximum possible concentration (EMPC) > RL		Jdets/A
		1-2,4-5,7	4 > calib range		Jdets/A

Comments: See sample calculation verification worksheet for recalculations

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: December 21, 2021

Parameters: Polychlorinated Dioxins/Dibenzofurans

Validation Level: Stage 2B

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21G0140

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-SC634A	21G0140-04	Sediment	07/12/21
LDW21-SC634A-FD	21G0140-05	Sediment	07/12/21
LDW21-SC634B	21G0140-06	Sediment	07/12/21
LDW21-SC634C	21G0140-07	Sediment	07/12/21
LDW21-SC634E	21G0140-08	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 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 2B data validation, which comprises an evaluation of quality control (QC) summary results.

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 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 with the following exceptions:

Date	Analyte	Concentration (Limits)	Associated Samples	Affected Analyte	Flag	A or P
09/21/21 (21092012)	13C-1,2,3,4,6,7,8-HpCDF 13C-1,2,3,4,7,8,9-HpCDF	73.6 ng/mL (78-129) 70.3 ng/mL (77-129)	LDW21-SC634A LDW21-SC634A-FD LDW21-SC634B LDW21-SC634C	1,2,3,4,6,7,8-HpCDF 1,2,3,4,7,8,9-HpCDF	J (all detects) J (all detects)	P
09/21/21 (21092022)	13C-1,2,3,4,6,7,8-HpCDF 13C-1,2,3,4,7,8,9-HpCDF	72.7 ng/mL (78-129) 69.9 ng/mL (77-129)	LDW21-SC634E	1,2,3,4,6,7,8-HpCDF 1,2,3,4,7,8,9-HpCDF	J (all detects) J (all detects)	P

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

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
BJH0152-BLK1	09/06/21	1,2,3,4,6,7,8-HpCDD OCDD Total HpCDD	0.346 ng/Kg 2.70 ng/Kg 0.346 ng/Kg	All samples in SDG 21G0140

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

Samples LDW21-SC634A and LDW21-SC634A-FD were identified as field duplicates. No results were detected in any of the samples with the following exceptions:

Analyte	Concentration (ng/Kg)		RPD
	LDW21-SC634A	LDW21-SC634A-FD	
2,3,7,8-TCDF	0.675	0.698	3
2,3,7,8-TCDD	0.378	0.353	7
1,2,3,7,8-PeCDF	0.539	0.525	3

Analyte	Concentration (ng/Kg)		RPD
	LDW21-SC634A	LDW21-SC634A-FD	
2,3,4,7,8-PeCDF	0.758	0.826	9
1,2,3,7,8-PeCDD	1.04	1.08	4
1,2,3,4,7,8-HxCDF	3.31	3.20	3
1,2,3,6,7,8-HxCDF	1.25	1.28	2
2,3,4,6,7,8-HxCDF	0.818	0.828	1
1,2,3,7,8,9-HxCDF	0.588	0.688	16
1,2,3,4,7,8-HxCDD	1.05	1.21	14
1,2,3,6,7,8-HxCDD	4.38	4.62	5
1,2,3,7,8,9-HxCDD	2.94	3.04	3
1,2,3,4,6,7,8-HpCDF	22.3	31.6	35
1,2,3,4,7,8,9-HpCDF	2.04	2.45	18
1,2,3,4,6,7,8-HpCDD	114	172	41
OCDF	47.1	213	128
OCDD	890	2080	80
Total TCDF	6.55	9.28	34
Total TCDD	1.99	4.18	71
Total PeCDF	16.0	16.5	3
Total PeCDD	2.56	4.50	55
Total HxCDF	36.2	39.7	9
Total HxCDD	36.0	38.4	6
Total HpCDF	71.5	137	63
Total HpCDD	255	357	33

X. Labeled Compounds

All percent recoveries (%R) for labeled compounds used to quantitate target analytes were within QC limits.

XI. Target Analyte Quantitation

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

Sample	Analyte	Flag	A or P
All samples in SDG 21G0140	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U (all non-detects)	A

Raw data were not reviewed for Stage 2B validation.

XII. Target Analyte Identification

Raw data were not reviewed for Stage 2B validation.

XIII. System Performance

Raw data were not reviewed for Stage 2B validation.

