CENWS-ODS-ND

MEMORANDUM FOR RECORD February 14, 2019

SUBJECT: DETERMINATION REGARDING THE SUITABILITY OF DREDGED MATERIAL FROM THE PORT TOWNSEND MARINA FEDERAL NAVIGATION CHANNEL EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT FOR UPLAND DISPOSAL AND UNCONFINED OPEN-WATER DISPOSAL AT A DISPERSIVE OR NONDISPERSIVE SITE.

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 up to 16,000 cubic yards (CY) of dredged material from the Port Townsend Marina federal navigation channel at the Port Townsend dispersive open-water disposal site.

2. Background. Port Townsend Marina Navigation Channel Project is a federally maintained navigation channel located on the northeast corner of the Olympic Peninsula in Jefferson County, Washington. The Port Townsend marina provides both commercial and recreational vessel moorage, a boat launch, fueling facilities, and a U.S. Coast Guard pier. The authorized design depth is -12 feet (ft) Mean Lower Low Water (MLLW). USACE is responsible for conducting maintenance dredging of the navigation channel as needed to maintain navigation (Figure 1).

   Portions of the navigation channel were last characterized in 2008 (DMMP, 2008). The project was ranked moderate. At the time, core samples from six locations were composited into two DMMUs, CH1 and CG2, representing the entrance to the navigation channel and an area near the U.S. Coast Guard pier, respectively (Figure 2). All standard chemicals of concern that were tested were below the existing 2008 DMMP screening levels (SLs). Dioxin Toxic Equivalency Quotients (TEQs) for CH1 and CG2 were 4.71 and 1.42 pptr, respectively. While DMMU CG2 passed, DMMU CH1 was determined to be not suitable for open-water dispersive disposal due to dioxin (no biological testing was conducted).

   Subsequently, in fall 2009, the USACE contracted to dredge approximately 1000 CY of material from near the U.S. Coast Guard pier and portions of the navigation channel between stations 4+00 and 6+00 and 2+00 to 3+00 (Figure 3). The section of the navigation channel immediately adjacent to the USCG pier was not included in the dredging plans. Written documentation of which sections were actually dredged is no longer available; however, review of an October 2009 post-dredge survey indicates that dredging likely occurred in all of the contracted areas. There has been no dredging of the navigation channel since 2009.

   A bathymetric survey conducted in 2017 indicated shoaling above the authorized depth; shoaling was primarily at the head (southwest end) of the channel with various high spots located elsewhere along the channel and towards the channel entrance (Figure 1). Based on the 2017 survey, 7,193 CY of material was determined to be present above the proposed dredging depth of -14 ft MLLW (includes 2 ft of overdepth). USACE contracted with Anamar

and subcontractor EcoAnalysts to characterize the navigation channel to the authorized depth plus two feet of overdepth for all shoaled areas.

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

Table 1. Project Summary and Tracking Information

Project ranking	Moderate
Authorized depth (ft MLLW)	-12
Characterized depth (authorized depth plus 2 ft depth)	-14 ft MLLW
Calculated volume (authorized depth plus 2 ft overdepth to -14 ft MLLW) (Sept 2017 survey)	7,193 CY
Characterized volume	16,000 CY
1st Draft SAP received	October 4, 2017
1st Draft SAP returned for revisions	October 13, 2017
2nd draft SAP received	October 27, 2017
2nd draft SAP returned for revisions	November 2, 2017
Final SAP received	November 7, 2017
Final SAP approved	November 7, 2017
Sampling date(s)	November 17, 2017
Analysis of dredge prism samples	February 2018
First analysis of Z-layer samples	April 2018
Second analysis of Z-layer samples	June 2018
Draft Sediment Characterization Report (SCR) received	July 20, 2018
Comments provided on draft SCR	July 30, 2018
Third analysis of Z-layer samples	August 2018
2nd draft SCR received	October 5, 2018
Comments provided on 2nd draft SCR	October 18, 2018
Final SCR received	October 23, 2018
Final SCR approved	October 24, 2018
DMMO tracking number	PTMAR-1-A-F-388
EIM Study ID	PTMAR17
Recency Determination (moderate)	November 2023

4. Project Ranking and Sampling Requirements. Sediments in the navigation channel are ranked as "moderate" concern for potential contamination (DMMP, 2016).

For a moderate-ranked project with heterogeneous sediment, the number of analyses and field samples are calculated as follows:

Maximum volume of sediment represented by each field sample: 4,000 CY
Maximum volume of sediment represented by each analysis: 16,000 CY

Given the relatively shallow depth of shoaling above the proposed dredging depth (-14 ft

MLLW), a distinction between surface and subsurface material was not required. However, core samples were required to ensure collection of representative sample material from both the dredge prism and z-layer.

The estimated volume in the navigation channel (based on the 2015 survey) was 7,193 CY (including 2 ft overdepth). One Dredged Material Management Unit (DMMU) was allocated to characterize this material. Due to concerns regarding elevated sediment dioxin concentrations in the navigation channel and lack of any historical sampling at the head of the navigation channel, sediment material was collected from a total of 5 sample locations to form the DMMU composite.

The total volume for the DMMU tested – based on the maximal volume allowed per DMMU and maximum volume allowed per field sample – is 16,000 CY.

5. Sampling and Analysis. Sampling occurred on November 17, 2017 using a vibracore sampler deployed from a sampling vessel. Figure 1 shows both target and actual sampling locations. Sediment material was collected from five locations (A through E) and composited into one (1) DMMU (Table 3). Archive material from the dredge prism and z-layer was collected from each of the sampling locations.

   Sample location PT17-A (at the head of the navigation channel) required two coring attempts after the core barrel came up mostly empty on the first attempt. On the second attempt, acceptable recovery was attained. A fine silt surface layer was underlain by sand, some gravel, and more densely packed coarse sand with silt beneath that.

   Sample location PT17-B was shifted approximately 15 feet to accommodate a boat parked on the target location. The substrate at PT17-B was reported as mostly silt with some sand and a high proportion of shell hash.

   Sample location PT17-C was moved more significantly -- approximately 130 ft southwest -- due to core refusal at the target station location. At the new location, the presence of shell hash in the top foot of sediment caused some difficulty, and recovery was attained on the second attempt.

   Sample locations PT17-D and PT17-E were sampled without incident; core logs indicated that the material at these locations was dominated by sand and silt with a small amount of fine wood debris.

   The intact cores were transported to the EcoAnalysts' Port Gamble laboratory, where the composites were created and archive samples taken. The DMMU composite and archived material were submitted to ALS, located in Kelso, Washington for conventionals and chemical analyses. The Kelso laboratory performed all method analyses except for dioxin/furan analysis, which was conducted by the ALS laboratory in Houston, Texas and the final (third round) of Z-layer dioxin/furan analysis, which was conducted by Analytical Resources, Inc (ARI) of Tukwila, Washington.

Initially, only the DMMU composite was analyzed; however, due to dioxin concentrations in the DMMU composite, the archived dredge prism and z-layer samples from each sampling location were subsequently analyzed for dioxins. The five individual dredge prism samples were analyzed in February 2018. The z-layer samples were first analyzed in April 2018, but were subsequently re-analyzed in June 2018 and again in August 2018 due to laboratory quality control issues. All laboratory analyses (Table 4) were performed by ALS, except for the August 2018 re-analysis of z-layer samples, which was conducted by ARI.

