MEMORANDUM FOR RECORD

SUBJECT: DETERMINATION ON THE SUITABILITY OF DIOXIN CONCENTRATIONS MEASURED WITHIN THE FEDERAL CHANELS IN BELLINGHAM HARBOR: SQUALICUM CREEK AND I&J STREET WATERWAYS FOR POTENTIAL OPEN-WATER DISPOSAL AT EITHER THE ROSARIO STRAIT DISPERSIVE SITE OR THE BELLINGHAM BAY NON-DISPERSIVE SITE.

1. The following summary reflects an assessment of dioxin concentrations in dredged material within two Federal Waterways in Bellingham, Washington as a screening level assessment on dioxin concentrations relative to potential suitability for unconfined open-water disposal at either a dispersive site (e.g., Rosario Strait) or a non-dispersive site (Bellingham Bay). This assessment on suitability for unconfined open-water disposal is restricted to dioxin only, and a full DMMP Chemical-of-Concern assessment (including dioxin) would be required to fully evaluate each Waterway during the time an actual maintenance dredged material project is scheduled/proposed.

2. Table 1 documents the regulatory tracking information and dates for the DMMP testing conducted.

Table 1. Regulatory Tracking Information and Dates

SAP submittal date (prepared by DMMO in coordination with DMMP)	July 14, 2011
SAP approval date:	August 30, 2011
Sampling date:	September 6 - 8, 2011 (vibracorer)
Characterization Data Summary Memorandum: submittal:	December 15, 2011
DAIS Tracking Number:	BSSDI-1-A-O`-316
Recency Determination Date: **Squalicum: Moderate: 5 years** **Squalicum: High: 2 years** **I&J: High: 2 years**	Dioxin Only September 2016 (**Moderate**) September 2013 (**High**)

Background/History:

3. The Squalicum Creek Waterway/channel is located in Bellingham Bay in Bellingham, Washington (**Figure 1**, Vicinity Map; **Figure 2**: Squalicum Waterway sampling locations). It is a federally maintained shallow draft navigation channel initially authorized by Congress in 3 July 1930 to construct and maintain an entrance channel 26 feet deep by 200 feet wide from deep water to the U.S. Pierhead line. Construction was completed in 1931. An additional authorization in August 1937 authorized maintenance of the southerly half and westerly end of the Squalicum Creek basin to a depth of 26 feet, provided that no dredging be done within 75 feet of wharves, piers, or similar structures.

4. The I & J Street Waterway/channel is a located in Bellingham Bay in Bellingham, Washington (**Figure 3**: I&J Street Waterway sampling stations). It was federally authorized by the Chief of Engineers on May 5, 1965 under the authority of Section 107, Public Law 86-645. It provides for a channel 100 feet wide and 18 feet deep at MLLW, from the 18-foot contour in Bellingham Bay to within 250 feet of the landward limit of the Federal pierhead line, a distance of 3,200 feet. The project was completed in 1966.
5. The authorized depth within the Squalicum Creek Waterway is -26 ft MLLW + 2 feet of authorized maintenance dredging, and was routinely dredged an additional 2 feet of advanced maintenance dredging to -30 feet MLLW through 1996. Future maintenance dredging within Squalicum Creek Waterway is anticipating dredging to the authorized depth of -26 ft + 2 ft of allowable overdepth with the critical pay depth limit of -28 ft MLLW.
6. Within the I&J Street Waterway, the authorized channel depth is 18 ft + 2 ft of allowable overdepth. This Waterway has not been dredged since 1993, and is being evaluated by Washington State under Toxics Cleanup Program (TCP) authorities for potential future cleanup.
7. Both waterways are used primarily for barge loading/offloading, marine commerce and USCG navigation, including small fishing and commercial fishing crafts. Sediment accumulation is primarily attributable to riverine input from the Nooksack River, and Squalicum Creek. The purpose of this dioxin characterization effort is to assess levels of dioxin in these two federal channels relative to new-interim dioxin guidelines implemented in December 2010 by the Dredged Material Management Program (DMMP).

Sampling:

8. **Figure 2** depicts the vibracore sampling stations in Squalicum Waterway and **Figure 3** depicts the vibracore sampling stations in I&J Street Waterwaay. Uncomposited samples were collected as summarized in **Table 2** within both Waterways. Sampling was initiated on September 6, 2011 and concluded on September 8, 2011. The Data Summary Memorandum was submitted to the DMMP agencies for review on December 14, 2011, and included full data validation on the dioxin testing results. The DMMP agencies concluded, after reviewing the data validation report, that the data was acceptable for decision-making using best professional judgment.

Chemical Testing Results:

9. The conventional and DMMP chemical analyses results for dioxin/furans are summarized in **Table 3**. The dioxin testing results are summarized below relative to the new-interim dioxin guidelines implemented in December 2010.

Table 2. Field Collection Summary Table

Waterway	Station ID	Actual Coordinates		Water Depth (ft)	Mudline Elevation (MLLW	Sample Interval (ft)
		Latitude (x)	Longitude (y)			
I& J Street	I-1	48 45.300 N	122 29.584 W	15.6	-15.1	0-4.6; 4.6-6.4 (Z)
	I-2	48 45.241 N	122 29.676 W	17.6	-16.3	0-3.3; 3.3-5.1 (Z)
	I-3	48 45.174 N	122 29.780 W	19.8	-17.2	0-2.2; 2.2-3.8 (Z)
	I-4	48 45.114 N	122 29.869 W	25.1	-17.7	0-1.0; 1.9-3.5 (Z)
	I-5	48 45.066 N	122 29.936 W	21.2	-16.6	0-3.3; 3.3-5.3 (Z)
	I-6	48 45.019 N	122 30.006 W	22.2	-16.2	0-3.2; 3.2-4.9 (Z)
	I-7	48 44.959 N	122 30.096 W	24.2	-16.3	0-3.1; 3.1-4.7 (Z)
Squalicum Creek	S-1	48 45.603 N	122 30.622 W	31.0	-23.9	0-4.1; 4.1-6.1 (Z)
	S-2	48 45.588 N	122 30.592 W	32.3	-25.0	0-2.6; 2.6-4.4 (Z)
	S-3	48 45.551 N	122 30.649 W	26.0	-25.2	0-2.7; 2.7-4.7 (Z)
	S-4	48 45.513 N	122 30.693 W	31.0	-23.2	0-4.1; 4.1-5.9 (Z)
	S-5	48 45.474 N	122 30.736 W	32.5	-24.6	0-3.4; 3.4-5.4 (Z)
	S-6	48 45.455 N	122 30.824 W	32.2	-24.5	0-3.4; 3.4-5.3 (Z)
	S-7	48 45.404 N	122 30.804 W	31.0	-24.2	0-3.5; 3.5-5.4 (Z)
	S-8	48 45.345 N	122 30.890 W	31.6	-28.2	0-0.2; 0.2-2.0 (Z)
	S-9	48 45.294 N	122 30.956 W	30.5	-28.7	0-1.7 (Z)
	S-10	48 45.251 N	122 30.991 W	31.1	-28.6	0-1.9 (Z)
	S-11	48 45.189 N	122 31.073 W	24.7	-31.3	0-1.7 (Z)
	S-12	48 45.121 N	122 31.147 W	24.8	-30.0	0-1.8 (Z)
	S-13	48 45.083 N	122 31.191 W	36.2	-30.2	0-1.8 (Z)
	S-14	48 45.041 N	122 31.236 W	36.5	-29.6	0-1.8 (Z)
	S-15	48 44.990 N	122 31.296 W	39.4	-31.5	0-1.8 (Z)
	S-16	48 44.923 N	122 31.371 W	42.3	-34.2	0-1.8 (Z)