XIV. 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 concentration and analytes reported as EMPC, data were qualified as estimated in five 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 21G0140

Sample	Analyte	Flag	A or P	Reason
LDW21-SC634A LDW21-SC634A-FD LDW21-SC634B LDW21-SC634C LDW21-SC634E	1,2,3,4,6,7,8-HpCDF 1,2,3,4,7,8,9-HpCDF	J (all detects) J (all detects)	P	Continuing calibration (concentration)
LDW21-SC634A LDW21-SC634A-FD LDW21-SC634B LDW21-SC634C LDW21-SC634E	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U (all non-detects)	A	Target analyte quantitation (EMPC)

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Laboratory Blank Data Qualification Summary - SDG 21G0140

No Sample Data Qualified in this SDG

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Field Blank Data Qualification Summary - SDG 21G0140

No Sample Data Qualified in this SDG

LDC #: 52219G21 **VALIDATION COMPLETENESS WORKSHEET** Date: 10/20/21
SDG #: 21G0140 Stage 2B Page: 1 of 1
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer:
2nd Reviewer:

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	SW	CCV ≤ QC limits
V.	Laboratory Blanks	SW	
VI.	Field blanks	N	
VII.	Matrix spike/Matrix spike duplicates	N	CO
VIII.	Laboratory control samples /SRM	A	LCS
IX.	Field duplicates	SW	D=1+2
X.	Internal standards	A	
XI.	Target analyte quantitation	A/N	
XII.	Target analyte identification	N	
XIII.	System performance	N	
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-SC634A	21G0140-04	Sediment	07/12/21
2	LDW21-SC634A-FD	21G0140-05	Sediment	07/12/21
3	LDW21-SC634B	21G0140-06	Sediment	07/12/21
4	LDW21-SC634C	21G0140-07	Sediment	07/12/21
5	LDW21-SC634E	21G0140-08	Sediment	07/12/21
6				
7				
8				
9				
10				

Notes:

	B1H0152-BLK1						

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 #: 52219F21

VALIDATION FINDINGS WORKSHEET
Continuing Calibration

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 Was a continuing calibration performed at the beginning of each 12 hour period?
Y N N/A Were all concentrations within method QC limits for unlabeled and labeled compounds?
Y N N/A Did all continuing calibration standards meet the Ion Abundance Ratio criteria?

#	Date	Standard ID	Compound	conc (ng/mL) ~~Finding %D~~	Finding Ion Abundance Ratio	Associated Samples	Qualifications
	9/6/21	210920024	13C-P	73.8 (77-129)		MB	J/UN/P
	9/11/21	21092012	13C-O	73.6 (78-129)		1-4. (dets)	J/UN/P (O.P.E)
			13C-P	70.3 (77-129)			↓
	9/11/21	21092022	13C-O	72.7 (78-129)		5 (dets	J/UN/P (O.P.E)
			13C-P	69.9 (77-129)			↓

LDC #: 52197B1

VALIDATION FINDINGS WORKSHEET
Blanks

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: 9/6/21
Conc. units: ng/kg Associated Samples: All

Compound	Blank ID	Sample Identification								
All	0150-BLK1									
F	0.346									
4	2.70									
U	0.346									

Blank extraction 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#: 52219G21

VALIDATION FINDINGS WORKSHEET
Field Duplicates

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

Compound	Concentration (ng/kg)		RPD
	1	2	
H	0.675	0.698	3
A	0.378	0.353	7
I	0.539	0.525	3
J	0.758	0.826	9
B	1.04	1.08	4
K	3.31	3.20	3
L	1.25	1.28	2
M	0.818	0.828	1
N	0.588	0.688	16
C	1.05	1.21	14
D	4.38	4.62	5
E	2.94	3.04	3
O	22.3	31.6	35
P	2.04	2.45	18
F	114	172	41
Q	47.1	213	128
G	890	2080	80
V	6.55	9.28	34
R	1.99	4.18	71
W	16.0	16.5	3
S	2.56	4.50	55
X	36.2	39.7	9
T	36.0	38.4	6
Y	71.5	137	63
U	255	357	33

LDC #: 52219G21

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~~		~~Jdets/A~~
		All	All compounds reported as estimated maximum possible concentration (EMPC) < RL		U/A

Comments: See sample calculation verification worksheet for recalculations

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: October 25, 2021

Parameters: Polychlorinated Dioxins/Dibenzofurans

Validation Level: Stage 2B

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21G0156

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT622A	21G0156-01	Sediment	07/14/21
LDW21-IT622B	21G0156-02	Sediment	07/14/21
LDW21-IT622C	21G0156-03	Sediment	07/14/21
LDW21-IT622E	21G0156-04	Sediment	07/14/21
LDW21-IT660B	21G0156-05	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 2B data validation, which comprises an evaluation of quality control (QC) summary results.