During the April 2018 analysis, the laboratory omitted the PS-SRM. Thus, for the June 2018 re-analysis, the laboratory re-extracted and re-analyzed the five z-layer samples for dioxin analysis. However, during the June 2018 analysis, while the PS-SRM was extracted alongside the samples, the laboratory failed to analyze the PS-SRM with the samples; the laboratory ran the PS-SRM 5 days after the five z-layer samples were analyzed. Consequently, the Z-layer samples were analyzed a third and final time (August 2018) by ARI, Inc. During the August 2018 analysis, the PS-SRM was run appropriately, and the DMMP found the results acceptable.

Data Validation. All sample chemistry data were validated to a minimum of EPA Stage 2B; in addition, dioxin sample data underwent 10% Stage 4 data validation. Only minor QA/QC issues were reported by the data validation sub-contractor; the issue with the PS-SRM was identified by the DMMP agencies. The final data presented in this memo were considered acceptable for use. Validation results are summarized in the sediment characterization report (Anamar, 2018)

6. Results. The conventional and chemistry results for the DMMU composite are presented alongside the DMMP marine guidelines in Table 6. Dioxin results for the DMMU composite and dredge prism samples are presented in Table 7. Final Z-layer dioxin results are presented in Table 8.

Grain Size and Sediment Conventionals. The composition of the DMMU composite was primarily sand (87%) with smaller amounts of fines (8.37%) and gravel (1.17%). The total organic carbon (TOC) content was fairly low (0.4%) as were the sulfides and ammonia concentrations at 34 and 4 mg/kg, respectively.

Standard DMMP Chemicals of Concern. In general, concentrations were low for all standard chemicals of concern (COC) No chemistry results (detects and non-detects) exceeded the DMMP Screening Level (SL), Bioaccumulation Trigger (BT), or Maximum Level (ML) for the standard COCs (which do not include TBT and dioxins/furans).

Tributyltin. Bulk sediment tributyltin (TBT) concentration in the DMMU composite was 5.3 µg/kg, which is well below the marine bioaccumulation trigger (BT) of 73 µg/kg.

Dioxins/furans. A dioxin TEQ of 8.42 pptr was measured in the DMMU composite sample; because this value exceeds the DMMP's dispersive disposal site guidelines for dioxin (and the nearest DMMP disposal site is the dispersive Port Townsend site), the five archived dredge prism samples (PT17A, PT17B, PT17C, PT17D, and PT17E) from each of the 5 sampling

locations were analyzed to try and identify the source of the elevated dioxins within the navigation channel. Dioxin TEQs for the five dredge prism samples ranged from a low of 2.6 (PT17E) to a high of 48.4 pptr (PT17C). The calculated dioxin TEQs exceeded the dispersive DMMP guideline of 4 pptr at stations PT17B (11.1 pptr), PT17C (48.4), and PT17D (4.3 pptr). Given analytical constraints and known variability, the DMMP considers the result of 4.3 pptr TEQ at station PT17D to meet the DMMP dispersive guideline of 4 pptr TEQ; thus only two of the five stations (C and D) fail to meet the DMMP dispersive guideline for dioxins.

Due to the elevated dioxin results in the dredge prism samples, the five underlying archived Z-layer samples (PT17A-Z, PT17B-Z, PT17C-Z, PT17D-Z, and PT17E-Z) were subsequently analyzed. Due to a laboratory failure to include appropriate analysis of the Puget Sound SRM, the z-layer archives were analyzed a total of three times. Z-layer samples were analyzed twice by ALS (April and June 2018) and one final time by ARI in August 2018.

The final (accepted) round of Z-layer dioxin results are presented in Table 8 with dioxin TEQs summarized in Table 2 (below). Dioxin TEQs ranged from a low of 0.1 pptr (PT17A-Z, PT17B-Z, and PT17E-Z) to a high of 19.5 pptr for sample PT17C-Z. The elevated Z-layer TEQ observed at sample location PT17C corresponded with the highest concentration (48.4 pptr) in the overlying dredge prism sample material.

Table 2. Dioxin/Furan TEQ Results Summary

Location	Dioxin TEQ (pptr)	
	Dredge Prism	Z-layer
PT17-COMP	8.42	NA
PT17A	2.9	0.1
PT17B	11.1	0.1
PT17C	48.4	19.5
PT17D	4.3	7.3
PT17E	2.6	0.1
Average	13.0	5.4

Comparison to SMS Benthic Criteria. Ecology does not recommend carbon-normalization when TOC is below 0.5 percent. The measured TOC for the DMMU composite was 0.4%; therefore, comparisons using OC-normalized chemistry results are not indicated.

7. Biological Testing. No bioassays or bioaccumulation testing were conducted. No chemicals of concern exceeded the DMMP screening levels, and although the bioaccumulation trigger (10 pptr TEQ) for dioxin was exceeded in the DMMU composite and two of the five individual prism samples, bioaccumulation testing was not conducted at this time.

8. Sediment Exposed by Dredging. Sediment exposed by dredging must meet either the State of Washington Sediment Quality Standards (SQS) or the State's antidegradation standard (DMMP, 2008).

There were no exceedances of the DMMP SL criteria for standard DMMP COCs in the dredge prism. Thus, no further evaluation of the z-layer material was required for the standard CoCs.

TBT and dioxins do not have a SL, but they do have a BT. TBT in the DMMU composite was well below the BT of 73 ug/kg, so no further evaluation of the z-layer was required for TBT.

The dioxin TEQ in the DMMU composite (8.42 pptr) exceeded the 4 pptr guideline for dispersive site disposal, but was less than the 10 pptr guidelines for non-dispersive disposal. Given the availability of the five dredge prism and five z-layer sample data, the DMMP subdivided the navigation channel into inner and outer channel sections (further described in Section 10 of this document) for the purpose of suitability and anti-degradation evaluations.

For the inner channel (Stations 6+00 to 21+63), the DMMP has determined that the sediment exposed by dredging does not meet the state anti-degradation requirement due to the following reasons:

- The average TEQ (6.6 pptr) for the z-layers of the three sample locations (PT17A, PT17B, and PT17C) exceeds natural background for dioxin (4 pptr TEQ);
- The dioxin TEQ at sample location PT17C (19.5 pptr) exceeds the DMMP's upper bound screening concentration of 10 pptr TEQ, and is more than two-orders-of-magnitude higher than that measured in the other two z-samples from the inner channel. Further analysis would be needed to characterize the spatial extent and magnitude of dioxin contamination in the area between PT17C and PT17 A and B.

For the outer channel (Stations 0+00 to 6+00), the DMMP has determined that the sediment exposed by dredging meets the state anti-degradation requirement due to the following reasons:

- At both sample locations PT17D and PT17E, the dioxin TEQ values in the z-layer are less than the BT of 10 pptr and the average of these two locations (3.7 pptr) is less than natural background for dioxin (4 pptr TEQ);
- The average TEQ for the z-layer is within analytical variability of the current average surface dioxin concentration of 3.5 pptr; and
- The maximum measured dioxin TEQ in the outer channel z-layer (7.3 pptr) still lies within the DMMP's upper bound screening concentration of 10 pptr TEQ.

