Prepared by:
The Dredged Material Management Office
Seattle District, U.S. Army Corps of Engineers

MEMORANDUM FOR RECORD June 15, 2019

SUBJECT: SUPPLEMENTAL DETERMINATION REGARDING THE SUITABILITY/UNSUITABILITY OF PROPOSED DREDGED MATERIAL FROM SUBAREA B OF THE SQUALICUM CREEK WATERWAY FEDERAL NAVIGATION PROJECT FOR UNCONFINED OPEN-WATER DISPOSAL AT THE PORT GARDNER NONDISPERSIVE SITE.

1. Introduction. This memorandum reflects the consensus determination of the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers [USACE], Washington Departments of Ecology and Natural Resources, and the Environmental Protection Agency) regarding the suitability/unsuitability of 14,618 cubic yards (cy) of dredged material from Subarea B of the Squalicum Creek Waterway Federal Navigation Project for placement at the Port Gardner open-water nondispersive dredged material disposal site.

2. Background. Sediment characterization of the Squalicum Creek Waterway was conducted by USACE in 2016-2017 (Herrera, 2017), including the Bellingham Cold Storage berthing area (aka left berthing area). The project was divided into Subareas A and B, with Subarea Area A ranked low-moderate and Subarea B ranked high (Figure 1).

   A DMMP suitability determination memorandum (SDM) based on the results of the sediment characterization was signed by the DMMP agencies on May 3, 2017 (Attachment 1; DMMP, 2017). All dredged material in Subarea A was found suitable for open-water disposal at the Rosario Strait dispersive site. In Subarea B, some material was found unsuitable for open-water disposal, while other material was potentially suitable for placement at the Rosario Strait and/or Port Gardner site, depending on the design of the dredging project.

   At the time of signing, USACE had not yet developed its maintenance dredging plans. The SDM, therefore, described the requirements the dredge design in Subarea B would need to meet for the dredged material to be eligible for open-water disposal and indicated that a supplemental SDM would be prepared and signed by the DMMP agencies when the dredge plan was ready. USACE recently finalized its plans for maintenance dredging, which is scheduled to start in the fall of 2019 and be completed by the end of the work window in February 2020. This memorandum supplements the May 3, 2017 SDM by documenting the evaluation of the dredge design in Subarea B vis-à-vis the requirements stipulated in the SDM.

3. Project Description. USACE plans to dredge all of the navigation channel in Subarea A and a portion of the navigation channel in Subarea B (dredging planned by Bellingham Cold Storage in its berthing area is addressed in a separate supplemental suitability determination). Figures 2 and 3 provide details of the dredge plan. The project stationing has changed since the time of the SDM; Figures 2 and 3 use the new stationing. Table 1 provides the dredging specifications in both the old and new stationing to facilitate comparison to the SDM.

4. Requirements from the SDM. As indicated previously, the SDM included requirements that need to be met by the dredge plan in Subarea B. These are as follows:

   a. The dioxin concentration of each individual DMMU taken to the Rosario Strait site must be at or below 4 ng/kg TEQ without volume-weighted averaging (VWA).

   b. The volume-weighted average dioxin concentration for dredged material taken to the Port Gardner site must be at or below 4 ng/kg TEQ.

   c. One-foot vertical buffers between suitable and unsuitable material and between material suitable for dispersive disposal and material suitable for nondispersive disposal must be incorporated in the dredge design at the discretion of the DMMP agencies.

   d. Where possible, dredged material taken to the Port Gardner site must be sequenced, with material with the highest dioxin concentrations disposed first and dredged material with the lowest dioxin concentrations last.

   e. The State of Washington's antidegradation standard must be met. This may mean leaving a one-foot vertical buffer of suitable material in place over sediment that does not meet the standard, or placing a one-foot clean sand cover following dredging.

   f. Side slopes of the dredge design may not cut into unsuitable material or material that does not meet the antidegradation standard, unless the area of exposed surface is determined to be insignificant by the DMMP agencies.

5. Meeting the Requirements. The ability of the dredge plan to meet each of the requirements in the SDM is evaluated in the following:

   a. Only dredged material from Subarea A will be taken to the Rosario Strait site. Each individual DMMU in Subarea A had a dioxin concentration below 4 ng/kg TEQ. None of the material from Subarea B will be taken to the Rosario Strait site.

   b. All material dredged from Subarea B will be taken to the Port Gardner site. Table 2 shows the calculated dredge volume for each of the DMMUs in Subarea B that is included in the dredge plan. These volumes were calculated using the same 2016 bathymetric survey upon which the DMMP sampling and analysis plan (SAP) and SDM were based.

      A 25% contingency factor was included in the SAP to cover additional sedimentation that could take place in Subarea B between the date of the bathymetric survey and the time of dredging. This contingency factor is also applied to the calculated volumes in Table 2.

      The dioxin concentrations in Table 2 are from the SDM. As shown in Table 2, the volume-weighted average dioxin concentration for material to be dredged from Subarea B is 3.0 ng/kg TEQ, which is below the disposal site management objective of 4 ng/kg TEQ.

   c. The dredge plan leaves a one-foot vertical buffer between suitable and unsuitable material. DMMU BS3 (north), which was found unsuitable, lies 12 to 18 ft below the 2016 mudline. The maximum mudline elevation within the dredge footprint is 0 ft MLLW. Therefore, the maximum elevation of the unsuitable material is -12 ft MLLW. Dredging in the area above BS3 is limited to -10 ft MLLW with 1 ft of overdepth. If all the overdepth is removed, a one-foot vertical buffer of suitable material will remain over the unsuitable material.

DMMU AMB1 is the other unsuitable DMMU that lies below the dredge prism. AMB1 consists of material between -28 and -30 ft MLLW. It lies below the dredge prism transition area from -10 ft MLLW to -26 ft MLLW. This transition area will initially be dredged to -10 ft MLLW with 1 ft of overdepth. A 2H:1V transition slope is anticipated to form during dredging as the sediment achieves its natural angle of repose. Material sloughing from the transition slope will be taken to the Port Gardner disposal site. With the toe of the transition slope at a maximum depth of -28 ft MLLW, it is anticipated that a vertical buffer will remain over the entirety of AMB1.

None of the material from Subarea B will be taken to the Rosario Strait site, so the requirement for vertical buffers between material destined for dispersive vs. nondispersive disposal is not applicable.

d. Two general dredging scenarios are possible, depending on which subarea is dredged first. Each scenario results in a different sequencing outcome.

<u>*Scenario 1 – Subarea B is dredged first.*</u> The deepest material being actively dredged from Subarea B is DMMU BS2 in Layer 3 as shown in Figure 10 of the SDM (provided as Figure 4 in this memorandum). This DMMU had a dioxin concentration of only 0.54 ng/kg TEQ so the material being actively dredged last in this area is also the material with the lowest dioxin concentration.

In addition to the material being actively dredged from Subarea B, sloughing will occur in the transition zone from -10 to -26 ft MLLW. The sloughing will include material from DMMUs BS3 (south) and BS4 (Layers 4 and 5 respectively). DMMU BS3 (south) had the lowest dioxin concentration of all the DMMUs at only 0.31 ng/kg TEQ. BS4 had a dioxin concentration of 5.60 ng/kg TEQ. While the deepest DMMU (BS4), with the highest dioxin concentration, will slough last, it will contribute the smallest volume (220 cy) of the DMMUs in the transition zone. The DMMU above it (BS3-south) had the lowest dioxin concentration and will contribute 808 cy. The sloughed material is likely to mix to some extent during the sloughing process and will be further mixed when dredged and placed in a barge. Given the mixing that will occur and the relative contribution from the DMMUs in the transition zone, it is likely that the last material placed at the Port Gardner site under this scenario will result in a final surface concentration less than the disposal site management objective of 4 ng/kg TEQ.

<u>*Scenario 2 – Subarea A is dredged first.*</u> In this scenario, portions of DMMUs B1, BS1 and BS2 would likely slough before Subarea B is dredged. Similar to Scenario 1, the sloughed material is likely to mix during the sloughing process and be further mixed when dredged and placed in the barge. Given the range of dioxin concentrations in the sloughed material in this scenario, and the relative volume contributions from the sloughed DMMUs, it is likely that the in-barge VWA will be less than 4 ng/kg TEQ. If the sloughed material were to be the last material taken to the Port Gardner site, the surface material at the disposal site should meet the disposal site management objective.

If the sloughed material were to be the first material taken to the Port Gardner site, the material actively dredged from Subarea B would be the last material placed. As was seen in the first scenario, the deepest material being actively dredged (BS2) had the lowest dioxin concentration, so the last material taken to the Port Gardner site would likely be (or at least include) material with the lowest dioxin concentration.

In either scenario, the sequence of placement at the Port Gardner disposal site should result in surface material at the site meeting the site management objective for dioxin. However, as a best management practice to better control the sloughing process, the Corps dredging contract will specify that Subarea B be dredged before Subarea A if practicable.

e. The State of Washington's antidegradation standard will be met in Subarea B. From Station 33+00 to 34+73 (5+27 to 7+00 in the old stationing), dredging will expose material in BS2, which had a dioxin concentration of only 0.54 ng/kg TEQ. In the transition slope that forms, the exposed surface will either be in DMMU BS3 (south), which had the lowest dioxin concentration of all DMMUs in Subarea B, or BS4, where the dioxin concentration was 5.60 ng/kg TEQ. While BS4 does have a dioxin concentration somewhat higher than the existing surface of DMMU B1 (2.69 ng/kg TEQ), the DMMP agencies agreed that this minor increase in exposed surface concentration is insignificant. The surface that will be exposed by dredging meets the antidegradation standard.

f. The dredge prism was designed such that the side slopes will not cut into any unsuitable material. As can be seen from Table 1, offsets from the channel lines were incorporated into the design for this purpose. Figure 5 shows these offsets in relation to the surface DMMUs. Figure 6 shows the toe of slope in relation to the DMMUs in each of the layers.

6. Supplemental Suitability Determination. This memorandum documents the evaluation of the suitability of sediment proposed for dredging in Subarea B of the Squalicum Creek Waterway Federal Navigation Channel for open-water disposal. All requirements stipulated in the SDM have been met. Based on this evaluation, the DMMP agencies have concluded that all 14,618 cubic yards of dredged material from Subarea B are suitable for open-water disposal at the Port Gardner nondispersive disposal site.

7. Recency Extension. The recency period for Subarea B expires in December 2019 (DMMP, 2017). While dredging will likely begin before the end of the recency period, it may extend into 2020. There is no reason to believe that conditions in the waterway will change between December 2019 and the end of the in-water work window in February 2020. Therefore, the DMMP agencies are in agreement that a recency extension to the end of the work window is acceptable.

8. References.

DMMP, 2017. *Memorandum for Record. Determination Regarding the Suitability of Dredged Material from Squalicum Creek Waterway and Port of Bellingham Berthing Areas, Evaluated under Section 404 of the Clean Water Act, for Unconfined Open-Water Disposal at the Rosario Strait Dispersive and Port Gardner Nondispersive Sites.* Prepared by the Seattle District Dredged Material Management Office for the Dredged Material Management Program, May 3, 2017.

Herrera, 2017. *Squalicum Creek Waterway Federal Navigation Channel Dredged Material Characterization, Bellingham, Washington – Data Report.* Prepared by Herrera and NewFields for the U.S. Army Corps of Engineers, Seattle District, April 2017.

9. Agency Signatures.

The signed copy is on file in the Dredged Material Managment Office.

Concur:

______________ ____________________________________

Date David Fox, P.E. - Seattle District Corps of Engineers

______________ ____________________________________

Date Justine Barton - Environmental Protection Agency

______________ ____________________________________

Date Laura Inouye, Ph.D. - Washington Department of Ecology

______________ ____________________________________

Date Abby Barnes - Washington Department of Natural Resources

Copies furnished:

DMMP signatories
Penny Kelley, Ecology
John Hicks, CENWS-ODS-NS
John Pell, CENWS-ODS-NS
David Michalsen, CENWS-ENH-HC
Chemine Jackals, CENWS-PME

Figure 1

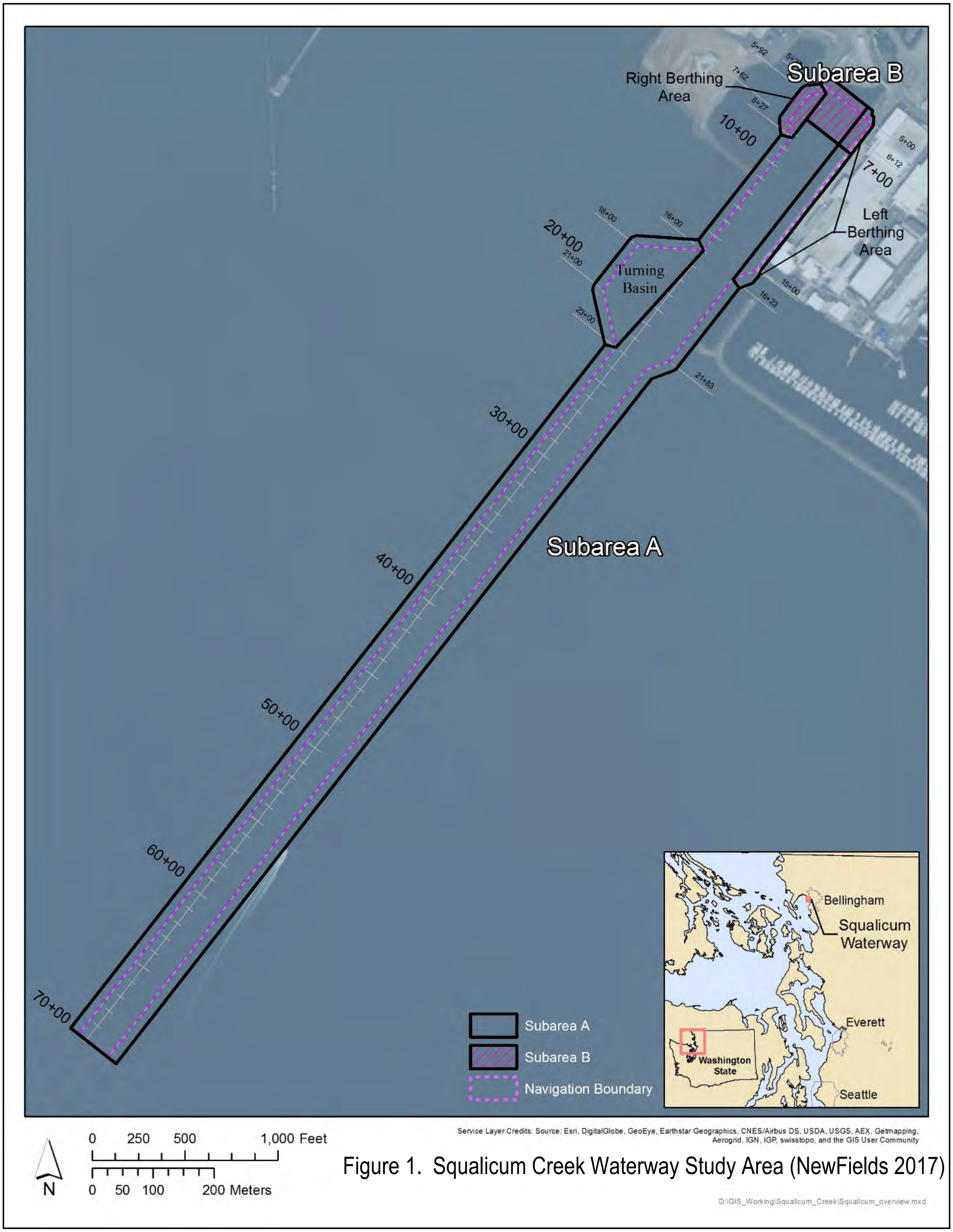
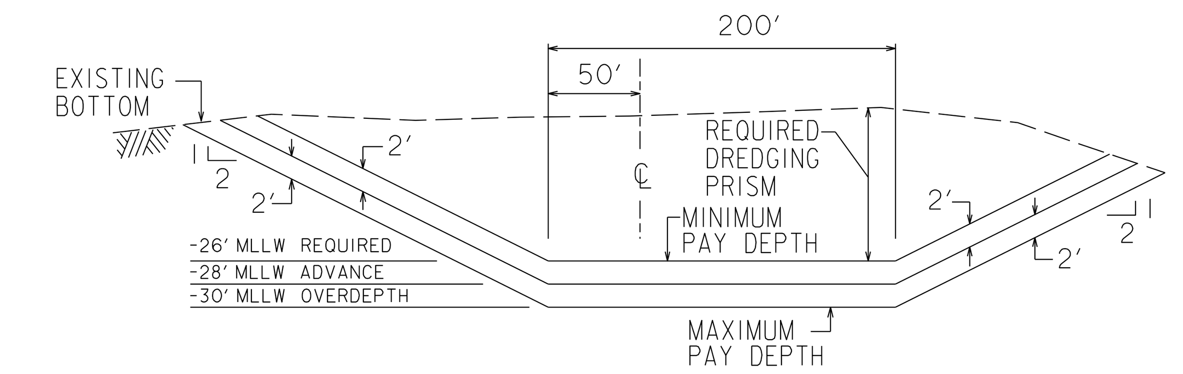
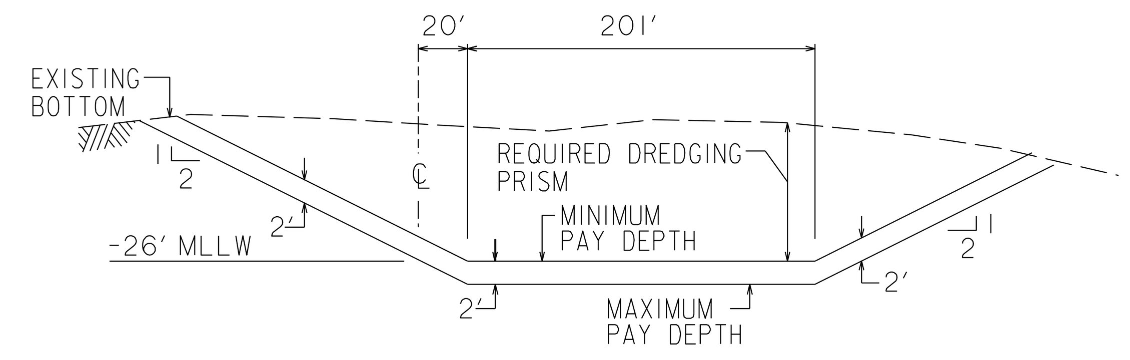


Figure 1. Squalicum Creek Waterway Study Area (NewFields 2017)



TYPICAL CHANNEL SECTION
STA. 0+00 TO STA. 17+00
NOT TO SCALE



TYPICAL CHANNEL SECTION
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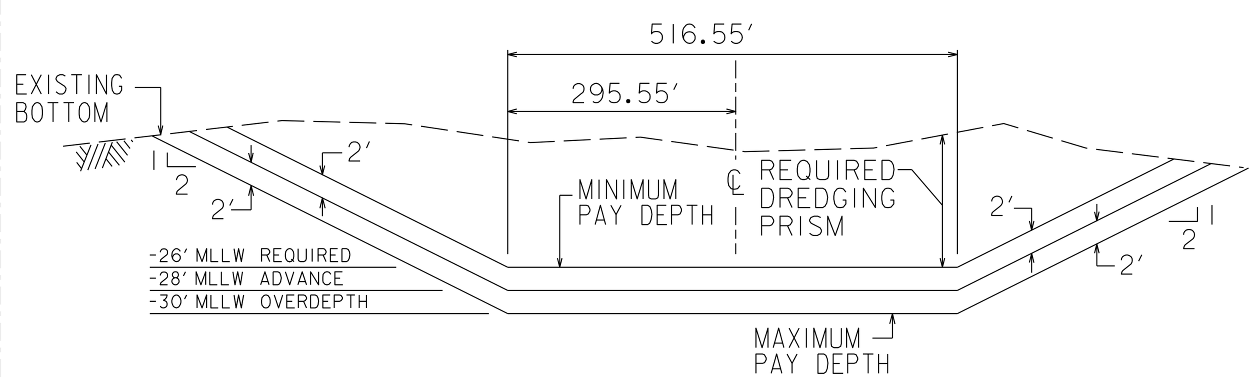
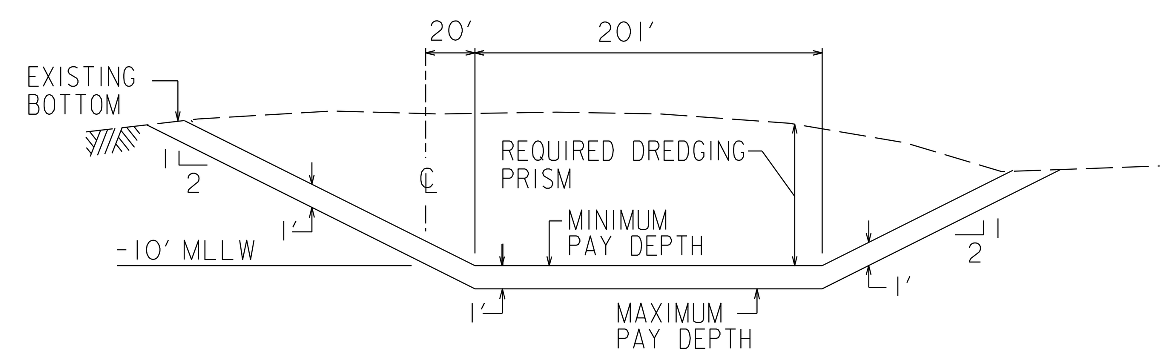
NOT TO SCALE



TYPICAL CHANNEL SECTION AT TURNING BASIN
STA. 19+00 TO STA. 22+00
NOT TO SCALE
STA. 17+00 TO STA. 19+00 WIDTH VARIES
STA. 22+00 TO STA. 24+00 WIDTH VARIES



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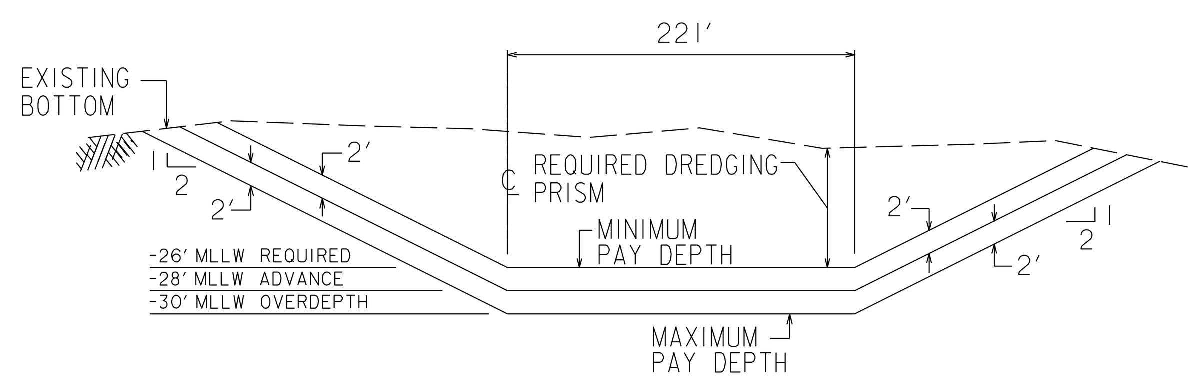
NOT TO SCALE



TYPICAL CHANNEL SECTION
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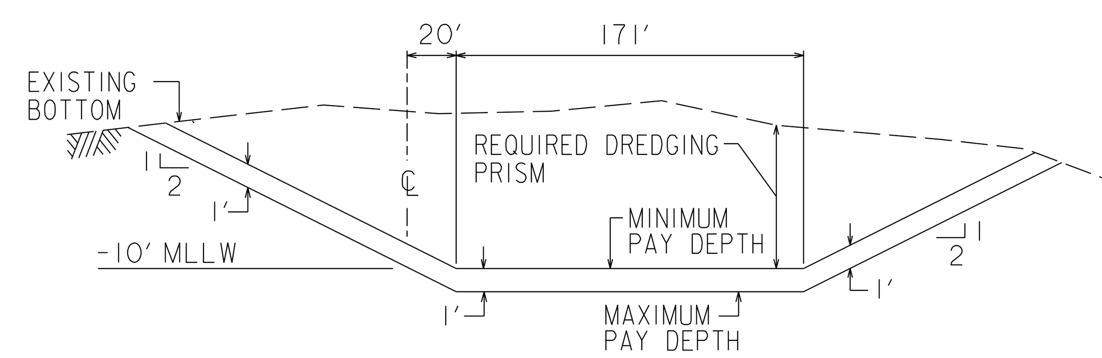
NOT TO SCALE

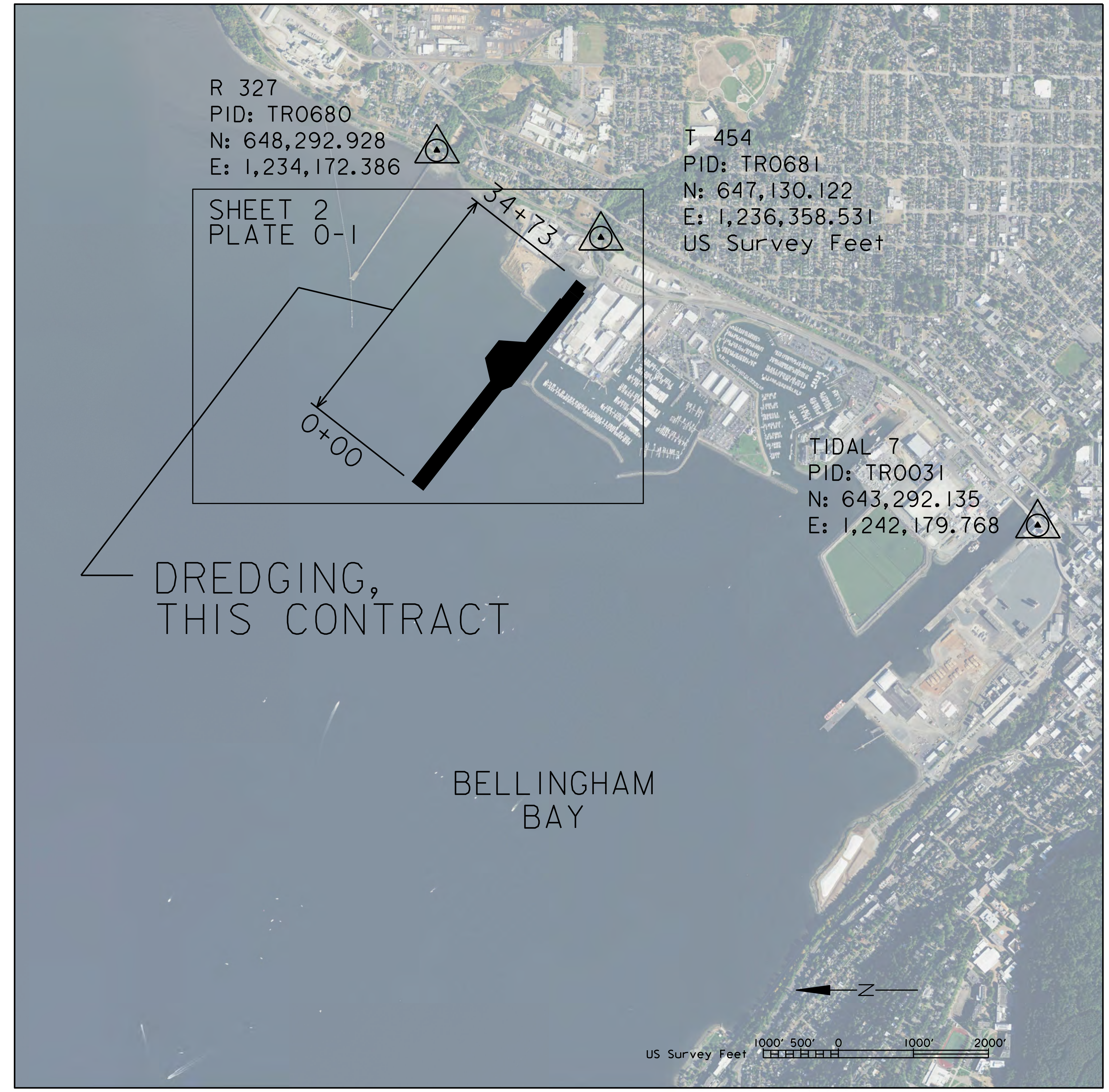


TYPICAL CHANNEL SECTION
STATION 33+96 TO 34+73
NOT TO SCALE

DREDGING CHANNEL CHARACTERISTICS

ALIGNMENT 2018 STATION	REQUIRED DREDGING DEPTH	ALLOWABLE OVERDEPTH	ADVANCE MAINTENANCE (WHEN DIRECTED)	CHANNEL SIDE SLOPE	BID ITEM NUMBER	DESIGNATED DISPOSAL/PLACEMENT SITE
33+00 TO 34+73	-10'	1'	NONE	1V:2H	BASE 1200	PORT GARDNER OPENWATER SITE
0+00 TO 33+00	-26'	2'	2'	1V:2H	BASE 1300	ROSARIO STRAIT OPENWATER SITE OR PORT GARDNER OPENWATER SITE
33+00 TO 34+73	-10'	1'	NONE	1V:2H	OPTION 2100	PORT GARDNER OPENWATER SITE
0+00 TO 31+47	-26'	2'	2'	1V:2H	OPTION 3100	ROSARIO STRAIT OPENWATER SITE OR PORT GARDNER OPENWATER SITE

Figure 2



NOTES:

1. HORIZONTAL DATUM: WGS-84 (WORLD GEODETIC SYSTEM 1984). PROJECTED COORDINATE SYSTEM: LAMBERT GRID PROJECTION, STATE PLANE, WASHINGTON NORTH ZONE, 4601. NORTH AMERICAN DATUM OF 1983/2011, PLOTTED IN NORTH AMERICAN DATUM OF 1983/91
2. ELEVATIONS ARE IN FEET AND REFER TO THE PLANE OF NOS (NATIONAL OCEAN SERVICE) MEAN LOWER LOW WATER (MLLW). EPOCH 1983-2001.
3. CHANNEL ALIGNMENT SHOWN IS ALIGNMENT 2017. AZIMUTHS ON CENTERLINE OF CHANNEL ARE LAMBERT AND DIFFER FROM TRUE NORTH AZIMUTH.
4. BASE IMAGERY PREPARED FROM NATURAL COLOR FOUR BAND IMAGERY (NAIP). TAKEN BY UNITED STATES DEPARTMENT OF AGRICULTURE (2017)
5. THE CONTRACTOR SHALL MAINTAIN A MINIMUM STANDOFF DISTANCE OF TWENTY FIVE (25) FEET OR AS DIRECTED BY THE COR (CONTRACTING OFFICER REPRESENTATIVE) FROM ALL PILINGS, BULKHEADS, TIMBER WALLS AND OTHER STRUCTURES.
6. THE CONTROL POINT/MONUMENT LOCATIONS ARE BASED ON THE GOVERNMENTS LATEST RECORD AND MAY REQUIRE VERIFICATION.
7. EVERY EFFORT HAS BEEN MADE TO PROVIDE ALL PERTINENT DETAILS ON THE LOCATION OF OBSTRUCTIONS/UTILITIES. THE DATA FURNISHED ON THE PLANS ARE BELIEVED TO BE SUBSTANTIALLY CORRECT. HOWEVER, THE EXACT LOCATIONS MAY VARY FROM THAT SHOWN.
8. CONTROL POINT/MONUMENT △

US Army Corps of Engineers
Seattle District

Symbol	Description	Date	Appr.