Yellow highlighted samples archived, not analyzed

10. **Table 3** provides a summary of the validated dioxin/furan congener specific testing results for both I&J Street Waterway and Squalicum Creek Waterways. For I&J Waterway, the dioxin results measured in dredged material ranged from 22.6 to 43.5 pptr-TEQ, and from 5.7 to 29.4 pptr-TEQ in underlying Z-samples analyzed. Within Squalicum Creek Waterway, the dioxin results ranged from 2.02 to 5.1 pptr-TEQ within the dredged material samples, and from 0.94 to 6.5 pptr-TEQ in underlying Z-samples analyzed.

11. **Dioxin Interim Interpretative Framework.** The DMMP implemented new interim guidelines for interpreting dioxin data implemented on December 6, 2010, and are summarized below for non-dispersive disposal sites and dispersive sites (http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/New_Interim_Guidelines_for_Dioxins.pdf):

    a. Nondispersive Screening Levels. DMMUs with dioxin concentrations below 10 pptr TEQ will be allowed for open-water disposal as long as the volume-weighted average concentration of dioxins in material from the entire dredging project does not exceed the Disposal Site Management Objective of 4 pptr TEQ.
    b. Dispersive Site Management Objective. All DMMUs evaluated must be less than or equal to 4 pptr-TEQ.

12. The dioxin data collected within I&J Street Waterway were all above the 10 pptr-TEQ upper limit, and demonstrate that none of the potential dredged material within this waterway is suitable for unconfined-open-water disposal (**Table 3**). All the material is unsuitable for open-water disposal and would be required to be disposed at an Ecology approved upland confined disposal site. An analysis of Z-samples underlying three of the overlying DMMUs showed that the dioxin concentrations were lower than the overlying potential dredged material, although generally still elevated, except as noted for I-3-Z (5.7 pptr-TEQ).

13. The dioxin data collected within Squalicum Creek Waterway, indicate that dioxin concentrations were all below 10 pptr-TEQ, and were below 4 pptr-TEQ except for 2 DMMUs (**Table 3**). Therefore, except for the material at the north end of Squalicum Waterway, the remaining dredged material would meet the dispersive site guidelines relative to dioxin. As assessment of the volume weighted average to assess non-dispersive disposal follows below.

14. **Tables 4, 5**, and **6** provide various alternatives to evaluate how much material would have to be mixed with the two DMMUs with dioxin above 4-pptr-TEQ at the head of Squalicum Waterway (S1 and S2) through volume weighted averaging to achieve the 4-pptr-TEQ non-dispersive site management standard. **Table 4** provides the volume-weighted average utilizing all the DMMUs evaluated, whereas **Table 5** provides a volume weighted average utilizing the two closest DMMUs (S3 and S4), whereas **Table 6** provides an example of volume weighted averaging utilizing a single DMMU mixing with the two at the head of Squalicum Waterway to achieve the 4 pptr-TEQ site management objective. All the examples provided demonstrate that achieving the 4-pptr-TEQ volume weighted average is easily achievable with the existing dredged material within Squalicum Creek Waterway. An evaluation of either underlying z-samples (S1, S7), or exposed sediments below the Federal project authorized depth indicate that the Washington State antidegradation standard was not exceeded for the stations/samples analyzed. Slightly elevated concentrations noted at S1-Z and S7-Z relative to overlying material are deemed to be similar and within the established analytical variability for this chemical.

Suitability Determination:

15. The results of this screening level survey to assess dioxin concentrations within I&J Street Waterway and Squalicum Creek Waterway federal channels concludes that the dredged material within I&J Waterway is **not** suitable for unconfined-open-water disposal at either dispersive or non-dispersive DMMP disposal sites, and would have to be disposed at an Ecology approved upland confined disposal site. All the material tested within Squalicum Waterway is suitable for unconfined-open-water disposal at a DMMP non-dispersive site, and all the material except the 17,547 cy of material (S1 and S2) located at the head of Squalicum Waterway would be suitable for dispersive site disposal (Rosario Strait) based on these testing results using best professional judgment (BPJ).

16. This memorandum documents the potential suitability of existing maintenance dredged material from the Bellingham Bay Federal Navigation Channels in I&J Street Waterway and Squalicum Creek Waterway relative to existing dioxin concentrations observed in Bellingham Bay, Washington, for open-water disposal at either the Rosario Strait dispersive site, or the Bellingham Bay non-dispersive site. However, this suitability determination does not constitute final agency approval of the project. A complete evaluation of all DMMP Chemicals-of-Concern would be required prior to evaluating maintenance material suitability for open-water disposal. A dredging plan for the project, would have to be completed and evaluated by the DMMP agencies as part of the final project approval process. A final decision would be made after full consideration of agency input, and after an alternatives analysis is done under Section 404(b)(1) of the Clean Water Act.