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 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 with the following exceptions:

Date	Analyte	Concentration (Limits)	Associated Samples	Affected Analyte	Flag	A or P
09/21/21	13C-1,2,3,4,6,7,8-HpCDF 13C-1,2,3,4,7,8,9-HpCDF	72.7 ng/mL (78-129) 69.9 ng/mL (77-129)	All samples in SDG 21G0156	1,2,3,4,6,7,8-HpCDF 1,2,3,4,7,8,9-HpCDF	J (all detects) UJ (all non-detects) J (all detects) UJ (all non-detects)	P

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

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
BJH0152-BLK1	09/06/21	1,2,3,4,6,7,8-HpCDD OCDD Total HpCDD	0.346 ng/Kg 2.70 ng/Kg 0.346 ng/Kg	All samples in SDG 21G0156

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-IT622B	1,2,3,4,6,7,8-HpCDD OCDD Total HpCDD	0.801 ng/Kg 7.24 ng/Kg 0.986 ng/Kg	0.801U ng/Kg 7.24U ng/Kg 0.986J ng/Kg
LDW21-IT622C	1,2,3,4,6,7,8-HpCDD OCDD Total HpCDD	0.725 ng/Kg 7.86 ng/Kg 0.970 ng/Kg	0.725U ng/Kg 7.86U ng/Kg 0.970J ng/Kg
LDW21-IT622E	1,2,3,4,6,7,8-HpCDD OCDD	0.921 ng/Kg 5.74 ng/Kg	0.921U ng/Kg 5.74U 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. Labeled Compounds

All percent recoveries (%R) for labeled compounds used to quantitate target analytes were within QC limits.

XI. Target Analyte Quantitation

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

Sample	Analyte	Flag	A or P
All samples in SDG 21G0156	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U (all non-detects)	A

Sample	Analyte	Finding	Criteria	Flag	A or P
LDW21-IT660B	OCDD	Sample result exceeded calibration range.	Reported result should be within calibration range.	J (all detects)	P

Raw data were not reviewed for Stage 2B validation.

XII. Target Analyte Identification

Raw data were not reviewed for Stage 2B validation.

XIII. System Performance

Raw data were not reviewed for Stage 2B validation.

XIV. 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 concentration, analytes reported as EMPC, and results exceeding calibration range, data were qualified as estimated in five samples.

Due to laboratory blank contamination, data were qualified as not detected or 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 21G0156

Sample	Analyte	Flag	A or P	Reason
LDW21-IT622A LDW21-IT622B LDW21-IT622C LDW21-IT622E LDW21-IT660B	1,2,3,4,6,7,8-HpCDF 1,2,3,4,7,8,9-HpCDF	J (all detects) UJ (all non-detects) J (all detects) UJ (all non-detects)	P	Continuing calibration (concentration)
LDW21-IT622A LDW21-IT622B LDW21-IT622C LDW21-IT622E LDW21-IT660B	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U (all non-detects)	A	Target analyte quantitation (EMPC)
LDW21-IT660B	OCDD	J (all detects)	P	Target analyte quantitation (exceeded range)

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Laboratory Blank Data Qualification Summary - SDG 21G0156

Sample	Analyte	Modified Final Concentration	A or P
LDW21-IT622B	1,2,3,4,6,7,8-HpCDD OCDD Total HpCDD	0.801U ng/Kg 7.24U ng/Kg 0.986J ng/Kg	A
LDW21-IT622C	1,2,3,4,6,7,8-HpCDD OCDD Total HpCDD	0.725U ng/Kg 7.86U ng/Kg 0.970J ng/Kg	A
LDW21-IT622E	1,2,3,4,6,7,8-HpCDD OCDD	0.921U ng/Kg 5.74U ng/Kg	A

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Field Blank Data Qualification Summary - SDG 21G0156

No Sample Data Qualified in this SDG

LDC #: 52219H21 **VALIDATION COMPLETENESS WORKSHEET** Date: 10/20/21
SDG #: 21G0156 Stage 2B Page: 1 of 1
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer:
2nd Reviewer:

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	SW	CCV ≤ QC limits
V.	Laboratory Blanks	SW	
VI.	Field blanks	N	
VII.	Matrix spike/Matrix spike duplicates	N	LCS
VIII.	Laboratory control samples / SRM	A	SRM LCS
IX.	Field duplicates	N	
X.	Internal standards	A	
XI.	Target analyte quantitation	A-N	
XII.	Target analyte identification	N	
XIII.	System performance	N	
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-IT622A	21G0156-01	Sediment	07/14/21
2	LDW21-IT622B	21G0156-02	Sediment	07/14/21
3	LDW21-IT622C	21G0156-03	Sediment	07/14/21
4	LDW21-IT622E	21G0156-04	Sediment	07/14/21
5	LDW21-IT660B	21G0156-05	Sediment	07/14/21
6				
7				
8				
9				
10				

Notes:

	B1H0150-BLK1						

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 #: 52219H21

VALIDATION FINDINGS WORKSHEET
Continuing Calibration

Reviewer: [illegible]

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 Was a continuing calibration performed at the beginning of each 12 hour period?