DESIGNED/SUBMITTED: JOHN L. PELL, PROJECT MANAGER, NAVIGATION SECTION
REVIEWED: DAVID R. MICHALSEN, P.E., DESIGN ENGINEER, HYDRAULIC ENGINEERING
APPROVED: JOHN A. HICKS, CHIEF, NAVIGATION SECTION

U.S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON
INVITATION NO. W912DW19B0013
DATE: 29 MAY 2019
FILE NO. E-9-7-85

SQUALICUM WATERWAY MAINTENANCE DREDGING FY19
BELLINGHAM HARBOR
WASHINGTON
GENERAL PLAN

Plate number:
G-2
Sheet 2 of 5

NOTES:

1. HORIZONTAL DATUM: WGS-84 (WORLD GEODETIC SYSTEM 1984). PROJECTED COORDINATE SYSTEM: LAMBERT GRID PROJECTION, STATE PLANE, WASHINGTON NORTH ZONE, 4601. NORTH AMERICAN DATUM OF 1983/2011, PLOTTED IN NORTH AMERICAN DATUM OF 1983/91
2. ELEVATIONS ARE IN FEET AND REFER TO THE PLANE OF NOS (NATIONAL OCEAN SERVICE) MEAN LOWER LOW WATER (MLLW). EPOCH 1983-2001.
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6. THE CONTROL POINT/MONUMENT LOCATIONS ARE BASED ON THE GOVERNMENTS LATEST RECORD AND MAY REQUIRE VERIFICATION.
7. EVERY EFFORT HAS BEEN MADE TO PROVIDE ALL PERTINENT DETAILS ON THE LOCATION OF OBSTRUCTIONS/UTILITIES. THE DATA FURNISHED ON THE PLANS ARE BELIEVED TO BE SUBSTANTIALLY CORRECT. HOWEVER, THE EXACT LOCATIONS MAY VARY FROM THAT SHOWN.

LEGEND

AREA TO BE DREDGED TO -26.0 MLLW
+2.0' ADVANCE (WHEN DIRECTED),
+2.0' OVERDEPTH,
BASE LINE ITEM #1300
OPTION ITEM #3100

AREA TO BE DREDGED TO -10.0' MLLW
+1.0' OVERDEPTH,
BASE LINE ITEM 1200
OPTION ITEM #2100

CONTROL POINT

DREDGING AREA CORNER LOCATIONS:

A N 643876.64 E 1233836.26	B N 645215.37 E 1234884.02	C N 645524.21 E 1234813.92
D N 645760.46 E 1234998.82	E N 645735.80 E 1235354.83	F N 646324.05 E 1235815.23
G N 646311.72 E 1235830.98	H N 646432.21 E 1235925.28	I N 646568.44 E 1236031.90
J N 646463.05 E 1236166.56	K N 646402.42 E 1236119.11	L N 646383.93 E 1236142.73
M N 646308.33 E 1236083.56	N N 645140.56 E 1235169.61	O N 645092.11 E 1235041.52
P N 643753.38 E 1233993.76		

Figure 3

CAUTION: NOT INTENDED FOR NAVIGATIONAL OR RELATED PURPOSES. The information on this map results from hydro surveys performed on the dates indicated. Although the U.S. Army Corps of Engineers strives to maintain accurate and precise maps, the information on this map may not be current and may be in error. The U.S. Army Corps of Engineers and its suppliers makes no warranties, express or implied, as to the accuracy of conditions depicted except as described above, including no warranties as to the usability or suitability for any particular purpose.

US Army Corps of Engineers
Seattle District

Symbol	Description	Date	Appr

DESIGNED/SUBMITTED: JOHN L. PELL, PROJECT MANAGER, NAVIGATION SECTION
REVIEWED: DAVID R. MICHALSEN, P.E., DESIGN ENGINEER, HYDRAULIC ENGINEERING
APPROVED: JOHN A. HICKS, CHIEF, NAVIGATION SECTION

U.S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

INVITATION NO. W912DW19B0011
DATE: 29 MAY 2019
FILE NO. E-9-7-85

SQUALICUM WATERWAY MAINTENANCE DREDGING FY19
SET NAME

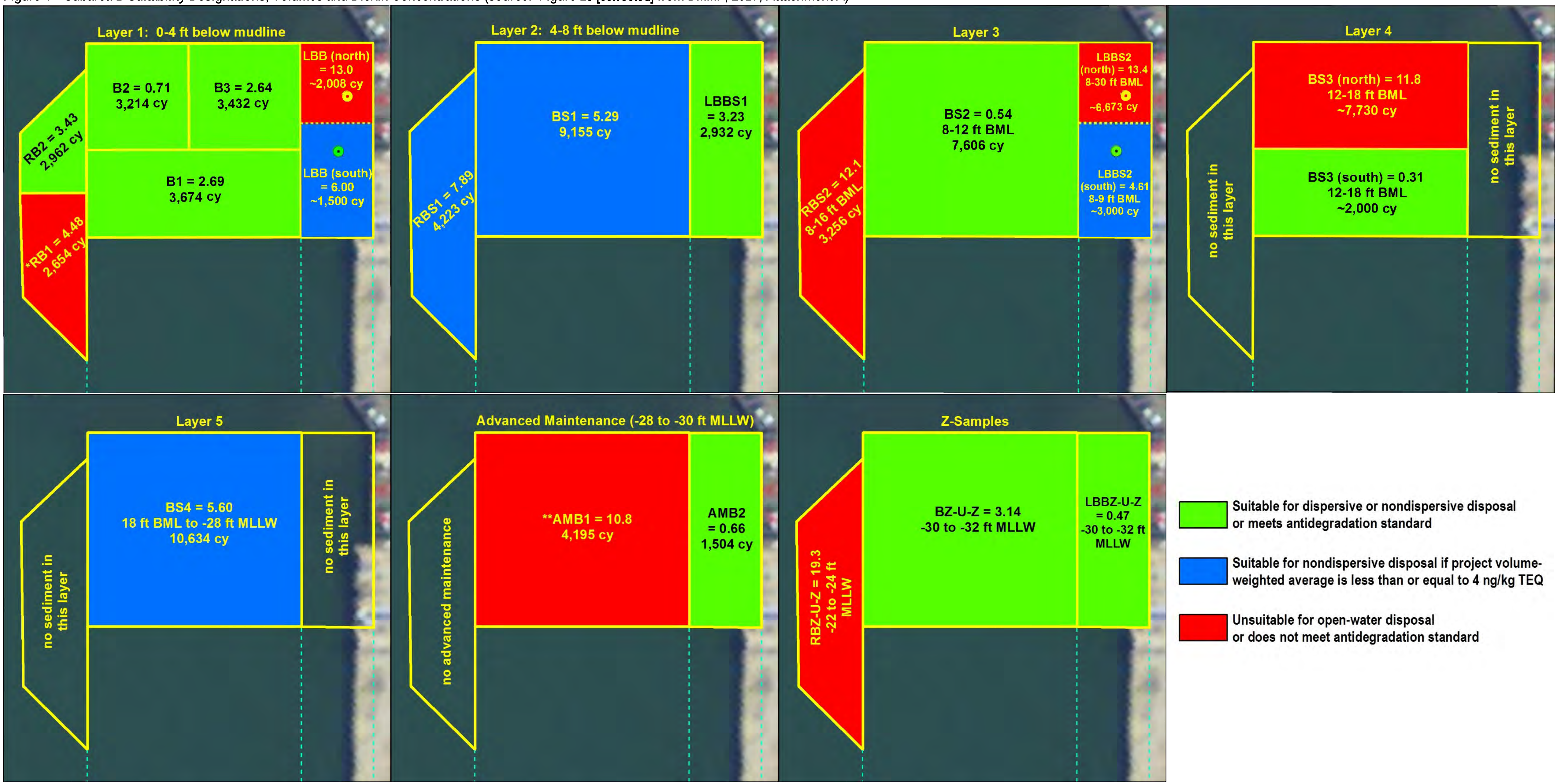
SQUALICUM WATERWAY DETAIL
STA. 0+00 TO STA. 34+73

BELLINGHAM HARBOR WASHINGTON

Plate number:
O-1

Sheet 4 of 5

Figure 4 – Subarea B Suitability Designations, Volumes and Dioxin Concentrations (source: Figure 10 [corrected] from DMMP, 2017; Attachment A)



Note: all dioxin concentrations in ng/kg toxic equivalents
BML = below mudline
MLLW = mean lower low water
TEQ – toxic equivalents

*DMMU RB1 exceeded the SL for 4-methylphenol but was not subjected to toxicity testing. It is therefore unsuitable for open-water disposal.
**In addition to the dioxin concentration exceeding 10 ng/kg TEQ, DMMU AMB1 exceeded the SL for several PAHs.

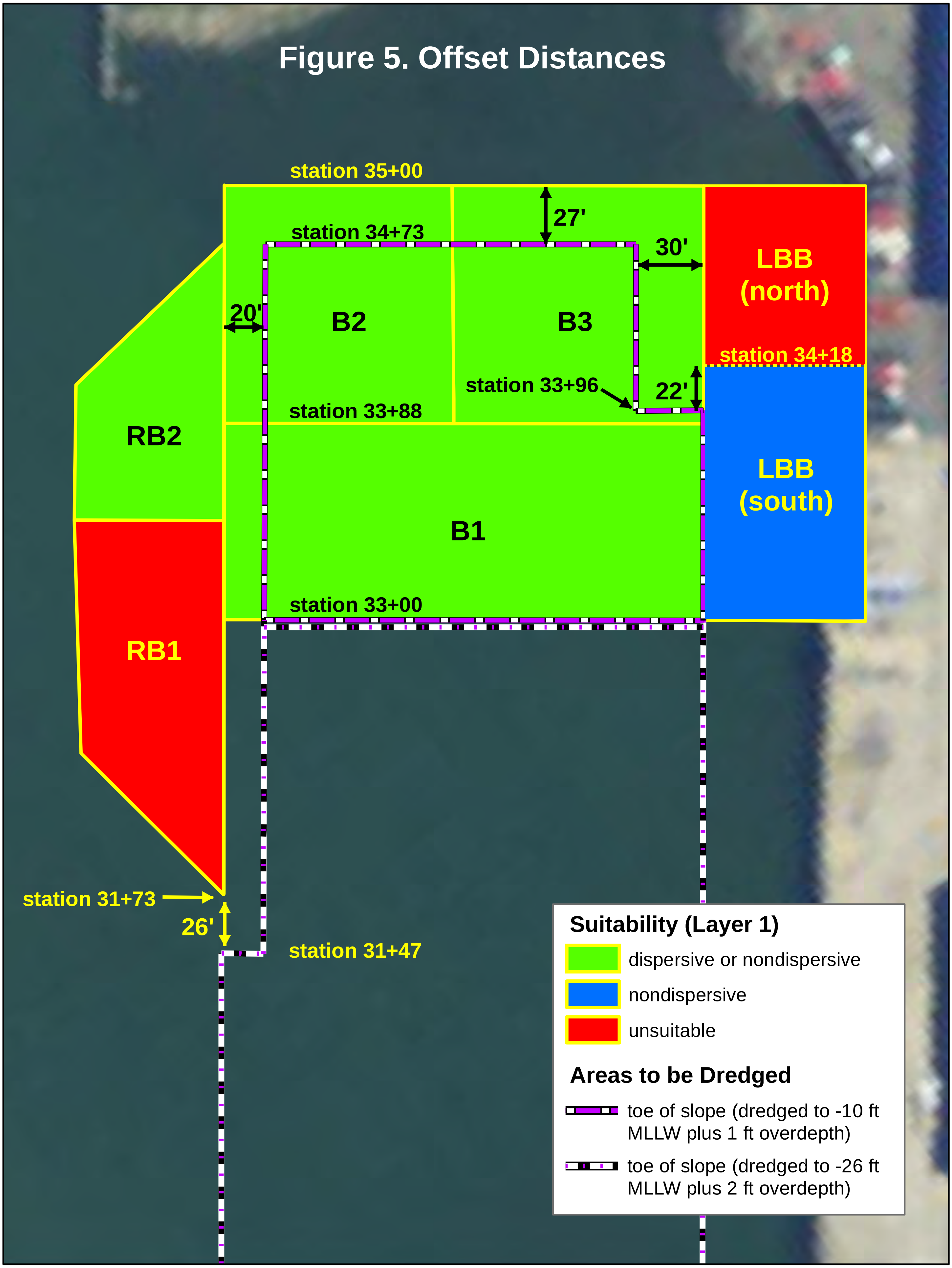
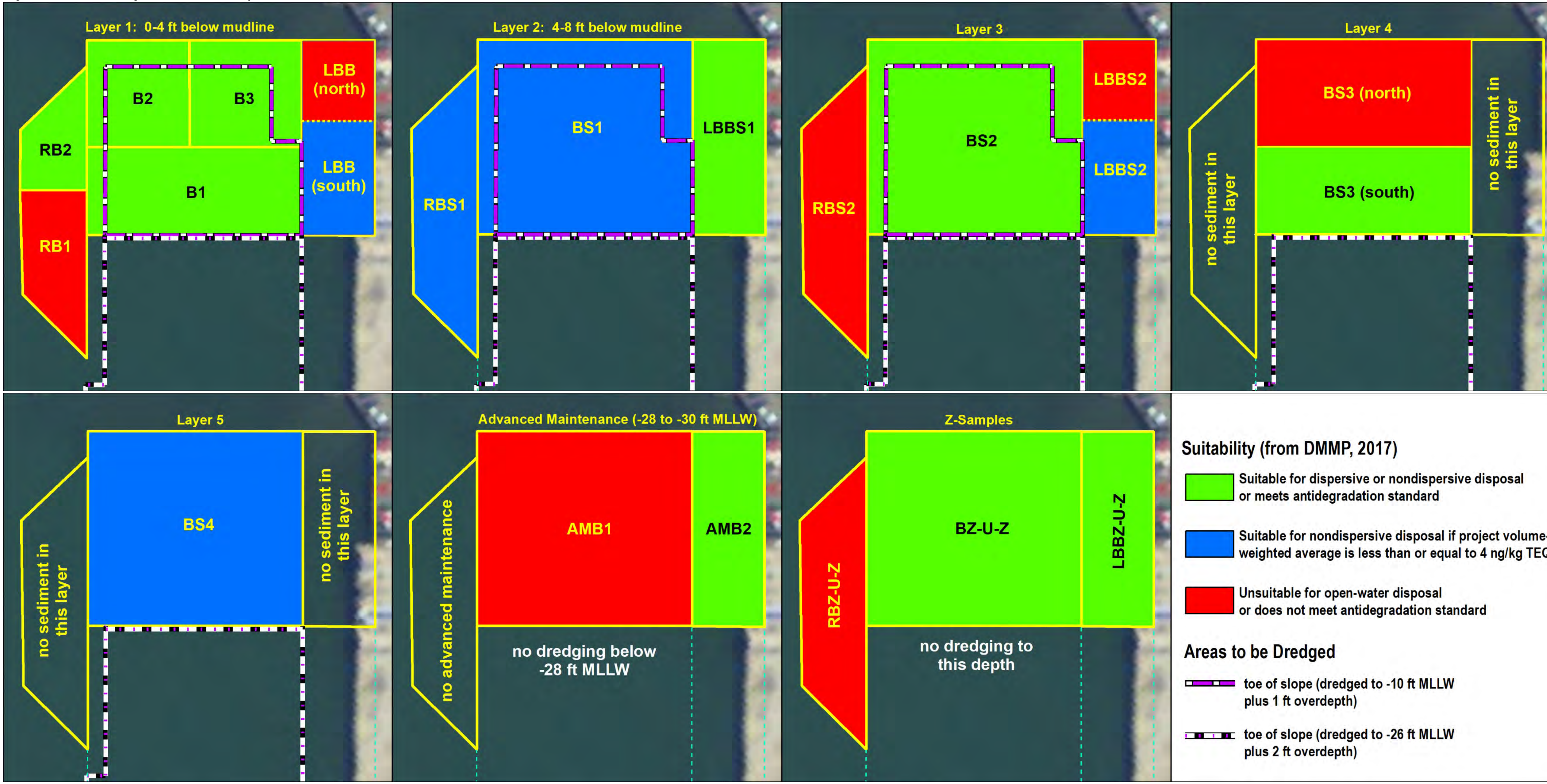


Figure 5. Offset Distances
station 35+00
station 34+73
27'
30'
LBB
(north)
20'
B2
B3
station 34+18
station 33+96
22'
RB2
station 33+88
LBB
(south)
B1
station 33+00
RB1
station 31+73
26'
station 31+47
Suitability (Layer 1)
dispersive or nondispersive
nondispersive
unsuitable
Areas to be Dredged
toe of slope (dredged to -10 ft MLLW plus 1 ft overdepth)
toe of slope (dredged to -26 ft MLLW plus 2 ft overdepth)

Figure 6 – Toe of Dredge Prism at Each Layer



MLLW = mean lower low water

Table 1. Dredging Specifications

Subarea	New Stationing	Old Stationing	Design Depth (ft MLLW)	Overdepth (ft)	Advanced Maintenance (ft)	Total Depth (ft MLLW)	Side Slope	Channel Dredge Width (ft)	Offset from right channel line (ft)	Offset from left channel line (ft)	Comments
A	0+00 to 31+47	40+00 to 8+53	-26	2	2	-30	1V:2H	full	0	0	No restrictions
A	31+47 to 33+00	8+53 to 7+00	-26	2	0	-28	1V:2H	201	20	0	20-ft offset from right channel line avoids incursion into unsuitable DMMUs RB1 and RBS2
B	33+00 to 33+96	7+00 to 6+04	-10	1	0	-11	1V:2H	201	20	0	20 ft offset from right channel line avoids incursion into unsuitable DMMUs RB1 and RBS2; a transition slope from -26 to -10 ft will form in this area during dredging as the sediment achieves its natural angle of repose; material sloughing from the transition slope will be taken to the Port Gardner disposal site.
B	33+96 to 34+73	6+04 to 5+27	-10	1	0	-11	1V:2H	171	20	30	20 ft offset from right channel line avoids incursion into unsuitable DMMUs RB1 and RBS2; 30 ft offset from left channel line avoids incursion into unsuitable DMMUs LBB (north) and LBBS2. Maximum dredge depth of -11 ft MLLW avoids incursion into unsuitable DMMU BS3 (north).
B	34+73 to 35+00	5+27 to 5+00	Transition from -10 to existing mudline	Not applicable	Not applicable	Transition from -10 to existing mudline	1V:2H	171	20	30	No active dredging in this range; only material sloughing from this area will be removed. Dredging was offset 27 feet from the northern extent of the federal project to avoid disturbing untested material.

Table 2. Project volume-weighted average for dioxins/furans (Subarea B only)

DMMU	layer	DMMU Boundaries (New Stationing)	DMMU Boundaries (Old Stationing)	Volume from 2016 bathymetry	Volume + 25% contingency	Dioxin Concentration ng/kg TEQ (u=1/2 EDL)	Volume x Dioxin TEQ
B1	0-4 feet below mudline	33+00 to 33+88	6+12 to 7+00	2,555	3,194	2.69	8,592
B2	0-4 feet below mudline	33+88 to 35+00	5+00 to 6+12	1,196	1,495	0.71	1,061
B3	0-4 feet below mudline	33+88 to 35+00	5+00 to 6+12	1,553	1,941	2.64	5,124
LBB (south)	0-4 feet below mudline	33+00 to 34+18	5+82 to 7+00	32	40	6.00	240
BS1	4-8 feet below mudline	33+00 to 35+00	5+00 to 7+00	3,966	4,958	5.29	26,228
BS2	8-12 feet below mudline	33+00 to 35+00	5+00 to 7+00	1,569	1,962	0.54	1,059
BS3 (south)	12-18 feet below mudline	33+00 to 33+88	6+12 to 7+00	646	808	0.31	250
BS4	18 ft BML to -28 ft MLLW	33+00 to 35+00	5+00 to 7+00	176	220	5.6	1,232
			Total:	11,693	14,618	---	43,786
					Dioxin VWA (ng/kg TEQ):	3.00	= 43,786 ÷ 14,618

Note 1: the stationing is for the boundaries of the DMMUs, not the dredge prism.
Note 2: the volumes for BS2, BS3 (south) and BS4 assume a 1V:2H transition slope forms from the area dredged to -11 ft to the area dredged to -28 ft (including overdepth).

Attachment 1

Errors were found in several dioxin concentrations after this document had been signed. Please see corrections on page 6 and in Figures 9 and 10.

CENWS-ODS-ND

MEMORANDUM FOR RECORD May 3, 2017

SUBJECT: DETERMINATION REGARDING THE SUITABILITY OF DREDGED MATERIAL FROM THE SQUALICUM CREEK WATERWAY AND PORT OF BELLINGHAM BERTHING AREAS, EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT, FOR UNCONFINED OPEN-WATER DISPOSAL AT THE ROSARIO STRAIT DISPERSIVE AND PORT GARDNER NONDISPERSIVE SITES.

1. Introduction. This memorandum reflects the consensus determination of the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers, Washington Departments of Ecology and Natural Resources, and the Environmental Protection Agency) regarding the suitability of 418,551 cubic yards (cy) of dredged material from the Squalicum Creek Waterway federal navigation channel and Port of Bellingham berthing areas for disposal at the Rosario Strait dispersive and Port Gardner nondispersive open-water disposal sites.

2. Background. As authorized by Congress in the Rivers and Harbors Acts of 1925 and 1930, the U.S. Army Corps of Engineers (USACE) Seattle District conducts maintenance dredging of the Squalicum Creek Waterway Federal Navigation Project in Bellingham, Washington (Figure 1). USACE is also authorized to conduct sediment characterization, but not dredging, in the Port of Bellingham's berthing areas adjacent to the federal channel. The authorized depth of the channel and berthing areas is -26 feet (ft) mean lower low water (MLLW).

   Sedimentation in Squalicum Creek Waterway is due to input from the Nooksack River and Squalicum Creek. Sediment in the waterway has been characterized by USACE under the Puget Sound Dredged Disposal Analysis (PSDDA) program or DMMP four times, including three full characterizations and a reconnaissance survey for dioxins. Bellingham Cold Storage, a tenant of the Port of Bellingham, has conducted sediment sampling in the waterway on two additional occasions. Table 1 provides a summary of the characterization and survey results. A complete description can be found in Attachment A.

   A bathymetric survey of the Squalicum Creek Waterway and berthing areas conducted by USACE in March 2016 showed that significant sedimentation had occurred. USACE contracted with Herrera Environmental and subcontractor NewFields to characterize the waterway and left berthing area to -30 ft MLLW (authorized depth of -26 ft plus 2 ft of advanced maintenance and 2 ft of overdepth). Characterization of the right berthing area, which is currently not in use, was restricted to -22 ft MLLW (-20 ft plus 2 ft of overdepth).

3. Project Summary. Table 2 includes project summary and tracking information.

Table 2. Project Summary and Tracking Information

Project ranking	Subarea A: low-moderate (LM) Subarea B: high (H)
Characterized volume	418,551 cubic yards
Characterized depth	channel and left berthing area: -30 ft MLLW (including advanced maintenance and overdepth) right berthing area: -22 ft MLLW (including overdepth)
Draft SAP received	October 21, 2016
Draft SAP returned for revisions	November 9, 2016
Revised SAP received	November 18, 2016
Revised SAP approved	November 23, 2016
Sampling dates	sonic drilling: November 30 to December 2, 2016 vibracoring: November 29 to December 2, 2016 and December 30, 2016
Draft data report received	March 17, 2017
Comments provided on draft report	April 6, 2017
Final data report received	April 14, 2017
DMMO tracking number	SQUAL-A-378-16
EIM Study ID	SQUAL16
Recency Determination	Subarea A: December 2022 (LM rank = 6 years) Subarea B: December 2019 (H rank = 3 years)

4. Project Ranking and Sampling Requirements. The project was divided into 2 subareas for characterization. Subarea A included the navigation channel and left berthing area waterward of station 7+00. Subarea B included the navigation channel and left berthing area between stations 5+00 and 7+00, and the entire right berthing area. The DMMP agencies reviewed data from the two previous characterizations of Subarea A, including the left berthing area. The only exceedance of the 2016 screening levels (SLs) was for benzyl alcohol in the left berthing area in 2015. This exceedance was attributed to natural sources and bioassays were not required. Based on the data review, Subarea A was ranked a “low-moderate” concern for potential contamination. Sediment in Subarea B had previously been found unsuitable for open-water disposal. Therefore, the DMMP agencies retained the rank of “high” listed in the DMMP User Manual (DMMP, 2016) for the head of the waterway. All material in both subareas is considered heterogeneous in nature due to the length of time between dredging events.

In the Dredged Material Management Program, “surface” material (i.e. the top 4 feet) is treated differently from “subsurface” material (deeper than 4 feet) for the purpose of calculating the number of field samples and dredged material management units (DMMUs) needed. The following guidelines applied to this project:

Subarea A (low-moderate ranked):

- Maximum volume of sediment represented by each field sample = 8,000 cy
- Maximum volume of sediment represented by each surface DMMU = 32,000 cy
- Maximum volume of sediment represented by each subsurface DMMU = 48,000 cy

Subarea B (high ranked):

- Maximum volume of sediment represented by each field sample = 4,000 cy
- Maximum volume of sediment represented by each surface DMMU = 4,000 cy
- Maximum volume of sediment represented by each subsurface DMMU = 12,000 cy

The volume of sediment requiring characterization was calculated using the March 2016 bathymetric survey data. It was not known at the time the sampling and analysis plan was developed when dredging might occur, so contingency factors were applied to the calculated volumes in the two subareas to cover additional sedimentation likely to occur over the time span covered by the recency period. The following contingency factors were calculated by USACE based on hydrosurveys conducted in 2009, 2010, 2013, 2015 and 2016:

Subarea A:

- main channel, turning basin and left berthing area (to -28 ft MLLW): 40%
- advanced maintenance in the main channel (-28 to -30 ft MLLW): 25%
- advanced maintenance in the turning basin (-28 to -30 ft MLLW): 0%
- advanced maintenance in the left berthing area (-28 to -30 ft MLLW): 15%

Subarea B:

- main channel and left berthing area (to -28 ft MLLW): 25%
- right berthing area (to -22 ft MLLW): 25%
- advanced maintenance in the main channel and left berthing area (-28 to -30 ft MLLW): 0%

Figures 2 and 3 are plan views of Subareas A and B, with insets showing cross-sections and schematics of the DMMU profiles. Figures 4-6 include the anticipated core profiles and compositing schemes. Tables 3 and 4 show the contingency factors and volume estimates for DMMUs in Subareas A and B respectively.

The volumes for all but one DMMU were within the DMMP volume limitations. DMMU AMA1, which represented the advanced maintenance material (-28 to -30 ft MLLW) underlying DMMUs A1 and A2 was allowed to slightly exceed the 48,000 cy limit for subsurface DMMUs in low-moderate ranked areas in order to maintain the same spatial coverage as DMMUs A1 and A2 combined.

Due to past findings of contamination in deeper sediment in Subarea B, subsurface DMMUs in this subarea were kept well below the limitation of 12,000 cy. In addition, DMMUs in the right and left berthing area were delineated separately from DMMUs in the main channel, so that independent determinations could be made for federal vs. non-federal dredged material.

Also, due to ambiguous results for past testing of dioxin in z-samples from Squalicum Creek Waterway (DMMP, 2012) and in order to potentially provide more precise vertical characterization of dioxin contamination if necessary to address antidegradation, USACE elected to collect z-samples in two one-foot increments at each station. Composites of the upper one-foot z-samples were slated to be analyzed for dioxin concurrently with testing of the DMMUs.

5. Sampling. Standard vibracoring was sufficient to collect samples from Subarea A, but gravel and cobble were anticipated in Subarea B, with cores up to 32 feet long needed to collect z-samples. Therefore, sonic drilling was required in that subarea.

   Field sampling was scheduled to be completed in a single week, however strong wind and waves were encountered prior to completion of the vibracoring. The sonic drilling in Subarea B was completed during the period November 30-December 2. Vibracoring began on November 29 but was suspended on December 2 due to safety concerns. Inclement weather throughout much of December prevented the sampling crew from returning until December 30. The remaining vibracore samples were collected that day.

   Other than the weather delay, vibracoring proceeded as described in the SAP, with one exception. DMMU AMA2 was to include a 2-ft core section (-28 to -30 ft MLLW) from all coring stations in DMMUs A3, A4 and A5. However, at the time of suspension of vibracoring due to weather, only 10 of the 12 cores from these three DMMUs had been collected. The two missing cores were from DMMU A3. Rather than risk exceeding holding times for AMA2, the DMMP agencies authorized analysis of AMA2 without contributions from the missing cores. Since A3 was farther away from likely sources of historical contamination than the other two DMMUs (A4 and A5) that made up AMA2, it was assumed that any sampling bias introduced by the missing cores would result in higher chemical concentrations in AMA2 rather than lower, so the decision to proceed with the processing of AMA2 was considered environmentally conservative by the DMMP agencies.

   For the sonic drilling, recovery rates in some sediment intervals – especially in the top 8 feet – were below the 75% target for recovery due to the presence of unconsolidated sand and gravel, which was difficult to retain in the cores. With vibracoring, low recovery can be an issue when long cores are being collected because it cannot be determined with certainty where the material that *is* recovered came from with regard to depth. The use of sonic drilling in Subarea B resolved this issue because the cores were advanced and collected in intervals that matched the upper and lower elevations of the DMMUs being sampled. Therefore, while recovery may have been less than the target fraction, it was known with certainty that the material being collected was representative of the DMMU being sampled. The DMMP agencies authorized the drillers to relax the acceptance criterion for recovery as long as sufficient material could be collected to conduct all the planned analyses.

   Two other issues were encountered during sonic drilling at station B3-2. A 20-ft length of drill casing was lost during drilling and could not be recovered. That casing remains buried within the sediment at B3-2. Also at this station, a hydrocarbon sheen and odor were encountered in the core section recovered from 27 to 32 ft below mudline. The mudline elevation at B3-2 was

-2.4 ft MLLW. Therefore, the elevation of the core section with the hydrocarbon sheen and odor was -29.4 to -34.4 ft MLLW. This core section was archived separately for possible later analysis.

Figures 7 and 8 show both the target and actual sampling stations in Subareas A and B respectively. There was good concurrence between the target coordinates and actual coordinates in Subarea A, with the exception of station A4-4. The sampling team discovered that the mudline elevation was -25.1 ft MLLW at the target coordinates for A4-4, which was significantly deeper than the mudline elevation of -20.9 ft MLLW anticipated in the SAP. This station was moved to shallower water, approximately 25 ft to the east of the target station, where the mudline elevation was -22.3 ft MLLW In Subarea B, concurrence between target and actual sampling stations was also good, with actual coordinates within 10 ft of the target coordinates in all cases. Tables 5 and 6 include sampling information for Subareas A and B respectively. Tables 7-11 include the core compositing schemes for all DMMUs.