Concur:

5 Jan 2012
Date — David Kendall, Ph.D., Seattle District Corps of Engineers

01/05/2012
Date — Laura Inouye, Ph.D., Washington Department of Ecology

1/5/12
Date — Erika Hoffman, Environmental Protection Agency, Region 10

1/5/12
Date — Celia Barton, Washington Department of Natural Resources

John Hicks, Corps Navigation Project Manager
Laura Inouye, Ph.D., Ecology
Erika Hoffman, EPA
Celia Barton, DNR
DMMO File

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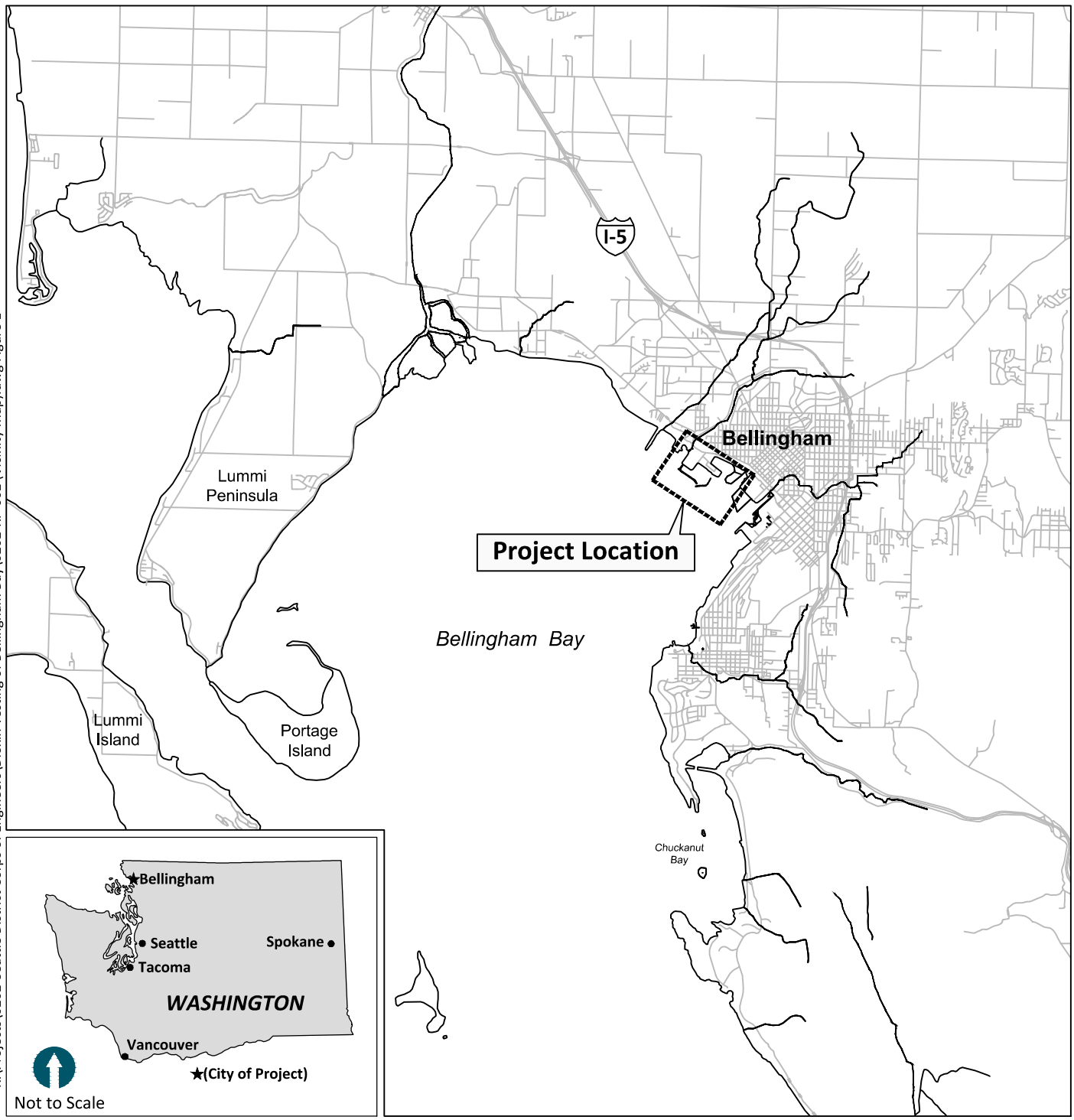


K:\Projects\0202-Seattle District Corps of Engineers\Dioxin Testing of Bellingham Bay\0202-RP-002 (Vicinity Map).dwg Figure 1