9. Debris Management. The DMMP agencies implemented a debris management requirement following the 2015 SMARM in order to prevent the disposal of debris (natural or anthropogenic) greater than 12 inches in any dimension at open-water disposal sites in Puget Sound. Debris screens are required unless it can be demonstrated that debris is unlikely to be present or that the debris is large woody debris that can be easily observed and removed by other means during dredging. Examples of projects where debris requiring the use of a screen is unlikely to be present include dredging of frequently maintained areas; areas where debris is not expected based on operational use; and past experience.

USACE maintenance dredging records for the Port Townsend navigation channel are limited to a focused dredging event in 2009 that removed approximately 1000 CY from the areas shown in Figure 3. Video footage from the 2009 dredging event shows what appears to be generally clean piles of sediment on the dredging scow. No large debris (anthropogenic or woody) was observed in the footage. Based on the video footage and the fact that dredging has occurred in the outer half of the navigation channel (closest to the entrance), the agencies agree that section of the channel between stations 0+00 to 6+00 is of low concern for debris and a screening grid is not required. However, if any debris larger than 12 inches in any dimension is encountered, it must be segregated and disposed of in an upland landfill or other appropriate location. At no time may any debris greater than 12 inches in any dimension be disposed at an open-water disposal site.

The need for a screening grid is not applicable for the inner portion of the navigation channel (6+00 to 21+63, since all material in this section has been determined to be unsuitable for open-water disposal by the DMMP agencies (Section 10).

10. Suitability Determination. This memorandum documents the evaluation of the suitability of sediment from the Port Townsend federal navigation channel for open-water disposal. The data gathered were determined to be sufficient and acceptable for regulatory decision-making under the DMMP program.

    The DMMP's final suitability decision utilized both the composite and the discrete prism sample data to determine which material is suitable for open-water disposal. Material with a dioxin TEQ of up to 10 pptr may go to a non-dispersive site only if the volume-weighted average (VWA) of all the DMMUs is 4 pptr or less.

    Using the dioxin data from the each of the five prism sample locations, the DMMP subdivided the navigation channel into two sections for independent evaluation: the inner channel represented by samples PT17A, PT17B, and PT17C (Stations 6+00 and 21+63) and the outer channel represented by samples PT17D and E (Stations 0+00 to 6+00).

    Elevated dioxin concentrations in the dredge prism material at locations PT17B and PT17C (11.1 and 48.4 pptr, respectively) render the inner channel unsuitable for both dispersive and non-dispersive open water disposal. However, the outer channel section, represented by PT17D and PT17E with dioxin concentrations of 4.3 and 2.6 pptr TEQ, respectively, is suitable for dispersive and non-dispersive open-water disposal when considering expected variability within the analytical method.

    Defining the boundary between the inner and outer channel sections material was challenging due to the large area and lack of data points between locations PT17C (unsuitable) and PT17D (suitable). The DMMP agencies chose to err on the side of caution by placing the delineation boundary in line with the extent of the 2009 dredging (Station 6+00), which is closer to sampling location PT17D.

    In Summary, up to 16,000 CY of material was characterized for open-water disposal per the DMMP guidelines for a moderate ranked project. The DMMP agencies evaluated the chemical

data from both the composite and the dioxin data from five individual sample locations within the composite and have made the following determination:

- Up to 8,000 CY of material from the outer channel (between stations 0+00 to 6+00) are suitable for open-water disposal at a dispersive or non-dispersive site. The nearest disposal site is the Port Townsend dispersive site.
- The remaining sediment (up to 8,000 CY) in the inner channel (stations 6+00 to 21+63) is unsuitable for dispersive and non-dispersive open-water disposal and must be disposed at an approved upland location. Additional requirements of the selected receiving entity may apply.

The outer channel meets state antidegradation policy, while the inner channel must propose a post-dredge surface management approach.

Portions of the inner channel may be considered suitable for open-water disposal in the future if the project proponent (1) further defines the extent of the dioxin sediment exceedance and/or (2) conducts bioaccumulation testing on the sediment and (3) the sediment passes the DMMP's bioaccumulation testing criteria.

Figure 4 summarizes the DMMP's suitability determination decision for the Port Townsend Federal Navigation Channel.

9. References.

Anamar, 2017. *Final Sampling and Analysis Plan, Port Townsend Marina Navigation Channel, Dredged Material Characterization; Port Townsend, Washington*. Prepared by Anamar and EcoAnalysts for the USACE, Revised November 2017.

Anamar, 2018. *Port Townsend Marina Federal Navigation Channel, Dredged Material Characterization Report; Port Townsend, Washington.* Prepared by Anamar and EcoAnalysts for the USACE, Revised October 18, 2018.

DMMP, 1998. Memorandum for Record: Determination of the suitability of dredged material tested under DMMP evaluation procedures for Port Townsend Marina for disposal at a PSDDA open water disposal site. October 5, 1998.

DMMP, 2008. Memorandum for Record: Determination regarding the suitability of proposed dredged material from the Port Townsend Marina navigation channel, Jefferson County, for beneficial use or unconfined open water disposal at the Port Townsend open water disposal site. September 22, 2008.

DMMP, 2009. Volume Increase for the Proposed Dredging Project at the Port Townsend Marina Navigation Channel, Jefferson County, for Beneficial Use or Disposal at the Port Townsend Open-Water Disposal Site. May 7, 2009.

DMMP, 2016. *Dredged Material Evaluation and Disposal Procedures (User Manual)*. Prepared by the Seattle District Dredged Material Management Office for the Dredged Material Management Program, August 2016.

Ecology, 2013. *Sediment Management Standards – Chapter 173-204 WAC*. Washington State Department of Ecology, Revised February 2013.

SAIC, 2009. Port Townsend Marina Navigation Channel Dredged Material Characterization, Port Townsend, Washington. Data Report. Final. Prepared for USACE Seattle by SAIC. April 22, 2009.

USACE, 1998. PSDDA Chemical Characterization of Port Townsend Marina Entrance Channel FY99 Operations and Maintenance Dredging, Seattle, Washington. Prepared for USACE Seattle by Striplin Environmental Associates, Inc., September 30, 1998.

10. Agency Signatures.

signed copy on file in DMMO - Seattle District office

Concur:

_____ _____
Date Heather Whitney Fourie - Seattle District Corps of Engineers

_____ _____
Date Erika Hoffman - Environmental Protection Agency

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

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Date Celia Barton - Washington Department of Natural Resources

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Table 3. Dredged Material Management Units

Feature	DMMU	Stations	Authorized Depth (ft MLLW)	Authorized Depth + 2ft Allowable Overdepth Volume (CY)	Characterized Volume (CY)
Navigation Channel	PT17	0+00 to 21+63	-12	7,193	16,000
				Total	**16,000**

DMMU =dredged material management unit
Characterized volume represents the total volume given the project rank (moderate) and the number of field samples collected.