One deviation from the SAP occurred during processing of core sections from station LBB-2, affecting three DMMUs:

- The core section from Core LBB-2 included in the composite representing DMMU LBBS1 was taken from 3.1 to 6.7 feet below mudline (-23.3 to -27.8 ft. MLLW); it should have been taken from 3.1 to 6.2 feet below mudline (-23.3 to -27.3 ft. MLLW).
- The core section from Core LBB-2 included in the composite representing DMMU LBBS2 was taken from 6.7 feet to 7.2 ft. below mudline (-27.8 to -28.5 ft. MLLW); it should have been taken from 6.2 to 6.7 feet below mudline (-27.3 to -28.0 ft. MLLW).
- The core section from Core LBB-2 included in the composite representing DMMU AMB2 was taken from 7.2 feet to 8.2 ft. below mudline (-28.5 to -30.0 ft. MLLW); whereas it should have been sampled from 6.7 to 8.2 feet below mudline (-28.0 to -30.0 ft. MLLW).

Following review of the chemical testing data – including dioxin – the DMMP agencies determined that this minor sample processing error at station LBB-2 had no effect on decision-making.

6. Chemical Analysis. Tables 12 and 13 present the sediment conventional and standard DMMP chemistry results for DMMUs and upper z-samples in Subareas A and B respectively. There were no detected SL exceedances in Subarea A and the detection limits for non-detects were all below SL as well. In Subarea B, two DMMUs had detected SL exceedances for at least one analyte. DMMU RB1-C exceeded the SL for 4-methylphenol. DMMU AMB1-C exceeded the SL for four individual PAHs, as well as Total LPAH. There were no bioaccumulation trigger (BT) exceedances for the standard DMMP chemicals of concern.

Dioxin was analyzed in all DMMUs and in the upper composited z-samples. Tables 14 and 15 include the dioxin data for Subareas A and B respectively. Figure 9 shows the dioxin data for Subarea B. The dioxin concentrations for all DMMUs and z-samples in Subarea A were below the DMMP disposal site management objective of 4 nanograms per kilogram (ng/kg) toxic equivalents (TEQ), with non-detected congeners set equal to one-half the estimated detection limit (EDL). In Subarea B, nine of the sixteen DMMUs exceeded 4 ng/kg TEQ. Of these, five DMMUs also exceeded the BT of 10 ng/kg. Three composited z-samples were tested for dioxin. The z-samples from the left berthing area and the main channel were both below 4 ng/kg TEQ, while the z-sample from the right berthing area had the highest concentration of all samples tested (19.3 ng/kg TEQ).

USACE evaluated the depth and spatial distribution of the chemical testing results within the context of planning an effective dredging project. Three decisions emerged from that evaluation:

a. It had already been determined that the Port of Bellingham's main tenant on the Squalicum Creek Waterway, Bellingham Cold Storage, no longer uses the right berthing area. Therefore, USACE determined that it was highly unlikely the right berthing area would be dredged within the recency period, thereby obviating the need to run bioassays to address the 4-methylphenol SL exceedance in DMMU RB1-C.
b. Given the SL exceedances for PAHs in the advanced maintenance material within the federal channel in Subarea B (DMMU AMB1-C), USACE decided that advanced maintenance dredging in that area would not be conducted. Under that scenario, bioassays on DMMU AMB1-C were not needed.
c. Finally, given the pattern of dioxin concentrations, it was suspected that dioxin contamination was likely higher toward the head of the waterway and lower in areas farther removed from the head. If this could be ascertained, USACE would be able to dredge more material from the outer portion of Subarea B, which would be beneficial for navigation. USACE hypothesized that the elevated concentration of dioxin found in DMMU BS3-C was likely due more to contributions from sediment collected from stations B2-1, B2-2, B3-1 and B3-2, rather than station B1-1. To test this hypothesis, USACE elected to analyze the individual core section from B1-1 that had been included in the composite for DMMU BS3-C (i.e. the sediment collected from 12 to 18 feet below mudline at B3-1). Similarly, in order to maximize the dredging that Bellingham Cold Storage could do in the left berthing area, USACE elected to analyze the individual core intervals from station LBB-2 that had been included in the composites for DMMUs LBB-C and LBBS2-C (0 to 4 ft below mudline and 8 to 9 feet below mudline respectively).

Results from the dioxin analysis of individual core sections can be found in Table 16. The hypothesis that cores farther removed from the head of the waterway would have lower dioxin concentrations was supported by the data. Whereas DMMU BS3-C – represented by composited material from five sampling stations – had a dioxin concentration of 11.8 ng/kg TEQ, the individual core section from station B1-1 had a dioxin concentration of only 2.44 ng/kg TEQ. Similarly, composited DMMUs LBB-C and LBBS2-C had dioxin concentrations of 13.0 and 13.4 ng/kg TEQ respectively, while corresponding individual core sections from station LBB-2 had dioxin concentrations of 7.34 and 5.33 ng/kg TEQ respectively.

This concentration was from a preliminary dataset in which non-detects were set equal to limits of detection. The concentration was 0.311 in the final dataset, in which non-detects were set equal to estimated detection limits in accordance with DMMP guidelines. See Table 16.

In response to the Essential Fish Habitat conservation recommendations that accompanied the National Marine Fisheries Service's biological opinion on the effects of dredged material disposal on listed rockfish species (DMMO, 2016), USACE agreed to conduct limited analysis

This was the preliminary concentration. The final concentration was 6.00

This was the preliminary concentration. The final concentration was 4.61

of polybrominated diphenyl ethers (PBDEs) for federal dredging projects in urban areas. For the Squalicum Creek Waterway O&M project, three DMMUs were analyzed for PBDEs. Results from this analysis are included in Table 17.

All chemistry data were validated by Herrera and EcoChem. EcoChem provided EPA Stage 4 validation for the dioxin and PBDE congener analyses. Herrera provided Stage 4 validation for the remaining organics and Stage 3 validation for metals and conventional parameters. Data qualifiers assigned by Herrera and EcoChem are found in the columns labeled “VQ” in Tables 12 to 17.

Only minor QA/QC issues were encountered with the chemical analysis. The initial metals analysis for DMMU A5-C resulted in a cadmium concentration of 6.9 mg/kg, which exceeded the SL of 5.1 mg/kg. But a laboratory duplicate run on that sample resulted in a cadmium concentration of only 0.20 J, which was well below SL and similar to the cadmium concentrations in other DMMUs. The lab reran DMMU A5-C in duplicate. Cadmium was undetected in both replicates at reporting limits that were well below SL (0.16 U and 0.17 U mg/kg). The result reported in Table 12 for cadmium in A5-C is from the first replicate of the reanalysis (i.e. 0.16 U mg/kg). Based on the totality of analytical results, the DMMP agencies determined that cadmium was not likely an issue in DMMU A5-C and bioassays were not required to be run on this sample.

A second minor QA/QC issue concerned chlordane. While undetected in all samples in the initial analysis, the lab was unable to achieve detection limits that were below the SL. This initial analysis was calibrated using a technical chlordane standard. The lab reanalyzed all samples using calibration standards for the individual chlordane components, which had lower detection limits than technical chlordane. The reanalysis resulted in either detected concentrations below the SL or non-detects with detection limits below SL.

7. Biological Testing. No bioassays or bioaccumulation testing were conducted.

8. Suitability Determination. This memorandum documents the evaluation of the suitability of sediment from the federal navigation project and berthing areas in the Squalicum Creek Waterway for open-water disposal. The data gathered were determined to be sufficient and acceptable for regulatory decision-making under the DMMP program.

Subarea A

Based on the results of the previously described testing, the DMMP agencies concluded that all 336,199 cubic yards of sediment in Subarea A, including the advanced maintenance material, are suitable for open-water disposal at the Rosario Strait site. Material from Subarea A may also be taken to the Port Gardner site if needed to bring the volume-weighted average of Subarea B material going to that site below the 4 ng/kg TEQ site management objective.

Sediment exposed by dredging must either meet the State of Washington Sediment Quality Standards (SQS) (Ecology, 2013) or the State’s antidegradation standard (DMMP, 2008). Comparison of the proposed dredged material to SQS serves as a first-tier indicator for this purpose. The SQS for metals, phenols, benzoic acid and benzyl alcohol are the same as the SLs for these chemicals. Therefore, there were no SQS exceedances for these chemicals in Subarea A. The remaining SQS chemicals are normalized for organic carbon. The carbon-normalized results for these chemicals are included in Table 18. As can be seen from the table, there were no SQS exceedances. Also, as was discussed previously in this memorandum, the composited upper z-samples in Subarea A were analyzed for dioxin. The dioxin concentrations (Table 14) were all below 4 ng/kg TEQ, thereby meeting the antidegradation standard. In addition, the dioxin concentrations in the advanced maintenance material (-28 to -30 ft MLLW) in Subarea A were also below 4 ng/kg TEQ. If Subarea A is dredged without removing the advanced maintenance material, this material would become the newly exposed surface and meets the antidegradation standard.

In summary, the antidegradation standard will be met in Subarea A for standard DMMP COCs and dioxin, regardless of whether advanced maintenance is included in the dredge plan or not.

Subarea B

Until a specific dredging design is proposed, the DMMP agencies cannot definitively determine the suitability of material in Subarea B for disposal at the Rosario Strait or Port Gardner disposal sites. The extent of any future dredging by USACE in Squalicum Creek Waterway will depend on the level of funding received. Bellingham Cold Storage plans to dredge the left berthing area, but the design has not been finalized at this time. Therefore, for Subarea B, this suitability determination will present approximate volumes and discuss the requirements that must be met by any dredging in this subarea. If and when USACE has a defined project, it will be reviewed by the DMMP agencies for compliance with the requirements stipulated in this suitability determination and a supplemental suitability determination will be prepared and signed by the agencies. The same is true for any dredging by Bellingham Cold Storage.

Table 20 includes the approximate volumes in Subarea B that are suitable for disposal at the Rosario Strait and Port Gardner disposal sites, as well as volumes unsuitable for open-water disposal. Figure 10 provides this information graphically and also includes dioxin concentrations for reference. Several caveats are required when reviewing Table 20 and Figure 10:

a. The volumes shown suitable for disposal at the Rosario Strait site are based strictly on the chemical testing results, without regard to the dredgeability of these DMMUs. For example, DMMU LBBS1-C had no SL exceedances and had a dioxin concentration of 3.23 ng/kg TEQ. It is, therefore, ostensibly suitable for placement at the Rosario Strait site. However, it is sandwiched between layers with higher dioxin concentrations, which reduces the likelihood that LBBS1-C will be dredged as an independent unit for disposal in Rosario Strait.
b. The volumes shown suitable for disposal at the Port Gardner site are only suitable if the volume-weighted average dioxin concentration for all material taken to Port Gardner is below 4 ng/kg TEQ. For example, DMMU BS1-C had a dioxin concentration of 5.29 ng/kg TEQ, which exceeds the disposal site management objective of 4 ng/kg TEQ. Under the DMMP dioxin guidelines, it must be dredged and disposed with cleaner material such that the entire volume disposed has a

volume-weighted average under 4 ng/kg TEQ.

c. The volume splits for those DMMUs that had an individual core section analyzed for dioxin are to be considered rough estimates. These estimates were made for reporting purposes only and are subject to change. The supplemental suitability determination/s will include volumes calculated based on the actual dredge design.

Any dredging proposed for Subarea B must meet the following requirements:

a. The dioxin concentration of each individual DMMU taken to the Rosario Strait site must be at or below 4 ng/kg TEQ without volume-weighted averaging.
b. The volume-weighted average dioxin concentration for dredged material taken to the Port Gardner site must be at or below 4 ng/kg TEQ.
c. One-foot vertical buffers between suitable and unsuitable material and between material suitable for dispersive disposal and material suitable for nondispersive disposal must be incorporated in the dredging design at the discretion of the DMMP agencies.
d. Where possible, dredged material taken to the Port Gardner site must be sequenced, with material with the highest dioxin concentrations disposed first and dredged material with the lowest dioxin concentrations last.
e. The State of Washington's antidegradation standard must be met. This may mean leaving a one-foot vertical buffer of suitable material in place over sediment that does not meet the standard, or placing a one-foot clean sand cover following dredging.
f. Side slopes of the dredge design may not cut into unsuitable material or material that does not meet the antidegradation standard, unless the area of exposed surface is determined to be insignificant by the DMMP agencies.

9. References.

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10. Agency Signatures.

The signed copy is on file in the Dredged Material Managment Office.

Concur:

Date	David Fox, P.E. - Seattle District Corps of Engineers
Date	Justine Barton - Environmental Protection Agency
Date	Laura Inouye, Ph.D. - Washington Department of Ecology
Date	Celia Barton - Washington Department of Natural Resources

Copies furnished:

DMMP signatories
Kym Anderson, CENWS-ODS-NS
Elizabeth Chien, CENWS-ODS-NS
John Pell, CENWS-ODS-NS
Randel Perry, CENWS-ODR
Mike Hogan, Port of Bellingham
Gary White, Bellingham Cold Storage

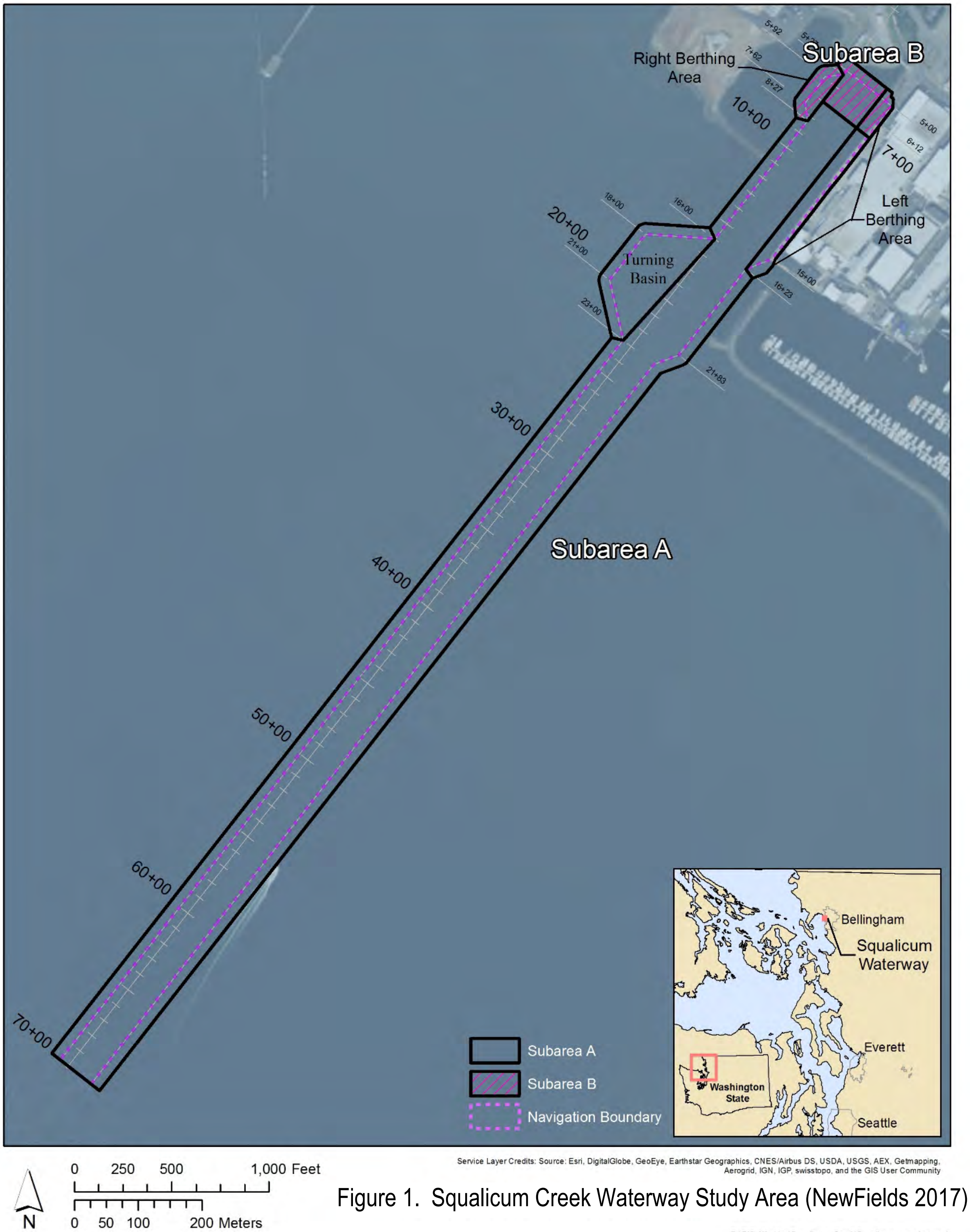
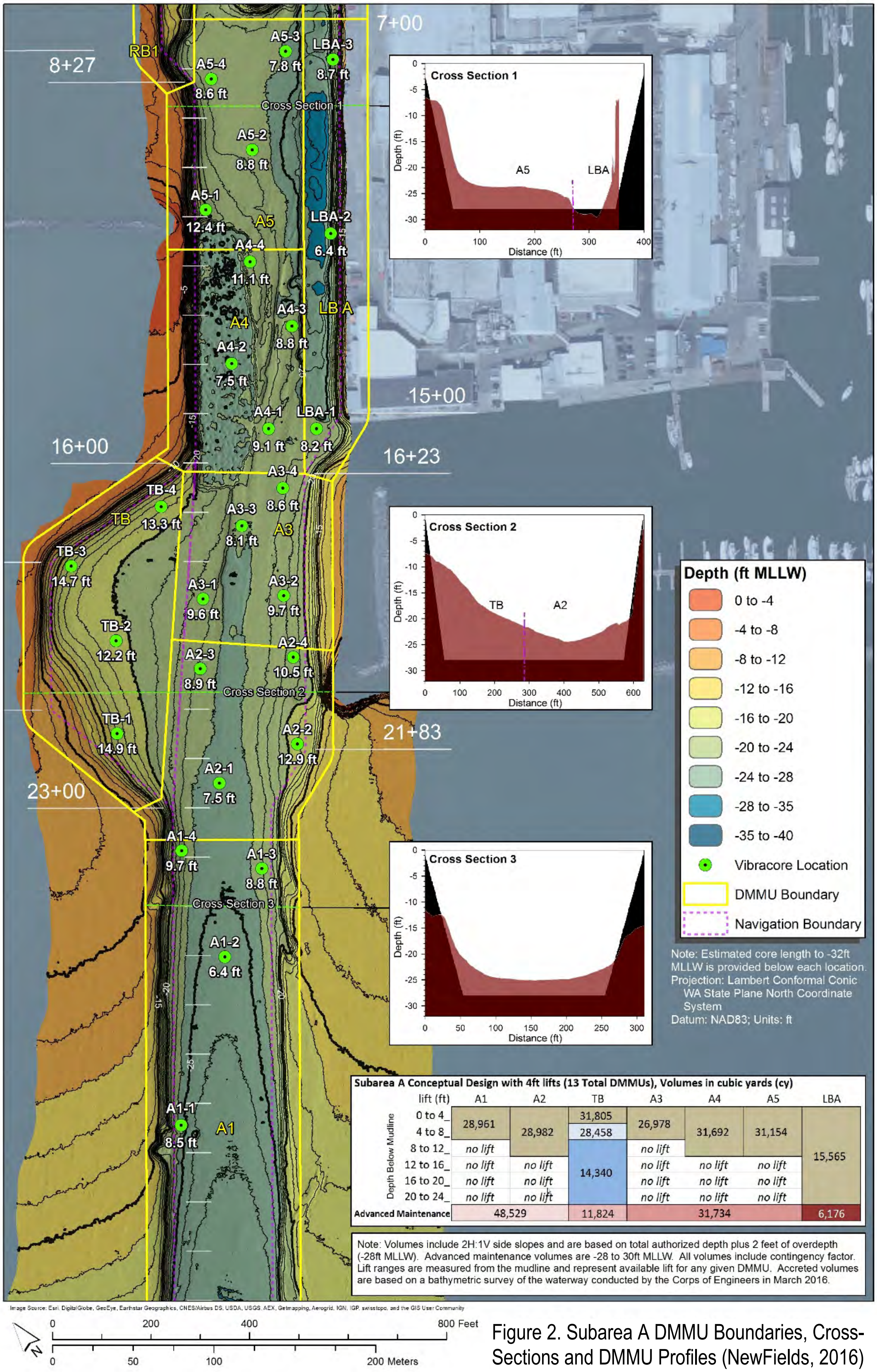


Figure 1. Squalicum Creek Waterway Study Area (NewFields 2017)

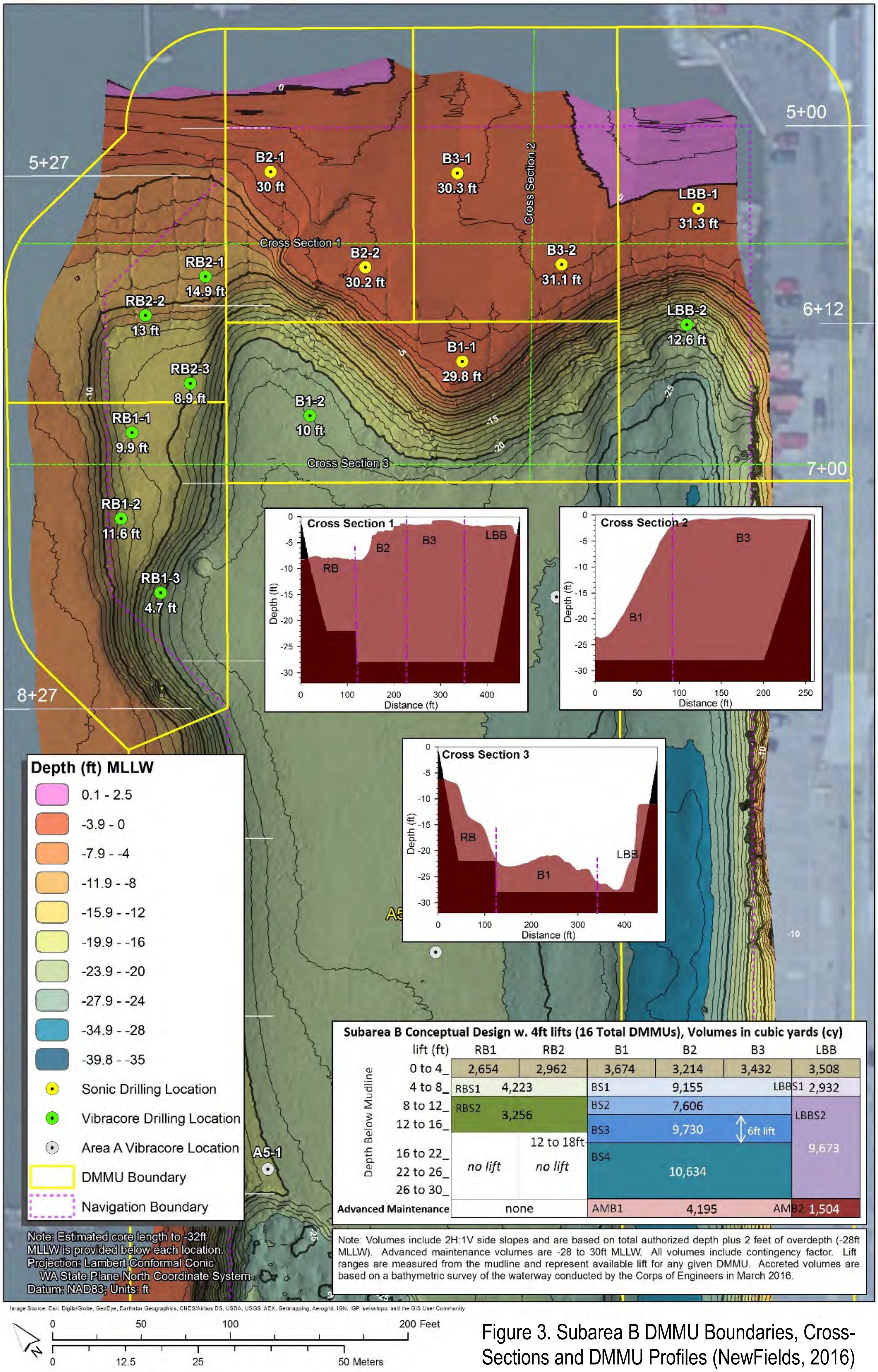


Subarea A Conceptual Design with 4ft lifts (13 Total DMMUs), Volumes in cubic yards (cy)

Depth Below Mudline, lift (ft)	A1	A2	TB	A3	A4	A5	LBA
0 to 4_	28,961	28,982	31,805	26,978	31,692	31,154	15,565
4 to 8_			28,458				
8 to 12_	*no lift*		14,340	*no lift*			
12 to 16_	*no lift*	*no lift*		*no lift*	*no lift*	*no lift*	
16 to 20_	*no lift*	*no lift*		*no lift*	*no lift*	*no lift*	
20 to 24_	*no lift*	*no lift*		*no lift*	*no lift*	*no lift*	
Advanced Maintenance	48,529		11,824	31,734			6,176

Note: Volumes include 2H:1V side slopes and are based on total authorized depth plus 2 feet of overdepth (-28ft MLLW). Advanced maintenance volumes are -28 to 30ft MLLW. All volumes include contingency factor. Lift ranges are measured from the mudline and represent available lift for any given DMMU. Accreted volumes are based on a bathymetric survey of the waterway conducted by the Corps of Engineers in March 2016.

Figure 2. Subarea A DMMU Boundaries, Cross-Sections and DMMU Profiles (NewFields, 2016)



Subarea B Conceptual Design w. 4ft lifts (16 Total DMMUs), Volumes in cubic yards (cy)

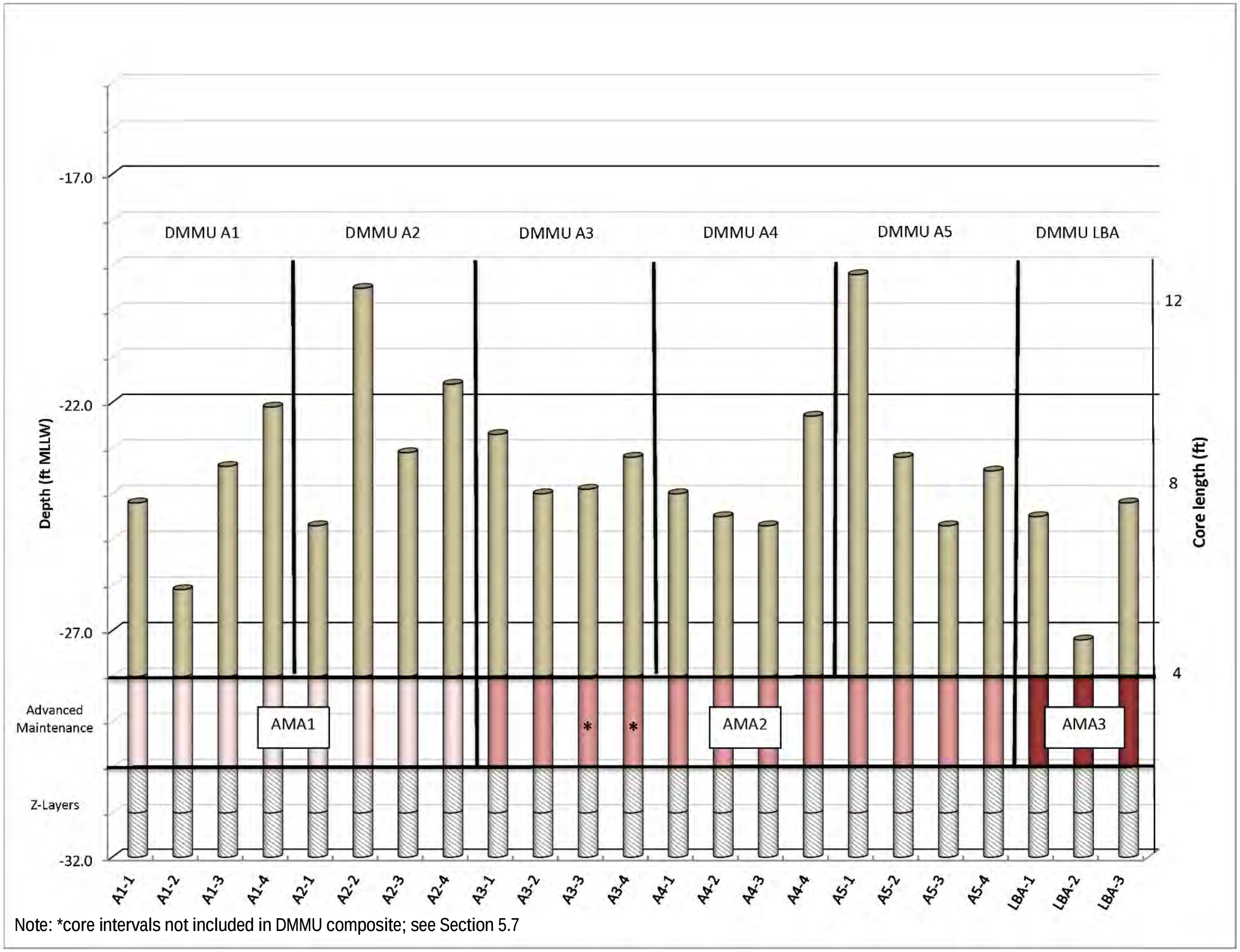
Depth Below Mudline – lift (ft)	RB1	RB2	B1	B2	B3	LBB
0 to 4	2,654	2,962	3,674	3,214	3,432	3,508
4 to 8	RBS1 4,223		BS1 9,155			LBBS1 2,932
8 to 12	RBS2 3,256		BS2 7,606			LBBS2 9,673
12 to 16			BS3 9,730 (6ft lift)			
16 to 22	no lift	no lift (12 to 18ft)	BS4 10,634			
22 to 26						
26 to 30						
Advanced Maintenance	none		AMB1 4,195			AMB2 1,504

Note: Volumes include 2H:1V side slopes and are based on total authorized depth plus 2 feet of overdepth (-28ft MLLW). Advanced maintenance volumes are -28 to 30ft MLLW. All volumes include contingency factor. Lift ranges are measured from the mudline and represent available lift for any given DMMU. Accreted volumes are based on a bathymetric survey of the waterway conducted by the Corps of Engineers in March 2016.