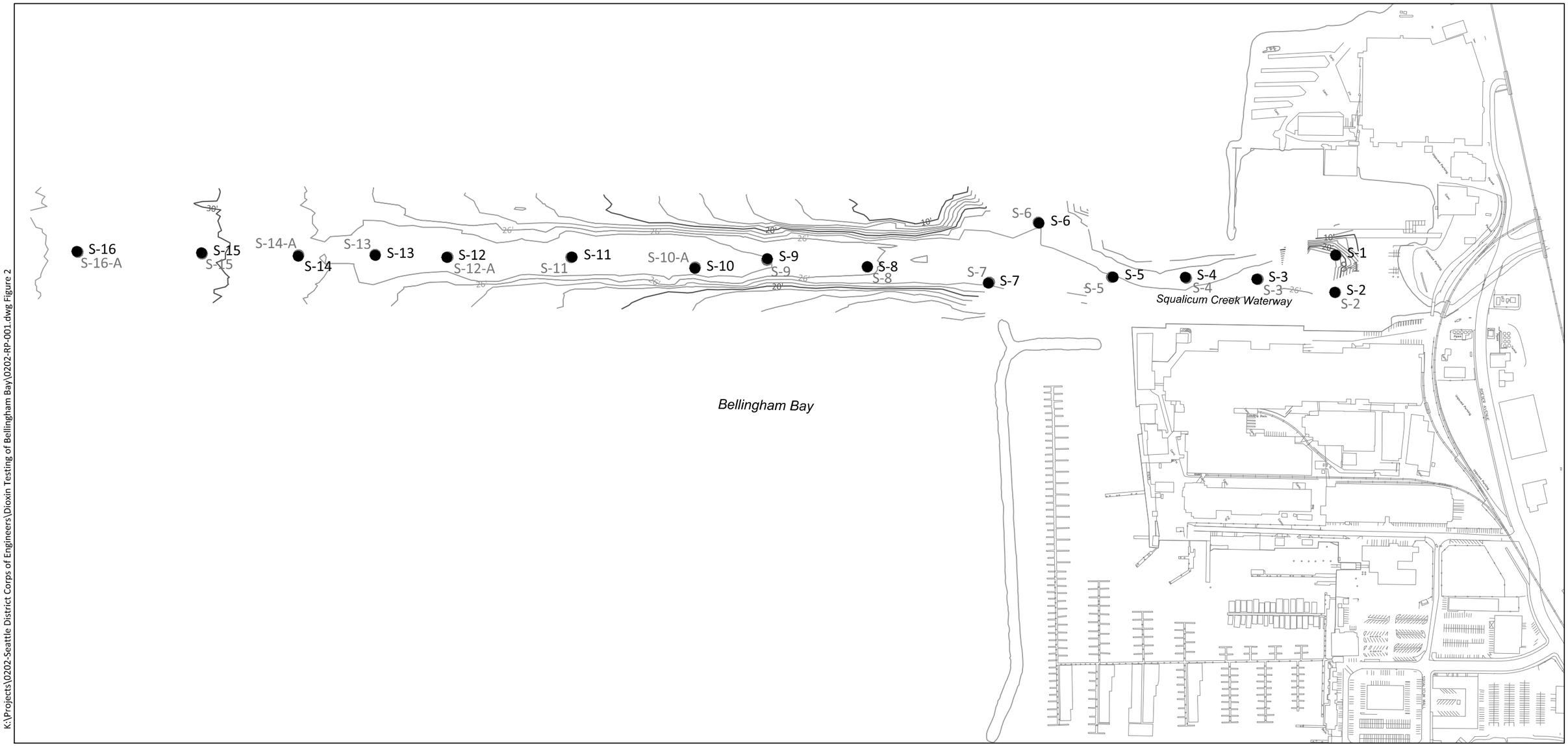
Dec 13, 2011 11:42am dholmer

SOURCE: GIS (undated).
HORIZONTAL DATUM: Washington State Plane North, NAD83, US Survey Feet.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

0 2
Scale in Miles

ANCHOR QEA

Figure 1
Vicinity Map
Dioxin Testing of Bellingham Bay Federal Project
U.S. Army Corps of Engineers



K:\Projects\0202-Seattle District Corps of Engineers\Dioxin Testing of Bellingham Bay\0202-RP-001.dwg Figure 2

Dec 13, 2011 11:42am dholmer

SOURCE: 2010 Bathymetric survey data provided by USACE.
HORIZONTAL DATUM: Washington State Plane North, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

LEGEND:

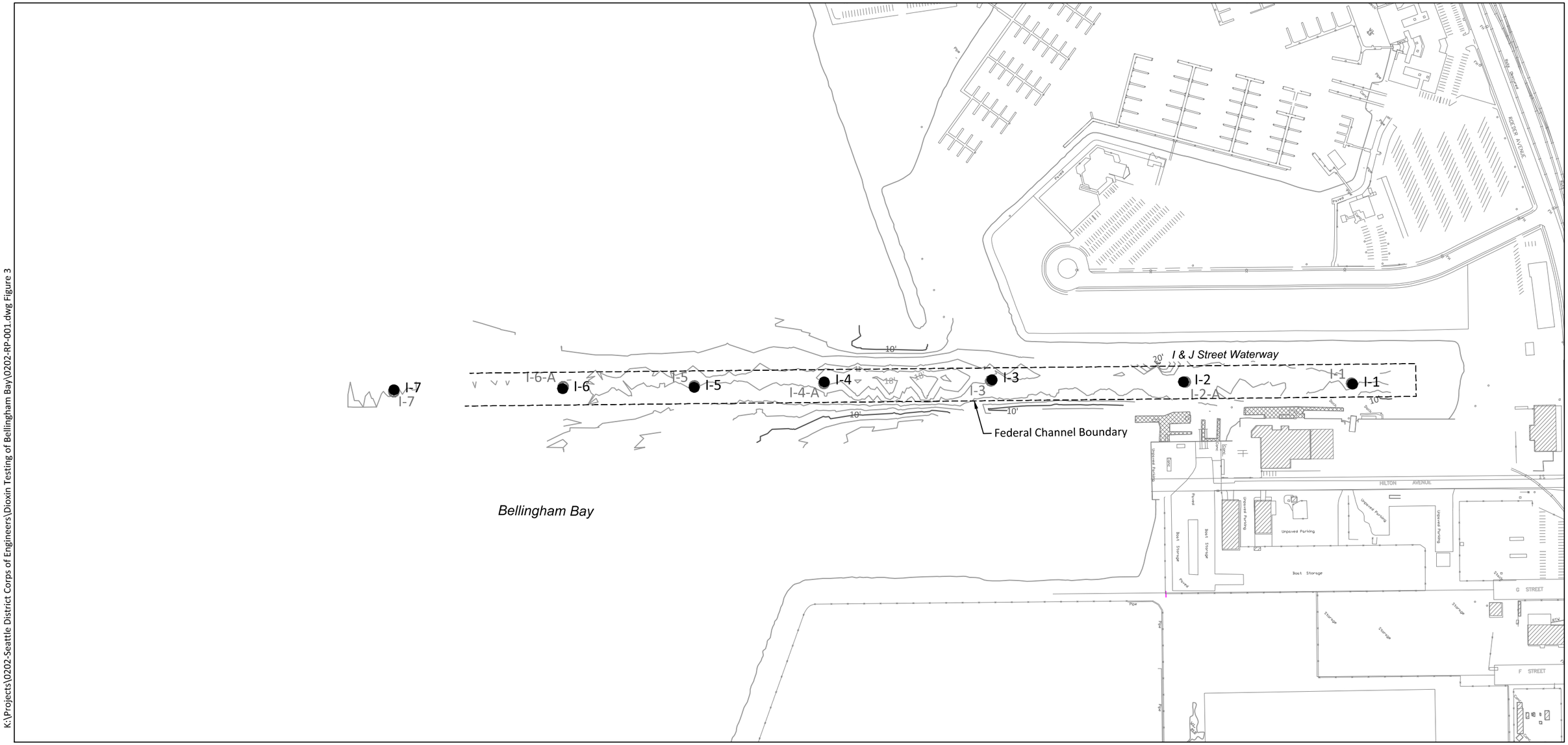
S-16 ⊕ Proposed Subsurface Sediment Sampling Location