Table 4. Sample Station Information

DMMU/ Composite	Sample ID	Date Collected	Time	Coordinate System: NAD 83		Coordinate System: State Plane North		Water Depth (ft.)	Tidal Stage (ft.)	Mudline Elevation (ft. MLLW)	Penetration (ft.)	Recovery	Elevation Interval (MLLW)		Elevation Interval (ft below mud line)	
				Latitude	Longitude	X (US ft.)	Y (US ft.)					(ft. [%])	Dredge Sample	Z Layer	Dredge Sample	Z Layer
PT17	A	11/17/2017	1321	48.10504	-122.777518	1165460	409086	16.3	7.9	-8.4	8.2	6.7 [82]	-8.4 to -14	-14 to -15.1	0 to 5.6	5.6 to 6.7
	B	11/17/2017	1201	48.105335	-122.776699	1165663	409188	18.6	7	-11.6	4.7	3.8 [81]	-11.6 to 14	-14 to -15.4	0 to 2.4	2.4 to 3.8
	C	11/17/2017	1524	48.106215	-122.77437	1166240	409495	21.5	8.1	-13.4	2.7	2.6 [96]	-13.4 to 14	-14 to -16	0 to 0.6	0.6 to 2.6
	D	11/17/2017	937	48.107322	-122.771085	1167053	409878	16.8	5.6	-11.2	5.3	4.8 [91]	-11.2 to 14	-14 to -16	0 to 2.8	2.8 to 4.8
	E	11/17/2017	850	48.107141	-122.770473	1167200	409809	16	5.5	-10.5	5.9	4.8 [81]	-10.5 to 14	-14 to -15.3	0 to 3.5	3.5 to 4.8

Table 5. Analyses Performed

Analyte	PT17-Comp	Sediment Reference Material	Dredge Prism Archives (PT-A through PT-E)	Dredge Z-layer Archives (PT-A-Z through PT-E-Z)
Grain Size	X			
Total Solids, TVS	X		X	
TOC	X	X		
Ammonia and Sulfides	X			
Mercury	X	X		
SVOC	X	X		
PCB Aroclors	X	X		
Pesticides	X	X		
Metals	X	X		
Dioxin/Furans	X	X	X	X
Bulk Tributyltin	X			

Table 6. Conventionals and chemistry results for the dredge prism composite (PT17-COMP)

Analyte	DMMP Guidelines			PT17-Comp				
	SL	BT	ML	Result	RL	MDL	LQ	VQ
Grain Size (%)								
Gravel				1.17				
Sand				87				
Silt				4.71				
Clay				3.66				
Fines (% Sand & Clay)				8.37				
Conventionals								
Ammonia as N (mg/kg)				4	0.66	0.06		
Sulfide (mg/kg)				34	13	5		
TOC (%)				0.414	0.05	0.02		
Total Solids (%)				73.7				
Total Volatile Solids (%)				2.6	0.1			
Metals (mg/kg dw)								
Antimony	150	---	200	0.059	0.053	0.021		J
Arsenic	57	507.1	700	3.65	0.53	0.04		
Cadmium	5.1	---	14	0.246	0.021	0.007		J
Chromium	260	---	---	28	0.21	0.06		J
Copper	390	---	1300	15.2	0.11	0.04		
Lead	450	975	1200	8.03	0.053	0.021		J
Mercury	0.41	1.5	2.3	0.024	0.021	0.002		
Nickel	---	---	---	39.3	0.21	0.03		J
Selenium	---	3	---	0.2	1.1	0.07	J	J
Silver	6.1	---	8.4	0.032	0.021	0.004		
Zinc (mg/kg dw)	410	---	3800	35	0.53	0.21		
Organometallic Compounds								
Bulk Tributyltin (µg/kg)	---	73	---	5.3	1.4	0.57		J
Pesticides (µg/kg)								
Heptachlor	1.5	---	270	0.45	1.2	0.45	U	U
Aldrin	9.5	---	---	0.68	1.2	0.68	U	U
Dieldrin	1.9	---	1700	0.26	1.2	0.26	U	U
4,4'-DDE	9	---	---	0.46	1.2	0.46	U	U
4,4'-DDD	16	---	---	0.69	1.2	0.69	U	U
4,4'-DDT	12	---	---	0.71	1.2	0.71	U	U
Total DDTs	---	50	69	0.71			U	U
Oxychlordane	---	---	---	0.29	1.2	0.29	U	U
gamma-Chlordane	---	---	---	0.44	1.2	0.44	U	U
cis-Chlordane	---	---	---	0.48	1.2	0.48	U	UJ
cis-Nonachlor	---	---	---	0.92	1.2	0.92	Ui	U
trans-Nonachlor	---	---	---	0.82	1.2	0.82	U	UJ
Total Chlordane	2.8	37	---	0.92			U	U
PCB Aroclors (µg/kg)								
Aroclor 1016	---	---	---	3.4	12	3.4	U	U
Aroclor 1221	---	---	---	3.4	23	3.4	U	U

Analyte	DMMP Guidelines			PT17-Comp				
	SL	BT	ML	Result	RL	MDL	LQ	VQ
Aroclor 1232	---	---	---	3.4	12	3.4	U	U
Aroclor 1242	---	---	---	3.4	12	3.4	U	U
Aroclor 1248	---	---	---	3.4	12	3.4	U	U
Aroclor 1254	---	---	---	14	12	3.4		
Aroclor 1260	---	---	---	3.4	12	3.4	U	U
Total PCBs	130	38	3100	14				
PAHs (µg/kg)								
2-Methylnaphthalene	670	---	1900	2.8	6.8	2.8	U	U
Acenaphthene	500	---	2000	3.2	6.8	3.2	U	U
Acenaphthylene	560	---	1300	2.6	6.8	2.6	U	U
Anthracene	960	---	13,000	7.2	6.8	3.2		
Fluorene	540	---	3600	3.3	6.8	3.3	U	U
Naphthalene	2100	---	2400	4.3	6.8	2.9	J	J
Phenanthrene	1500	---	21,000	14	6.8	3.6		
Total LPAHs	5,200	---	29,000	25.5			J	J
Benzo(a)anthracene	1300	---	5100	18	6.8	3.6		
Benzo(a)pyrene	1600	---	3600	25	6.8	3.6		J
Benzo(b)fluoranthene	3200	---	9900	49	6.8	3.4		
Benzo(g,h,i)perylene	670	---	3200	14	6.8	3.7		
Benzo(k)fluoranthene	3200	---	9900	18	6.8	4		
Chrysene	1400	---	21,000	50	6.8	4.1		
Dibenz(a,h)anthracene	230	---	1900	4	6.8	3	J	J
Fluoranthene	1700	4600	30,000	65	6.8	3.7		
Indeno(1,2,3-cd)pyrene	600	---	4400	17	6.8	3.2		
Pyrene	2600	11,980	16,000	77	6.8	3.7		
Total HPAHs	12,000	---	69,000	337			J	J
Other SVOCs (ug/kg)								
1,4-Dichlorobenzene	110	---	120	2.5	6.8	2.5	U	U
1,2-Dichlorobenzene	35	---	110	2.4	6.8	2.4	U	U
1,2,4-Trichlorobenzene	31	---	64	2.6	6.8	2.6	U	U
Hexachlorobenzene	22	168	230	3.3	6.8	3.3	U	U
Benzyl Alcohol	57	---	870	4.9	14	4.9	U	U
Benzoic Acid	650	---	760	96	270	96	U	U
Dibenzofuran	540	---	1700	3.4	6.8	3.4	U	U
Hexachlorobutadiene	11	---	270	3	6.8	3	U	U
N-Nitrosodiphenylamine	28	---	130	3.2	6.8	3.2	U	U
Phthalates (µg/kg)								
Dimethyl Phthalate	71	---	1400	4.8	6.8	4	J	J
Diethyl Phthalate	200	---	1200	3.7	6.8	3.7	U	U
Di-n-butyl Phthalate	1400	---	5100	26	14	4.8		
Butyl Benzyl Phthalate	63	---	970	3.7	6.8	3.7	U	U
Bis(2-ethylhexyl) Phthalate	1300	---	8300	20	68	8.9	J	J
Di-n-octyl Phthalate	6200	---	6200	3.2	6.8	3.2	U	U
Phenols (µg/kg)								
Phenol	420	---	1200	19	21	3.1	J	J