Image Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 3. Subarea B DMMU Boundaries, Cross-Sections and DMMU Profiles (NewFields, 2016)

Figure 4. Subarea A (Main Channel): Core Profiles and Compositing Scheme (NewFields, 2017)



Note: *core intervals not included in DMMU composite; see Section 5.7

Figure 5. Subarea A (Turning Basin): Core Profiles and Compositing Scheme (NewFields, 2017)

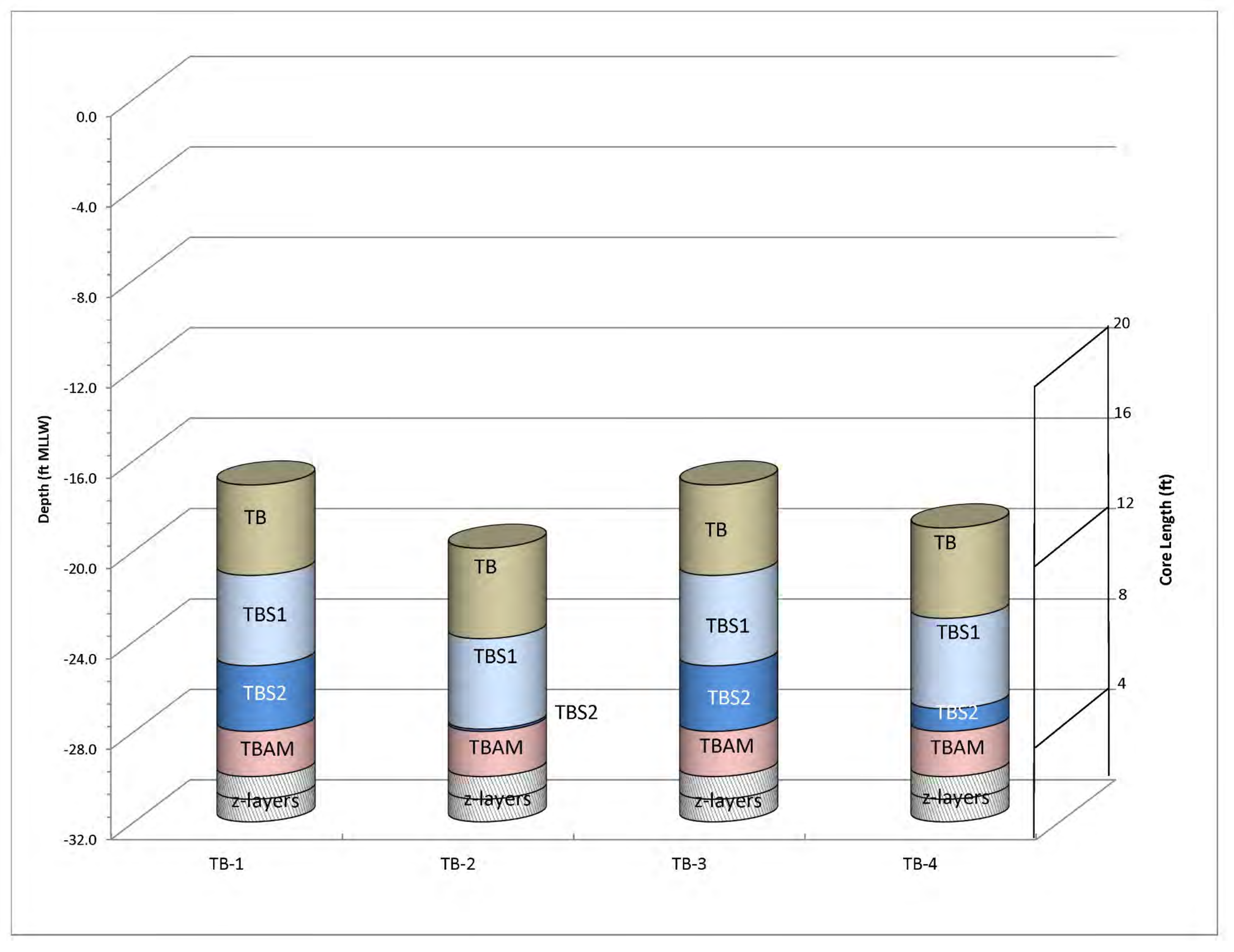
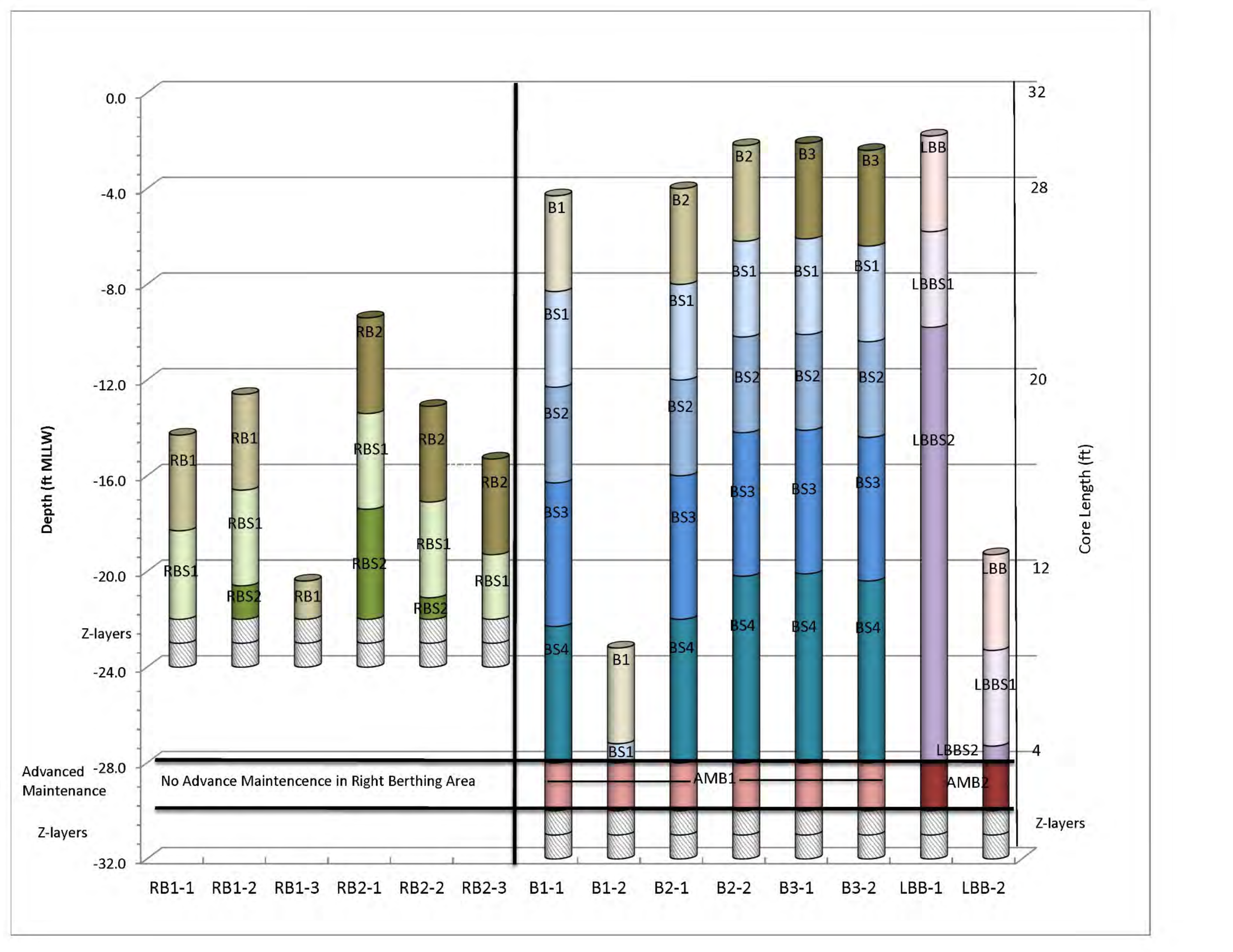
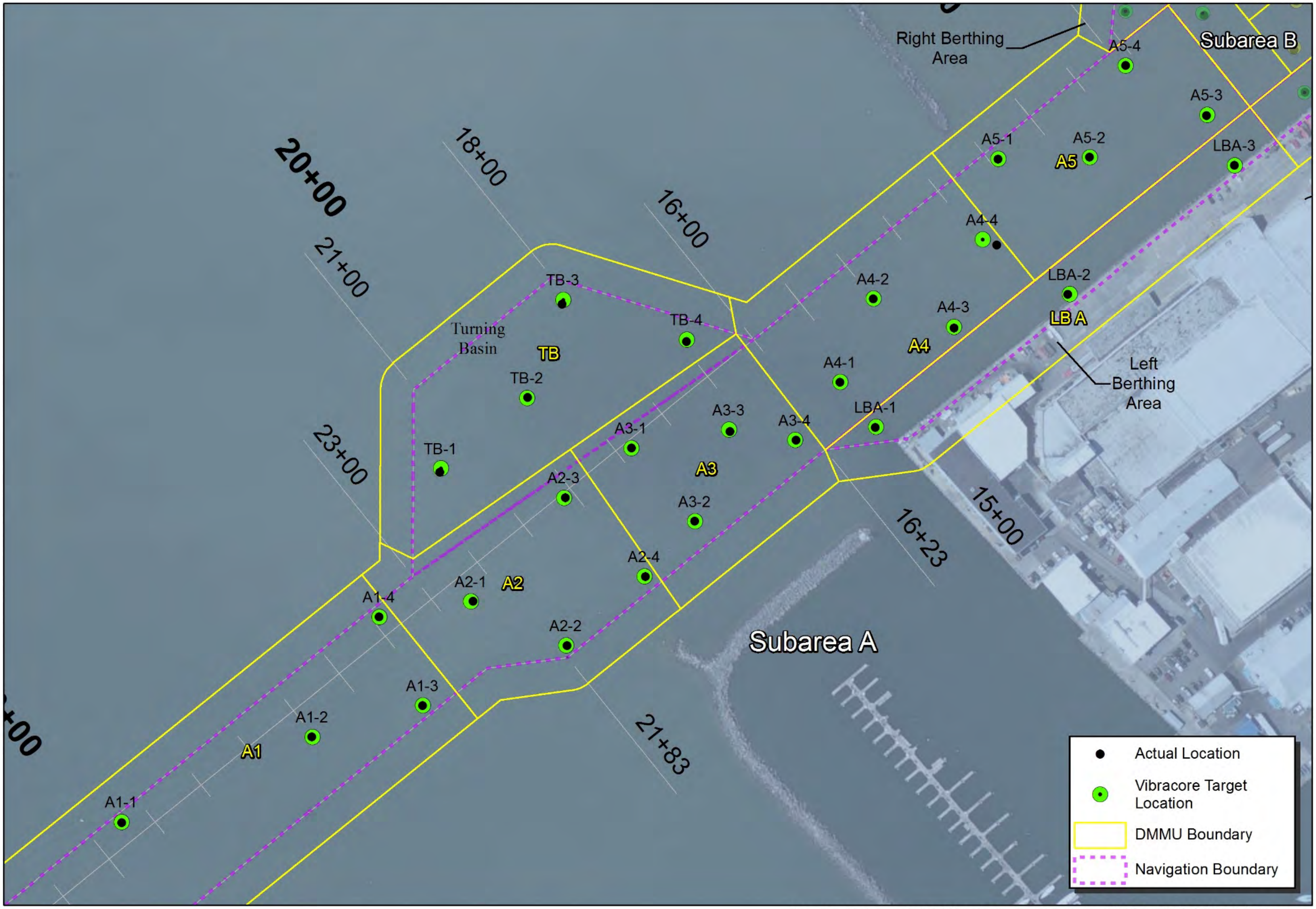


Figure 6. Subarea B: Core Profiles and Compositing Scheme (NewFields, 2017)





Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

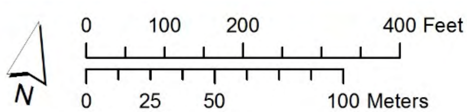


Figure 7. Squalicum Creek Waterway Target and Actual Sample Locations, Subarea A

D:\GIS_Working\Squalicum_Creek\Squalicum_Actual_Sample_AreaA.mxd

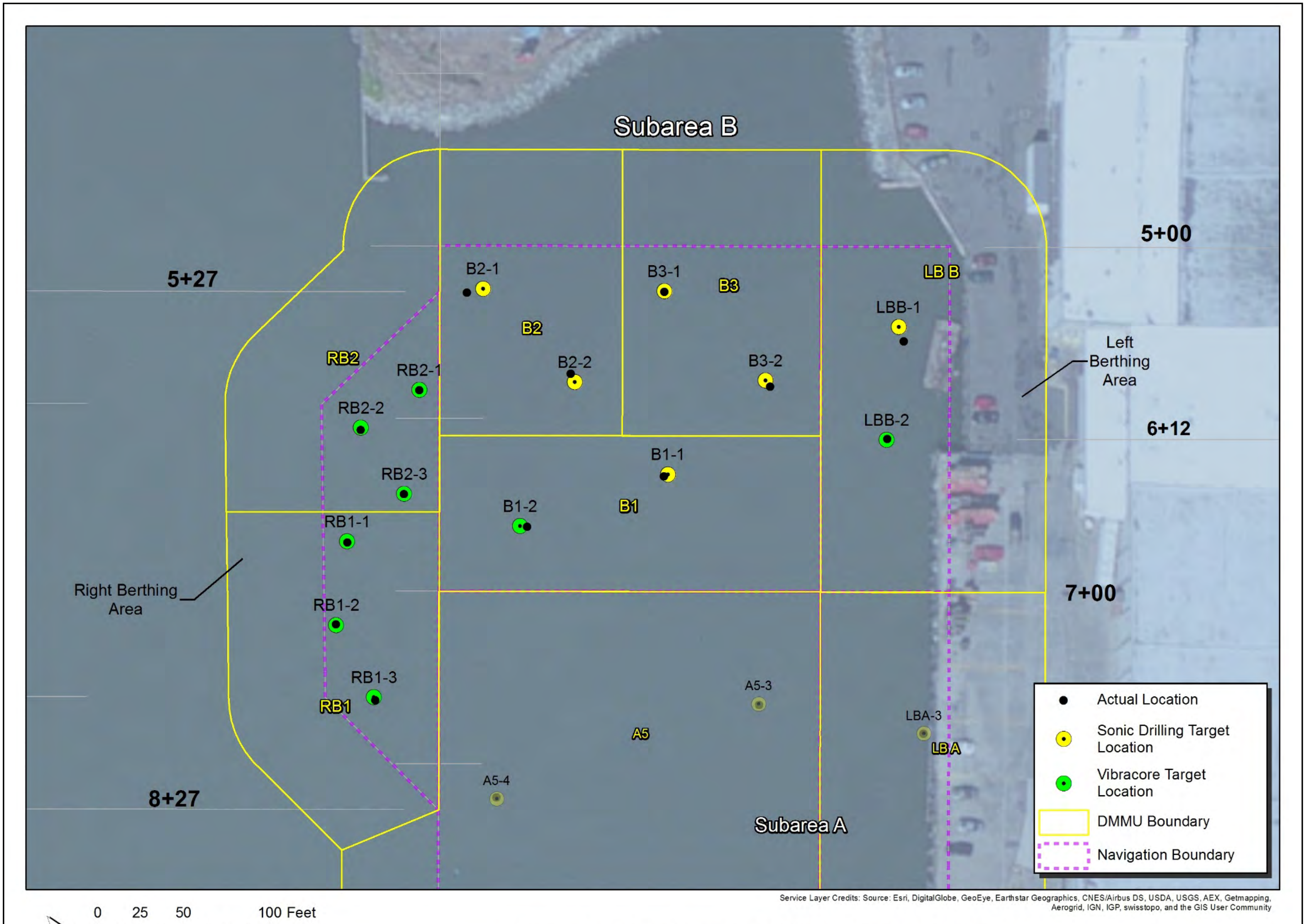


Figure 8. Squalicum Creek Waterway Target and Actual Sample Locations, Subarea B

D:\GIS_Working\Squalicum_Creek\Squalicum_Actual_Sample_AreaB.mxd

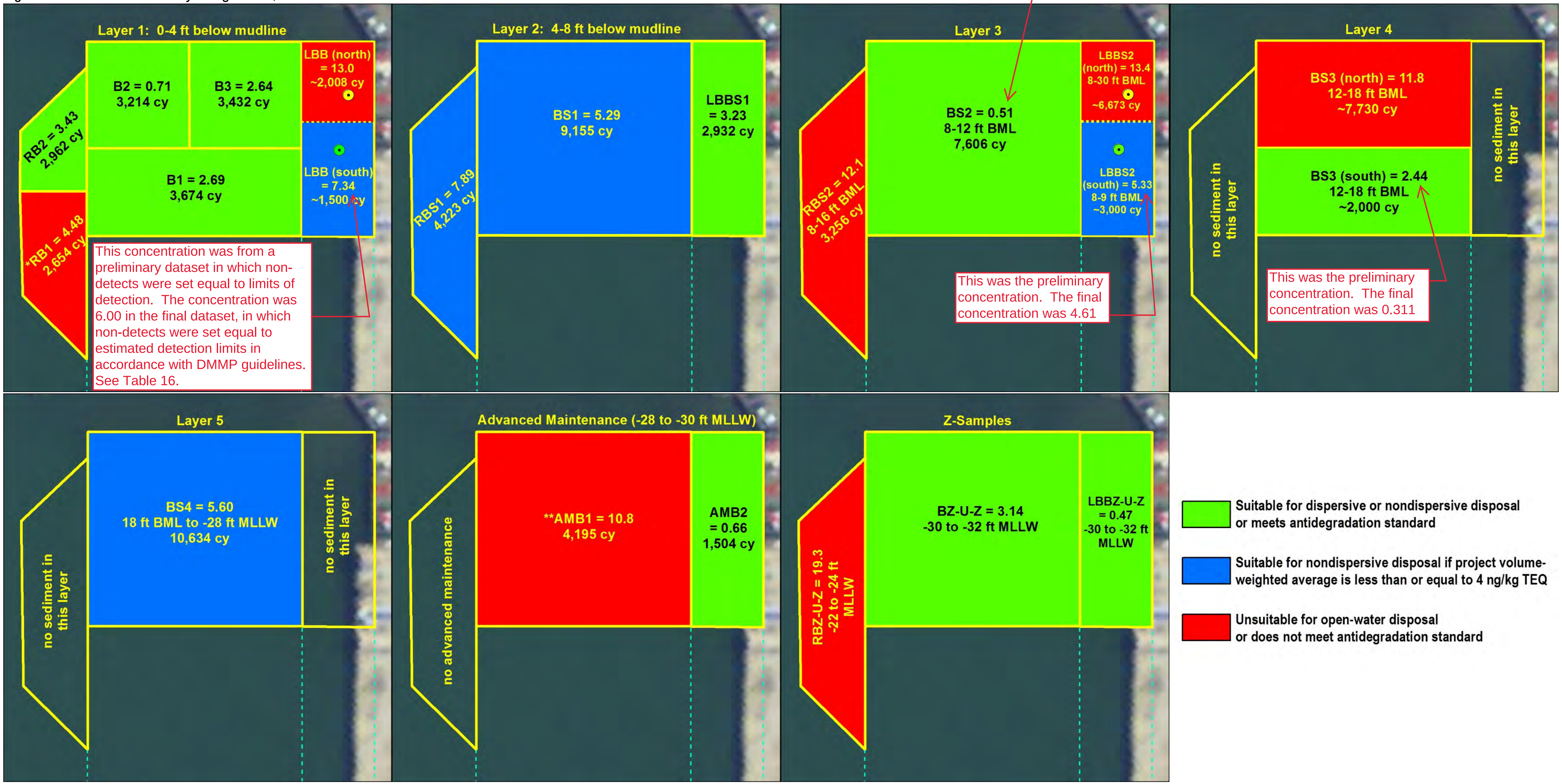
Figure 9 – Subarea B Dioxin Concentrations

Note: all dioxin concentrations in ng/kg toxic equivalents

BML = below mudline
MLLW = mean lower low water

This concentration was a typographic error. It should have been 0.54 (rounded from 0.537). See Table 15.

Figure 10 – Subarea B Suitability Designations, Volumes and Dioxin Concentrations



Note: all dioxin concentrations in ng/kg toxic equivalents
BML = below mudline
MLLW = mean lower low water
TEQ – toxic equivalents

*DMMU RB1 exceeded the SL for 4-methylphenol but was not subjected to toxicity testing. It is therefore unsuitable for open-water disposal.
**In addition to the dioxin concentration exceeding 10 ng/kg TEQ, DMMU AMB1 exceeded the SL for several PAHs.

Table 1. Summary of Past Sediment Characterizations of Squalicum Creek Waterway

Characterization Event	Dredge Material Volume	Results	Suitability Determination	Outcome
1990-91 USACE Characterization	194,214 cy	DDT and PCBs exceeded SL/BT at the head of the waterway	164,912 cy suitable for open-water disposal; 29,302 not suitable for open-water disposal	Material determined suitable for open-water disposal was dredged in 1992; the unsuitable material was left in place.
1994-95 USACE Characterization	258,000 cy	No BTs exceeded; SL exceedances passed biological testing	258,000 cy suitable for open-water disposal	The majority of the material was dredged in 1995; remaining material dredged in 1998. Dredging appears to have occurred from Station 5+40 to the outer channel.
2000 USACE Characterization	171,888 cy	2,4-dimethylphenol exceeded SL and lead exceeded ML in right berthing area; no biological testing was conducted	All material suitable for open-water disposal except one DMMU in the right berthing area	The waterway was dredged in 2004, except for the unsuitable DMMU, and the overlying DMMU which were left in place. Dredging appears to have occurred from Station 6+12 to the outer channel.
2010 Bellingham Cold Storage Characterization	6,600 cy	No SLs exceeded; TBT< BT; Volume-weighted dioxin 6.3 ng/kg TEQ	Suitable for disposal at Elliott Bay open-water disposal site	The material was dredged and disposed of at the Elliott Bay disposal site in 2012. Dredging appears to have occurred from Station 6+12 to Station 15+00.
2011 USACE Dioxin Characterization	NA	Dioxin concentrations ranged from 2.0 to 5.1 ng/kg TEQ	NA	Sediment characterization was for planning purposes only; no dredging was performed
2015 Bellingham Cold Storage Characterization	14,200 cy	Benzyl alcohol exceeded SL	DMMP agencies determined material suitable for open-water disposal without requiring bioassays	Material was dredged and disposed at Rosario Strait dispersive disposal site in 2016.

cy: yards
NA: not applicable
DMMU: dredged material management unit

USACE: U.S. Army Corps of Engineers
DMMP: Dredged Material Management Program

SL: screening level
BT: bioaccumulation trigger
ML: maximum level

DDT: dichlorodiphenyltrichloroethane
PCBs: polychlorinated biphenyls
TBT: tributyltin
TEQ: toxic equivalents
ng/kg: nanograms per kilogram

Table 3. Subarea A: Contingency Factors and DMMU Volumes (NewFields, 2016)

DMMU	Contingency Factors (%)	Design Depth + Allowable Overdepth Volume (cy)	Advanced Maintenance Volume (cy)	Total Estimated Volume Including Overdepth and Advanced Maintenance (cy)
A1	40	28,961	-	28,961
A2	40	28,982	-	28,982
A3	40	26,978	-	26,978
A4	40	31,692	-	31,692
A5	40	31,154	-	31,154
TB	40	31,805	-	31,805
TBS1	40	28,458	-	28,458
TBS2	40	14,340	-	14,340
LBA	40	15,565	-	15,565
AMA1	25	-	48,529	48,529
AMA2	25	-	31,734	31,734
AMA3	15	-	6,176	6,176
TBAM	0	-	11,824	11,824
Totals		**237,936**	**98,263**	**336,199**

Table 4. Subarea B: Contingency Factors and DMMU Volumes (NewFields, 2016)

DMMU	Contingency Factors (%)	Design Depth + Allowable Overdepth Volume (cy)	Advanced Maintenance Volume (cy)	Total Estimated Volume Including Overdepth and Advanced Maintenance (cy)
RB1	25	2,654	-	2,654
RB2	25	2,962	-	2,962
RBS1	25	4,223	-	4,223
RBS2	25	3,256	-	3,256
B1	25	3,674	-	3,674
B2	25	3,214	-	3,214
B3	25	3,432	-	3,432
BS1	25	9,155	-	9,155
BS2	25	7,606	-	7,606
BS3	25	9,730	-	9,730
BS4	25	10,634	-	10,634
LBB	25	3,508	-	3,508
LBBS1	25	2,932	-	2,932
LBBS2	25	9,673	-	9,673
AMB1	0	-	4,195	6,887
AMB2	0	-	1,504	1,504
Totals		**76,653**	**5,699**	**82,352**

Table 5. Sampling Coordinates, Mudline Elevations, Penetration and Recovery for Subarea A

Surface DMMU	Subsurface DMMUs and Z-samples	Location Name	Date	State Plane WA-N, NAD83		Latitude (N) NAD83	Longtitude (W) NAD 83	Core Penetration (ft)	Core Recovery (ft)	Recovery (%)	Water Depth (ft)	Tidal Height (ft MLLW)	Mudline (ft MLLW)
				Northing	Easting								
Subarea A													
A1	AMA1, A1Z-U, A1Z-L	A1-1	12/1/2016	644698.6	1234498.3	48.755170	122.516101	9.5	7.9	83	30.5	6.3	-24.2
		A1-2	12/1/2016	644912.4	1234778.8	48.755773	122.514958	7.8	6.8	87	32.6	6.5	-26.1
		A1-3	12/1/2016	645006.7	1234949.2	48.756041	122.514260	10.0	9.7	97	30.1	6.7	-23.4
		A1-4	12/1/2016	645135.8	1234843.6	48.756389	122.514710	11.1	8.6	78	29.1	7.0	-22.1
A2		A2-1	12/30/2016	645197.6	1234992.5	48.756567	122.514098	8.0	6.2	78	31.0	6.3	-24.7
		A2-2	12/30/2016	645160.5	1235164.9	48.756476	122.513380	13.0	12.8	99	28.4	8.9	-19.5
		A2-3	12/30/2016	645403.7	1235104.9	48.757139	122.513651	9.9	7.7	78	29.5	6.4	-23.1
		A2-4	12/30/2016	645304.3	1235267.0	48.756876	122.512970	11.0	9.8	89	28.2	6.6	-21.6
A3	AMA2, A2Z-U, A2Z-L	A3-1	12/1/2016	645510.7	1235195.1	48.757437	122.513287	10.0	8.6	86	30.0	7.3	-22.7
		A3-2	12/2/2016	645414.5	1235327.5	48.757182	122.512729	9.4	8.0	85	31.5	7.5	-24.0
		A3-3	12/30/2016	645575.5	1235350.9	48.757624	122.512647	9.0	7.5	83	30.7	6.8	-23.9
		A3-4	12/30/2016	645586.4	1235463.0	48.757661	122.512183	9.0	7.5	83	30.2	7.0	-23.2
A4		A4-1	12/1/2016	645698.9	1235513.7	48.757972	122.511983	9.2	7.5	82	30.5	6.5	-24.0
		A4-2	11/30/2016	645848.7	1235536.5	48.758384	122.511902	7.5	6.1	81	32.3	7.8	-24.5
		A4-3	11/30/2016	645832.2	1235680.6	48.758347	122.511304	7.5	6.6	88	31.0	6.3	-24.7
		A4-4	12/1/2016	645985.1	1235719.0	48.758769	122.511158	11.1	10.2	92	29.5	7.2	-22.3
A5		A5-1	11/29/2016	646126.4	1235688.1	48.759154	122.511299	12.8	10.0	78	27.2	8.0	-19.2
		A5-2	11/29/2016	646164.9	1235838.6	48.759269	122.510679	9.7	7.2	75	30.2	7.0	-23.2
		A5-3	11/29/2016	646278.5	1236015.4	48.759590	122.509956	7.3	5.9	81	31.0	6.3	-24.7
		A5-4	11/29/2016	646329.8	1235862.4	48.759722	122.510595	8.5	6.8	80	30.1	6.6	-23.5
LBA	AMA3, LBAZ-U, LBAZ-L	LBA-1	11/29/2016	645637.8	1235589.1	48.757809	122.511665	7.5	6.0	80	30.6	6.1	-24.5
		LBA-2	11/29/2016	645931.0	1235855.2	48.758629	122.510589	5.0	4.1	82	33.4	6.2	-27.2
		LBA-3	11/29/2016	646206.9	1236080.4	48.759398	122.509681	8.0	7.3	91	31.4	7.3	-24.2
TB	TBS1, TBS2, TBAM, TBZ-U, TBZ-L	TB-1	12/30/2016	645397.2	1234888.7	48.757108	122.514546	15.4	13.0	84	25.3	8.2	-17.1
		TB-2	12/30/2016	645554.3	1235004.8	48.757545	122.514079	13.0	11.4	88	26.4	6.5	-19.9
		TB-3	12/30/2016	645720.7	1235025.9	48.758003	122.514007	15.4	14.3	93	24.6	7.5	-17.1
		TB-4	12/30/2016	645707.0	1235244.8	48.757978	122.513099	14.1	11.7	83	25.8	6.8	-19.0

Table 6. Sampling Coordinates, Mudline Elevations, Penetration and Recovery for Subarea B

Surface DMMU	Subsurface DMMUs and Z-samples	Location Name	Date	State Plane WA-N, NAD83		Latitude (N) NAD83	Longtitude (W) NAD 83	Core Penetration (ft)	Core Recovery (ft)	Recovery (%)	Water Depth (ft)	Tidal Height (ft MLLW)	Mudline (ft MLLW)
				Northing	Easting								
Subarea B													
B1	BS1, BS2, BS3, BS4, AMB1, BZ-U, BZ-L	B1-1	12/1/2016	646416.8	1236053.3	48.759972	122.509812	28.0	*	*	11.2	6.9	-4.3
		B1-2	11/30/2016	646442.6	1235972.8	48.760038	122.510148	9.7	7.5	77	29.5	6.3	-23.2
B2		B2-1	12/2/2016	646571.1	1236028.6	48.760393	122.509928	28.0	*	*	12.4	8.4	-4.0
		B2-2	12/2/2016	646497.1	1236047.1	48.760191	122.509845	32.0	*	*	10.4	8.2	-2.2
B3		B3-1	12/1/2016	646501.2	1236119.2	48.760207	122.509546	30.0	*	*	10.5	8.4	-2.1
		B3-2	12/1/2016	646420.0	1236133.8	48.759985	122.509478	32.0	*	*	9.0	6.6	-2.4
LBB	LBBS1, LBBS2, AMB2, LBBZ-U, LBBZ-L	LBB-1	11/30/2016	646393.2	1236211.1	48.759916	122.509156	32.0	*	*	8.6	6.8	-1.8
		LBB-2	12/1/2016	646354.5	1236168.6	48.759808	122.509328	13.0	10.0	77	27.9	8.6	-19.3
RB1	RBS1, RBS2, RBZ-U, RBZ-L	RB1-1	11/30/2016	646499.5	1235884.9	48.760188	122.510517	10.1	8.7	86	21.3	7.0	-14.3
		RB1-2	11/30/2016	646466.1	1235850.6	48.760094	122.510657	11.6	11.1	96	19.9	7.3	-12.6
		RB1-3	11/30/2016	646417.4	1235841.6	48.759961	122.510689	3.6	2.8	78	28.0	7.6	-20.4
RB2		RB2-1	12/2/2016	646543.3	1235972.1	48.760313	122.510160	15.3	11.8	77	16.7	7.3	-9.4
		RB2-2	12/2/2016	646546.2	1235931.2	48.760319	122.510330	13.1	9.9	76	19.4	6.3	-13.1
		RB2-3	12/2/2016	646501.4	1235928.2	48.760196	122.510338	9.5	8.1	85	23.4	8.1	-15.3

** This core was collected in discrete segments by sonic drilling. Recovery data for individual segments can be found in the core logs in Appendix B of NewFields (2017).*

Table 7. Core Compositing Scheme for DMMUs A1, A2, A3, A4, A5, LBA, AMA1, AMA2, and AMA3