Y (N) N/A Were all concentrations within method QC limits for unlabeled and labeled compounds?

(Y) N N/A Did all continuing calibration standards meet the Ion Abundance Ratio criteria?

#	Date	Standard ID	Compound	conc (ng/mL) ~~Finding %D~~	Finding Ion Abundance Ratio	Associated Samples	Qualifications
	9/20/21	21092002A	13C-P	73.8 (77-129)		MB	J/UJ/P
	9/21/21	21092022	13C-O	72.7 (78-129)		All (dets+ND)	J/UJ/P (O, P ~~[illegible]~~)
			13C-P	69.9 (77-129)			↓

LDC #: 52194A1

VALIDATION FINDINGS WORKSHEET
Blanks

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: 9/6/21
Conc. units: ng/kg Associated Samples: All

Compound	Blank ID	Sample Identification								
	BJH0150-BLK1	1	2	3	4	5				
F	0.346		0.801 /U	0.725/U	0.921/U					
G	2.70		7.24 /U	7.86/U	5.74/U					
U	0.346		0.986 /J	0.970/J						

Blank extraction 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 #: 52219H21

VALIDATION FINDINGS WORKSHEET
Compound Quantitation and Reported RLs

Page: ___of___
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~~
		All	All compounds reported as estimated maximum possible concentration (EMPC) < RL		U/A
		5	4 > edeb range		Jdets/A

Comments: See sample calculation verification worksheet for recalculations

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: October 25, 2021

Parameters: Polychlorinated Dioxins/Dibenzofurans

Validation Level: Stage 2B

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21G0211

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT665B	21G0211-11	Sediment	07/19/21
LDW21-IT665C	21G0211-12	Sediment	07/19/21
LDW21-IT665E	21G0211-13	Sediment	07/19/21
LDW21-IT666B	21G0211-14	Sediment	07/19/21
LDW21-IT666C	21G0211-15	Sediment	07/19/21
LDW21-IT666E	21G0211-16	Sediment	07/19/21
LDW21-IT665BDUP	21G0211-11DUP	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 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 2B data validation, which comprises an evaluation of quality control (QC) summary results.

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 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 with the following exceptions:

Date	Analyte	Concentration (Limits)	Associated Samples	Affected Analyte	Flag	A or P
09/21/21 (21092022A)	13C-1,2,3,4,6,7,8-HpCDF 13C-1,2,3,4,7,8,9-HpCDF	72.7 ng/mL (78-129) 69.9 ng/mL (77-129)	LDW21-IT665BDUP	1,2,3,4,6,7,8-HpCDF 1,2,3,4,7,8,9-HpCDF	J (all detects) J (all detects)	P
09/21/21 (21092034A)	13C-1,2,3,4,6,7,8-HpCDF 13C-1,2,3,4,7,8,9-HpCDF	76.2 ng/mL (78-129) 72.9 ng/mL (77-129)	LDW21-IT665B LDW21-IT665C LDW21-IT665E LDW21-IT666B LDW21-IT666C LDW21-IT666E	1,2,3,4,6,7,8-HpCDF 1,2,3,4,7,8,9-HpCDF	J (all detects) UJ (all non-detects) J (all detects) UJ (all non-detects)	P

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

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
BJH0203-BLK1	09/09/21	1,2,3,4,6,7,8-HpCDD OCDD Total HpCDD	0.247 ng/Kg 4.03 ng/Kg 0.266 ng/Kg	All samples in SDG 21G0211

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-IT666E	1,2,3,4,6,7,8-HpCDD OCDD	2.41 ng/Kg 18.9 ng/Kg	2.41U ng/Kg 18.9U ng/Kg

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. Labeled Compounds

All percent recoveries (%R) for labeled compounds used to quantitate target analytes were within QC limits.

XI. Target Analyte Quantitation

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

Sample	Analyte	Flag	A or P
All samples in SDG 21G0211	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U (all non-detects)	A
All samples in SDG 21G0211	All results flagged "X" by the laboratory due to chlorinated diphenyl ether (CDPE) interference.	J (all detects)	A
All samples in SDG 21G0211	All compounds reported as estimated maximum possible concentration (EMPC) and greater than the reporting limit.	J (all detects)	A

Sample	Analyte	Finding	Criteria	Flag	A or P
LDW21-IT665C	OCDD	Sample result exceeded calibration range.	Reported result should be within calibration range.	J (all detects)	P

Raw data were not reviewed for Stage 2B validation.