Analyte	DMMP Guidelines			PT17-Comp				
	SL	BT	ML	Result	RL	MDL	LQ	VQ
2-Methylphenol	63	---	77	4.1	6.8	4.1	U	U
4-Methylphenol	670	---	3600	16	6.8	4.5		
2,4-Dimethylphenol	29	---	210	6.3	34	6.3	U	U
Pentachlorophenol	400	540	690	5.3	68	5.3	U	U

Notes: LQ: laboratory qualifier VQ: validation qualifier SL: screening level ML: maximum level BT: bioaccumulation trigger
U the analyte was analyzed for, but not detected
J the result is estimated
Percent Fines = sum of silt and clay fractions
Total LPAH = sum of detected values of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene
Total HPAH = 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
Total PCBs = sum of detected PCB Aroclors
Total DDTs = sum of 4,4'-DDE, 4,4'-DDD, and 4,4'-DDT
Total Chlordane = sum of gamma-chlordane, cis-chlordane, cis-nonachlor, trans-nonachlor, and oxychlordane

Table 7. Dioxin/Furan Results for Dredge Prism Samples

Analyte	PT17-Comp (12/19/17)							PT17-A (2/20/18)							PT17-B (2/20/18)						
(ng/Kg)	Result	RL	EDL	LQ	VQ	TEQ (ND=0)	TEQ (ND=0.5EDL)	Result	RL	EDL	LQ	VQ	TEQ (ND=0)	TEQ (ND=0.5EDL)	Result	RL	EDL	LQ	VQ	TEQ (ND=0)	TEQ (ND=0.5EDL)
Total Solids (%)								71.2							66.7						
2,3,7,8-TCDD	0.157	0.632	0.157	U	U	0	0.0785	0.0821	0.695	0.0821	U	U	0	0.0411	0.819	0.819	0.819	U	U	0	0.41
1,2,3,7,8-PeCDD	1.51	3.16	0.0773	J	J	1.51	1.51	0.677	3.48	0.0479	J	J	0.677	0.677	2.1	3.45	0.336	J	J	2.1	2.1
1,2,3,4,7,8-HxCDD	1.87	3.16	0.0842	JK	U	0	0.00421	1.23	3.48	0.0341	J	J	0.123	0.123	3.8	3.45	0.388	K	U	0	0.0194
1,2,3,6,7,8-HxCDD	9.33	3.16	0.0901			0.933	0.933	4.47	3.48	0.0373			0.447	0.447	16.7	3.45	0.425			1.67	1.67
1,2,3,7,8,9-HxCDD	5.61	3.16	0.0837			0.561	0.561	2.84	3.48	0.0348	J	J	0.284	0.284	10.9	3.45	0.395			1.09	1.09
1,2,3,4,6,7,8-HpCDD	235	3.16	0.856			2.35	2.35	84.9	3.48	0.156			0.849	0.849	314	3.45	3.09			3.14	3.14
OCDD	3650	6.32	4.43			1.095	1.095	605	6.95	0.322			0.182	0.182	2120	6.91	0.33			0.636	0.636
2,3,7,8-TCDF	1.09	0.632	0.191			0.109	0.109	0.155	0.695	0.0352	J	J	0.0155	0.0155	0.86	0.86	0.86	U	U	0	0.043
1,2,3,7,8-PeCDF	0.944	3.16	0.113	J	J	0.0283	0.0283	0.246	3.48	0.0503	JK	U	0	0.000755	1.04	3.45	0.516	J	J	0.0312	0.0312
2,3,4,7,8-PeCDF	2.52	3.16	0.115	J	J	0.756	0.756	0.51	3.48	0.0533	JK	U	0	0.008	3.19	3.45	0.513	J	J	0.957	0.957
1,2,3,4,7,8-HxCDF	2.27	3.16	0.521	J	J	0.227	0.227	0.872	3.48	0.0646	JK	U	0	0.00323	4.54	3.45	1.23			0.454	0.454
1,2,3,6,7,8-HxCDF	1.71	3.16	0.517	J	J	0.171	0.171	0.706	3.48	0.0651	J	J	0.0706	0.0706	2.7	3.45	1.2	JK	U	0	0.06
1,2,3,7,8,9-HxCDF	0.68	3.16	0.505	BJ	J	0.068	0.068	0.242	3.48	0.0678	J	J	0.0242	0.0242	1.42	3.45	1.42	U	U	0	0.071
2,3,4,6,7,8-HxCDF	2.03	3.16	0.532	J	J	0.203	0.203	0.797	3.48	0.0654	J	J	0.0797	0.0797	2.55	3.45	1.25	JK	U	0	0.0625
1,2,3,4,6,7,8-HpCDF	26.2	3.16	0.218			0.262	0.262	10.5	3.48	0.0501			0.105	0.105	34.9	3.45	0.631			0.349	0.349
1,2,3,4,7,8,9-HpCDF	2.05	3.16	0.253	J	J	0.0205	0.0205	0.661	3.48	0.0573	J	J	0.00661	0.00661	1.26	3.45	0.739	JK	U	0	0.0037
OCDF	142	6.32	0.0725			0.0426	0.0426	15.8	6.95	0.166			0.00474	0.00474	59.4	6.91	0.747			0.01782	0.01782
Dioxin/Furan TEQ						8.34	8.42						2.87	2.92						10.45	11.11