DMMU	Station ID	Mudline Depth MLLW (ft.)	Surface DMMU MLLW (ft.)		Advanced Maintenance MLLW (ft.)		Z-Layer Upper MLLW (ft.)		Z-Layer Lower MLLW (ft.)	
			Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
					AMA1					
A1	A1-1	-24.2	-24.2	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	A1-2	-26.1	-26.1	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	A1-3	-23.4	-23.4	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	A1-4	-22.1	-22.1	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
A2	A2-1	-24.7	-24.7	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	A2-2	-19.5	-19.5	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	A2-3	-23.1	-23.1	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	A2-4	-21.6	-21.6	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
					AMA2					
A3	A3-1	-22.7	-22.7	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	A3-2	-24.0	-24.0	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	A3-3	-23.9	-23.9	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	A3-4	-23.2	-23.2	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
A4	A4-1	-24.0	-24.0	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	A4-2	-24.5	-24.5	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	A4-3	-24.7	-24.7	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	A4-4	-22.3	-22.3	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
A5	A5-1	-19.2	-19.2	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	A5-2	-23.2	-23.2	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	A5-3	-24.7	-24.7	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	A5-4	-23.5	-23.5	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
					AMA3					
LBA	LBA-1	-24.5	-24.5	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	LBA-2	-27.2	-27.2	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	LBA-3	-24.2	-24.2	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0

Table 8. Core Compositing Scheme for DMMUs TB, TBS1, TBS2, and TBAM

DMMU	Station ID	Mudline Depth MLLW (ft.)	Surface DMMU MLLW (ft.)		Subsurface DMMU TBS1 MLLW (ft.)		Subsurface DMMU TBS2 MLLW (ft.)		TBAM MLLW (ft.)		Z-Layer Upper MLLW (ft.)		Z-Layer Lower MLLW (ft.)	
			Top	**Bottom**	**Top**	**Bottom**	**Top**	**Bottom**	**Top**	**Bottom**	**Top**	**Bottom**	**Top**	**Bottom**
TB	TB-1	-17.1	-17.1	-21.1	-21.1	-25.1	-25.1	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	TB-2	-19.9	-19.9	-23.9	-23.9	-27.9	-27.9	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	TB-3	-17.1	-17.1	-21.1	-21.1	-25.1	-25.1	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	TB-4	-19.0	-19.0	-23.0	-23.0	-27.0	-27.0	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0

Table 9. Core Compositing Scheme for DMMUs B1, B2, B3, BS1, BS2, BS3, BS4, and AMB1

DMMU	Station ID	Mudline Depth MLLW (ft.)	Surface DMMU MLLW (ft.)		Subsurface DMMU BS1 MLLW (ft.)		Subsurface DMMU BS2 MLLW (ft.)		Subsurface DMMU BS3 MLLW (ft.)		Subsurface DMMU BS4 MLLW (ft.)		AMB1 MLLW (ft.)		Z-Layer Upper MLLW (ft.)		Z-Layer Lower MLLW (ft.)	
			Top	**Bottom**	**Top**	**Bottom**	**Top**	**Bottom**	**Top**	**Bottom**	**Top**	**Bottom**	**Top**	**Bottom**	**Top**	**Bottom**	**Top**	**Bottom**
B1	B1-1	-4.3	-4.3	-8.3	-8.3	-12.3	-12.3	-16.3	-16.3	-22.3	-22.3	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	B1-2	-23.2	-23.2	-27.2	-27.2	-28.0	*no sample interval*						-28.0	-30.0	-30.0	-31.0	-31.0	-30.0
B2	B2-1	-4.0	-4.0	-8.0	-8.0	-12.0	-12.0	-16.0	-16.0	-22.0	-22.0	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	B2-2	-2.2	-2.2	-6.2	-6.2	-10.2	-10.2	-14.2	-14.2	-20.2	-20.2	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
B3	B3-1	-2.1	-2.1	-6.1	-6.1	-10.1	-10.1	-14.1	-14.1	-20.1	-20.1	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	B3-2	-2.4	-2.4	-6.4	-6.4	-10.4	-10.4	-14.4	-14.4	-20.4	-20.4	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0

Table 10. Core Compositing Scheme for DMMUs RB1, RB2, RBS1, and RBS2

DMMU	Station ID	Mudline Depth MLLW (ft.)	Surface DMMU MLLW (ft.)		Subsurface DMMU RBS1 MLLW (ft.)		Subsurface DMMU RBS2 MLLW (ft.)		Z-Layer Upper MLLW (ft.)		Z-Layer Lower MLLW (ft.)	
			Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
RB1	RB1-1	-14.3	-14.3	-18.3	-18.3	-22.0	*no sample interval*		-22.0	-23.0	-23.0	-24.0
	RB1-2	-12.6	-12.6	-16.6	-16.6	-20.6	-20.6	-22.0	-22.0	-23.0	-23.0	-24.0
	RB1-3	-20.4	-20.4	-22.0	*no sample interval*				-22.0	-23.0	-23.0	-23.0
RB2	RB2-1	-9.4	-9.4	-13.4	-13.4	-17.4	-17.4	-22.0	-22.0	-23.0	-23.0	-24.0
	RB2-2	-13.1	-13.1	-17.1	-17.1	-21.1	-21.1	-22.0	-22.0	-23.0	-23.0	-24.0
	RB2-3	-15.3	-15.3	-19.3	-19.3	-22.0	*no sample interval*		-22.0	-23.0	-23.0	-24.0

Table 11. Core Compositing Scheme for DMMUs LBB, LBBS1, LBBS2, and AMB2

DMMU	Station ID	Mudline Depth (ft. MLLW)	Surface DMMU		Subsurface DMMU LBBS1		Subsurface DMMU LBBS2		AMB2 -28 to -30 MLLW		Z-Layer Upper -30 to -31 ft. MLLW		Z-Layer Lower -31 to -32 ft. MLLW	
			Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
LBB	LBB-1	-1.8	-1.8	-5.8	-5.8	-9.8	-9.8	-28.0	-28.0	-30.0	-30.0	-31.0	-31.0	-32.0
	LBB-2	-19.3	-19.3	-23.3	-23.3	-27.8[1]	-27.8[2]	-28.5[3]	-28.5[4]	-30.0	-30.0	-31.0	-31.0	-32.0

Notes

1: The bottom of this interval should have been -27.3 ft. MLLW; see Section 2.7 for discussion.

2: The top of this interval should have been -27.3 ft. MLLW; see Section 2.7 for discussion.

3: The bottom of this interval should have been -28.0 ft. MLLW; see Section 2.7 for discussion.

4: The top of this interval should have been -28.0 ft. MLLW; see Section 2.7 for discussion.

Table 12. Subarea A Chemistry and Conventionals Results

	SL	ML	BT	A1-C 12/1/16	LQ	VQ	A2-C 12/30/16	LQ	VQ	A3-C 12/30/16	LQ	VQ	A4-C 12/1/16	LQ	VQ	A5-C 11/29/16	LQ	VQ	AMA1-C 12/30/16	LQ	VQ	AMA2-C 11/29/16	LQ	VQ	AZ1-U-Z 12/30/16	LQ	VQ	AZ2-U-Z 11/29/16	LQ	VQ
Conventionals																														
Total Solids (%)	--	--	--	57.1			56.2			55.6			59.6			55.1			57.7			57			55.2			57		
Total Organic Carbon (%)	--	--	--	2.24			2.06			1.96			2.19			2.55			1.86			2.22			1.98			2.16		
Sulfides (mg/kg)	--	--	--	1100			1210			1090			640			830			1340			1030			--			--		
Ammonia (mg/kg)	--	--	--	34.1			39.7			41.4			39.6			46.3			70.8			90.6			--			--		
Total Volatile Solids (%)	--	--	--	6.4	*		5.7			5.6			6.2	*		6.7			5.2			6.4	*		5.9			6.3	*	
Grain Size (%)																														
Gravel	--	--	--	0			0			0			0.33			0			0			0			0			0		
Sand	--	--	--	0.9			0.2			0.46			1.05			3.13			0.4			2.47			0.72			3		
Silt	--	--	--	81.18			72.21			80.56			83.05			82.23			75.89			81.05			73.57			78.32		
Clay	--	--	--	18.26			22.3			17.54			14.9			14.68			20.26			17.28			22.81			18.29		
Percent Fines[a]	--	--	--	99.44			94.51			98.1			97.95			96.91			96.15			98.33			96.38			96.61		
Metals (mg/kg)																														
Antimony	150	200	--	1.5	T		4.9	U		4.5	U		0.7	T		2.4	T	J	4.9	U		6.2	U		--			--		
Arsenic	57	700	507.1	10.1			9.7			9.1			7.5			12.6			9.3			8.4			--			--		
Cadmium	5.1	14	11.3	0.06	T		0.05	T		0.22	U		0.13	T		0.16	U		0.24	U		0.31	U		--			--		
Chromium	260	--	--	62.4			61.6			59.9			57.7			72.3		J	62.6			62.4			--			--		
Copper	390	1300	--	45.4			44.3			42.5			40.9			52.3		J	43.9			43.5			--			--		
Lead	450	1200	975	8.6			7.5			7.6			7.9			16.4		J	8			8.1			--			--		
Mercury	0.41	2.3	1.5	0.077			0.072			0.068			0.07			0.074			0.069			0.075			--			--		
Selenium	--	--	3	0.54			0.48			0.46			0.47			0.45			0.45			0.5			--			--		
Silver	6.1	8.4	--	1.3	U		0.97	U		0.9	U		1.3	U		0.5	T	J	0.97	U		1.2	U		--			--		
Zinc	410	3800	--	82.8			82.7			79.2			79.4			105		J	79.8			84.9			--			--		
Polycyclic Aromatic Hydrocarbons (ug/kg)																														
Naphthalene	2100	2400	--	4.7	T		4.5	T		5	T		6	T		5.4	T		5.3	T		9.3			--			--		
Acenaphthylene	560	1300	--	8.7	U		8.9	U		9	U		8.4	U		8.9	U		8.7	U		8.8	U		--			--		
Acenaphthene	500	2000	--	8.7	U		8.9	U		9	U		8.4	U		8.9	U		8.7	U		3.9	T		--			--		
Fluorene	540	3600	--	3.5	T		8.9	U		4.4	T		5.3	T		5.7	T		3.9	T		8	T		--			--		
Phenanthrene	1500	21000	--	13			12			15			19			19			15			25			--			--		
Anthracene	960	13000	--	8.7	U		8.9	U		4.6	T		4.6	T		6.4	T		8.7	U		6.5	T		--			--		
2-Methylnaphthalene	670	1900	--	8.1	T		7	T		8	T		9			7.9	T		8.3	T		13			--			--		
Total LPAH[b]	5200	29000	--	21.2			16.5			29			34.9			36.5			24.2			52.7			--			--		
Fluoranthene	1700	30000	4600	17			17			19			37			46			17			49			--			--		
Pyrene	2600	16000	11980	11			11			13			23			32			11			34			--			--		
Benzo(a)anthracene	1300	5100	--	4.5	T		4.9	T		8.8	T		9.9			15			4.8	T		15			--			--		
Chrysene	1400	21000	--	11			9.3			20			23			31			11			29			--			--		
Benzo(b)fluoranthene	--	--	--	9.6			9.5			12			20			30			10			29			--			--		
Benzo(k)fluoranthene	--	--	--	8.7	U		8.9	U		4.8	T		5.4	T		9.6			8.7	U		11			--			--		
Benzofluoranthene	3200	9900	--	9.6			9.5			16.8			25.4			39.6			10			40			--			--		
Benzo(a)pyrene	1600	3600	--	3.8	T		4.3	T		5.8	T		7.6	T		14			4.4	T		13			--			--		
Indeno(1,2,3-cd)pyrene	600	4400	--	3.8	T		4.3	T		5.5	T		7.9	T		15			4.4	T		13			--			--		
Dibenzo(a,h)anthracene	230	1900	--	8.7	U		8.9	U		9	U		8.4	U		3.6	T		8.7	U		3.2	T		--			--		
Benzo(ghi)perylene	670	3200	--	5	T		5.4	T		5.9	T		8.6			16			5.4	T		14			--			--		
Total HPAH[c]	12000	69000	--	65.7			65.7			94.8			142.4			212.2			68.0			210.2			--			--		
Phenols (ug/kg)																														
2,4-Dimethylphenol[g]	29	210	--	6.3	U		6.3	U	UJ	6.3	U		6.3	U		6.3	U		6.3	U		6.2	U		--			--		
2-Methylphenol	63	77	--	8.7	U		8.9	U		9	U		8.4	U		8.9	U		8.7	U		8.8	U		--			--		
4-Methylphenol	670	3600	--	8.5	T		7.4	T	J	44			35			27			5.7	T		6.8	T		--			--		
Pentachlorophenol	400	690	504	87	U		89	U		90	U		84	U		89	U		87	U		88	U		--			--		
Phenol	420	1200	--	110			77			52			140			110			56			100			--			--		
Phthalates (ug/kg)																														
Butylbenzylphthalate	63	970	--	5.1	T		4.6	T		6.3	T		6.1	T		6.3	T		5.8	T		8.8	U		--			--		
Di-N-Butylphthalate	1400	5100	--	8.6	T		11	T		8.1	T		8.5	T		9	T		7.9	T		8.2	T		--			--		
Di-N-Octyl Phthalate	6200	6200	--	8.7	U		8.9	U		9	U		8.4	U		8.9	U		8.7	U		8.8	U		--			--		

Table 12. Subarea A Chemistry and Conventionals Results (cont.)

				A1-C			A2-C			A3-C			A4-C			A5-C			AMA1-C			AMA2-C			AZ1-U-Z			AZ2-U-Z		
	SL	ML	BT	12/1/16	LQ	VQ	12/30/16	LQ	VQ	12/30/16	LQ	VQ	12/1/16	LQ	VQ	11/29/16	LQ	VQ	12/30/16	LQ	VQ	11/29/16	LQ	VQ	12/30/16	LQ	VQ	11/29/16	LQ	VQ
Diethylphthalate	200	1200	--	8.7	U		8.9	U		9	U		8.4	U		8.9	U		8.7	U		8.8	U		--			--		
Dimethylphthalate	71	1400	--	8.7	U		8.9	U		9	U		8.4	U		8.9	U		8.7	U		8.8	U		--			--		
Bis(2-Ethylhexyl) Phthalate	1300	8300	--	87	U		14	T		90	U		12	T		27	T		87	U		24	T		--			--		
Other Semi-Volatile Organic Compounds (ug/kg)																														
Dibenzofuran	540	1700	--	8.7	U		8.9	U		3.7	T		4.5	T		5.4	T		8.7	U		6.8	T		--			--		
Benzoic Acid	650	760	--	200	U	UJ	200	U	UJ	200	U	UJ	200	U	UJ	200	U	UJ	200	U	UJ	200	U	UJ	--			--		
Benzyl Alcohol	57	870	--	7.1	T		6	T		7.5	T		6.6	T		6.4	T		6.9	T		7.7	T		--			--		
1,2-Dichlorobenzene	35	110	--	8.7	U		8.9	U		9	U		8.4	U		8.9	U		8.7	U		8.8	U		--			--		
1,4-Dichlorobenzene	110	120	--	8.7	U		8.9	U		9	U		8.4	U		8.9	U		8.7	U		8.8	U		--			--		
Hexachlorobenzene	22	230	168	8.7	U		8.9	U		9	U		8.4	U		8.9	U		8.7	U		8.8	U		--			--		
Hexachlorobutadiene	11	270	--	8.7	U		8.9	U		9	U		8.4	U		8.9	U		8.7	U		8.8	U		--			--		
N-Nitrosodiphenylamine	28	130	--	8.7	U		8.9	U		9	U		8.4	U		8.9	U		8.7	U		8.8	U		--			--		
1,2,4-Trichlorobenzene	31	64	--	8.7	U		8.9	U		9	U		8.4	U		8.9	U		8.7	U		8.8	U		--			--		
Polychlorinated Biphenyl Aroclors (ug/kg)																														
PCB-aroclor 1016	--	--	--	8.7	U		8.9	U		9	U		8.4	U		8.8	U		8.6	U		8.8	U		--			--		
PCB-aroclor 1221	--	--	--	18	U		18	U		18	U		17	U		18	U		18	U		18	U		--			--		
PCB-aroclor 1232	--	--	--	8.7	U		8.9	U		9	U		8.4	U		8.8	U		8.6	U		8.8	U		--			--		
PCB-aroclor 1242	--	--	--	8.7	U		8.9	U		9	U		8.4	U		8.8	U		8.6	U		8.8	U		--			--		
PCB-aroclor 1248	--	--	--	8.7	U		8.9	U		9	U		8.4	U		8.8	U		8.6	U		8.8	U		--			--		
PCB-aroclor 1254	--	--	--	8.7	U		8.9	U		9	U		8.4	U		8.8	U		8.6	U		8.8	U		--			--		
PCB-aroclor 1260	--	--	--	8.7	U		8.9	U		9	U		8.4	U		8.8	U		8.6	U		8.8	U		--			--		
Total PCBs[d]	130	3100	--	18	U		18	U		18	U		17	U		18	U		18	U		18	U		--			--		
Total PCBs (OC)	--	--	38	0.804	U		0.874	U		0.918	U		0.776	U		0.706	U		0.968	U		0.811	U		--			--		
Pesticides (ug/kg)																														
Heptachlor[g]	1.5	270	--	0.25	U		0.25	U		0.25	U		0.25	U		0.25	U		0.25	U		0.25	U		--			--		
Aldrin	9.5	--	--	4.4	U		4.5	U		4.5	U		4.2	U		4.4	U		4.3	U		4.4	U		--			--		
Dieldrin[g]	1.9	1700	--	0.4	U		0.4	U		0.4	U		0.4	U		0.4	U		0.4	U		0.4	U		--			--		
4,4'-DDE	9	--	--	4.4	U		0.11	T		0.086	T		0.14	T		0.096	T		0.087	T		0.097	T		--			--		
4,4'-DDD	16	--	--	4.4	U		4.5	U		4.5	U		4.2	U		4.4	U		4.3	U		4.4	U		--			--		
4,4'-DDT	12	--	--	4.4	U		0.093	T		4.5	U		0.099	T		4.4	U		4.3	U		4.4	U		--			--		
Total DDT[e]	--	69	50	4.4	U		0.203	T		0.086	T		0.239	T		0.096	T		0.087	T		0.097	T		--			--		
gamma-Chlordane	--	--	--	0.88	U		0.89	U		0.9	U		0.84	U		0.091	JP		0.87	U		0.09	JP		--			--		
cis-Chlordane	--	--	--	0.88	U		0.89	U		0.9	U		0.84	U		0.11	J		0.87	U		0.09	J		--			--		
cis-Nonachlor	--	--	--	0.88	U		0.89	U		0.9	U		0.84	U		0.89	U		0.87	U		0.88	U		--			--		
trans-Nonachlor	--	--	--	0.88	U		0.89	U		0.9	U		0.84	U		0.89	U		0.87	U		0.88	U		--			--		
Oxychlordane	--	--	--	0.88	U		0.89	U		0.9	U		0.84	U		0.89	U		0.87	U		0.88	U		--			--		
Total Chlordane[f]	2.8	--	37	0.88	U		0.89	U		0.9	U		0.84	U		0.201	J		0.87	U		0.18	J		--			--		

Notes: LQ: laboratory qualifier **VQ**: validation qualifier **SL**: screening level **ML**: maximum level **BT**: bioaccumulation trigger Exceeds SL Exceeds BT

* analyzed after expiration of the holding time

U the analyte was analyzed for, but not detected

i the LOQ is elevated due to chromatographic interference

T the result is detected above the method detection limit, but below the limit of quantitation

J the result is estimated

P RPD difference greater than 40% between the two column results

--not targeted for analysis

a. sum of silt and clay fractions

b. sum of detected values of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene

c. sum of detected values of fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzofluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(ghi)perylene

d. sum of detected PCB Aroclors

e. sum of 4,4'-DDE, 4,4'-DDD, and 4,4'-DDT

f. sum of gamma-chlordane, cis-chlordane, cis-nonachlor, trans-nonachlor, and oxychlordane

g. non-detect results reported at the method detection limit

Table 12. Subarea A Chemistry and Conventionals Results (cont.)

				LBA-C			AMA3-C			LBAZ-U-Z			TB-C			TBS1-C			TBS2-C			TBAM-C			TBZ-U-Z		
				11/29/16	LQ	VQ	11/29/16	LQ	VQ	11/29/16	LQ	VQ	12/30/16	LQ	VQ	12/30/16	LQ	VQ	12/30/16	LQ	VQ	12/30/16	LQ	VQ	12/30/16	LQ	VQ
Conventionals																											
Total Solids (%)	--	--	--	53.4			54			53.2			55.2			56.8			56.4			57.2			59.1		
Total Organic Carbon (%)	--	--	--	2.61			2.33			2.28			2.53			2.15			2.25			2.11			2.05		
Sulfides (mg/kg)	--	--	--	157			530			1350			690			1570			1050			1230			--		
Ammonia (mg/kg)	--	--	--	53.2			88.3			--			36.3			68.5			91.4			101			--		
Total Volatile Solids (%)	--	--	--	6.9			6.5			6.7	*		6.7			6			6			5.8			5.6		
Grain Size (%)																											
Gravel	--	--	--	0.19			1.62			0.62			0			0			0.24			0			0		
Sand	--	--	--	5.29			5.01			2.99			0.36			0.95			0.84			0.15			0.54		
Silt	--	--	--	79.18			79.81			80.02			78.27			79.29			80.96			77.96			76.73		
Clay	--	--	--	15.52			13.48			16.47			19.22			17.23			18.21			20.08			19.22		
Percent Fines[a]	--	--	--	94.7			93.29			96.49			97.49			96.52			99.17			98.04			95.95		
Metals (mg/kg)																											
Antimony	150	200	--	1.1	T		0.8	T		--			5.1	U		1	T		4.3	U		0.5	T		--		
Arsenic	57	700	507.1	9.4			9.5			--			9.8			9.2			9.6			10.6			--		
Cadmium	5.1	14	11.3	0.25	T		0.16	T		--			0.26	U		0.12	T		0.04	T		0.05	T		--		
Chromium	260	--	--	69.1			67.4			--			59.3			61.7			65.1			66.4			--		
Copper	390	1300	--	54			51.2			--			45.4			43.9			44.9			46.4			--		
Lead	450	1200	975	11.2			10			--			8.6			7.3			7.7			8.1			--		
Mercury	0.41	2.3	1.5	0.099			0.079			--			0.072			0.068			0.068			0.072			--		
Selenium	--	--	3	0.56			0.52			--			0.49			0.43			0.44			0.47			--		
Silver	6.1	8.4	--	1.4	U		1.2	U		--			1	U		0.92	U		0.86	U		0.93	U		--		
Zinc	410	3800	--	110			102			--			80			80.8			81.9			83.3			--		
Polycyclic Aromatic Hydrocarbons (ug/kg)																											
Naphthalene	2100	2400	--	15			15			--			5.2	T		5.2	T		7.4	T		4.6	T		--		
Acenaphthylene	560	1300	--	5.3	T		6.3	T		--			9.1	U		8.8	U		8.9	U		8.7	U		--		
Acenaphthene	500	2000	--	11			21			--			9.1	U		8.8	U		8.9	U		8.7	U		--		
Fluorene	540	3600	--	21			23			--			3.5	T		3.4	T		4.6	T		8.7	U		--		
Phenanthrene	1500	21000	--	47			67			--			16			12			17			14			--		
Anthracene	960	13000	--	22			30			--			9.1	U		5.8	T		8.9	U		8.7	U		--		
2-Methylnaphthalene	670	1900	--	19			18			--			8.6	T		8.4	T		11			6.9	T		--		
Total LPAH[b]	5200	29000	--	121.3			162.3			--			24.7			26.4			29			18.6			--		
Fluoranthene	1700	30000	4600	140			290			--			26			18			22			32			--		
Pyrene	2600	16000	11980	130			200			--			16			12			14			19			--		
Benzo(a)anthracene	1300	5100	--	67			110			--			5.6	T		5.6	T		5.7	T		6	T		--		
Chrysene	1400	21000	--	91			130			--			11			19			11			18			--		
Benzo(b)fluoranthene	--	--	--	84			120			--			11			11			13			13			--		
Benzo(k)fluoranthene	--	--	--	29			41			--			9.1	U		8.8	U		8.9	U		4.3	T		--		
Benzofluoranthene	3200	9900	--	113			161			--			11			11			13			17.3			--		
Benzo(a)pyrene	1600	3600	--	44			60			--			4.1	T		5.1	T		5.4	T		5.3	T		--		
Indeno(1,2,3-cd)pyrene	600	4400	--	34			39			--			4.4	T		4.7	T		4.8	T		5	T		--		
Dibenzo(a,h)anthracene	230	1900	--	8.2	T		9.4	T		--			9.1	U		8.8	U		8.9	U		8.7	U		--		
Benzo(ghi)perylene	670	3200	--	31			36			--			5.2	T		5.7	T		6	T		5.7	T		--		
Total HPAH[c]	12000	69000	--	658.2			1035.4			--			83.3			81.1			81.9			108.3			--		
Phenols (ug/kg)																											
2,4-Dimethylphenol[g]	29	210	--	6.7	U		6.5	U		--			6.3	U		6.3	U		6.3	U		6.3	U		--		
2-Methylphenol	63	77	--	11	U		11	U		--			9.1	U		8.8	U		8.9	U		8.7	U		--		
4-Methylphenol	670	3600	--	16			58			--			22			8.2	T		9.3			6.6	T		--		
Pentachlorophenol	400	690	504	110	U		110	U		--			91	U		88	U		89	U		87	U		--		
Phenol	420	1200	--	30	T		27	T		--			76			92			60			60			--		
Phthalates (ug/kg)																											
Butylbenzylphthalate	63	970	--	11	T		11	U		--			10			6.3	T		7.8	T		5	T		--		
Di-N-Butylphthalate	1400	5100	--	11	T		11	T		--			8.4	T		9.5	T		9	T		6.9	T		--		

Table 12. Subarea A Chemistry and Conventionals Results (cont.)

				LBA-C			AMA3-C			LBAZ-U-Z			TB-C			TBS1-C			TBS2-C			TBAM-C			TBZ-U-Z		
				11/29/16	LQ	VQ	11/29/16	LQ	VQ	11/29/16	LQ	VQ	12/30/16	LQ	VQ	12/30/16	LQ	VQ	12/30/16	LQ	VQ	12/30/16	LQ	VQ	12/30/16	LQ	VQ
Di-N-Octyl Phthalate	6200	6200	--	11	U		11	U		--			9.1	U		8.8	U		8.9	U		8.7	U		--		
Diethylphthalate	200	1200	--	11	U		11	U		--			9.1	U		8.8	U		8.9	U		8.7	U		--		
Dimethylphthalate	71	1400	--	11	U		11	U		--			9.1	U		8.8	U		8.9	U		8.7	U		--		
Bis(2-Ethylhexyl) Phthalate	1300	8300	--	38	T		29	T		--			9.4	T		11	T		9	T		87	U		--		
Other Semi-volatile Organic Compounds (ug/kg)																											
Dibenzofuran	540	1700	--	21			23			--			9.1	U		8.8	U		3.6	T		8.7	U		--		
Benzoic Acid	650	760	--	220	U	UJ	210	U	UJ	--			200	U	UJ	200	U	UJ	200	U	UJ	200	U	UJ	--		
Benzyl Alcohol	57	870	--	11	T		7.9	T		--			10	T		7.9	T		7.6	T		6.1	T		--		
1,2-Dichlorobenzene	35	110	--	11	U		11	U		--			9.1	U		8.8	U		8.9	U		8.7	U		--		
1,4-Dichlorobenzene	110	120	--	11	U		11	U		--			9.1	U		8.8	U		8.9	U		8.7	U		--		
Hexachlorobenzene	22	230	168	11	U		11	U		--			9.1	U		8.8	U		8.9	U		8.7	U		--		
Hexachlorobutadiene	11	270	--	11	U		11	U		--			9.1	U		8.8	U		8.9	U		8.7	U		--		
N-Nitrosodiphenylamine	28	130	--	11	U		11	U		--			9.1	U		8.8	U		8.9	U		8.7	U		--		
1,2,4-Trichlorobenzene	31	64	--	11	U		11	U		--			9.1	U		8.8	U		8.9	U		8.7	U		--		
Polychlorinated Biphenyl Aroclors (ug/kg)																											
PCB-aroclor 1016	--	--	--	11	U		11	U		--			9	U		8.8	U		8.9	U		8.7	U		--		
PCB-aroclor 1221	--	--	--	21	U		21	U		--			18	U		18	U		18	U		18	U		--		
PCB-aroclor 1232	--	--	--	11	U		11	U		--			9	U		8.8	U		8.9	U		8.7	U		--		
PCB-aroclor 1242	--	--	--	11	U		11	U		--			9	U		8.8	U		8.9	U		8.7	U		--		
PCB-aroclor 1248	--	--	--	11	U		11	U		--			9	U		8.8	U		8.9	U		8.7	U		--		
PCB-aroclor 1254	--	--	--	11	U		11	U		--			9	U		8.8	U		8.9	U		8.7	U		--		
PCB-aroclor 1260	--	--	--	11	U		11	U		--			9	U		8.8	U		8.9	U		8.7	U		--		
Total PCBs[d]	130	3100	--	21	U		21	U		--			18	U		18	U		18	U		18	U		--		
Total PCBs (OC)	--	--	38	0.805	U		0.901	U		--			0.711	U		0.837	U		0.8	U		0.853	U		--		
Pesticides (ug/kg)																											
Heptachlor[g]	1.5	270	--	0.27	U		0.26	U		--			0.25	U		0.25	U		0.25	U		0.25	U		--		
Aldrin	9.5	--	--	5.3	Ui		5.2	U		--			4.5	U		4.4	U		4.5	U		4.4	U		--		
Dieldrin[g]	1.9	1700	--	0.42	Ui		0.41	U		--			0.4	U		0.4	U		0.4	U		0.4	U		--		
4,4'-DDE	9	--	--	0.14	T		0.13	T		--			0.1	T		0.12	T		4.5	U		0.11	T		--		
4,4'-DDD	16	--	--	0.15	T		5.2	Ui		--			4.5	U		4.4	U		4.5	U		4.4	U		--		
4,4'-DDT	12	--	--	5.3	Ui		5.2	Ui		--			4.5	U		4.4	U		4.5	U		0.088	T		--		
Total DDT[e]	--	69	50	0.29	T		0.13	T		--			0.1	T		0.12	T		4.5	U		0.198	T		--		
gamma-Chlordane	--	--	--	0.12	JP		0.23	J		--			0.91	U		0.88	U		0.88	U		0.87	U		--		
cis-Chlordane	--	--	--	0.12	J		0.23	J		--			0.91	U		0.88	U		0.88	U		0.87	U		--		
cis-Nonachlor	--	--	--	1.1	U		1.1	U		--			0.91	U		0.88	U		0.88	U		0.87	U		--		
trans-Nonachlor	--	--	--	1.1	U		1.1	U		--			0.91	U		0.88	U		0.88	U		0.87	U		--		
Oxychlordane	--	--	--	1.1	U		1.1	U		--			0.91	U		0.88	U		0.88	U		0.87	U		--		
Total Chlordane[f]	2.8	--	37	0.24	J		0.46	J		--			0.91	U		0.88	U		0.88	U		0.87	U		--		