XII. Target Analyte Identification

Raw data were not reviewed for Stage 2B validation.

XIII. System Performance

Raw data were not reviewed for Stage 2B validation.

XIV. 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 concentration, analytes reported as EMPC, CDPE interference, and results exceeding calibration range, data were qualified as estimated in seven 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 21G0211

Sample	Analyte	Flag	A or P	Reason
LDW21-IT665B LDW21-IT665C LDW21-IT665E LDW21-IT666B LDW21-IT666C LDW21-IT666E LDW21-IT665BDUP	1,2,3,4,6,7,8-HpCDF 1,2,3,4,7,8,9-HpCDF	J (all detects) UJ (all non-detects) J (all detects) UJ (all non-detects)	P	Continuing calibration (concentration)
LDW21-IT665B LDW21-IT665C LDW21-IT665E LDW21-IT666B LDW21-IT666C LDW21-IT666E LDW21-IT665BDUP	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U (all non-detects)	A	Target analyte quantitation (EMPC)
LDW21-IT665B LDW21-IT665C LDW21-IT665E LDW21-IT666B LDW21-IT666C LDW21-IT666E LDW21-IT665BDUP	All results flagged "X" by the laboratory due to chlorinated diphenyl ether (CDPE) interference.	J (all detects)	A	Target analyte quantitation (CDPE interference)
LDW21-IT665B LDW21-IT665C LDW21-IT665E LDW21-IT666B LDW21-IT666C LDW21-IT666E LDW21-IT665BDUP	All compounds reported as estimated maximum possible concentration (EMPC) and greater than the reporting limit.	J (all detects)	A	Target analyte quantitation (EMPC)
LDW21-IT665C	OCDD	J (all detects)	P	Target analyte quantitation (exceeded range)

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Laboratory Blank Data Qualification Summary - SDG 21G0211

Sample	Analyte	Modified Final Concentration	A or P
LDW21-IT666E	1,2,3,4,6,7,8-HpCDD OCDD	2.41U ng/Kg 18.9U ng/Kg	A

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Field Blank Data Qualification Summary - SDG 21G0211

No Sample Data Qualified in this SDG

LDC #: 52219I21 **VALIDATION COMPLETENESS WORKSHEET** Date: 10/20/21
SDG #: 21G0211 Stage 2B Page: 1 of 1
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer:
2nd Reviewer: a

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	SW	CCV ≤ QC limits
V.	Laboratory Blanks	SW	
VI.	Field blanks	N	
VII.	Matrix spike/Matrix spike duplicates /dup	N/A	>RL
VIII.	Laboratory control samples /SRM	A	LCS
IX.	Field duplicates	N	
X.	Internal standards	A	
XI.	Target analyte quantitation	SW	
XII.	Target analyte identification	N	
XIII.	System performance	N	
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-IT665B	21G0211-11	Sediment	07/19/21
2	LDW21-IT665C	21G0211-12	Sediment	07/19/21
3	LDW21-IT665E	21G0211-13	Sediment	07/19/21
4	LDW21-IT666B	21G0211-14	Sediment	07/19/21
5	LDW21-IT666C	21G0211-15	Sediment	07/19/21
6	LDW21-IT666E	21G0211-16	Sediment	07/19/21
7	LDW21-IT665BDUP	21G0211-11DUP	Sediment	07/19/21
8				
9				
10				

Notes:

	BH0203						

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 #: 52219I21

VALIDATION FINDINGS WORKSHEET
Continuing Calibration

Page: 1 of 1
Reviewer: Q

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 Was a continuing calibration performed at the beginning of each 12 hour period?

Y (N) N/A Were all concentrations within method QC limits for unlabeled and labeled compounds?

(Y) N N/A Did all continuing calibration standards meet the Ion Abundance Ratio criteria?

#	Date	Standard ID	Compound	conc (ng/mL) ~~Finding %D~~	Finding Ion Abundance Ratio	Associated Samples	Qualifications
	9/24/21	21092022A	13C-O	72.7 (78-129)		MB, 7 (dets)	J/UJ/P (O, P)
			13C-P	59.9 (77-129)			
	9/21/21	21092034A	13C-O	76.2 (78-129)		1-6 (dets + ND)	J/UJ/P (O, P)
			13C-P	72.9 (77-129)			

LDC #: 52219121

VALIDATION FINDINGS WORKSHEET
Blanks

Reviewer: Q

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: 9/9/21
Conc. units: ng/kg   Associated Samples: All

Compound	Blank ID	Sample Identification								
	BJHD203-BK1		6							
F	0.247		2.41/U							
G	4.03		18.9/U							
U	0.266									

Blank extraction 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 #: 51090I21