Analyte	PT17-C (2/20/18)							PT17-D (2/20/18)							PT17-E (2/20/18)						
(ng/Kg)	Result	RL	EDL	LQ	VQ	TEQ (ND=0)	TEQ (ND=0.5EDL)	Result	RL	EDL	LQ	VQ	TEQ (ND=0)	TEQ (ND=0.5EDL)	Result	RL	EDL	LQ	VQ	TEQ (ND=0)	TEQ (ND=0.5EDL)
Total Solids (%)	46.3							64.9							67.6						
2,3,7,8-TCDD	1.28	1.28	1.28	U	U	0	0.64	0.923	0.923	0.923	U	U	0	0.462	0.803	0.803	0.803	U	U	0	0.402
1,2,3,7,8-PeCDD	9.36	5.01	1.47			9.36	9.36	0.658	3.68	0.55	JK	U	0	0.275	0.687	3.63	0.527	J	J	0.687	0.687
1,2,3,4,7,8-HxCDD	17.8	5.01	1.29			1.78	1.78	0.552	3.68	0.552	U	U	0	0.0276	0.457	3.63	0.457	U	U	0	0.0229
1,2,3,6,7,8-HxCDD	70.6	5.01	1.42			7.06	7.06	6.81	3.68	0.616			0.681	0.681	2.71	3.63	0.516	J	J	0.271	0.271
1,2,3,7,8,9-HxCDD	44.9	5.01	1.31			4.49	4.49	2.62	3.68	0.567	J	J	0.262	0.262	1.31	3.63	0.472	JK	U	0	0.0236
1,2,3,4,6,7,8-HpCDD	1430	9.65	9.65			14.3	14.3	144	3.68	1.76			1.44	1.44	23	3.63	0.693			0.23	0.23
OCDD	9810	10	1.28	E	J	2.94	2.94	1170	7.37	0.628			0.351	0.351	140	7.26	0.509			0.042	0.042
2,3,7,8-TCDF	3.5	1.18	1.18			0.35	0.35	0.963	0.963	0.963	U	U	0	0.0482	0.851	0.851	0.851	U	U	0	0.0426
1,2,3,7,8-PeCDF	5.58	5.01	1.25			0.167	0.167	0.519	3.68	0.519	U	U	0	0.00779	0.67	3.63	0.67	U	U	0	0.0101
2,3,4,7,8-PeCDF	12.3	5.01	1.22	K	U	0	0.183	1.23	3.68	0.514	J	J	0.369	0.369	1.74	3.63	0.652	J	J	0.522	0.522
1,2,3,4,7,8-HxCDF	16.9	5.01	3.49			1.69	1.69	0.746	3.68	0.746	U	U	0	0.0373	0.979	3.63	0.619	J	J	0.0979	0.0979
1,2,3,6,7,8-HxCDF	13.7	5.01	3.36			1.37	1.37	0.735	3.68	0.735	U	U	0	0.0368	0.596	3.63	0.596	U	U	0	0.0298
1,2,3,7,8,9-HxCDF	5.14	5.01	3.88			0.514	0.514	0.814	3.68	0.814	U	U	0	0.0407	0.647	3.63	0.647	U	U	0	0.0324
2,3,4,6,7,8-HxCDF	15.9	5.01	3.59			1.59	1.59	1.05	3.68	0.787	J	J	0.105	0.105	1.26	3.63	0.612	J	J	0.126	0.126
1,2,3,4,6,7,8-HpCDF	176	5.01	1.51			1.76	1.76	15.4	3.68	0.775			0.154	0.154	7.81	3.63	0.512			0.0781	0.0781
1,2,3,4,7,8,9-HpCDF	7.45	5.01	1.95			0.0745	0.0745	1.53	3.68	0.922	J	J	0.0153	0.0153	0.612	3.63	0.612	U	U	0	0.00306
OCDF	349	10	1.33			0.1047	0.1047	84.7	7.37	0.896			0.02541	0.02541	15	7.26	0.798			0.0045	0.0045
Dioxin/Furan TEQ						47.55	48.37						3.4	4.34						2.06	2.62

Table 8. Dioxin/Furan Results for Z Layer Samples (Third Round; August 2018 analysis, SRM run appropriately)

Analyte	PT17-A-Z							PT17-B-Z							PT17-C-Z						
(ng/Kg)	Result	RL	EDL	LQ	VQ	TEQ (ND=0)	TEQ (ND=0.5EDL)	Result	RL	EDL	LQ	VQ	TEQ (ND=0)	TEQ (ND=0.5EDL)	Result	RL	EDL	LQ	VQ	TEQ (ND=0)	TEQ (ND=0.5EDL)
2,3,7,8-TCDD	0.998	0.998	0.045	U	U	0	0.0225	0.999	0.999	0.038	U	U	0	0.019	0.288	0.997	0.049	J	U	0	0.0245
1,2,3,7,8-PeCDD	0.998	0.998	0.038	U	U	0	0.019	0.076	0.999	0.052	J	U	0	0.026	4.04	0.997	0.072			4.04	4.04
1,2,3,4,7,8-HxCDD	0.998	0.998	0.037	U	U	0	0.00185	0.073	0.999	0.053	J	U	0	0.00265	6.4	0.997	0.102			0.64	0.64
1,2,3,6,7,8-HxCDD	0.998	0.998	0.035	U	U	0	0.00175	0.307	0.999	0.054	J	J	0.0307	0.0307	28.3	0.997	0.098			2.83	2.83
1,2,3,7,8,9-HxCDD	0.998	0.998	0.036	U	U	0	0.0018	0.219	0.999	0.053	J,B	U	0	0.00265	17.5	0.997	0.099	B		1.75	1.75
1,2,3,4,6,7,8-HpCDD	0.281	2.5	0.062	J	U	0	0.00031	4.33	2.5	0.068			0.0433	0.0433	586	2.49	0.425			5.86	5.86
OCDD	1.83	9.98	0.065	J,B	U	0	0.00000975	26.6	9.99	0.103	B	U	0	0.00001545	3310	9.97	0.363	B	U	0	5.445E-05
2,3,7,8-TCDF	0.998	0.998	0.036	U	U	0	0.0018	0.999	0.999	0.035	U	U	0	0.00175	1.05	0.997	0.041			0.105	0.105
1,2,3,7,8-PeCDF	0.998	0.998	0.055	U	U	0	0.000825	0.06	0.999	0.038	J	U	0	0.00057	2.79	0.997	0.064			0.0837	0.0837
2,3,4,7,8-PeCDF	0.998	0.998	0.052	U	U	0	0.0078	0.999	0.999	0.038	U	U	0	0.0057	2.5	0.997	0.059			0.75	0.75
1,2,3,4,7,8-HxCDF	0.998	0.998	0.033	U	U	0	0.00165	0.066	0.999	0.033	J	U	0	0.00165	8.4	0.997	0.078			0.84	0.84
1,2,3,6,7,8-HxCDF	0.998	0.998	0.032	U	U	0	0.0016	0.999	0.999	0.032	U	U	0	0.0016	6.76	0.997	0.077			0.676	0.676
1,2,3,7,8,9-HxCDF	0.053	0.998	0.032	J	J	0.0053	0.0053	0.074	0.999	0.031	J	J	0.0074	0.0074	2.76	0.997	0.091			0.276	0.276
2,3,4,6,7,8-HxCDF	0.998	0.998	0.03	U	U	0	0.0015	0.063	0.999	0.03	J	U	0	0.0015	7.03	0.997	0.075			0.703	0.703
1,2,3,4,6,7,8-HpCDF	0.041	0.998	0.028	J,B	J	0.00041	0.00041	0.667	0.999	0.024	J,B	U	0	0.00012	80.5	0.997	0.068	B	J	0.805	0.805
1,2,3,4,7,8,9-HpCDF	0.998	0.998	0.039	U	U	0	0.000195	0.078	0.999	0.034	J	U	0	0.00017	3.65	0.997	0.089			0.0365	0.0365
OCDF	2	2	0.088	U	U	0	0.0000132	1.12	2	0.088	J	J	0.000336	0.000336	106	1.99	0.117			0.0318	0.0318
Dioxin/Furan TEQ						0.01	0.07						0.08	0.15						19.43	19.45