Notes: LQ: laboratory qualifier **VQ**: validation qualifier **SL**: screening level **ML**: maximum level **BT**: bioaccumulation trigger Exceeds SL Exceeds BT

***** analyzed after expiration of the holding time
U the analyte was analyzed for, but not detected
i the LOQ is elevated due to chromatographic interference
T the result is detected above the method detection limit, but below the limit of quantitation
J the result is estimated
P RPD difference greater than 40% between the two column results
--not targeted for analysis
a. sum of silt and clay fractions
b. sum of detected values of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene
c. sum of detected values of fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzofluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(ghi)perylene
d. sum of detected PCB Aroclors
e. sum of 4,4'-DDE, 4,4'-DDD, and 4,4'-DDT
f. sum of gamma-chlordane, cis-chlordane, cis-nonachlor, trans-nonachlor, and oxychlordane
g. non-detect results reported at the method detection limit

Table 13. Subarea B Chemistry and Conventionals Results

				B1-C			B2-C			B3-C			BS1-C			BS2-C			BS3-C			BS4-C			AMB1-C			BZ-U-Z			LBB-C		
				12/1/16	LQ	VQ	12/2/16	LQ	VQ	12/1/16	LQ	VQ	12/2/16	LQ	VQ	12/2/16	LQ	VQ	12/2/16	LQ	VQ	12/2/16	LQ	VQ	12/2/16	LQ	VQ	12/2/16	LQ	VQ	12/1/16	LQ	VQ
Conventionals																																	
Total Solids	--	--	--	57.9			91.6			81.5			80.4			85.7			62.9			79.5			68.1			73.3			68.9		
Total Organic Carbon	--	--	--	3.48			2.64			7.15			3.84			2.64			5.53			4.93			5.93			2.17			5.56		
Sulfides	--	--	--	1320			67			390			240			55			1300			470			840			--			480		
Ammonia	--	--	--	24.7			0.78			4.07			14.5			2.73			85.8			34.5			63.6			--			15		
Total Volatile Solids	--	--	--	7.6	*		4.2	*		13.1	*	J	8.8	*		7.8	*		10.8	*		9	*		9.1	*		7.8	*		10.9	*	
Grain Size (%)																																	
Gravel	--	--	--	25.06			38.45			22.89			32.45			25.44			17.9			27.15			9.78			23.34			29.77		
Sand	--	--	--	28.14			52.21			68.63			51.76			70.26			27.24			42.44			36.67			17.69			47.71		
Silt	--	--	--	55.97			2.45			4.61			8.58			2.18			12.93			17.04			31.92			31.67			16.65		
Clay	--	--	--	12.21			2.05			2.66			5.41			1.65			18.34			12.62			21.31			29.67			5.76		
Percent Fines[a]	--	--	--	68.18			4.5			7.27			13.99			3.83			31.27			29.66			53.23			61.34			22.41		
Metals (mg/kg)																																	
Antimony	150	200	--	0.9	J		3.5	U		4.2	U		4.9	U		4.2	U		5.7	U		4.9	U		5.8	U		--			5.1	U	
Arsenic	57	700	507.1	7.6			4.4			5.9			3.8	J		3.2	J		5.9			5			8.8			--			5	J	
Cadmium	5.1	14	11.3	0.32	U		0.17	U		0.04	J		0.07	J		0.21	U		0.29	U		0.25	U		0.29	U		--			0.25	U	
Chromium	260	--	--	47			17.7			27.5			27.1			26.2			51.9			48.1			46.9			--			37.1		
Copper	390	1300	--	36.8			25.3			42.9			33.6			27.2			48.5			43.6			64.4			--			34.9		
Lead	450	1200	975	8.2			5.7			11.4			8.7			5.8			20.7			19.5			17.4			--			8.8		
Mercury	0.41	2.3	1.5	0.062			0.02	J		0.035			0.047			0.032			0.296			0.099			0.159			--			0.059		
Selenium	--	--	3	0.33			0.065	J		0.084	J		0.15			0.17			0.34			0.2			0.34			--			0.19		
Silver	6.1	8.4	--	1.3	U		0.69	U		0.85	U		0.98	U		0.84	U		0.3	J		0.98	U		1.2	U		--			1	U	
Zinc	410	3800	--	79.4			58.2			77.8			59.1			51.7			88.7			65.9			78.9			--			61		
PAH (ug/kg)																																	
Naphthalene	2100	2400	--	6.2	J		12			38			29			20			31			390			2000			--			21		
Acenaphthylene	560	1300	--	8.4	U		6	U		6.1	U		6.3	U		6	U		9.6			18			17			--			7.3	U	
Acenaphthene	500	2000	--	3.3	J		6	U		6.5			5.7	J		3.3	J		12			68			590			--			16		
Fluorene	540	3600	--	7.4	J		6	U		6.1	U		11			5.4	J		24			73			600			--			20		
Phenanthrene	1500	21000	--	26			10			28			35			17			61			240			2600			--			65		
Anthracene	960	13000	--	10			3.5	J		10			18			6.3			41			65			510			--			16		
2-Methylnaphthalene	670	1900	--	9.2			23			68			47			38			36			120			240			--			28		
Total LPAH[b]	5200	29000	--	52.9			25.5			82.5			98.7			52			178.6			854			6317			--			138		
Fluoranthene	1700	30000	4600	61			14			85			100			20			210			330			2000			--			110		
Pyrene	2600	16000	11980	55			14			84			88			21			230			300			1000			--			89		
Benzo(a)anthracene	1300	5100	--	35			5.4	J		23			30			6.5			70			120			280			--			38		
Chrysene	1400	21000	--	53			7.4			41			42			7.7			100			150			330			--			56		
Benzo(b)fluoranthene	--	--	--	46			7.7			38			49			7.6			100			160			190			--			56		
Benzo(k)fluoranthene	--	--	--	16			6	U		14			16			6	U		37			57			68			--			21		
Benzofluoranthene	3200	9900	--	62			7.7			52			65			7.6			137			217			258			--			77		
Benzo(a)pyrene	1600	3600	--	28			4.5	J		17			30			4.2	J		63			110			120			--			36		
Indeno(1,2,3-cd)pyrene	600	4400	--	14			6	U		5.4	J		11			6	U		12			39			35			--			22		
Dibenzo(a,h)anthracene	230	1900	--	3.1	J		6	U		6.1	U		3.3	J		6	U		7.3	U		9.9			9.7			--			5	J	
Benzo(ghi)perylene	670	3200	--	11			6	U		4.9	J		7.8			6	U		8.5			25			22			--			20		
Total HPAH[c]	12000	69000	--	322.1			53			312.3			377.1			67			830.5			1300.9			4054.7			--			453		
Phenols (ug/kg)																																	
2,4-Dimethylphenol[g]	29	210	--	6.3	U		6.3	U		6.3	U		6.3	U		6.3	U		6.3	U		19	J		23	J		--			6.3	U	
2-Methylphenol	63	77	--	8.4	U		6	U		6.1	U		6.3	U		6	U		7.3	U		5.7	J		7.3	U		--			7.3	U	
4-Methylphenol	670	3600	--	7.5	J		6	U		7.9			5.8	J		6	U		22			13			9.6			--			7.3	U	
Pentachlorophenol	400	690	504	84	U		55	U		61	U		19	J		59	U		34	J		63	U		29	J		--			73	U	
Phenol	420	1200	--	12	J		17	U		19	U		19	U		18	U		26			5	J		19	J		--			22	U	
Phthalates (ug/kg)																																	
Butylbenzylphthalate	63	970	--	8.4	U		6	U		6.1	U		6.3	U		6	U		7.3	U		6.3	U		7.3	U		--			33		
Di-N-Butylphthalate	1400	5100	--	9.9	J		5	J		7.6	J		6.8	J		5.1	J		10	J		20			16			--			6.2	J	
Di-N-Octyl Phthalate	6200	6200	--	8.4	U		6	U		6.1	U		6.3	U		6	U		7.3	U		6.3	U		7.3	U		--			7.3	U	
Diethylphthalate	200	1200	--	8.4	U		6	U		6.1	U		6.3	U		6	U		7.3	U		6.3	U		7.3	U		--			7.3	U	

Table 3-4. Subarea B Chemistry and Conventionals Results (cont.)

				B1-C 12/1/16	LQ	VQ	B2-C 12/2/16	LQ	VQ	B3-C 12/1/16	LQ	VQ	BS1-C 12/2/16	LQ	VQ	BS2-C 12/2/16	LQ	VQ	BS3-C 12/2/16	LQ	VQ	BS4-C 12/2/16	LQ	VQ	AMB1-C 12/2/16	LQ	VQ	BZ-U-Z 12/2/16	LQ	VQ	LBB-C 12/1/16	LQ	VQ
Dimethylphthalate	71	1400	--	8.4	U		6	U		6.1	U		6.3	U		6	U		7.3	U		6.3	U		7.3	U		--			7.3	U	
Bis(2-Ethylhexyl) Phthalate	1300	8300	--	52	J		18	J		370			49	J		55	J		110			22	J		21	J		--			67	J	
Other SVOC (ug/kg)																																	
Dibenzofuran	540	1700	--	7.3	J		16			45			34			26			30			81			500			--			29		
Benzoic Acid	650	760	--	200	U	UJ	200	U	UJ	200	U	UJ	200	U	UJ	200	U	UJ	200	U	UJ	200	U	UJ	200	U	UJ	--			200	U	UJ
Benzyl Alcohol	57	870	--	9.6	J		11	U		13	U		13	U		12	U		15	U		13	U		15	U		--			5	J	
1,2-Dichlorobenzene	35	110	--	8.4	U		6	U		6.1	U		6.3	U		6	U		7.3	U		6.3	U		7.3	U		--			7.3	U	
1,4-Dichlorobenzene	110	120	--	8.4	U		6	U		6.1	U		6.3	U		6	U		7.3	U		6.3	U		7.3	U		--			7.3	U	
Hexachlorobenzene	22	230	168	8.4	U		6	U		6.1	U		6.3	U		6	U		7.3	U		6.3	U		7.3	U		--			7.3	U	
Hexachlorobutadiene	11	270	--	8.4	U		6	U		6.1	U		6.3	U		6	U		7.3	U		6.3	U		7.3	U		--			7.3	U	
N-Nitrosodiphenylamine	28	130	--	8.4	U		6	U		6.1	U		6.3	U		6	U		7.3	U		6.3	U		7.3	U		--			7.3	U	
1,2,4-Trichlorobenzene	31	64	--	8.4	U		6	U		6.1	U		6.3	U		6	U		7.3	U		6.3	U		7.3	U		--			7.3	U	
PCB Aroclors (ug/kg)																																	
PCB-aroclor 1016	--	--	--	8.4	U		5.5	U		6.1	U		6.2	U		5.9	U		7.3	U		6.3	U		7.4	U		--			7.3	U	
PCB-aroclor 1221	--	--	--	17	U		11	U		13	U		13	U		12	U		15	U		13	U		15	U		--			15	U	
PCB-aroclor 1232	--	--	--	8.4	U		5.5	U		6.1	U		6.2	U		5.9	U		7.3	U		6.3	U		7.4	U		--			7.3	U	
PCB-aroclor 1242	--	--	--	8.4	U		5.5	U		6.1	U		6.2	U		5.9	U		22	Ui		6.4	P		28	P		--			7.3	U	
PCB-aroclor 1248	--	--	--	8.4	U		5.5	U		6.1	U		6.2	U		5.9	U		7.3	U		6.3	U		7.4	U		--			7.3	U	
PCB-aroclor 1254	--	--	--	8.4	U		5.5	U		3.6	J		10			3	J		32			6.9			10			--			3.3	JP	
PCB-aroclor 1260	--	--	--	8.4	U		5.5	U		6.1	U		6.2	U		5.9	U		8.9			3.5	J		4.5	J		--			7.3	U	
Total PCBs[d]	130	3100	--	8.4	U		6	U		6.1	U		6.3	U		6	U		7.3	U		6.3	U		7.3	U		--			7.3	U	
Total PCBs (OC)	--	--	38	8.4	U		6	U		6.1	U		6.3	U		6	U		7.3	U		6.3	U		7.3	U		--			7.3	U	
Pesticides (ug/kg)																																	
Heptachlor[g]	1.5	270	--	0.25	Ui		0.25	U		0.25	U		0.25	U		0.25	U		0.25	U		0.25	U		0.25	U		--			0.25	Ui	
Aldrin	9.5	--	--	4.2	Ui		2.8	U		3.1	Ui		3.1	U		3	U		3.7	Ui		3.2	Ui		3.7	Ui		--			3.7	U	
Dieldrin[g]	1.9	1700	--	1.6	Ui		0.4	U		0.4	Ui		0.55	Ui		0.4	Ui		1.7	Ui		0.4	Ui		0.41	Ui		--			0.7	Ui	
4,4'-DDE	9	--	--	0.13	J		2.8	U		0.52	J		0.14	JP		0.097	J		0.96	JP		3.2	Ui		3.7	U		--			0.18	JP	
4,4'-DDD	16	--	--	4.2	Ui		2.8	U		1	J		0.28	JP		3	U		1.6	J		0.38	J		0.74	J		--			3.7	U	
4,4'-DDT	12	--	--	4.2	Ui		2.8	Ui		3.1	Ui		3.1	Ui		0.27	JP		3.7	Ui		3.2	Ui		3.7	Ui		--			3.7	Ui	
Total DDT[e]	--	69	50	0.13	J		2.8	U		1.52	J		0.42	JP		0.367	J		2.56	J		0.38	J		0.74	J		--			0.18	JP	
gamma-Chlordane	--	--	--	0.17	JP		0.55	U		0.16	JP		0.18	JP		0.079	JP		0.79	Ui		0.63	U		0.74	Ui		--			0.29	JP	
cis-Chlordane	--	--	--	0.24	J		0.55	U		0.19	J		0.21	J		0.087	J		0.79	Ui		0.63	U		0.74	U		--			0.35	J	
cis-Nonachlor	--	--	--	0.87	U		0.68	U		0.68	U		0.68	U		0.68	U		2.5			0.68	U		0.56	JP		--			0.72	U	
trans-Nonachlor	--	--	--	0.87	U		0.68	U		0.68	U		0.68	U		0.68	U		0.88	Ui		0.68	U		0.74	U		--			0.72	U	
Oxychlordane	--	--	--	0.87	U		0.68	U		0.68	U		0.68	U		0.68	U		0.79	U		0.68	U		0.74	U		--			0.72	U	
Total Chlordane[f]	2.8	--	37	0.41	J		0.68	U		0.35	J		0.39	J		0.166	J		2.5			0.68	U		0.56	J		--			0.64	J	

Notes:

LQ: laboratory qualifier **VQ**: validation qualifier **SL**: screening level **ML**: maximum level **BT**: bioaccumulation trigger Exceeds SL Exceeds BT

* analyzed after expiration of the holding time

U the analyte was analyzed for, but not detected

i the LOQ is elevated due to chromatographic interference

T the result is detected above the method detection limit, but below the limit of quantitation

J the result is estimated

P RPD difference greater than 40% between the two column results

--not targeted for analysis

a. sum of silt and clay fractions

b. sum of detected values of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene

c. sum of detected values of fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzofluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(ghi)perylene

d. sum of detected PCB Aroclors

e. sum of 4,4'-DDE, 4,4'-DDD, and 4,4'-DDT

f. sum of gamma-chlordane, cis-chlordane, cis-nonachlor, trans-nonachlor, and oxychlordane

g. non-detect results reported at the method detection limit

Table 13. Subarea B Chemistry and Conventionals Results (cont.)

				LBBS1-C 12/1/16	LQ	VQ	LBBS2-C 11/30/16	LQ	VQ	AMB2-C 11/30/16	LQ	VQ	LBBZ-U-Z 11/30/16	LQ	VQ	RB1-C 11/30/16	LQ	VQ	RB2-C 12/2/16	LQ	VQ	RBS1-C 12/2/16	LQ	VQ	RBS2-C 12/2/16	LQ	VQ	RBZ-U-Z 12/2/16	LQ	VQ
Conventionals																														
Total Solids	--	--	--	76.8			79.6			81.8			83.1			57.8			55.5			56.5			58.2			58.1		
Total Organic Carbon	--	--	--	12.5			7.64			4.53			10.8			2.62			2.98			2.6			2.99			6.42		
Sulfides	--	--	--	640			450			560	J		--			1410			1840			990			2.4			--		
Ammonia	--	--	--	15.5			16.9	*		13			--			35.6			37.6			61.8			61.4			--		
Total Volatile Solids	--	--	--	13	*		8.2	*		6.6	*		13	*		6.7			7.7	*		7.4	*		7.9	*		11.8	*	
Grain Size (%)																														
Gravel	--	--	--	18.52			33			4.87			9.87			0.1			0.46			0.12			0.1			0.25		
Sand	--	--	--	66.28			43.09			88.64			81.52			3.91			8.03			3.67			8			7.59		
Silt	--	--	--	8.36			15.84			3.44			4.91			76			73.45			71.38			62.05			60.12		
Clay	--	--	--	4.59			8.5			1.76			3.14			20.77			16.32			24.77			31.08			32.18		
Percent Fines[a]	--	--	--	12.95			24.34			5.2			8.05			96.77			89.77			96.15			93.13			92.3		
Metals (mg/kg)																														
Antimony	150	200	--	4.4	U		1.2	J		0.6	J		--			35.8			6.6	U		1	J		6.6	U		1.5	J	
Arsenic	57	700	507.1	4	J		4.4	J		3.1	J		--			11.2			9.1			11.8			10.6			10.4		
Cadmium	5.1	14	11.3	0.07	J		0.1	J		0.07	J		--			0.37	U		0.33	U		0.32	U		0.33	U		0.34	U	
Chromium	260	--	--	30.6			36.5			24.7			--			75.9			64.6			77.5			71.7			61.8		
Copper	390	1300	--	25.9			40.1			24			--			54.5			48.5			57.3			60.4			65.1		
Lead	450	1200	975	10.4			12.8			4.7			--			12.6			12.7			15.6			36.2			33		
Mercury	0.41	2.3	1.5	0.064			0.07			0.053			--			0.088			0.084			0.143			0.319			0.531		
Selenium	--	--	3	0.14			0.18			0.276			--			0.56			0.43			0.54			0.37			0.48		
Silver	6.1	8.4	--	0.88	U		0.96	U		0.95	U		--			1.5	U		1.3	U		1.3	U		1.3	U		1.3	U	
Zinc	410	3800	--	58.2			54.9			51.9			--			117			103			116			115			98.3		
PAH (ug/kg)																														
Naphthalene	2100	2400	--	43			120			63			--			83		J	18			9.6			11			--		
Acenaphthylene	560	1300	--	6.5	U		6.3	U		6.1	U		--			43		J	3.5	J		7.7	J		5.4	J		--		
Acenaphthene	500	2000	--	18			54			19			--			13		J	5.8	J		5.4	J		3.6	J		--		
Fluorene	540	3600	--	22			48			19			--			26		J	11			24			8.1	J		--		
Phenanthrene	1500	21000	--	60			100			41			--			230		J	40			100			29			--		
Anthracene	960	13000	--	21			41			14			--			76		J	14		J	100			16			--		
2-Methylnaphthalene	670	1900	--	47			97			48			--			31		J	12			9.9			13			--		
Total LPAH[b]	5200	29000	--	164			363			156			--			471		J	92.3			246.7			73.1			--		
Fluoranthene	1700	30000	4600	130			120			76			--			280		J	110		J	1200	D		60			--		
Pyrene	2600	16000	11980	120			310			65			--			230		J	110		J	840			95			--		
Benzo(a)anthracene	1300	5100	--	44			43			19			--			69		J	39		J	450			31			--		
Chrysene	1400	21000	--	60			75			29			--			110		J	65		J	580			54			--		
Benzo(b)fluoranthene	--	--	--	67			66			28			--			89		J	72		J	390			53			--		
Benzo(k)fluoranthene	--	--	--	24			26			10			--			30		J	26		J	130			20			--		
Benzofluoranthene	3200	9900	--	91			92			38			--			119		J	98		J	520			73			--		
Benzo(a)pyrene	1600	3600	--	39			42			16			--			41		J	39		J	180			31			--		
Indeno(1,2,3-cd)pyrene	600	4400	--	23			21			12			--			28		J	21			52			14			--		
Dibenzo(a,h)anthracene	230	1900	--	5.8	J		5.2	J		6.1	U		--			6.6	J		5.3	J		18			4.1	J		--		
Benzo(ghi)perylene	670	3200	--	20			19			11			--			27		J	16			32			11			--		
Total HPAH[c]	12000	69000	--	532.8			727.2			266			--			910.6		J	503.3			3872			373.1			--		
Phenols (ug/kg)																														
2,4-Dimethylphenol[g]	29	210	--	6.3	U		22	J		11	J		--			6.3	U	UJ	6.3	U		6.3	U		6.3	U		--		
2-Methylphenol	63	77	--	6.5	U		5.5	J		6.1	U		--			9.9	U	UJ	9	U		8.9	U		8.6	U		--		
4-Methylphenol	670	3600	--	5.8	J		18			8.5			--			830		J	8.8	J		6.1	J		6.6	J		--		
Pentachlorophenol	400	690	504	65	U		28	J		61	U		--			99	U	UJ	90	U		89	U		86	U		--		
Phenol	420	1200	--	13	J		12	J		4.6	J		--			410		J	63			110			110			--		
Phthalates (ug/kg)																														
Butylbenzylphthalate	63	970	--	6.5	U		6.3	U		6.1	U		--			12		J	9	U	UJ	8.9	U		8.6	U		--		
Di-N-Butylphthalate	1400	5100	--	11	J		9.5	J		6	J		--			13	J		11	J		7.5	J		23			--		
Di-N-Octyl Phthalate	6200	6200	--	6.5	U		6.3	U		6.1	U		--			9.9	U	UJ	9	U		8.9	U		8.6	U		--		

Table 3-4. Subarea B Chemistry and Conventionals Results (cont.)

				LBBS1-C 12/1/16	LQ	VQ	LBBS2-C 11/30/16	LQ	VQ	AMB2-C 11/30/16	LQ	VQ	LBBZ-U-Z 11/30/16	LQ	VQ
Diethylphthalate	200	1200	--	6.5	U		6.3	U		6.1	U		--		
Dimethylphthalate	71	1400	--	6.5	U		6.3	U		6.1	U		--		
Bis(2-Ethylhexyl) Phthalate	1300	8300	--	100			24	J		15	J		--		
Other SVOC (ug/kg)															
Dibenzofuran	540	1700	--	40			83			36			--		
Benzoic Acid	650	760	--	200	U	UJ	200	U	UJ	200	U	UJ	--		
Benzyl Alcohol	57	870	--	24			13	U		13	U		--		
1,2-Dichlorobenzene	35	110	--	6.5	U		6.3	U		6.1	U		--		
1,4-Dichlorobenzene	110	120	--	6.5	U		6.3	U		6.1	U		--		
Hexachlorobenzene	22	230	168	6.5	U		6.3	U		6.1	U		--		
Hexachlorobutadiene	11	270	--	6.5	U		6.3	U		6.1	U		--		
N-Nitrosodiphenylamine	28	130	--	6.5	U		6.3	U		6.1	U		--		
1,2,4-Trichlorobenzene	31	64	--	6.5	U		6.3	U		6.1	U		--		
PCB Aroclors (ug/kg)															
PCB-aroclor 1016	--	--	--	6.5	U		6.3	U		6.1	U		--		
PCB-aroclor 1221	--	--	--	13	U		13	U		13	U		--		
PCB-aroclor 1232	--	--	--	6.5	U		6.3	U		6.1	U		--		
PCB-aroclor 1242	--	--	--	6.5	U		42			6.1	U		--		
PCB-aroclor 1248	--	--	--	6.5	U		6.3	U		6.1	U		--		
PCB-aroclor 1254	--	--	--	3.2	JP		16			6.1	U		--		
PCB-aroclor 1260	--	--	--	6.5	U		4.8	J		6.1	U		--		
Total PCBs[d]	130	3100	--	3.2	JP		62.8			13	U		--		
Total PCBs (OC)	--	--	38	0.026			0.822			0.287	U		--		
Pesticides (ug/kg)															
Heptachlor[g]	1.5	270	--	0.25	U		0.25	U		0.25	U		--		
Aldrin	9.5	--	--	3.3	Ui		3.2	Ui		3.1	U		--		
Dieldrin[g]	1.9	1700	--	0.4	U		0.84	J		0.4	Ui		--		
4,4'-DDE	9	--	--	0.31	JP		3.2	Ui		0.094	JP		--		
4,4'-DDD	16	--	--	0.44	J		0.91	J		3.1	Ui		--		
4,4'-DDT	12	--	--	3.3	Ui		3.2	Ui		3.1	Ui		--		
Total DDT[e]	--	69	50	0.75	J		0.91	J		0.094	J		--		
gamma-Chlordane	--	--	--	0.55	JP		0.63	Ui		0.15	J		--		
cis-Chlordane	--	--	--	0.5	J		0.63	U		0.082	J		--		
cis-Nonachlor	--	--	--	0.67	J		0.91			0.68	U		--		
trans-Nonachlor	--	--	--	0.68	U		0.68	U		0.68	U		--		
Oxychlordane	--	--	--	0.68	U		0.68	U		0.68	U		--		
Total Chlordane[f]	2.8	--	37	1.72	J		0.91			0.232	J		--		

	RB1-C 11/30/16	LQ	VQ	RB2-C 12/2/16	LQ	VQ	RBS1-C 12/2/16	LQ	VQ	RBS2-C 12/2/16	LQ	VQ	RBZ-U-Z 12/2/16	LQ	VQ
Diethylphthalate	9.1	J		9	U		8.9	U		8.6	U		--		
Dimethylphthalate	4.6	J		9	U		4.1	J		5.9	J		--		
Bis(2-Ethylhexyl) Phthalate	75	J		95		J	58	J		33	J		--		
Other SVOC (ug/kg)															
Dibenzofuran	39		J	12			9.6			9.1			--		
Benzoic Acid	200	U	UJ	200	U	UJ	200	U	UJ	200	U	UJ	--		
Benzyl Alcohol	7.7	J		6.6	J		18	U		18	U		--		
1,2-Dichlorobenzene	9.9	U	UJ	9	U		8.9	U		8.6	U		--		
1,4-Dichlorobenzene	9.9	U	UJ	9	U		8.9	U		8.6	U		--		
Hexachlorobenzene	9.9	U	UJ	9	U		8.9	U		8.6	U		--		
Hexachlorobutadiene	9.9	U	UJ	9	U		8.9	U		8.6	U		--		
N-Nitrosodiphenylamine	9.9	U	UJ	9	U		8.9	U		8.6	U		--		
1,2,4-Trichlorobenzene	9.9	U	UJ	9	U		8.9	U		8.6	U		--		
PCB Aroclors (ug/kg)															
PCB-aroclor 1016	9.8	U		9	U		8.8	Ui		8.6	U		--		
PCB-aroclor 1221	20	U		18	U		18	U		18	U		--		
PCB-aroclor 1232	9.8	U		9	U		8.8	Ui		8.6	U		--		
PCB-aroclor 1242	9.8	U		9	U		8.8	Ui		8.6	Ui		--		
PCB-aroclor 1248	9.8	U		9	U		8.8	Ui		8.6	U		--		
PCB-aroclor 1254	2.6	J		9	U		8.8	Ui		18			--		
PCB-aroclor 1260	9.8	U		9	U		74			13			--		
Total PCBs[d]	2.6	J		18	U		74			31			--		
Total PCBs (OC)	0.099	J		0.604	U		2.85			1.04			--		
Pesticides (ug/kg)															
Heptachlor[g]	0.25	U	UJ	0.25	U		0.25	U		0.25	U		--		
Aldrin	4.9	U	UJ	4.5	U		4.4	U		4.3	U		--		
Dieldrin[g]	0.4	Ui	UJ	0.36	JP		0.4	U		0.4	U		--		
4,4'-DDE	0.22	J		4.5	Ui		4.4	Ui		4.3	U		--		
4,4'-DDD	0.15	JP		4.5	Ui		0.4	JP		0.79	J		--		
4,4'-DDT	4.9	U	UJ	4.5	U		4.4	Ui		4.3	Ui		--		
Total DDT[e]	0.37	J		4.5	U		0.4	JP		0.79	J		--		
gamma-Chlordane	0.87	U		0.13	JP		0.89	Ui		0.86	Ui		--		
cis-Chlordane	0.11	J		0.17	J		0.89	Ui		0.86	Ui		--		
cis-Nonachlor	0.87	U		0.9	U		0.89	Ui		1.5			--		
trans-Nonachlor	0.87	U		0.9	U		0.89	U		0.86	U		--		
Oxychlordane	0.87	U		0.9	U		0.89	U		0.86	U		--		
Total Chlordane[f]	0.11	J		0.9	J		0.89	U		1.5			--		

Notes:

LQ: laboratory qualifier **VQ**: validation qualifier **SL**: screening level **ML**: maximum level **BT**: bioaccumulation trigger Exceeds SL Exceeds BT

* analyzed after expiration of the holding time

U the analyte was analyzed for, but not detected

i the LOQ is elevated due to chromatographic interference

T the result is detected above the method detection limit, but below the limit of quantitation