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		U/A
		All	All compounds flagged "X" due to chlorinated diphenyl either interference		Jdets/A
		All	All compounds reported as estimated maximum possible concentration (EMPC) > RL		Jdets/A
		2	4 > calib range		Jdets/A

Comments: See sample calculation verification worksheet for recalculations

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: October 25, 2021

Parameters: Polychlorinated Dioxins/Dibenzofurans

Validation Level: Stage 2B

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21G0283

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-IT664B	21G0283-11	Sediment	07/20/21
LDW21-IT664C	21G0283-12	Sediment	07/20/21
LDW21-IT664E	21G0283-13	Sediment	07/20/21
LDW21-IT670B	21G0283-14	Sediment	07/20/21
LDW21-IT670C	21G0283-15	Sediment	07/20/21
LDW21-IT670E	21G0283-16	Sediment	07/20/21
LDW21-IT650B	21G0283-17	Sediment	07/20/21
LDW21-IT650C	21G0283-18	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 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 2B data validation, which comprises an evaluation of quality control (QC) summary results.

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 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 with the following exceptions:

Date	Analyte	Concentration (Limits)	Associated Samples	Affected Analyte	Flag	A or P
09/22/21 (21092044)	13C-1,2,3,4,6,7,8-HpCDF 13C-1,2,3,4,7,8,9-HpCDF	77.3 ng/mL (78-129) 72.5 ng/mL (77-129)	LDW21-IT664B LDW21-IT664C LDW21-IT664E LDW21-IT670B	1,2,3,4,6,7,8-HpCDF 1,2,3,4,7,8,9-HpCDF	J (all detects) UJ (all non-detects) J (all detects) UJ (all non-detects)	P
09/22/21 (21092054)	13C-2,3,4,7,8-PeCDF 1,2,3,4,7,8,9-HpCDF	76.4 ng/mL (77-130) 76.0 ng/mL (77-129)	LDW21-IT670C LDW21-IT670E LDW21-IT650B LDW21-IT650C	2,3,4,7,8-PeCDF 1,2,3,4,7,8,9-HpCDF	J (all detects) UJ (all non-detects) J (all detects) UJ (all non-detects)	P

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

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
BJH0203-BLK1	09/09/21	1,2,3,4,6,7,8-HpCDD OCDD Total HpCDD	0.247 ng/Kg 4.03 ng/Kg 0.266 ng/Kg	All samples in SDG 21G0283

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-IT670B	1,2,3,4,6,7,8-HpCDD	2.15 ng/Kg	2.15U ng/Kg
LDW21-IT670C	1,2,3,4,6,7,8-HpCDD OCDD	1.84 ng/Kg 15.9 ng/Kg	1.84U ng/Kg 15.9U ng/Kg
LDW21-IT670E	1,2,3,4,6,7,8-HpCDD OCDD Total HpCDD	0.848 ng/Kg 8.71 ng/Kg 1.17 ng/Kg	0.848U ng/Kg 8.71U ng/Kg 1.17J 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. Labeled Compounds

All percent recoveries (%R) for labeled compounds used to quantitate target analytes were within QC limits.

XI. Target Analyte Quantitation

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

Sample	Analyte	Flag	A or P
All samples in SDG 21G0283	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U (all non-detects)	A
All samples in SDG 21G0283	All results flagged "X" by the laboratory due to chlorinated diphenyl ether (CDPE) interference.	J (all detects)	A
All samples in SDG 21G0283	All compounds reported as estimated maximum possible concentration (EMPC) and greater than the reporting limit.	J (all detects)	A

Sample	Analyte	Finding	Criteria	Flag	A or P
LDW21-IT664B	OCDD	Sample result exceeded calibration range.	Reported result should be within calibration range.	J (all detects)	P

Raw data were not reviewed for Stage 2B validation.

XII. Target Analyte Identification

Raw data were not reviewed for Stage 2B validation.

XIII. System Performance

Raw data were not reviewed for Stage 2B validation.

XIV. 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 concentration, analytes reported as EMPC, CDPE interference, and results exceeding calibration range, data were qualified as estimated in eight samples.