Analyte	PT17-D-Z							PT17-E-Z						
(ng/Kg)	Result	RL	EDL	LQ	VQ	TEQ (ND=0)	TEQ (ND=0.5EDL)	Result	RL	EDL	LQ	VQ	TEQ (ND=0)	TEQ (ND=0.5EDL)
2,3,7,8-TCDD	0.377	0.989	0.034	J	U	0	0.017	0.998	0.998	0.084	U	U	0	0.042
1,2,3,7,8-PeCDD	2.09	0.989	0.078			2.09	2.09	0.04	0.998	0.051	J	J	0.04	0.04
1,2,3,4,7,8-HxCDD	1.23	0.989	0.087			0.123	0.123	0.998	0.998	0.038	U	U	0	0.0019
1,2,3,6,7,8-HxCDD	11.4	0.989	0.084			1.14	1.14	0.998	0.998	0.039	U	U	0	0.00195
1,2,3,7,8,9-HxCDD	5.82	0.989	0.085			0.582	0.582	0.051	0.998	0.038	J,B	U	0	0.0019
1,2,3,4,6,7,8-HpCDD	185	2.47	0.335			1.85	1.85	1.01	2.49	0.074	J	J	0.0101	0.0101
OCDD	1530	9.89	0.48	B		0.459	0.459	15.4	9.98	0.077	B	U	0	0.00001155
2,3,7,8-TCDF	1.01	0.989	0.044			0.101	0.101	0.998	0.998	0.101	U	U	0	0.00505
1,2,3,7,8-PeCDF	0.844	0.989	0.056	J	J	0.02532	0.02532	0.998	0.998	0.037	U	U	0	0.000555
2,3,4,7,8-PeCDF	0.825	0.989	0.051	J	J	0.2475	0.2475	0.034	0.998	0.035	J	U	0	0.00525
1,2,3,4,7,8-HxCDF	1.71	0.989	0.041			0.171	0.171	0.998	0.998	0.04	U	U	0	0.002
1,2,3,6,7,8-HxCDF	1.18	0.989	0.041			0.118	0.118	0.036	0.998	0.039	J	U	0	0.00195
1,2,3,7,8,9-HxCDF	0.571	0.989	0.041	J,B	J	0.0571	0.0571	0.998	0.998	0.04	U	U	0	0.002
2,3,4,6,7,8-HxCDF	1.56	0.989	0.041			0.156	0.156	0.998	0.998	0.038	U	U	0	0.0019
1,2,3,4,6,7,8-HpCDF	18.8	0.989	0.067		J	0.188	0.188	0.106	0.998	0.023	J,B	U	0	0.000115
1,2,3,4,7,8,9-HpCDF	0.89	0.989	0.096	J	J	0.0089	0.0089	0.998	0.998	0.031	U	U	0	0.000155
OCDF	34.1	1.98	0.202		J	0.01023	0.01023	0.27	2	0.086	J	U	0	0.0000129
Dioxin/Furan TEQ						7.33	7.34				U	U	0.05	0.12

Figure 1. Project map with sampling locations

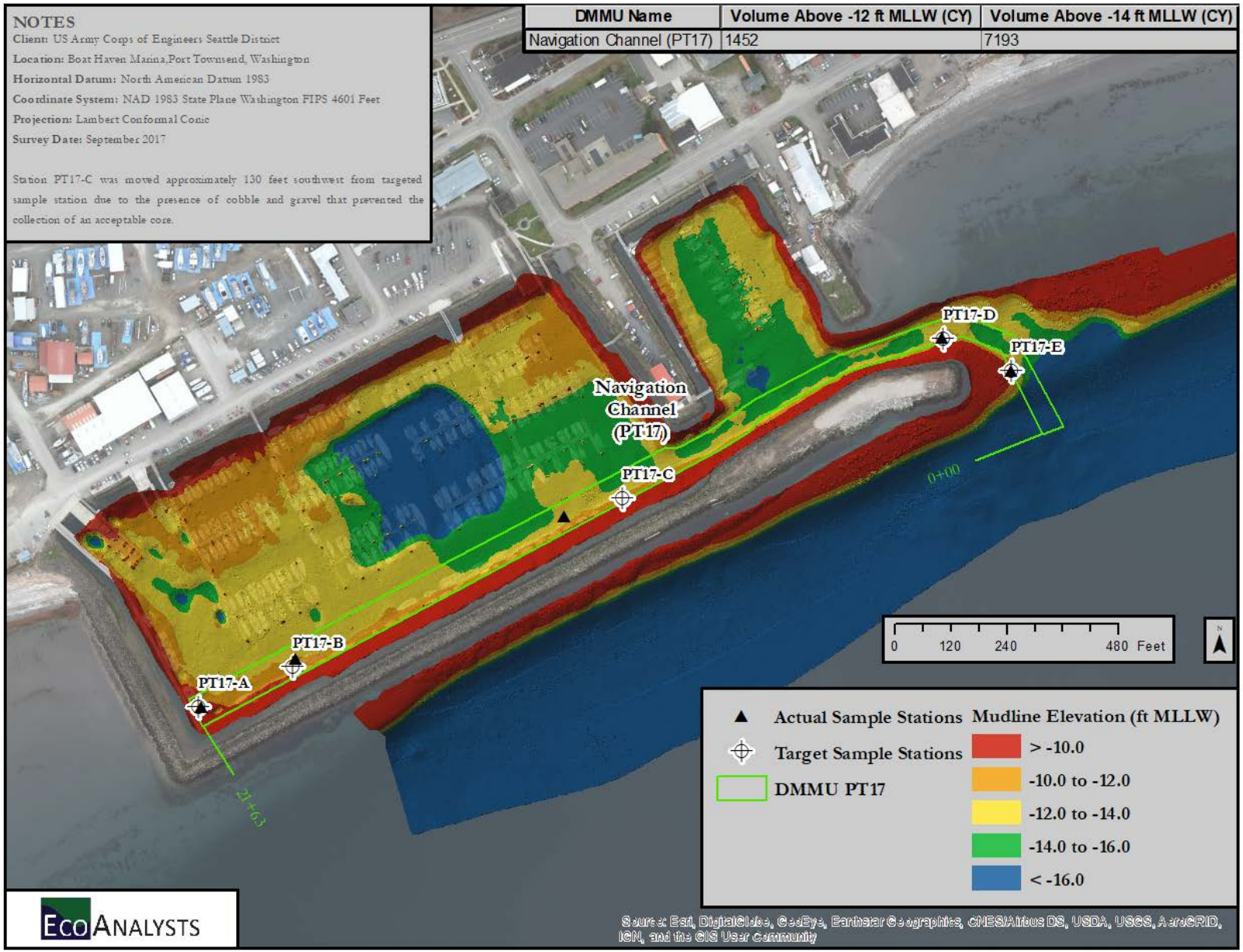

Figure 2. Sampling locations and DMMUs from the 2008 Port Townsend federal navigation channel sediment characterization.

Figure 3. Dredging area details from 2009 USACE dredging contract.