S-16-A ● Actual Subsurface Sediment Sampling Location

0 400
Scale in Feet

ANCHOR QEA

Figure 2
Squalicum Creek Waterway Subsurface Sediment Sampling Locations
Dioxin Testing of Bellingham Bay Federal Project
U.S. Army Corps of Engineers



K:\Projects\0202-Seattle District Corps of Engineers\Dioxin Testing of Bellingham Bay\0202-RP-001.dwg Figure 3

Dec 13, 2011 11:42am dholmer

SOURCE: 2010 Bathymetric survey data provided by USACE.
HORIZONTAL DATUM: Washington State Plane North, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

LEGEND:

I-4 ⊕ Proposed Subsurface Sediment Sampling Location

I-4-A ● Actual Subsurface Sediment Sampling Location

0 300
Scale in Feet

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Figure 3
I & J Street Waterway Subsurface Sediment Sampling Locations
Dioxin Testing of Bellingham Bay Federal Project
U.S. Army Corps of Engineers

Table 3. Dioxin Special Study: Bellingham Harbor Project (Squalicum, I and J Waterways)

		I & J STREET WATERWAY																							
	WHO (05)	I-1 (0-4.6 ft)			I-1-Z (4.6 - 6.4 ft)			I-3 (0-2.2 ft)			I-3-Z (2.2 - 3.8 ft)			I-5 (0 - 3.3 ft)			I-5 (dup) (0 - 3.3 ft)			I-5-Z (3.3 - 5.3 ft)			I-7 (0 - 3.1 ft)		
Analyte	TEF	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ
2,3,7,8-TCDD	1	1.73		1.73	1.6		1.6	1.07		1.07	0.199	J	0.199	2.71		2.71	2.58		2.58	0.664	J	0.664	1.15		1.15
1,2,3,7,8-PeCDD	1	7.22	J	7.22	6.49	J	6.49	4.09	J	4.09	0.904	J	0.904	5.82	J	5.82	5.47		5.47	3.42	J	3.42	4.67	J	4.67
1,2,3,4,7,8-HxCDD	0.1	14.5		1.45	7.68		0.768	7.68		0.768	1.09	J	0.109	9.95		0.995	9.32		0.932	3.73		0.373	11.5		1.15
1,2,3,6,7,8-HxCDD	0.1	49	J	4.9	34.2	J	3.42	37.9	J	3.79	7.29	J	0.729	51.9	J	5.19	50.1		5.01	32.3	J	3.23	30.4	J	3.04
1,2,3,7,8,9-HxCDD	0.1	24.4	J	2.44	15.7	J	1.57	13.9	J	1.39	2.24	J	0.224	19.6	J	1.96	18.4		1.84	9.31	J	0.931	15.5	J	1.55
1,2,3,4,6,7,8-HpCDD	0.01	971	J	9.71	677		6.77	815	J	8.15	153		1.53	1200	J	12	1180		11.8	767		7.67	493	J	4.93
OCDD	0.0003	7750	J	2.325	5790		1.737	7250	J	2.175	1370		0.411	11100	J	3.33	11400	E	3.42	7070		2.121	3830	J	1.149
2,3,7,8-TCDF	0.1	16.8		1.68	9.02		0.902	10.6		1.06	0.918	J	0.0918	21.7	J	2.17	21.5		2.15	5.42		0.542	13.8		1.38
1,2,3,7,8-PeCDF	0.03	4.45	J	0.1335	3.11		0.0933	4.29	J	0.1287	0.637	J	0.01911	7.12		0.2136	6.79		0.2037	4.51		0.1353	2.8	J	0.084
2,3,4,7,8-PeCDF	0.3	4.73		1.419	4		1.2	4.01		1.203	0.828	J	0.2484	5.88		1.764	5.79		1.737	3.92		1.176	2.73		0.819
1,2,3,4,7,8-HxCDF	0.1	13.9	J	1.39	11.1		1.11	14.8	J	1.48	3.06		0.306	23.3		2.33	20.7		2.07	15.4		1.54	7.27	J	0.727
1,2,3,6,7,8-HxCDF	0.1	6.58		0.658	5.99		0.599	5.23		0.523	1.28	J	0.128	7.54		0.754	6.93		0.693	5.45		0.545	3.08		0.308
2,3,4,6,7,8-HxCDF	0.1	4.57	J	0.457	3.62		0.362	4.22	J	0.422	0.926	J	0.0926	7.36		0.736	10.1		1.01	5.02		0.502	2.26	J	0.226
1,2,3,7,8,9-HxCDF	0.1	7.76	J	0.776	10	J	1	7.24	J	0.724	2.15	J	0.215	10.5	J	1.05	7.03		0.703	7.71	J	0.771	4.64	J	0.464
1,2,3,4,6,7,8-HpCDF	0.01	145		1.45	153		1.53	137		1.37	46.7		0.467	213		2.13	219		2.19	160		1.6	77.9		0.779
1,2,3,4,7,8,9-HpCDF	0.01	9.94		0.0994	10.4	J	0.104	9.78		0.0978	2.92	J	0.0292	14.7		0.147	14.4		0.144	11.2	J	0.112	5.33		0.0533
OCDF	0.0003	381		0.1143	445	J	0.1335	395		0.1185	140	J	0.042	615		0.1845	648		0.1944	486	J	0.1458	251		0.0753
Total TEQ (u = 1/2):				38.0			29.4			28.6			5.7			43.5			42.1			25.5			22.6
Total TEQ (u=0):				38.0			29.4			28.6			5.7			43.5			42.1			25.5			22.6
TOC (%)				4.1						3.3						4.2			4.2						2.1
TVS (%)				9.1						6.5						11.2									6.8
Total Solids (%)				48.3						57.6						46.7									49.7
Ammonia (mg/kg)				113.0						10.6						87.9									28.6
Sulfide (mg/kg)				2650						1830						2320									1970
Gravel (%)				0.2						2.9						0.1 U									0.1 U
Sand (%)				13.3						34.4						17.1									4.8
Silt (%)				46.6						34.4						48.1									56.6
Clay (%)				40.0						28.2						34.7									38.6
Fines (Silt + Clay) (%)				86.6						62.6						82.8									95.2
DMMP Determination:		Unsuitable						Unsuitable						Unsuitable									Unsuitable		
Area Rank (M, H)				H						H						H			H						H
DMMU Volume (cy):				8178						8333						8796			8796						3280