Due to laboratory blank contamination, data were qualified as not detected or 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 21G0283

Sample	Analyte	Flag	A or P	Reason
LDW21-IT664B LDW21-IT664C LDW21-IT664E LDW21-IT670B	1,2,3,4,6,7,8-HpCDF 1,2,3,4,7,8,9-HpCDF	J (all detects) UJ (all non-detects) J (all detects) UJ (all non-detects)	P	Continuing calibration (concentration)
LDW21-IT670C LDW21-IT670E LDW21-IT650B LDW21-IT650C	2,3,4,7,8-PeCDF 1,2,3,4,7,8,9-HpCDF	J (all detects) UJ (all non-detects) J (all detects) UJ (all non-detects)	P	Continuing calibration (concentration)
LDW21-IT664B LDW21-IT664C LDW21-IT664E LDW21-IT670B LDW21-IT670C LDW21-IT670E LDW21-IT650B LDW21-IT650C	All analytes reported as estimated maximum possible concentration (EMPC) and less than the reporting limit (RL).	U (all non-detects)	A	Target analyte quantitation (EMPC)
LDW21-IT664B LDW21-IT664C LDW21-IT664E LDW21-IT670B LDW21-IT670C LDW21-IT670E LDW21-IT650B LDW21-IT650C	All results flagged "X" by the laboratory due to chlorinated diphenyl ether (CDPE) interference.	J (all detects)	A	Target analyte quantitation (CDPE interference)
LDW21-IT664B LDW21-IT664C LDW21-IT664E LDW21-IT670B LDW21-IT670C LDW21-IT670E LDW21-IT650B LDW21-IT650C	All compounds reported as estimated maximum possible concentration (EMPC) and greater than the reporting limit.	J (all detects)	A	Target analyte quantitation (EMPC)
LDW21-IT664B	OCDD	J (all detects)	P	Target analyte quantitation (exceeded range)

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Laboratory Blank Data Qualification Summary - SDG 21G0283

Sample	Analyte	Modified Final Concentration	A or P
LDW21-IT670B	1,2,3,4,6,7,8-HpCDD	2.15U ng/Kg	A
LDW21-IT670C	1,2,3,4,6,7,8-HpCDD OCDD	1.84U ng/Kg 15.9U ng/Kg	A

Sample	Analyte	Modified Final Concentration	A or P
LDW21-IT670E	1,2,3,4,6,7,8-HpCDD OCDD Total HpCDD	0.848U ng/Kg 8.71U ng/Kg 1.17J ng/Kg	A

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Field Blank Data Qualification Summary - SDG 21G0283

No Sample Data Qualified in this SDG

LDC #: 52219J21 **VALIDATION COMPLETENESS WORKSHEET** Date: 10/20/21
SDG #: 21G0283 Stage 2B Page: 1 of 1
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer: 9
2nd Reviewer: 6

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 ≤ 20/25% ICV ≤ QC limits
IV.	Continuing calibration	SW	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	N	
XIII.	System performance	N	
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-IT664B	21G0283-11	Sediment	07/20/21
2	LDW21-IT664C	21G0283-12	Sediment	07/20/21
3	LDW21-IT664E	21G0283-13	Sediment	07/20/21
4	LDW21-IT670B	21G0283-14	Sediment	07/20/21
5	LDW21-IT670C	21G0283-15	Sediment	07/20/21
6	LDW21-IT670E	21G0283-16	Sediment	07/20/21
7	LDW21-IT650B	21G0283-17	Sediment	07/20/21
8	LDW21-IT650C	21G0283-18	Sediment	07/20/21
9				
10				

Notes:

	BH0203-BK1						

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 #: 52219121

VALIDATION FINDINGS WORKSHEET
Continuing Calibration

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 Was a continuing calibration performed at the beginning of each 12 hour period?
Y N N/A Were all concentrations within method QC limits for unlabeled and labeled compounds?
Y N N/A Did all continuing calibration standards meet the Ion Abundance Ratio criteria?

#	Date	Standard ID	Compound	conc (ng/mL) ~~Finding %D~~	Finding Ion Abundance Ratio	Associated Samples	Qualifications
	9/21/21	210920224	13C-O	72.7 (78-129		MB	J/U/P
			13C-P	69.9 (77-129)			
	9/22/21	210920424	13C-O	77.3 (78-129)		1-4. (def3+ND)	J/U/P (O.P)
			13C-P	72.5 (77-129)			
	9/22/21	210920524	13C-J	76.4 (77-130)		5-8 (def3+ND)	J/U/P (J, P)
			13C-P	76.0 (77-129)			

LDC #: 52191-2

VALIDATION FINDINGS WORKSHEET
Blanks

Reviewer: 2

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: 9/9/21
Conc. units: pg/kg Associated Samples: All

Compound	Blank ID	Sample Identification								
	BJH0203-BK1	1	4	5	6					
F	0.247		2.15/U	1.84/U	0.848/U					
G	4.03			15.9/U	8.71/U					
U	0.266				1.17/J					

Blank extraction 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 #: ~~51090J21~~ 52191/2/

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		U/A
		All	All compounds flagged "X" due to chlorinated diphenyl either interference		Jdets/A
		All	All compounds reported as estimated maximum possible concentration (EMPC) > RL		Jdets/A
		1	4 > calib range		~~Jdets/A~~

Comments: See sample calculation verification worksheet for recalculations

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Duwamish AOC4

LDC Report Date: October 25, 2021

Parameters: Polychlorinated Dioxins/Dibenzofurans

Validation Level: Stage 2B

Laboratory: Analytical Resources, Inc., Tukwila, WA

Sample Delivery Group (SDG): 21G0286

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LDW21-SS646	21G0286-05	Sediment	07/22/21
LDW21-SS646DUP	21G0286-05DUP	Sediment	07/22/21

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 2B data validation, which comprises an evaluation of quality control (QC) summary results.