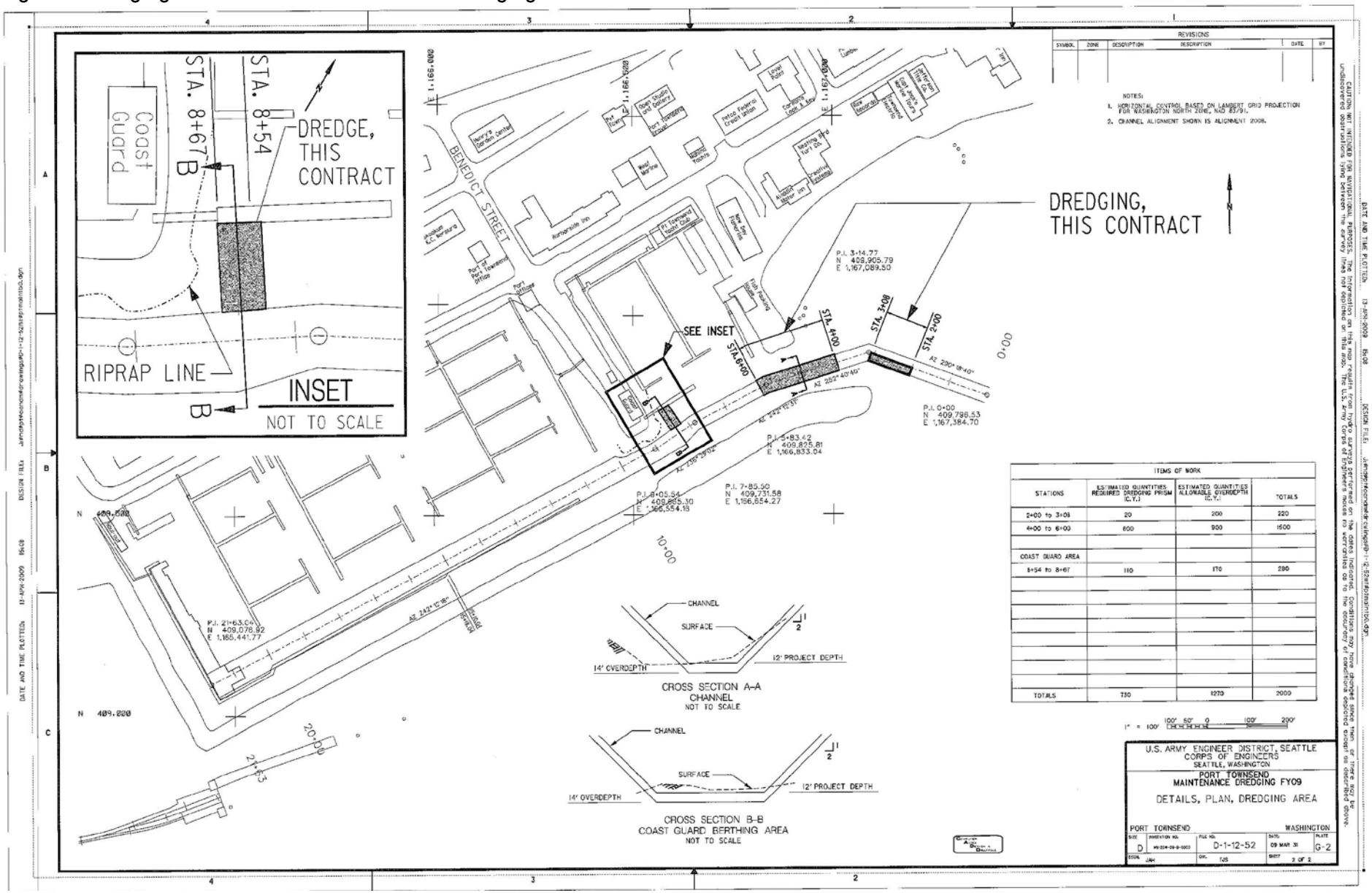
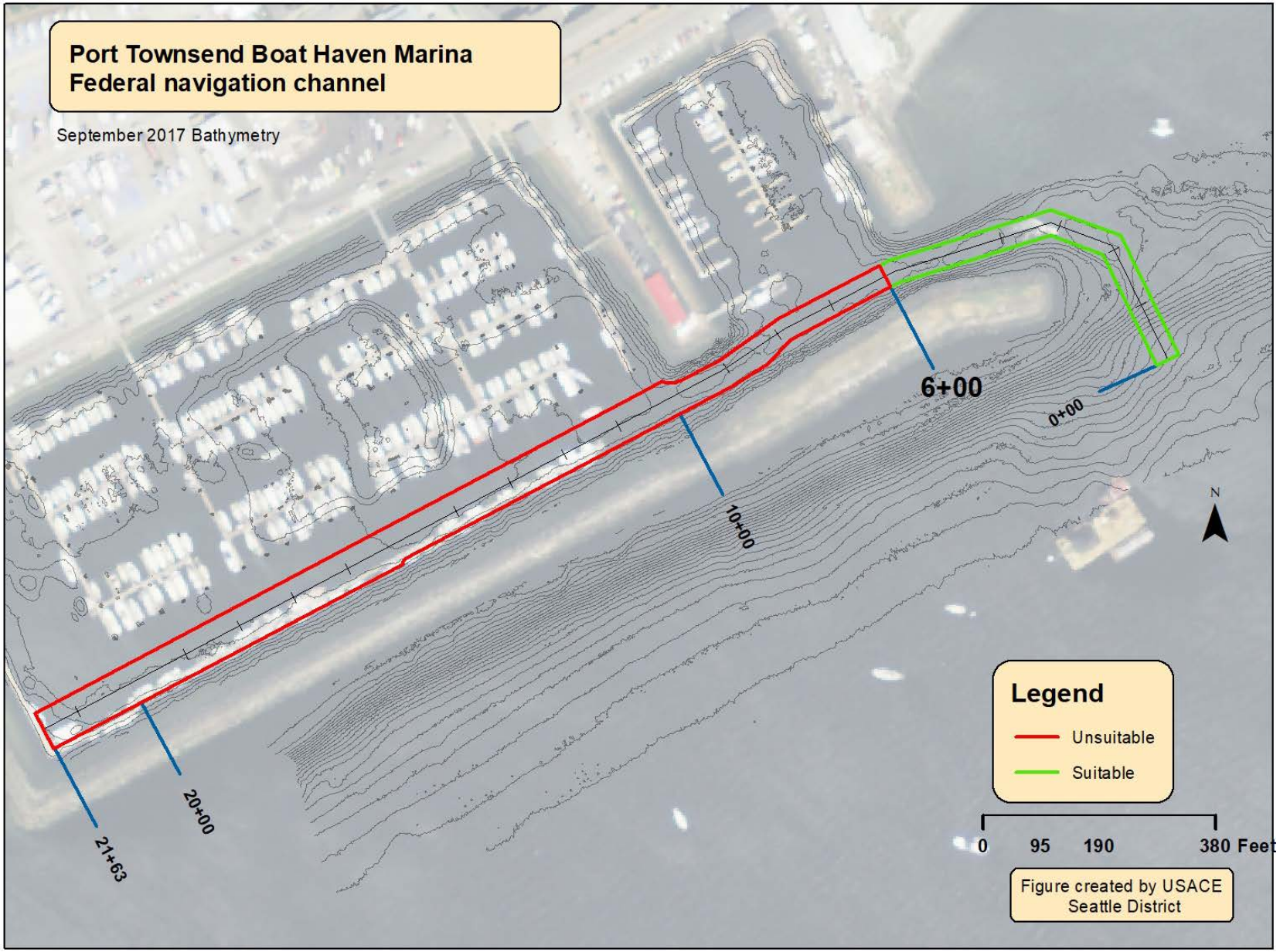
Figure 4. Boundaries of Suitable and Unsuitable Material as determined in this Suitability Determination