Legend:

J = Estimated value

U = Undetected at the detection limit

EMPC = EMPC qualified data undetected

B = Analyte detected in Method Blank

X = Interferences from diphenylether (Furans only)

Z-samples analyzed

Unsuitable

Suitable (ND/D)

ND = Nondispersive site (see discussion)

D = Dispersive site

Table 3. Dioxin Special Study: Bellingham Harbor Project (Squalicum, I and J Waterways)

		SQUALICUM CREEK WATERWAY																							
	WHO (05)	S-1 (0 - 4.1 ft)			S-1-Z (4.1 - 6.1 ft)			S-2 (0 - 2.6 ft)			S-3 (0 - 2.7 ft)			S-4 (0 - 4.1 ft)			S-4 (dup) (0 - 4.1 ft)			S-5 (0 - 3.4 ft)			S-6 0 - 3.4 ft)		
Analyte	TEF	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ
2,3,7,8-TCDD	1	0.159	J	0.159	0.262	J	0.262	0.176	J	0.176	0.103	J	0.103	0.135	J	0.135	0.0876	EMPC	0.0876	0.0747	U	0.03735	0.0806	U	0.0403
1,2,3,7,8-PeCDD	1	0.947	J	0.947	1.34	J	1.34	1.02	J	1.02	0.537	J	0.537	0.444	J	0.444	0.39	EMPC	0.195	0.427	J	0.427	0.382	J	0.382
1,2,3,4,7,8-HxCDD	0.1	1.53	J	0.153	2.39	J	0.239	1.4	J	0.14	0.78	J	0.078	0.618	J	0.0618	0.761	J	0.0761	0.625	J	0.0625	0.536	J	0.0536
1,2,3,6,7,8-HxCDD	0.1	6.29	J	0.629	7.47	J	0.747	6.19	J	0.619	3.38	J	0.338	2.93	J	0.293	2.87	J	0.287	2.56	J	0.256	2.45	J	0.245
1,2,3,7,8,9-HxCDD	0.1	3.03	J	0.303	4.31	J	0.431	3.22	J	0.322	1.7	J	0.17	1.35	J	0.135	1.48	J	0.148	1.25	J	0.125	1.25	J	0.125
1,2,3,4,6,7,8-HpCDD	0.01	150	J	1.5	164		1.64	143	J	1.43	79.4	J	0.794	69.9	J	0.699	64.1		0.641	61.3	J	0.613	58.7	J	0.587
OCDD	0.0003	1260	J	0.378	1310		0.393	1220	J	0.366	679	J	0.2037	611	J	0.1833	611	J	0.1833	534	J	0.1602	521	J	0.1563
2,3,7,8-TCDF	0.1	0.676	J	0.0676	1.69		0.169	0.558	J	0.0558	0.4	J	0.04	0.388	J	0.0388	0.321	J	0.0321	0.435	J	0.0435	0.369	J	0.0369
1,2,3,7,8-PeCDF	0.03	0.453	J	0.01359	0.908	J	0.02724	0.503	J	0.01509	0.299	J	0.00897	0.261	J	0.00783	0.275	BJ	0.00825	0.222	J	0.00666	0.213	J	0.00639
2,3,4,7,8-PeCDF	0.3	0.592	J	0.1776	0.932	J	0.2796	0.616	J	0.1848	0.354	J	0.1062	0.277	J	0.0831	0.321	J	0.0963	0.258	J	0.0774	0.282	J	0.0846
1,2,3,4,7,8-HxCDF	0.1	1.8	J	0.18	2.54	J	0.254	1.82	J	0.182	1.04	J	0.104	0.992	J	0.0992	0.96	J	0.096	0.773	J	0.0773	0.827	J	0.0827
1,2,3,6,7,8-HxCDF	0.1	0.936	J	0.0936	1.51	J	0.151	0.954	J	0.0954	0.505	J	0.0505	0.439	J	0.0439	0.456	J	0.0456	0.378	J	0.0378	0.411	J	0.0411
2,3,4,6,7,8-HxCDF	0.1	0.617	J	0.0617	1.03	J	0.103	0.691	J	0.0691	0.378	J	0.0378	0.374	J	0.0374	0.572	J	0.0572	0.287	J	0.0287	0.294	J	0.0294
1,2,3,7,8,9-HxCDF	0.1	1.34	J	0.134	1.96	J	0.196	1.4	J	0.14	0.714	J	0.0714	0.62	J	0.062	0.375	J	0.0375	0.531	J	0.0531	0.56	J	0.056
1,2,3,4,6,7,8-HpCDF	0.01	21.4		0.214	25.7		0.257	19.9		0.199	11.8		0.118	10.1		0.101	9.5		0.095	8.22		0.0822	8.16		0.0816
1,2,3,4,7,8,9-HpCDF	0.01	1.48	J	0.0148	1.92	J	0.0192	1.51	J	0.0151	0.836	J	0.00836	0.78	J	0.0078	0.733	J	0.00733	0.578	J	0.00578	0.683	J	0.00683
OCDF	0.0003	73.8		0.02214	83.5	J	0.02505	69.4		0.02082	39.2		0.01176	34.3		0.01029	29.2		0.00876	26.3		0.00789	26.8		0.00804
Total TEQ (u = 1/2):				5.0			6.5			5.1			2.8			2.44			2.10			2.10			2.02
Total TEQ (u=0):				5.0			6.5			5.1			2.8			2.44			1.82			2.06			1.98
TOC (%)				1.8						1.9			1.3			2.5			2.5			1.5			1.5
TVS (%)				6.4						6.9			5.8			4.9						5.2			5.7
Total Solids (%)				55.1						54.5			55.0			61.1						58.3			54.2
Ammonia (mg/kg)				70.7						106.0			53.2			41.8						48.8			61.9
Sulfide (mg/kg)				3810						2730			1710			895.0						1040			2070
Gravel (%)				0.1 U						0.1 U			0.1 U			0.1 U						0.1 U			0.1 U
Sand (%)				5.6						26.8			7.5			3.3						2.3			8.5
Silt (%)				72.4						58.3			74.9			81.0						81.6			75.5
Clay (%)				21.8						15.0			17.6			15.7						16.2			15.8
Fines (Silt + Clay) (%)				94.2						73.3			92.5			96.7						97.8			91.3
DMMP Determination:		Suitable (ND)						Suitable (ND)			Suitable (ND/D)			Suitable (ND/D)						Suitable (ND/D)			Suitable (ND/D)		
Area Rank (M, H)				H						M			M			M			M			M			M
DMMU Volume (cy):				12234						5313			9364			14008			14008			17698			35491