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 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.

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
BJH0773-BLK1	09/02/21	OCDD	4.53 ng/Kg	All samples in SDG 21G0286

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 with the following exceptions:

SRM ID (Associated Samples)	Analyte	%R (Limits)	Flag	A or P
BJH0773-SRM1 (All samples in SDG 21G0286)	1,2,3,7,8,9-HxCDF	154 (50-150)	J (all detects)	A

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Labeled Compounds

All percent recoveries (%R) for labeled compounds used to quantitate target analytes were within QC limits.

XI. Target Analyte Quantitation

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

Sample	Analyte	Flag	A or P
All samples in SDG 21G0286	All compounds reported as estimated maximum possible concentration (EMPC) and greater than the reporting limit.	J (all detects)	A

Sample	Analyte	Finding	Criteria	Flag	A or P
LDW21-SS646	OCDD	Sample result exceeded calibration range.	Reported result should be within calibration range.	J (all detects)	P

Raw data were not reviewed for Stage 2B validation.

XII. Target Analyte Identification

Raw data were not reviewed for Stage 2B validation.

XIII. System Performance

Raw data were not reviewed for Stage 2B validation.

XIV. Overall Assessment of Data

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

Due to SRM %R, analytes reported as EMPC, and results exceeding calibration range, 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 21G0286

Sample	Analyte	Flag	A or P	Reason
LDW21-SS646 LDW21-SS646DUP	1,2,3,7,8,9-HxCDF	J (all detects)	A	Standard reference materials (%R)
LDW21-SS646 LDW21-SS646DUP	All compounds reported as estimated maximum possible concentration (EMPC) and greater than the reporting limit.	J (all detects)	A	Target analyte quantitation (EMPC)
LDW21-SS646	OCDD	J (all detects)	P	Target analyte quantitation (exceeded range)

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Laboratory Blank Data Qualification Summary - SDG 21G0286

No Sample Data Qualified in this SDG

Duwamish AOC4
Polychlorinated Dioxins/Dibenzofurans - Field Blank Data Qualification Summary - SDG 21G0286

No Sample Data Qualified in this SDG

LDC #: 52219K21 **VALIDATION COMPLETENESS WORKSHEET** Date: 10/20/21
SDG #: 21G0286 Stage 2B Page: 1 of 1
Laboratory: Analytical Resources, Inc., Tukwila, WA Reviewer: 2nd Reviewer:

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 ≤ 20/25% 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	> RL
VIII.	Laboratory control samples /SRM	A/SW	LCS
IX.	Field duplicates	N	
X.	Internal standards	A	
XI.	Target analyte quantitation	A/N	
XII.	Target analyte identification	N	
XIII.	System performance	N	
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-SS646	21G0286-05	Sediment	07/22/21
2	LDW21-SS646DUP	21G0286-05DUP	Sediment	07/22/21
3				
4				
5				
6				
7				
8				
9				
10				

Notes:

	BJH0773-BLK						

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 #: 52219K2/

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: 9/3/21
Conc. units: pg/KG Associated Samples: All

Compound	Blank ID	Sample Identification								
	BJH0773-BK1									
4	4.53									

Blank extraction 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 #: 52219E21

VALIDATION FINDINGS WORKSHEET
Laboratory Control Samples (LCS)

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 Was a LCS required?

Y N N/A Was a LCS analyzed every 20 samples for each matrix or whenever a sample extraction was performed?

(Y) N N/A Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?

#	Date	Lab ID/Reference	Compound	LCS %R (Limits)	LCSD %R (Limits)	RPD (Limits)	Associated Samples	Qualifications
		B1H0773-SRM1	N	154 (50-150)	( )	( )	All (dets)	J dets / A
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
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				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		

LDC #: 52219K21

VALIDATION FINDINGS WORKSHEET
Compound Quantitation and Reported RLs

Page: 1 of 1
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
		~~All~~	~~All compounds reported as estimated maximum possible concentration (EMPC) < RL~~		~~U/A~~
		1	4 > calib range		Jdets/A

Comments: See sample calculation verification worksheet for recalculations