J the result is estimated

P RPD difference greater than 40% between the two column results

--not targeted for analysis

a. sum of silt and clay fractions

b. sum of detected values of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene

c. sum of detected values of fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzofluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(ghi)perylene

d. sum of detected PCB Aroclors

e. sum of 4,4'-DDE, 4,4'-DDD, and 4,4'-DDT

f. sum of gamma-chlordane, cis-chlordane, cis-nonachlor, trans-nonachlor, and oxychlordane

g. non-detect results reported at the method detection limit

Table 14. Subarea A Dioxin/Furan Congener Results

	TEF		A1-C			A2-C			A3-C			A4-C			A5-C			AMA1-C			AMA2-C			AZ1-U-Z			AZ2-U-Z		
	SL	BT	12/1/2016	LQ	VQ	12/30/2016	LQ	VQ	12/30/2016	LQ	VQ	12/1/2016	LQ	VQ	11/29/2016	LQ	VQ	12/30/2016	LQ	VQ	11/29/2016	LQ	VQ	12/30/2016	LQ	VQ	11/29/2016	LQ	VQ
Dioxin/Furan Concentration (ng/kg DW)																													
2,3,7,8-TCDD	1	--	0.156	U		0.138	U		0.137	U		0.151	U		0.242	U		0.161	U		0.266	U		0.134	U		0.374	U	
1,2,3,7,8-PeCDD	1	--	0.468	JK	U	0.217	JK	U	0.359			0.296	U	UJ	0.693	JK	U	0.339	JK	U	0.422	JK	U	0.485			0.475		
1,2,3,4,7,8-HxCDD	0.1	--	0.595	JK	U	0.494	JK	U	0.501	JK	U	0.448	JK	U	0.64	JK	U	0.423	JK	U	0.664			0.646			0.584	JK	U
1,2,3,6,7,8-HxCDD	0.1	--	1.57			1.54			1.68			1.31	JK	U	2.46	JK	U	1.56			2.71			1.73	JK	U	2.56		
1,2,3,7,8,9-HxCDD	0.1	--	1.02	JK	U	1.09			1.1			0.421	JK	U	1.31	JK	U	0.804			1.54			1.08			1.21		
1,2,3,4,6,7,8-HpCDD	0.01	--	32.9			56.1			34.7			44.1			57			37.8			60.7			42.1			54.4		
OCDD	0.0003	--	297			599			352			378			534			420			623			444			559		
2,3,7,8-TCDF	0.1	--	0.41			0.303			0.0928	U		0.092	U		0.129	U		0.077	U		0.286			0.563			0.203	U	
1,2,3,7,8-PeCDF	0.03	--	0.277	JK	U	0.263	JK	U	0.299			0.293	JK	UJ	0.432	JK	U	0.203	JK	U	0.306			0.267	JK	U	0.177	U	
2,3,4,7,8-PeCDF	0.3	--	0.52			0.425			0.541			0.568	U	UJ	0.195	U		0.437	JK	U	0.533			0.613			0.55	JK	U
1,2,3,4,7,8-HxCDF	0.1	--	0.565			0.456	JK	U	0.465	JK	U	0.262	JK	U	0.884	JK	U	0.723			0.776	JK	U	0.732			0.906		
1,2,3,6,7,8-HxCDF	0.1	--	0.318		U	0.291		U	0.347		U	0.216	JK	U	0.225	JK	U	0.326		U	0.421		U	0.328	JK	U	0.365		U
1,2,3,7,8,9-HxCDF	0.1	--	0.527			0.381			0.276	JK	U	0.428			0.38			0.263	JK	U	0.396			0.412	JK	U	0.433		
2,3,4,6,7,8-HxCDF	0.1	--	0.65			0.39			0.395	JK	U	0.208	U		0.341	JK	U	0.557			0.708			0.502	JK	U	0.517	JK	U
1,2,3,4,6,7,8-HpCDF	0.01	--	4.55	K	U	5.74			5.19			4.01	JK	U	8.45	K	U	5.54			8.33			5.95			7.55		J
1,2,3,4,7,8,9-HpCDF	0.01	--	0.519			0.549	JK	U	0.4	JK	U	0.373			0.298	JK	U	0.618			0.724			0.586	JK	U	0.527	JK	U
OCDF	0.0003	--	17.4			38.3			20.1			4.21	JK	U	31			21.9			33.2			24.2			29.5		
Dioxin/Furan 1/2 DL TEC (ng TEC/kg DW)																													
2,3,7,8-TCDD	1	--	0.078	U		0.069	U		0.0685	U		0.0755	U		0.121	U		0.0805	U		0.133	U		0.067	U		0.187	U	
1,2,3,7,8-PeCDD	1	--	0.234	JK	U	0.109	JK	U	0.359			0.148	U	UJ	0.347	JK	U	0.17	JK	U	0.211	JK	U	0.485			0.475		
1,2,3,4,7,8-HxCDD	0.1	--	0.0298	JK	U	0.0247	JK	U	0.0251	JK	U	0.0224	JK	U	0.032	JK	U	0.0212	JK	U	0.0664			0.0646			0.0292	JK	U
1,2,3,6,7,8-HxCDD	0.1	--	0.157			0.154			0.168			0.0655	JK	U	0.123	JK	U	0.156			0.271			0.0865	JK	U	0.256		
1,2,3,7,8,9-HxCDD	0.1	--	0.051	JK	U	0.109			0.11			0.0211	JK	U	0.0655	JK	U	0.0804			0.154			0.108			0.121		
1,2,3,4,6,7,8-HpCDD	0.01	--	0.329			0.561			0.347			0.441			0.57			0.378			0.607			0.421			0.544		
OCDD	0.0003	--	0.0891			0.18			0.106			0.113			0.16			0.126			0.187			0.133			0.168		
2,3,7,8-TCDF	0.1	--	0.041			0.0303			0.00464	U		0.0046	U		0.00645	U		0.00385	U		0.0286			0.0563			0.0102	U	
1,2,3,7,8-PeCDF	0.03	--	0.00416	JK	U	0.00395	JK	U	0.00897			0.0044	JK	UJ	0.00648	JK	U	0.00305	JK	U	0.00918			0.00401	JK	U	0.00266	U	
2,3,4,7,8-PeCDF	0.3	--	0.156			0.128			0.162			0.0852	U	UJ	0.0293	U		0.0656	JK	U	0.16			0.184			0.0825	JK	U
1,2,3,4,7,8-HxCDF	0.1	--	0.0565			0.0228	JK	U	0.0233	JK	U	0.0131	JK	U	0.0442	JK	U	0.0723			0.0388	JK	U	0.0732			0.0906		
1,2,3,6,7,8-HxCDF	0.1	--	0.0159		U	0.0146		U	0.0174		U	0.0108	JK	U	0.0113	JK	U	0.0163		U	0.0211		U	0.0164	JK	U	0.0183		U
1,2,3,7,8,9-HxCDF	0.1	--	0.0527			0.0381			0.0138	JK	U	0.0428			0.038			0.0132	JK	U	0.0396			0.0206	JK	U	0.0433		
2,3,4,6,7,8-HxCDF	0.1	--	0.065			0.039			0.0198	JK	U	0.0104	U		0.0171	JK	U	0.0557			0.0708			0.0251	JK	U	0.0259	JK	U
1,2,3,4,6,7,8-HpCDF	0.01	--	0.0228	K	U	0.0574			0.0519			0.0201	JK	U	0.0423	K	U	0.0554			0.0833			0.0595			0.0755		J
1,2,3,4,7,8,9-HpCDF	0.01	--	0.00519			0.00275	JK	U	0.002	JK	U	0.00373			0.00149	JK	U	0.00618			0.00724			0.00293	JK	U	0.00264	JK	U
OCDF	0.0003	--	0.00522			0.0115			0.00603			0.000632	JK	U	0.0093			0.00657			0.00996			0.00726			0.00885		
Dx/F TEQ (0 DL)	4	10	0.957			1.31			1.32			0.601			0.778			0.937			1.69			1.59			1.78		
Dx/F TEQ (1/2 DL)	4	10	1.39			1.56			1.49			1.08			1.62			1.31			2.1			1.81			2.14		

Notes:
LQ: laboratory qualifier **VQ**: validation qualifier **DW**: dry weight **DL**: detection limit
TEF: toxicity equivalent factor **TEC**: toxicity equivalent concentration **TEQ**: toxicity equivalents
SL: screening level **ML**: maximum level **BT**: bioaccumulation trigger Exceeds SL Exceeds BT
U the analyte was analyzed for, but not detected
J the result is estimated
K estimated maximum potential concentration

Table 14. Subarea A Dioxin/Furan Congener Results (cont.)

			LBA-C			AMA3-C			LBAZ-U-Z			TB-C			TBS1-C			TBS2-C			TBAM-C			TBZ-U-Z		
			11/29/2016	LQ	VQ	11/29/2016	LQ	VQ	11/29/2016	LQ	VQ	12/30/2016	LQ	VQ	12/30/2016	LQ	VQ	12/30/2016	LQ	VQ	12/30/2016	LQ	VQ	12/30/2016	LQ	VQ
Dioxin/Furan Concentration (ng/kg DW)																										
2,3,7,8-TCDD	1	--	0.347	U		0.119	U		0.152	U		0.118	U		0.134	U		0.313	U		0.105	U		0.29	U	
1,2,3,7,8-PeCDD	1	--	0.82			0.317	U		1.03			0.294			0.339			0.364			0.335	JK	U	0.368		
1,2,3,4,7,8-HxCDD	0.1	--	0.822	JK	U	0.197	U		0.762	JK	U	0.632			0.349	JK	U	0.347	JK	U	0.543			0.407	JK	U
1,2,3,6,7,8-HxCDD	0.1	--	3.91			3.41			3.06	JK	U	1.58			1.46			1.59			1.34	JK	U	1.72		
1,2,3,7,8,9-HxCDD	0.1	--	1.84	JK	U	1.13	JK	U	1.66	JK	U	0.827	JK	U	0.741			0.674	JK	U	0.706	JK	U	0.819		
1,2,3,4,6,7,8-HpCDD	0.01	--	150			134			115			48.7			32.1			37.4			36.2			44.8		
OCDD	0.0003	--	1540			1310			1090			391			308			391			381			516		
2,3,7,8-TCDF	0.1	--	0.26	U		0.28	U		0.188	U		0.0824	U		0.0731	U		0.171	U		0.158	JK	U	0.231		
1,2,3,7,8-PeCDF	0.03	--	0.573	JK	U	0.126	U		0.281	JK	U	0.0889	U		0.109	U		0.192	JK	U	0.233	JK	U	0.255	JK	U
2,3,4,7,8-PeCDF	0.3	--	0.539	JK	U	0.232	U		0.167	U		0.438			0.342	JK	U	0.497			0.439	JK	U	0.469	JK	U
1,2,3,4,7,8-HxCDF	0.1	--	1.24			0.977	JK	U	1.13	JK	U	0.447	JK	U	0.558			0.643			0.557	JK	U	0.705		
1,2,3,6,7,8-HxCDF	0.1	--	0.74			0.344	JK	U	0.248	JK	U	0.244	JK	U	0.258	JK	U	0.287	JK	U	0.412	JK	U	0.336		U
1,2,3,7,8,9-HxCDF	0.1	--	0.237	U		0.617	JK	U	0.67	JK	U	0.336	JK	U	0.239	JK	U	0.22	JK	U	0.259	JK	U	0.407		
2,3,4,6,7,8-HxCDF	0.1	--	0.71	JK	U	0.398	JK	U	0.805			0.433			0.412			0.368	JK	U	0.466			0.435	JK	U
1,2,3,4,6,7,8-HpCDF	0.01	--	13.4			13.3			12.2			3.7			4.04			5.05			5.1			5.73		
1,2,3,4,7,8,9-HpCDF	0.01	--	0.901	JK	U	0.668	JK	U	0.421	JK	U	0.0798	U		0.441			0.494			0.534	JK	U	0.537	JK	U
OCDF	0.0003	--	44.4			48.9			44.8			2.47	JK	U	16			18.7			19			21.4		
Dioxin/Furan 1/2 DL TEC (ng TEC/kg DW)																										
2,3,7,8-TCDD	1	--	0.1735	U		0.0595	U		0.076	U		0.059	U		0.067	U		0.157	U		0.0525	U		0.145	U	
1,2,3,7,8-PeCDD	1	--	0.82			0.159	U		1.03			0.294			0.339			0.364			0.168	JK	U	0.368		
1,2,3,4,7,8-HxCDD	0.1	--	0.0411	JK	U	0.00985	U		0.0381	JK	U	0.0632			0.0175	JK	U	0.0174	JK	U	0.0543			0.0204	JK	U
1,2,3,6,7,8-HxCDD	0.1	--	0.391			0.341			0.153	JK	U	0.158			0.146			0.159			0.067	JK	U	0.172		
1,2,3,7,8,9-HxCDD	0.1	--	0.092	JK	U	0.0565	JK	U	0.083	JK	U	0.0414	JK	U	0.0741			0.0337	JK	U	0.0353	JK	U	0.0819		
1,2,3,4,6,7,8-HpCDD	0.01	--	1.5			1.34			1.15			0.487			0.321			0.374			0.362			0.448		
OCDD	0.0003	--	0.462			0.393			0.327			0.117			0.0924			0.117			0.114			0.155		
2,3,7,8-TCDF	0.1	--	0.013	U		0.014	U		0.0094	U		0.00412	U		0.00366	U		0.00855	U		0.0079	JK	U	0.0231		
1,2,3,7,8-PeCDF	0.03	--	0.008595	JK	U	0.00189	U		0.00422	JK	U	0.00133	U		0.00164	U		0.00288	JK	U	0.0035	JK	U	0.00383	JK	U
2,3,4,7,8-PeCDF	0.3	--	0.08085	JK	U	0.0348	U		0.0251	U		0.131			0.0513	JK	U	0.149			0.0659	JK	U	0.0704	JK	U
1,2,3,4,7,8-HxCDF	0.1	--	0.124			0.0489	JK	U	0.0565	JK	U	0.0224	JK	U	0.0558			0.0643			0.0279	JK	U	0.0705		
1,2,3,6,7,8-HxCDF	0.1	--	0.074			0.0172	JK	U	0.0124	JK	U	0.0122	JK	U	0.0129	JK	U	0.0144	JK	U	0.0206	JK	U	0.0168		U
1,2,3,7,8,9-HxCDF	0.1	--	0.01185	U		0.0309	JK	U	0.0335	JK	U	0.0168	JK	U	0.012	JK	U	0.011	JK	U	0.013	JK	U	0.0407		
2,3,4,6,7,8-HxCDF	0.1	--	0.0355	JK	U	0.0199	JK	U	0.0805			0.0433			0.0412			0.0184	JK	U	0.0466			0.0218	JK	U
1,2,3,4,6,7,8-HpCDF	0.01	--	0.134			0.133			0.122			0.037			0.0404			0.0505			0.051			0.0573		
1,2,3,4,7,8,9-HpCDF	0.01	--	0.004505	JK	U	0.00334	JK	U	0.00211	JK	U	0.000399	U		0.00441			0.00494			0.00267	JK	U	0.00269	JK	U
OCDF	0.0003	--	0.0133			0.0147			0.0134			0.000371	JK	U	0.0048			0.00561			0.0057			0.00642		
Dx/F TEQ (0 DL)	4	10	3.52			2.22			2.72			1.33			1.12			1.29			0.634			1.42		
Dx/F TEQ (1/2 DL)	4	10	3.98			2.68			3.22			1.49			1.29			1.55			1.1			1.7		

Notes:

LQ: laboratory qualifier **VQ**: validation qualifier **DW**: dry weight **DL**: detection limit

TEF: toxicity equivalent factor **TEC**: toxicity equivalent concentration **TEQ**: toxicity equivalents

SL: screening level **ML**: maximum level **BT**: bioaccumulation trigger Exceeds SL Exceeds BT

U the analyte was analyzed for, but not detected

J the result is estimated

K estimated maximum potential concentration

Table 15. Subarea B Dioxin/Furan Congener Results

			B1-C			B2-C			B3-C			BS1-C			BS2-C			BS3-C			BS4-C			AMB1-C			BZ-U-Z			LBB-C		
			12/1/2016	LQ	VQ	12/2/2016	LQ	VQ	12/1/2016	LQ	VQ	12/2/2016	LQ	VQ	12/2/2016	LQ	VQ	12/2/2016	LQ	VQ	12/2/2016	LQ	VQ	12/2/2016	LQ	VQ	12/2/2016	LQ	VQ	12/1/2016	LQ	VQ
Dioxin/Furan Concentration (ng/kg DW)																																
2,3,7,8-TCDD	1	--	0.481	U		0.0318	U		0.159	JK	U	0.169	JK	U	0.188	U		0.472	JK	U	0.273	U		0.42	JK	U	0.203	U		3.49		
1,2,3,7,8-PeCDD	1	--	0.466	JK	U	0.306	J		0.337	JK	U	0.753	J		0.104	J		1.32	JK	U	0.604	J		1.21	J		0.447	JK	U	1.97	JK	U
1,2,3,4,7,8-HxCDD	0.1	--	1.04	J		0.231	J		0.726	J		1.25	J		0.151	J		2.43	J		0.778	JK	U	1.68	J		1.16	J		1.4	J	
1,2,3,6,7,8-HxCDD	0.1	--	3	J		0.47	J		3.02			5.48			0.538	JK	U	14			4.82			11.6			3.83			8.84		
1,2,3,7,8,9-HxCDD	0.1	--	2.53	J		0.344	J		1.63	J		2.75	J		0.362	J		5.88			1.76	J		4.15			2	J		4.72		
1,2,3,4,6,7,8-HpCDD	0.01	--	90.1			8.26			82.9			165			10.6			377			153			317			111			269		
OCDD	0.0003	--	947			61.2			655			1260			92.6			3360			1410			3170			979			3120		
2,3,7,8-TCDF	0.1	--	0.518	U		0.116	JK	U	0.235	JK	U	0.841	J		0.361	U		1.82	J		0.761	J		0.646	J		0.305	U		25.1		
1,2,3,7,8-PeCDF	0.03	--	0.25	U		0.199	J		0.173	JK	U	0.693	JP	J	0.0889	U		0.931	J		0.733	JK	U	0.625	J		0.182	U		1.37	J	
2,3,4,7,8-PeCDF	0.3	--	0.261	U		0.258	J		0.223	JK	U	1.44	J		0.0937	U		2.92	J		2.42	J		2.3	J		0.439	JK	U	1.75	J	
1,2,3,4,7,8-HxCDF	0.1	--	0.814	J		0.229	J		1.39	J		2.97	J		0.295	J		6.13			4.03			4.63			1.35	J		0.959	J	
1,2,3,6,7,8-HxCDF	0.1	--	0.349	JK	U	0.189	J		0.72	JK	U	0.992	J		0.115	JK	U	2.33	J		1.59	JK	U	2.03	J		0.606	J		0.49	J	
1,2,3,7,8,9-HxCDF	0.1	--	0.301	U		0.256	JK	U	0.33	J		1.13	J		0.101	J		0.827	U		0.881	J		1.28	U		0.465	U		0.301	U	
2,3,4,6,7,8-HxCDF	0.1	--	0.655	J		0.248	J		1.23	J		1.56	J		0.161	J		4.63			2.85	J		4.27			1.04	J		0.602	JK	U
1,2,3,4,6,7,8-HpCDF	0.01	--	10.8			1.44	J		39.2			23.2			2.78	J		118			46.8			131			27.2			13.9		
1,2,3,4,7,8,9-HpCDF	0.01	--	0.621	J		0.238	JK	U	1.64	J		1.85	J		0.175	JK	U	6.33			2.47	J		5.98			1.9	J		0.827	JK	U
OCDF	0.0003	--	29.3			3.93	J		127			70.1			10.9			664			165			680			55.9			65.4		
Dioxin/Furan 1/2 DL TEC (ng TEC/kg DW)																																
2,3,7,8-TCDD	1	--	0.241	U		0.0159	U		0.0795	JK	U	0.0845	JK	U	0.094	U		0.236	JK	U	0.137	U		0.21	JK	U	0.102	U		3.49		
1,2,3,7,8-PeCDD	1	--	0.233	JK	U	0.306	J		0.169	JK	U	0.753	J		0.104	J		0.66	JK	U	0.604	J		1.21	J		0.224	JK	U	0.985	JK	U
1,2,3,4,7,8-HxCDD	0.1	--	0.104	J		0.0231	J		0.0726	J		0.125	J		0.0151	J		0.243	J		0.0389	JK	U	0.168	J		0.116	J		0.14	J	
1,2,3,6,7,8-HxCDD	0.1	--	0.3	J		0.047	J		0.302			0.548			0.0269	JK	U	1.4			0.482			1.16			0.383			0.884		
1,2,3,7,8,9-HxCDD	0.1	--	0.253	J		0.0344	J		0.163	J		0.275	J		0.0362	J		0.588			0.176	J		0.415			0.2	J		0.472		
1,2,3,4,6,7,8-HpCDD	0.01	--	0.901			0.0826			0.829			1.65			0.106			3.77			1.53			3.17			1.11			2.69		
OCDD	0.0003	--	0.284			0.0184			0.197			0.378			0.0278			1.01			0.423			0.951			0.294			0.936		
2,3,7,8-TCDF	0.1	--	0.0259	U		0.0058	JK	U	0.0118	JK	U	0.0841	J		0.0181	U		0.182	J		0.0761	J		0.0646	J		0.0153	U		2.51		
1,2,3,7,8-PeCDF	0.03	--	0.00375	U		0.00597	J		0.0026	JK	U	0.0208	JP	J	0.00133	U		0.0279	J		0.011	JK	U	0.0188	J		0.00273	U		0.0411	J	
2,3,4,7,8-PeCDF	0.3	--	0.0392	U		0.0774	J		0.0335	JK	U	0.432	J		0.0141	U		0.876	J		0.726	J		0.69	J		0.0659	JK	U	0.525	J	
1,2,3,4,7,8-HxCDF	0.1	--	0.0814	J		0.0229	J		0.139	J		0.297	J		0.0295	J		0.613			0.403			0.463			0.135	J		0.0959	J	
1,2,3,6,7,8-HxCDF	0.1	--	0.0175	JK	U	0.0189	J		0.036	JK	U	0.0992	J		0.00575	JK	U	0.233	J		0.0795	JK	U	0.203	J		0.0606	J		0.049	J	
1,2,3,7,8,9-HxCDF	0.1	--	0.0151	U		0.0128	JK	U	0.033	J		0.113	J		0.0101	J		0.0414	U		0.0881	J		0.064	U		0.0233	U		0.0151	U	
2,3,4,6,7,8-HxCDF	0.1	--	0.0655	J		0.0248	J		0.123	J		0.156	J		0.0161	J		0.463			0.285	J		0.427			0.104	J		0.0301	JK	U
1,2,3,4,6,7,8-HpCDF	0.01	--	0.108			0.0144	J		0.392			0.232			0.0278	J		1.18			0.468			1.31			0.272			0.139		
1,2,3,4,7,8,9-HpCDF	0.01	--	0.00621	J		0.00119	JK	U	0.0164	J		0.0185	J		0.000875	JK	U	0.0633			0.0247	J		0.0598			0.019	J		0.00414	JK	U
OCDF	0.0003	--	0.00879			0.00118	J		0.0381			0.021			0.00327			0.199			0.0495			0.204			0.0168			0.0196		
Dx/F TEQ (0 DL)	4	10	2.11			0.677			2.3			5.2			0.376			10.8			5.34			10.5			2.71			12		
Dx/F TEQ (1/2 DL)	4	10	2.69			0.713			2.64			5.29			0.537			11.8			5.60			10.8			3.14			13		

Notes:
LQ: laboratory qualifier **VQ**: validation qualifier **DW**: dry weight **DL**: detection limit
TEF: toxicity equivalent factor **TEC**: toxicity equivalent concentration **TEQ**: toxicity equivalents
SL: screening level **ML**: maximum level **BT**: bioaccumulation trigger Exceeds SL Exceeds BT
U the analyte was analyzed for, but not detected
J the result is estimated
K estimated maximum potential concentration

Table 15. Subarea B Dioxin/Furan Congener Results (cont.)

			LBBS1-C 12/1/2016	LQ	VQ	LBBS2-C 11/30/2016	LQ	VQ	AMB2-C 11/30/2016	LQ	VQ	LBBZ-U-Z 11/30/2016	LQ	VQ	RB1-C 11/30/2016	LQ	VQ	RB2-C 12/2/2016	LQ	VQ	RBS1-C 12/2/2016	LQ	VQ	RBS2-C 12/2/2016	LQ	VQ	RBZ-U-Z 12/2/2016	LQ	VQ
Dioxin/Furan Concentration (ng/kg DW)																													
2,3,7,8-TCDD	1	--	0.249	JK	U	0.259	JK	U	0.259	U		0.346	U		0.432	U		0.809	U		0.601	J		0.399	JK	U	0.469	JK	U
1,2,3,7,8-PeCDD	1	--	0.454	JK	U	0.887	J		0.0683	JK	U	0.17	U		0.715	JK	U	0.493	J		1.37	J		1.79	JK	U	2.26	J	
1,2,3,4,7,8-HxCDD	0.1	--	0.664	JK	U	1.44	J		0.185	J		0.148	U		1.42	J		0.992	J		2.02	J		3.78	JK	U	3.5	J	
1,2,3,6,7,8-HxCDD	0.1	--	4.29			14.8			0.859	J		0.338	JK	U	5.63			3.58	J		7.4			14.5			21		
1,2,3,7,8,9-HxCDD	0.1	--	1.83	J		4.02			0.512	J		0.143	U		2.94	J		2.02	J		4.2			7.13			7.91		
1,2,3,4,6,7,8-HpCDD	0.01	--	115			449			15.1			6.3			143			107			252			455			566		
OCDD	0.0003	--	892			3170			119			58.9			1210			1010			2350			3710			5010		
2,3,7,8-TCDF	0.1	--	1.82	J		0.564	J		0.195	U		0.401	U		0.584	J		0.798	U		1.47	JK	U	2.91			1.62	J	
1,2,3,7,8-PeCDF	0.03	--	0.494	J		0.439	J		0.0716	U		0.191	U		0.586	J		0.381	U		0.507	J		0.974	J		1.11	J	
2,3,4,7,8-PeCDF	0.3	--	0.476	JK	U	0.322	U		0.224	JK	U	0.204	U		1.05	JK	U	0.401	U		1.45	J		3.05	J		4.2		
1,2,3,4,7,8-HxCDF	0.1	--	1.64	J		4.03			0.361	J		0.133	U		2.3	J		1.03	J		2.5	J		4.99			10.6		
1,2,3,6,7,8-HxCDF	0.1	--	0.619	J		2.93	J		0.115	U		0.121	U		0.894	JK	U	0.486	U		0.929	JK	U	1.86	JK	U	3.93	J	
1,2,3,7,8,9-HxCDF	0.1	--	0.578	JK	U	1.09	JK	U	0.154	U		0.184	U		1.21	J		0.681	U		0.616	U		1.24	JK	U	2.81	J	
2,3,4,6,7,8-HxCDF	0.1	--	1.07	J		6.34			0.256	JK	U	0.145	U		1.8	J		0.738	J		1.64	JK	U	3.13	J		7.26		
1,2,3,4,6,7,8-HpCDF	0.01	--	16.4			274			4.12			1.26	J		25.5			13.8			35.5			69.4			206		
1,2,3,4,7,8,9-HpCDF	0.01	--	1.06	J		11.8			0.337	JK	U	0.184	U		2.25	J		1.02	J		2.13	J		3.59	JK	U	11.7		
OCDF	0.0003	--	50			1870			15.4			6.93			105			50.7			68.9			121			1160		
Dioxin/Furan 1/2 DL TEC (ng TEC/kg DW)																													
2,3,7,8-TCDD	1	--	0.125	JK	U	0.13	JK	U	0.13	U		0.173	U		0.216	U		0.405	U		0.601	J		0.2	JK	U	0.235	JK	U
1,2,3,7,8-PeCDD	1	--	0.227	JK	U	0.887	J		0.0342	JK	U	0.085	U		0.358	JK	U	0.493	J		1.37	J		0.895	JK	U	2.26	J	
1,2,3,4,7,8-HxCDD	0.1	--	0.0332	JK	U	0.144	J		0.0185	J		0.0074	U		0.142	J		0.0992	J		0.202	J		0.189	JK	U	0.35	J	
1,2,3,6,7,8-HxCDD	0.1	--	0.429			1.48			0.0859	J		0.0169	JK	U	0.563			0.358	J		0.74			1.45			2.1		
1,2,3,7,8,9-HxCDD	0.1	--	0.183	J		0.402			0.0512	J		0.00715	U		0.294	J		0.202	J		0.42			0.713			0.791		
1,2,3,4,6,7,8-HpCDD	0.01	--	1.15			4.49			0.151			0.063			1.43			1.07			2.52			4.55			5.66		
OCDD	0.0003	--	0.268			0.951			0.0357			0.0177			0.363			0.303			0.705			1.11			1.5		
2,3,7,8-TCDF	0.1	--	0.182	J		0.0564	J		0.00975	U		0.0201	U		0.0584	J		0.0399	U		0.0735	JK	U	0.291			0.162	J	
1,2,3,7,8-PeCDF	0.03	--	0.0148	J		0.0132	J		0.00107	U		0.00287	U		0.0176	J		0.00572	U		0.0152	J		0.0292	J		0.0333	J	
2,3,4,7,8-PeCDF	0.3	--	0.0714	JK	U	0.0483	U		0.0336	JK	U	0.0306	U		0.158	JK	U	0.0602	U		0.435	J		0.915	J		1.26		
1,2,3,4,7,8-HxCDF	0.1	--	0.164	J		0.403			0.0361	J		0.00665	U		0.23	J		0.103	J		0.25	J		0.499			1.06		
1,2,3,6,7,8-HxCDF	0.1	--	0.0619	J		0.293	J		0.00575	U		0.00605	U		0.0447	JK	U	0.0243	U		0.0465	JK	U	0.093	JK	U	0.393	J	
1,2,3,7,8,9-HxCDF	0.1	--	0.0289	JK	U	0.0545	JK	U	0.0077	U		0.0092	U		0.121	J		0.0341	U		0.0308	U		0.062	JK	U	0.281	J	
2,3,4,6,7,8-HxCDF	0.1	--	0.107	J		0.634			0.0128	JK	U	0.00725	U		0.18	J		0.0738	J		0.082	JK	U	0.313	J		0.726		
1,2,3,4,6,7,8-HpCDF	0.01	--	0.164			2.74			0.0412			0.0126	J		0.255			0.138			0.355			0.694			2.06		
1,2,3,4,7,8,9-HpCDF	0.01	--	0.0106	J		0.118			0.00169	JK	U	0.00092	U		0.0225	J		0.0102	J		0.0213	J		0.018	JK	U	0.117		
OCDF	0.0003	--	0.015			0.561			0.00462			0.00208			0.0315			0.0152			0.0207			0.0363			0.348		
Dx/F TEQ (0 DL)	4	10	2.75			13.2			0.424			0.0953			3.71			2.87			7.66			10.6			19.1		
Dx/F TEQ (1/2 DL)	4	10	3.23			13.4			0.661			0.468			4.48			3.43			7.89			12.1			19.3		

Notes:

LQ: laboratory qualifier **VQ**: validation qualifier **DW**: dry weight **DL**: detection limit

TEF: toxicity equivalent factor **TEC**: toxicity equivalent concentration **TEQ**: toxicity equivalents

SL: screening level **ML**: maximum level **BT**: bioaccumulation trigger Exceeds SL Exceeds BT