Legend:

J = Estimated value

U = Undetected at the detection limit

EMPC = EMPC qualified data undetect

B = Analyte detected in Method Blank

X = Interferences from diphenylether (I

Z-samples analyzed

Unsuitable

Suitable (ND/D)

ND = Nondispersive site (see discu

D = Dispersive site

Table 3. Dioxin Special Study: Bellingham Harbor Project (Squalicum, I and J Waterways)

		SQUALICUM CREEK WATERWAY																				
	WHO (05)	S-7 (0 - 3.5 ft)			S-7-Z (3.5 - 5.4 ft)			S-7-Z (dup) (3.5 - 5.4 ft)			S-8-Z (0.2 - 2 ft)			S-9-Z (0 - 1.7 ft)			S-11-Z (0 - 1.7 ft)			S-12-Z (0 - 1.8 ft)		
Analyte	TEF	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ
2,3,7,8-TCDD	1	0.109	J	0.109	0.148	J	0.148	0.172	EMPC	0.086	0.0918	U	0.0459	0.106	J	0.106	0.0757	U	0.03785	0.219	J	0.219
1,2,3,7,8-PeCDD	1	0.405	J	0.405	0.655	J	0.655	0.696	J	0.696	0.449	J	0.449	0.614	J	0.614	0.404	J	0.404	0.851	J	0.851
1,2,3,4,7,8-HxCDD	0.1	0.622	J	0.0622	1.19	J	0.119	1.15	J	0.115	0.611	J	0.0611	0.972	J	0.0972	0.629	J	0.0629	2.11	J	0.211
1,2,3,6,7,8-HxCDD	0.1	2.8	J	0.28	4.21	J	0.421	4.12	J	0.412	2.78	J	0.278	3.75	J	0.375	2.24	J	0.224	4.45	J	0.445
1,2,3,7,8,9-HxCDD	0.1	1.16	J	0.116	2.15	J	0.215	2.07	J	0.207	1.27	J	0.127	1.85	J	0.185	1.2	J	0.12	2.64	J	0.264
1,2,3,4,6,7,8-HpCDD	0.01	67.3	J	0.673	84.3		0.843	83.4		0.834	62.1		0.621	75	J	0.75	47.2	J	0.472	66		0.66
OCDD	0.0003	637	J	0.1911	730		0.219	737		0.2211	570		0.171	653	J	0.1959	405	J	0.1215	438		0.1314
2,3,7,8-TCDF	0.1	0.423	J	0.0423	1.55	J	0.155	1.48	J	0.148	0.449	J	0.0449	1.36		0.136	0.606	J	0.0606	3.8		0.38
1,2,3,7,8-PeCDF	0.03	0.288	J	0.00864	0.423	J	0.01269	0.374	BJX	0.01122	0.272	J	0.00816	0.367	J	0.01101	0.221	J	0.00663	0.419	J	0.01257
2,3,4,7,8-PeCDF	0.3	0.357	J	0.1071	0.532	J	0.1596	0.849	J	0.2547	0.326	J	0.0978	0.398	J	0.1194	0.277	J	0.0831	0.488	J	0.1464
1,2,3,4,7,8-HxCDF	0.1	1.09	J	0.109	3.98		0.398	1.25	J	0.125	0.934	J	0.0934	1.16	J	0.116	0.701	J	0.0701	0.93	J	0.093
1,2,3,6,7,8-HxCDF	0.1	0.451	J	0.0451	0.897	J	0.0897	0.593	J	0.0593	0.446	J	0.0446	0.548	J	0.0548	0.363	J	0.0363	0.53	J	0.053
2,3,4,6,7,8-HxCDF	0.1	0.407	J	0.0407	0.523	J	0.0523	0.849	J	0.0849	0.31	J	0.031	0.42	J	0.042	0.253	J	0.0253	0.373	J	0.0373
1,2,3,7,8,9-HxCDF	0.1	0.713	J	0.0713	0.842	J	0.0842	0.456	J	0.0456	0.63	J	0.063	0.749	J	0.0749	0.49	J	0.049	0.681	J	0.0681
1,2,3,4,6,7,8-HpCDF	0.01	9.66		0.0966	14.5		0.145	12.2		0.122	9.43		0.0943	10.6		0.106	6.8		0.068	8.75		0.0875
1,2,3,4,7,8,9-HpCDF	0.01	0.751	J	0.00751	1.67	J	0.0167	0.945	J	0.00945	0.709	J	0.00709	0.807	J	0.00807	0.512	J	0.00512	0.759	J	0.00759
OCDF	0.0003	31.4		0.00942	39.4	J	0.01182	39.8		0.01194	30.8	J	0.00924	34.2		0.01026	23.7		0.00711	27.7	J	0.00831
Total TEQ (u = 1/2):				2.37			3.75			3.44			2.25			3.0			1.85			3.68
Total TEQ (u=0):				2.37			3.75			3.36			2.20			3.0			1.82			3.68
TOC (%)				1.5												1.9			1.8			
TVS (%)				5.6												6.1			6.1			
Total Solids (%)				57.4												50.9			53.3			
Ammonia (mg/kg)				61.6												86.8			34.5			
Sulfide (mg/kg)				1630												2030			1650			
Gravel (%)				0.1												0.1 U			0.1 U			
Sand (%)				2.4												6.3			5.5			
Silt (%)				79.0												73.1			68.1			
Clay (%)				18.7												20.5			26.5			
Fines (Silt + Clay) (%)				97.7												93.6			94.6			
DMMP Determination:		Suitable (ND/D)																				
Area Rank (M, H)				M			M			M			M			M			M			M
DMMU Volume (cy):				17170																		

Legend:

J = Estimated value

U = Undetected at the detection limit

EMPC = EMPC qualified data undetect

B = Analyte detected in Method Blank

X = Interferences from diphenylether (I

Z-samples analyzed

Unsuitable

Suitable (ND/D)

ND = Nondispersive site (see discu

D = Dispersive site

Table 3. Dioxin Special Study: Bellingham Harbor Project (Squalicum, I and J Waterways)

		SQUALICUM WATERWAY					
	WHO (05)	S-13-Z (0 - 1.8 ft)			S-15-Z (0 - 1.8 ft)		
Analyte	TEF	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ
2,3,7,8-TCDD	1	0.0813	U	0.04065	0.297	J	0.297
1,2,3,7,8-PeCDD	1	0.285	J	0.285	1.67	J	1.67
1,2,3,4,7,8-HxCDD	0.1	0.252	J	0.0252	4.63		0.463
1,2,3,6,7,8-HxCDD	0.1	0.892	J	0.0892	8.1	J	0.81
1,2,3,7,8,9-HxCDD	0.1	0.585	J	0.0585	5.64	J	0.564
1,2,3,4,6,7,8-HpCDD	0.01	15.1	J	0.151	93.1	J	0.931
OCDD	0.0003	118	J	0.0354	488	J	0.1464
2,3,7,8-TCDF	0.1	0.559	J	0.0559	6.85		0.685
1,2,3,7,8-PeCDF	0.03	0.208	J	0.00624	0.788	J	0.02364
2,3,4,7,8-PeCDF	0.3	0.256	J	0.0768	0.812	J	0.2436
1,2,3,4,7,8-HxCDF	0.1	0.279	J	0.0279	1.26	J	0.126
1,2,3,6,7,8-HxCDF	0.1	0.216	J	0.0216	0.725	J	0.0725
2,3,4,6,7,8-HxCDF	0.1	0.111	J	0.0111	0.432	J	0.0432
1,2,3,7,8,9-HxCDF	0.1	0.25	J	0.025	0.959	J	0.0959
1,2,3,4,6,7,8-HpCDF	0.01	2.46		0.0246	10		0.1
1,2,3,4,7,8,9-HpCDF	0.01	0.157	J	0.00157	0.759	J	0.00759
OCDF	0.0003	8.38		0.002514	29.2		0.00876
Total TEQ (u = 1/2):				0.94			6.29
Total TEQ (u=0):				0.90			6.29
TOC (%)				1.6			1.6
TVS (%)				5.2			5.4
Total Solids (%)				53.8			53.0
Ammonia (mg/kg)				20.2			24.4
Sulfide (mg/kg)				2340			1930
Gravel (%)				0.1			0.1 U
Sand (%)				5.2			4.2
Silt (%)				62.4			62.3
Clay (%)				32.3			33.4
Fines (Silt + Clay) (%)				94.7			95.7
DMMP Determination:							
Area Rank (M, H)				M			M
DMMU Volume (cy):							

Legend:

J = Estimated value

U = Undetected at the detection limit

EMPC = EMPC qualified data undetect

B = Analyte detected in Method Blank

X = Interferences from diphenylether (I

Z-samples analyzed

Unsuitable

Suitable (ND/D)

ND = Nondispersive site (see discu

D = Dispersive site

Table 4. Volume Weighted Average (VWA) Dioxin Concentrations for Squalicum Creek Waterway O&M Project

DMMU ID:	Volume (CY)	TCDD/F TEQ	ng/kg-dw	Product (Vol x TEQ)	ng x cy/kg x DMMU	Prod./total	Proportional contribution/Suitable DMMU
S1	12,234	5	ng/kg-dw	61,170	ng x cy/kg	20.7%	% of Total DMMU
S2	5,313	5.1	ng/kg-dw	27,096	ng x cy/kg	9.2%	% of Total DMMU
S3	9,364	2.8	ng/kg-dw	26,219	ng x cy/kg	8.9%	% of Total DMMU
S4*	14,008	2.3	ng/kg-dw	31,798	ng x cy/kg	10.7%	% of Total DMMU
S5	17,698	2.1	ng/kg-dw	37,166	ng x cy/kg	12.6%	% of Total DMMU
S6	35,491	2.02	ng/kg-dw	71,692	ng x cy/kg	24.2%	% of Total DMMU
S7	17,170	2.37	ng/kg-dw	40,693	ng x cy/kg	13.8%	% of Total DMMU
Totals (Volume):	111,278	3.09	ng/kg-dw	295,834	ng x cy/kg	2.66	ng/kg-dw/Project (VWA)

* Average: 2.44 + 2.1 = 2.27

Table 5. Selective Volume Weighted Average (VWA) Dioxin Concentrations for Squalicum Creek Waterway O&M Project

DMMU ID:	Volume (CY)	TCDD/F TEQ	ng/kg-dw	Product (Vol x TEQ)	ng x cy/kg x DMMU	Prod./total	Proportional contribution/Suitable DMMU
S1	12,234	5	ng/kg-dw	61,170	ng x cy/kg	41.8%	% of Total DMMU
S2	5,313	5.1	ng/kg-dw	27,096	ng x cy/kg	18.5%	% of Total DMMU
S3	9,364	2.8	ng/kg-dw	26,219	ng x cy/kg	17.9%	% of Total DMMU
S4*	14,008	2.3	ng/kg-dw	31,798	ng x cy/kg	21.7%	% of Total DMMU
Totals (Volume):	40,919	3.79	ng/kg-dw	146,284	ng x cy/kg	3.57	ng/kg-dw/Project (VWA)

Table 6. Selective Volume Weighted Average (VWA) Dioxin Concentrations for Squalicum Creek Waterway O&M Project

DMMU ID:	Volume (CY)	TCDD/F TEQ	ng/kg-dw	Product (Vol x TEQ)	ng x cy/kg x DMMU	Prod./total	Proportional contribution/Suitable DMMU
S1	12,234	5	ng/kg-dw	61,170	ng x cy/kg	50.9%	% of Total DMMU
S2	5,313	5.1	ng/kg-dw	27,096	ng x cy/kg	22.6%	% of Total DMMU
S4*	14,008	2.3	ng/kg-dw	31,798	ng x cy/kg	26.5%	% of Total DMMU
Totals (Volume):	31,555	4.12	ng/kg-dw	120,064	ng x cy/kg	3.80	ng/kg-dw/Project (VWA)