U the analyte was analyzed for, but not detected

J the result is estimated

K estimated maximum potential concentration

Table 16. Dioxin Congener Results for Individual Core Sections

			LBB-LBB-2-S 12/1/2016	LQ	VQ	LBBS2-LBB-2-S 12/1/2016	LQ	VQ	BS3-B1-1-S 12/1/2016	LQ	VQ
Dioxin/Furan Concentration (ng/kg DW)											
2,3,7,8-TCDD	1	--	0.52	U		0.574	U		0.258	U	
1,2,3,7,8-PeCDD	1	--	0.818	JK	U	0.514	JK	U	0.145	U	
1,2,3,4,7,8-HxCDD	0.1	--	2.46	J		1.32	JK	U	0.11	U	
1,2,3,6,7,8-HxCDD	0.1	--	8.01			5.32			0.166	JK	U
1,2,3,7,8,9-HxCDD	0.1	--	4.58	J		2.44	J		0.102	U	
1,2,3,4,6,7,8-HpCDD	0.01	--	206			145			3.01		
OCDD	0.0003	--	1690		J	1300			20.4		
2,3,7,8-TCDF	0.1	--	0.601	U		1.2	J		0.204	U	
1,2,3,7,8-PeCDF	0.03	--	0.512	JK	U	0.564	JK	U	0.081	U	
2,3,4,7,8-PeCDF	0.3	--	1.24	J		1.58	J		0.0871	U	
1,2,3,4,7,8-HxCDF	0.1	--	2.17	J		2.03	J		0.104	U	
1,2,3,6,7,8-HxCDF	0.1	--	0.971	JK	U	0.82	J		0.0915	U	
1,2,3,7,8,9-HxCDF	0.1	--	0.939	J		0.608	U		0.126	U	
2,3,4,6,7,8-HxCDF	0.1	--	1.82	J		1.41	J		0.113	U	
1,2,3,4,6,7,8-HpCDF	0.01	--	27			27.2			0.723	J	
1,2,3,4,7,8,9-HpCDF	0.01	--	1.61	JK	U	1.78	J		0.0946	U	
OCDF	0.0003	--	100			113			1.72	J	
Dioxin/Furan 1/2 DL TEC (ng TEC/kg DW)											
2,3,7,8-TCDD	1	--	0.26	U		0.287	U		0.129	U	
1,2,3,7,8-PeCDD	1	--	0.409	JK	U	0.257	JK	U	0.0725	U	
1,2,3,4,7,8-HxCDD	0.1	--	0.246	J		0.066	JK	U	0.0055	U	
1,2,3,6,7,8-HxCDD	0.1	--	0.801			0.532			0.0083	JK	U
1,2,3,7,8,9-HxCDD	0.1	--	0.458	J		0.244	J		0.0051	U	
1,2,3,4,6,7,8-HpCDD	0.01	--	2.06			1.45			0.0301		
OCDD	0.0003	--	0.507		J	0.39			0.00612		
2,3,7,8-TCDF	0.1	--	0.0301	U		0.12	J		0.0102	U	
1,2,3,7,8-PeCDF	0.03	--	0.00768	JK	U	0.00846	JK	U	0.00122	U	
2,3,4,7,8-PeCDF	0.3	--	0.372	J		0.474	J		0.0131	U	
1,2,3,4,7,8-HxCDF	0.1	--	0.217	J		0.203	J		0.0052	U	
1,2,3,6,7,8-HxCDF	0.1	--	0.0486	JK	U	0.082	J		0.00458	U	
1,2,3,7,8,9-HxCDF	0.1	--	0.0939	J		0.0304	U		0.0063	U	
2,3,4,6,7,8-HxCDF	0.1	--	0.182	J		0.141	J		0.00565	U	
1,2,3,4,6,7,8-HpCDF	0.01	--	0.27			0.272			0.00723	J	
1,2,3,4,7,8,9-HpCDF	0.01	--	0.00805	JK	U	0.0178	J		0.000473	U	
OCDF	0.0003	--	0.03			0.0339			0.000516	J	
Dx/F TEQ (0 DL)	4	10	5.24			3.96			0.044		
Dx/F TEQ (1/2 DL)	4	10	6.00			4.61			0.311		

Notes:

LQ: laboratory qualifier **VQ**: validation qualifier **DW**: dry weight **DL**: detection limit

TEF: toxicity equivalent factor **TEC**: toxicity equivalent concentration **TEQ**: toxicity equivalent quotient

SL: screening level **ML**: maximum level **BT**: bioaccumulation trigger Exceeds SL Exceeds BT

U the analyte was analyzed for, but not detected

J the result is estimated

K estimated maximum potential concentration

Table 17. Polybrominated Diphenyl Ether Results

	A5-C 11/29/2016	LQ	VQ	BS3-C 12/2/2016	LQ	VQ	LBA-C 11/29/2016	LQ	VQ
Polybrominated diphenyl ethers (ng/kg DW)									
BDE 8/11	13	R		3.16	J		11.4		
BDE 15	10	R		4.23			7.12		
BDE 17/25	75.1			16.4			67.3		
BDE 28/33	12.7			3.86	M		12.7		
BDE 32	1.75	J		0.63	U		1.5	JR	
BDE 35	0.23	MJR		2.8	JR		0.23	U	
BDE 37	0.81	JR		0.584	J		0.94	J	
BDE 47	156			37.2			199		
BDE 49	88.5	M		19.6	M		99.5	M	
BDE 51	10.9	M		2.59	J		10.4		
BDE 66	7.31	J		1.93	J		9.58		
BDE 71	4.6	MJ		0.831	MJ		4.6	MR	
BDE 75	0.39	U		0.185	J		0.46	J	
BDE 77	0.37	U		0.22	MJR		0.31	U	
BDE 79	0.33	U		0.13	MJR		0.27	U	
BDE 85	4.41	J		1.2	J		8.8		
BDE 99	120			16.4			196		
BDE 100	32.2	M		5.25			47.5	M	
BDE 105	0.84	U		0.42	J		0.8	U	
BDE 118	0.83	U		0.54	MJ		1.3	MJR	
BDE 119/120	4.85	MJ		0.87	MJ		7.55	MJ	
BDE 126	0.59	U		0.48	J		0.5	U	
BDE 128	2.5	U		0.74	U		2.4	U	
BDE 138/166	1.9	U		0.56	U		1.8	U	
BDE 140	1.2	U		0.36	U		1.1	U	
BDE 153	14.1	J		1.86	J		23.5		
BDE 154	13.9	MJ		1.4	U		24.7	J	
BDE 155	2.22	J		1.4	U		2.4	MJR	
BDE 156	2.8	U		0.83	U		2.7	U	
BDE 181	1.2	U		0.25	U		1.3	U	
BDE 183	6.97	J		1.13	J		8.89	J	
BDE 184	1.96	MJ		0.54	J		1.88	MJ	
BDE 190	1.7	U		0.35	U		1.8	U	
BDE 191	1.4	U		0.28	U		1.4	U	
BDE 196	4.6	JR		0.32	U		6.9	JR	
BDE 197	7.6	MJ		0.89	J		9.1	J	
BDE 203	4.8	MJR		0.35	U		8.5	MJR	
BDE 206	70.2	J		5.96	J		150		
BDE 207	44.4	J		5.3	J		64.2		
BDE 208	36.5	J		2.45	J		40		
BDE 209	1940			156			4280		

Notes:

LQ: laboratory qualifier **VQ**: validation qualifier **DW**: dry weight **BDE:** brominated diphenyl ether

M a peak has been manually integrated

R the ion abundance ratio(s) did not meet the acceptance criteria. Value is an estimated maximum.

J the analyte was detected below the calibrated range but above the EDL

U the analyte was not detected above the EDL

Table 18. Subarea A Carbon-Normalized Chemistry Results Compared to SQS

	SQS	CSL	A1-C	LQ	VQ	A2-C	LQ	VQ	A3-C	LQ	VQ	A4-C	LQ	VQ	A5-C	LQ	VQ	AMA1-C	LQ	VQ	AMA2-C	LQ	VQ	LBA-C	LQ	VQ	AMA3-C	LQ	VQ	TB-C	LQ	VQ	TBS1-C	LQ	VQ	TBS2-C	LQ	VQ	TBAM-C	LQ	VQ
Conventionals																																									
Total Organic Carbon	--	--	2.24			2.06			1.96			2.19			2.55			1.86			2.22			2.61			2.33			2.53			2.15			2.25			2.11		
PAH (mg/kg OC)																																									
Naphthalene	99	170	0.21	T		0.218	T		0.255	T		0.274	T		0.212	T		0.285	T		0.419			0.575			0.644			0.206	T		0.242	T		0.329	T		0.218	T	
Acenaphthylene	66	66	0.388	U		0.432	U		0.459	U		0.384	U		0.349	U		0.468	U		0.396	U		0.203	T		0.27	T		0.36	U		0.409	U		0.396	U		0.412	U	
Acenaphthene	16	57	0.388	U		0.432	U		0.459	U		0.384	U		0.349	U		0.468	U		0.176	T		0.421			0.901			0.36	U		0.409	U		0.396	U		0.412	U	
Fluorene	220	1200	0.156	T		0.432	U		0.224	T		0.242	T		0.224	T		0.21	T		0.36	T		0.805			0.987			0.138	T		0.158	T		0.204	T		0.412	U	
Phenanthrene	23	79	0.58			0.583			0.765			0.868			0.745			0.806			1.13			1.8			2.88			0.632			0.558			0.756			0.664		
Anthracene	100	480	0.388	U		0.432	U		0.235	T		0.21	T		0.251	T		0.468	U		0.293	T		0.843			1.29			0.36	U		0.27	T		0.396	U		0.412	U	
2-Methylnaphthalene	38	64	0.362	T		0.34	T		0.408	T		0.411			0.31	T		0.446	T		0.586			0.728			0.773			0.34	T		0.391	T		0.489			0.327	T	
Total LPAH[a]	370	780	0.946			0.801			1.48			1.59			1.43			1.3			2.37			4.65			6.97			0.976			1.23			1.29			0.882		
Fluoranthene	160	1200	0.759			0.825			0.969			1.69			1.8			0.914			2.21			5.36			12.4			1.03			0.837			0.978			1.52		
Pyrene	1000	1400	0.491			0.534			0.663			1.05			1.25			0.591			1.53			4.98			8.58			0.632			0.558			0.622			0.9		
Benzo(a)anthracene	110	270	0.201	T		0.238	T		0.449	T		0.452			0.588			0.258	T		0.676			2.57			4.72			0.221	T		0.26	T		0.253	T		0.284	T	
Chrysene	110	460	0.491			0.451			1.02			1.05			1.22			0.591			1.31			3.49			5.58			0.435			0.884			0.489			0.853		
Benzo(b)fluoranthene	--	--	0.429			0.461			0.612			0.913			1.18			0.538			1.31			3.22			5.15			0.435			0.512			0.578			0.616		
Benzo(k)fluoranthene	--	--	0.388	U		0.432	U		0.245	T		0.247	T		0.376			0.468	U		0.495			1.11			1.76			0.36	U		0.409	U		0.396	U		0.204	T	
Benzofluoranthene	230	450	0.429			0.461			0.857			1.16			1.55			0.538			1.8			4.33			6.91			0.435			0.512			0.578			0.82		
Benzo(a)pyrene	99	210	0.17	T		0.209	T		0.296	T		0.347	T		0.549			0.237	T		0.586			1.69			2.58			0.162	T		0.237	T		0.24	T		0.251	T	
Indeno(1,2,3-cd)pyrene	34	88	0.17	T		0.209	T		0.281	T		0.361	T		0.588			0.237	T		0.586			1.3			1.67			0.174	T		0.219	T		0.213	T		0.237	T	
Dibenzo(a,h)anthracene	12	33	0.388	U		0.432	U		0.459	U		0.384	U		0.141	T		0.468	U		0.144	T		0.314	T		0.403	T		0.36	U		0.409	U		0.396	U		0.412	U	
Benzo(ghi)perylene	31	78	0.223	T		0.262	T		0.301	T		0.393			0.627			0.29	T		0.631			1.19			1.55			0.206	T		0.265	T		0.267	T		0.27	T	
Total HPAH[b]	960	5300	2.71			2.93			4.54			6.11			7.69			3.37			8.84			24			42.9			3.09			3.51			3.37			4.86		
Phthalates (mg/kg OC)																																									
Butylbenzylphthalate	4.9	64	0.228	T		0.223	T		0.321	T		0.279	T		0.247	T		0.312	T		0.396	U		0.421	T		0.472	U		0.395			0.293	T		0.347	T		0.237	T	
Di-N-Butylphthalate	220	1700	0.384	T		0.534	T		0.413	T		0.388	T		0.353	T		0.425	T		0.369	T		0.421	T		0.472	T		0.332	T		0.442	T		0.4	T		0.327	T	
Di-N-Octyl Phthalate	58	4500	0.388	U		0.432	U		0.459	U		0.384	U		0.349	U		0.468	U		0.396	U		0.421	U		0.472	U		0.36	U		0.409	U		0.396	U		0.412	U	
Diethylphthalate	61	110	0.388	U		0.432	U		0.459	U		0.384	U		0.349	U		0.468	U		0.396	U		0.421	U		0.472	U		0.36	U		0.409	U		0.396	U		0.412	U	
Dimethylphthalate	53	53	0.388	U		0.432	U		0.459	U		0.384	U		0.349	U		0.468	U		0.396	U		0.421	U		0.472	U		0.36	U		0.409	U		0.396	U		0.412	U	
Bis(2-Ethylhexyl) Phthalate	47	78	3.88	U		0.68	T		4.59	U		0.548	T		1.06	T		4.68	U		1.08	T		1.46	T		1.24	T		0.372	T		0.512	T		0.4	T		4.12	U	
Other SVOC (mg/kg OC)																																									
Dibenzofuran	15	58	0.388	U		0.432	U		0.189	T		0.205	T		0.212	T		0.468	U		0.306	T		0.805			0.987			0.36	U		0.409	U		0.16	T		0.412	U	
1,2-Dichlorobenzene	2.3	2.3	0.388	U		0.432	U		0.459	U		0.384	U		0.349	U		0.468	U		0.396	U		0.421	U		0.472	U		0.36	U		0.409	U		0.396	U		0.412	U	
1,4-Dichlorobenzene	3.1	9	0.388	U		0.432	U		0.459	U		0.384	U		0.349	U		0.468	U		0.396	U		0.421	U		0.472	U		0.36	U		0.409	U		0.396	U		0.412	U	
Hexachlorobenzene	0.38	2.3	0.388	U		0.432	U		0.459	U		0.384	U		0.349	U		0.468	U		0.396	U		0.421	U		0.472	U		0.36	U		0.409	U		0.396	U		0.412	U	
Hexachlorobutadiene	3.9	6.2	0.388	U		0.432	U		0.459	U		0.384	U		0.349	U		0.468	U		0.396	U		0.421	U		0.472	U		0.36	U		0.409	U		0.396	U		0.412	U	
N-Nitrosodiphenylamine	11	11	0.388	U		0.432	U		0.459	U		0.384	U		0.349	U		0.468	U		0.396	U		0.421	U		0.472	U		0.36	U		0.409	U		0.396	U		0.412	U	
1,2,4-Trichlorobenzene	0.81	1.8	0.388	U		0.432	U		0.459	U		0.384	U		0.349	U		0.468	U		0.396	U		0.421	U		0.472	U		0.36	U		0.409	U		0.396	U		0.412	U	
PCB Aroclors (mg/kg OC)																																									
Total PCBs[c]	12	65	0.804	U		0.804	U		0.804	U		0.804	U		0.804	U		0.804	U		0.804	U		0.804	U		0.804	U		0.804	U		0.804	U		0.804	U		0.804	U	

Notes:

LQ: laboratory qualifier **VQ**: validation qualifier **SQS**: sediment quality standard **CSL**: cleanup screening level **OC:** organic carbon normalized Exceeds SQS Exceeds CSL

U the analyte was analyzed for, but not detected

T the result is detected above the method detection limit, but below the limit of quantitation

a. sum of detected values of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene

b. sum of detected values of fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzofluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(ghi)perylene

c. sum of detected PCB Aroclors

Table 19. Subarea B Carbon-Normalized Chemistry Results Compared to SQS

			B1-C 12/1/16	LQ	VQ	B2-C 12/2/16	LQ	VQ	BS2-C 12/2/16	LQ	VQ	RB1-C 11/30/16	LQ	VQ	RB2-C 12/2/16	LQ	VQ	RBS1-C 12/2/16	LQ	VQ	RBS2-C 12/2/16	LQ	VQ
Conventionals	**SQS**	**CSL**																					
Total Organic Carbon	--	--	3.48			2.64			2.64			2.62			2.98			2.6			2.99		
PAH (mg/kg OC)																							
Naphthalene	99	170	0.178	J		0.455			0.758			3.17		J	0.604			0.369			0.368		
Acenaphthylene	66	66	0.241	U		0.227	U		0.227	U		1.64		J	0.117	J		0.296	J		0.181	J	
Acenaphthene	16	57	0.0948	J		0.227	U		0.125	J		0.496		J	0.195	J		0.208	J		0.12	J	
Fluorene	220	1200	0.213	J		0.227	U		0.205	J		0.992		J	0.369			0.923			0.271	J	
Phenanthrene	23	79	0.747			0.379			0.644			8.78		J	1.34			3.85			0.97		
Anthracene	100	480	0.287			0.133	J		0.239			2.9		J	0.47		J	3.85			0.535		
2-Methylnaphthalene	38	64	0.264			0.871			1.44			1.18		J	0.403			0.381			0.435		
Total LPAH	370	780	1.52			0.966			1.97			18		J	3.1			9.49			2.44		
Fluoranthene	160	1200	1.75			0.53			0.758			10.7		J	3.69		J	46.2	D		2.01		
Pyrene	1000	1400	1.58			0.53			0.795			8.78		J	3.69		J	32.3			3.18		
Benzo(a)anthracene	110	270	1.01			0.205	J		0.246			2.63		J	1.31		J	17.3			1.04		
Chrysene	110	460	1.52			0.28			0.292			4.2		J	2.18		J	22.3			1.81		
Benzo(b)fluoranthene	--	--	1.32			0.292			0.288			3.4		J	2.42		J	15			1.77		
Benzo(k)fluoranthene	--	--	0.46			0.227	U		0.227	U		1.15		J	0.872		J	5			0.669		
Benzofluoranthene	230	450	1.78			0.292			0.288			4.54		J	3.29		J	20			2.44		
Benzo(a)pyrene	99	210	0.805			0.17	J		0.159	J		1.56		J	1.31		J	6.92			1.04		
Indeno(1,2,3-cd)pyrene	34	88	0.402			0.227	U		0.227	U		1.07		J	0.705			2			0.468		
Dibenzo(a,h)anthracene	12	33	0.0891	J		0.227	U		0.227	U		0.252	J		0.178	J		0.692			0.137	J	
Benzo(ghi)perylene	31	78	0.316			0.227	U		0.227	U		1.03		J	0.537			1.23			0.368		
Total HPAH	960	5300	8.94			2.01			2.54			33.7		J	16.4			148			12.1		
Phthalates (mg/kg OC)																							
Butylbenzylphthalate	4.9	64	0.241	U		0.227	U		0.227	U		0.458		J	0.302	U	UJ	0.342	U		0.288	U	
Di-N-Butylphthalate	220	1700	0.284	J		0.189	J		0.193	J		0.496	J		0.369	J		0.288	J		0.769		
Di-N-Octyl Phthalate	58	4500	0.241	U		0.227	U		0.227	U		0.378	U	UJ	0.302	U		0.342	U		0.288	U	
Diethylphthalate	61	110	0.241	U		0.227	U		0.227	U		0.347	J		0.302	U		0.342	U		0.288	U	
Dimethylphthalate	53	53	0.241	U		0.227	U		0.227	U		0.176	J		0.302	U		0.158	J		0.197	J	
Bis(2-Ethylhexyl) Phthalate	47	78	1.49	J		0.682	J		2.08	J		2.86	J		3.19		J	2.23	J		1.1	J	
Other SVOC (mg/kg OC)																							
Dibenzofuran	15	58	0.21	J		0.606			0.985			1.49		J	0.403			0.369			0.304		
1,2-Dichlorobenzene	2.3	2.3	0.241	U		0.227	U		0.227	U		0.378	U	UJ	0.302	U		0.342	U		0.288	U	
1,4-Dichlorobenzene	3.1	9	0.241	U		0.227	U		0.227	U		0.378	U	UJ	0.302	U		0.342	U		0.288	U	
Hexachlorobenzene	0.38	2.3	0.241	U		0.227	U		0.227	U		0.378	U	UJ	0.302	U		0.342	U		0.288	U	
Hexachlorobutadiene	3.9	6.2	0.241	U		0.227	U		0.227	U		0.378	U	UJ	0.302	U		0.342	U		0.288	U	
N-Nitrosodiphenylamine	11	11	0.241	U		0.227	U		0.227	U		0.378	U	UJ	0.302	U		0.342	U		0.288	U	
1,2,4-Trichlorobenzene	0.81	1.8	0.241	U		0.227	U		0.227	U		0.378	U	UJ	0.302	U		0.342	U		0.288	U	
PCB Aroclors (mg/kg OC)																							
Total PCBs (OC)	12	65	0.489	U		0.417	U		0.114	J		0.099	J		0.604	U		2.85			1.04		

Notes:

For consistency with SMS, the table only includes results where TOC is less than 3.5 percent

LQ: laboratory qualifier **VQ**: validation qualifier **SQS**: sediment quality standard **CSL**: cleanup screening level **OC:** organic carbon normalized Exceeds SQS Exceeds CSL

U the analyte was analyzed for, but not detected

T the result is detected above the method detection limit, but below the limit of quantitation

a. sum of detected values of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene

b. sum of detected values of fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzofluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(ghi)perylene

c. sum of detected PCB Aroclors

Table 20. Suitability Volume Estimates for Subarea B

Portion of Subarea B	DMMU	DMMU Volume (cy)	Volume suitable for Rosario Strait	Volume suitable for Port Gardner	Volume unsuitable for open-water disposal
right berthing area	RB1-C	2,654	0	0	2,654
	RB2-C	2,962	2,962	---[a]	0
	RBS1-C	4,223	0	4,223[b]	0
	RBS2-C	3,256	0	0	3,256
main channel	B1-C	3,674	3,674	---[a]	0
	B2-C	3,214	3,214	---[a]	0
	B3-C	3,432	3,432	---[a]	0
	BS1-C	9,155	0	9,155 [b]	0
	BS2-C	7,606	7,606	---[a]	0
	BS3-C	9,730	~2,000[c]	---[a]	~7,730[c]
	BS4-C	10,634	0	10,634[b]	0
	AMB1-C	4,195	0	0	4,195
left berthing area	LBB-C	3,508	0	~1,500[bc]	~2,008[c]
	LBBS1-C	2,932	2,932	---[a]	0
	LBBS2-C	9,673	0	~3,000[bc]	~6,673[c]
	AMB2-C	1,504	1,504	---[a]	0
totals:		82,352	~27,324	~28,512	~26,516

[a]Dredged material suitable for Rosario Strait is also suitable for Port Gardner

[b]This material is only suitable for Port Gardner if the volume-weighted average of all sediment taken to Port Gardner is below 4 ng/kg TEQ for dioxin

[c]Testing was conducted for an individual core from this DMMU, resulting in a split volume. This volume is a rough estimate made for reporting purposed only. The supplement suitability determination/s for future dredging will include definitive volumes associated with the planned disposal option/s.

Attachment A

Description of Previous Sediment Characterizations
Squalicum Creek Waterway

Note: The following information was compiled by David Fox (USACE) during preparation of the scope of work for sediment characterization of the Squalicum Creek Waterway in 2016. Sources of information included suitability determinations made under the Puget Sound Dredged Disposal Analysis (PSDDA) program and the Dredged Material Management Program (DMMP), as well as other project documentation available to the Dredged Material Management Office (DMMO). The available documentation did always include enough detail to determine definitively what occurred. This was especially true in certain years for the depths of sampling and the extent of dredging. As a result, this compilation has limitations and the information included should not be considered definitive in nature.

Squalicum Creek Waterway is a federally maintained shallow-draft navigation channel initially authorized by Congress in 1930 as an entrance channel -26 ft deep (MLLW) by 200 feet wide. Construction was completed in 1931. Additional congressional action in 1937 authorized dredging of berthing areas adjacent to the inner portion of the channel and a turning basin at mid-channel on the northwest side. The authorized depth of the expanded dredging area was also -26 ft MLLW.

Sedimentation in Squalicum Creek Waterway is due to input from the Nooksack River and Squalicum Creek. Accreted sediment in the waterway has been characterized by USACE under the PSDDA program or DMMP four times, including three full characterizations and a reconnaissance survey for dioxin. Descriptions of these characterization efforts follows.

1990-1991 USACE Characterization

The first full characterization occurred in 1990-91, when 194,214 cubic yards (cy) of sediment from the waterway and adjacent Port of Bellingham berthing area on the southeast side of the waterway (hereafter referred to as the left berthing area) were tested. Testing difficulties were encountered, but, in the end, 164,912 cy were found suitable for disposal at the Bellingham Bay site. The remaining 29,302 cy were found unsuitable for open-water disposal. The unsuitable material was located at the head of the waterway (5+00 to 7+00). Of the 164,912 cy found suitable for disposal at the non-dispersive Bellingham Bay site, 145,338 cy were also suitable for disposal at the dispersive site in Rosario Strait, including all material from the left berthing area (USACE 1991; USACE 1992).

While not specifically stated in the suitability determination, it appears from the volumes included in the dredged material management units (DMMUs) that the waterway and berthing area were characterized under a ‘low-moderate’ or ‘moderate’ rank. It is also not clear to what depth the samples were taken, although it appears that -27 ft MLLW might have been the limit of characterization. TBT and dioxins/furans were not analyzed.

The material at the head of the waterway was found unsuitable due to DDT detected above the screening level (SL) or bioaccumulation trigger (BT) in two samples (concentrations of 8.2 and 63.7 B ug/kg). PCBs exceeded SL (concentration = 510 ug/kg) in the same sample with the highest DDT level. This sample was a subsurface sample (i.e. > 4 feet deep). Supplemental sampling and testing conducted in late 1991 confirmed the presence of DDT in both surface and subsurface sediment at the head of the waterway (concentrations of 17.2 and 11.1 ug/kg respectively). PCBs were undetected in both surface and subsurface sediment samples, although the reporting limit for one of the subsurface samples was 190 ug/kg. Bioassays were not conducted on the DMMUs at the head of the waterway due to the BT exceedance and previous testing complications.

Squalicum Creek Waterway was subsequently dredged in 1992, with the exception of the unsuitable material at the head of the waterway, which was left in place.

1994-1995 USACE Characterization

Full characterization of Squalicum Creek Waterway occurred for the second time in 1994-95, when 258,000 cy were sampled and tested. DMMUs at the head of the waterway were ranked 'high', including those within the navigation channel, as well as in the left berthing area and an additional small berthing in the northwest corner of the channel (hereafter referred to as the right berthing area). The rest of the waterway and berthing area were ranked 'moderate'. The target characterization depth was -30 ft MLLW (-26 ft + 2 ft advanced maintenance + 2 ft overdepth), with the exception of the right berthing area where the target characterization depth was -22 ft (-20 ft + 2 ft overdepth).

All 258,000 cy were found suitable for disposal at the Bellingham Bay site. Of this volume, 214,000 cy were also found suitable for disposal at the Rosario Strait site. The 44,000 cy that were not eligible for disposal at the Rosario Strait site were contained in two DMMUs in the outer part of the channel, as well as a subsurface DMMU from the right berthing area. Chemicals exceeding SL in one or more DMMU included copper, mercury, lead, nickel, indeno(1,2,3-cd)pyrene and DDT. No BTs were exceeded. TBT and dioxins/furans were not analyzed. All DMMUs with SL exceedances passed biological testing.

The majority of the characterized material was dredged in 1995. Small volumes of material could not be dredged at the time and were covered by subsequent recency determinations, including up to 8,000 cy in the federal portion of the project and 1,200 cy in the left berthing area. The remaining material was dredged in 1998.

It should be noted that since the time this characterization was conducted, the SLs for copper, mercury, lead and indeno(1,2,3-cd)pyrene have all increased, such that the concentrations of these chemicals found in 1994-95 would no longer exceed SL. In addition, nickel has been dropped from the list of chemicals of concern for marine projects and the SL for total DDT has been eliminated. The bioaccumulation trigger for total DDT remains at 50 ug/kg. Screening levels have been added for 4,4'-DDD (16 ug/kg), 4-4'-DDE (9 ug/kg) and 4,4'-DDT (12 ug/kg).

2000 USACE Characterization

The third full characterization effort occurred in 2000, when 171,888 cy of material from the waterway and adjacent berthing areas were sampled and tested. As in the previous testing cycle, DMMUs at the head of the waterway were ranked 'high'. This included the entire right berthing area, the navigation channel from station 6+12 to station 7+00, and the left berthing area from station 6+12 to station 7+57. The remaining portions of the navigation channel and left berthing area were ranked 'moderate'. The target characterization depth in the federal channel and left berthing area was -30 ft (-26 ft + 2 ft advanced maintenance + 2 ft overdepth). The full -30 ft MLLW dredge cut in those areas began at station 6+12. The target characterization depth in the right berthing area was -22 ft (-20 ft + 2 ft overdepth). The head end of the left berthing area extended to station 5+40.

All material was found suitable for open-water disposal at either the Bellingham Bay or Rosario Strait site, with the exception of one subsurface DMMU – consisting of 1,688 cy − in the right berthing area. Lead (2,100 mg/kg) and 2,4-dimethylphenol (62 ug/kg) exceeded their respective SLs in the unsuitable DMMU. The concentration of lead in this DMMU also exceeded the maximum level of 1,200 mg/kg. Nickel exceeded the SL in effect at the time in three other DMMUs. However, nickel has since been removed from the list of COCs for marine projects. The DMMP agencies required both bioassays and bioaccumulation to be conducted on the DMMU with the elevated lead concentration if open-water disposal were to be pursued as an option. Bellingham Cold Storage – the Port tenant using the right berthing area – elected not to conduct this testing. In the absence of biological testing data, this material was found unsuitable for open-water disposal. This DMMU, along with the overlying DMMU, were left in place. TBT was tested in porewater samples from four of the DMMUs. It was undetected in two samples and detected at concentrations below the BT in the other two. The highest concentration (0.13 ug/L) occurred in the left berthing area. Dioxins/furans were not analyzed.

The waterway was dredged in 2004, with the exception of the right berthing area, as noted previously.

2011 USACE Dioxin Characterization

In 2011, the Squalicum Creek Waterway was tested for dioxin to determine the feasibility of maintenance dredging under the 2010 revised DMMP dioxin guidelines for open-water disposal in Puget Sound. Samples were taken to an elevation of -28 ft MLLW (authorized depth of -26 ft plus 2 ft of overdepth) to represent potential dredged material. Dioxin/furan concentrations ranged from 2.0 to 5.1 ng/kg TEQ (n = 7). Dioxin/furan concentrations in Z-samples ranged from 0.94 to 6.3 ng/kg TEQ (n = 8).

2010 Bellingham Cold Storage Characterization

In addition to sediment characterization by USACE, Bellingham Cold Storage has conducted sampling and testing in the Squalicum Creek Waterway on two occasions. The first occurred in 2010, when 6,660 cy were characterized in the left berthing area between station 6+12 and 15+00. The project was ranked ‘moderate’.

There were no SL exceedances for standard COCs. TBT was also analyzed in porewater samples and was undetected well below the BT. The dioxin/furan concentration in one DMMU was 1.7 ng/kg TEQ. Both a field and laboratory duplicate were run on the second DMMU, yielding a mean concentration of 10.6 ng/kg TEQ for the three measurements. The volume-weighted average was less than the interim dioxin guideline of 8.7 ng/kg TEQ in effect at the time for the Elliott Bay site. The material was subsequently dredged and disposed at the Elliott Bay site.

2015 Bellingham Cold Storage Characterization

The second characterization event by Bellingham Cold Storage occurred in 2015 for 14,200 cy within the navigation channel itself. The purpose of the proposed dredging was to remove a shoal in the right-half of the channel, just northeast of the turning basin that was posing a navigation impediment for vessels using the Bellingham Cold Storage facility. A rank of ‘moderate’ was applied. The target characterization depth was -26 ft MLLW (-24 ft + 2 ft overdepth).

There was a single SL exceedance, which occurred for benzyl alcohol. The DMMP agencies used best professional judgment in finding the dredged material suitable for open-water disposal without requiring bioassays. Bulk TBT was tested in both the dredged material and Z-sample; it was undetected in both at a reporting limit well below the BT. The dioxin/furan concentrations in the dredged material and Z-sample were 1.7 and 1.6 ng/kg TEQ respectively. The dredged material was found suitable for dispersive disposal and was subsequently dredged and placed at the Rosario Strait site.