CENWS-OD-TS-DMMO

MEMORANDUM FOR: RECORD January 27, 2015

SUBJECT: DETERMINATION REGARDING THE SUITABILITY OF PROPOSED DREDGED MATERIAL FROM THE KENMORE FEDERAL NAVIGATION CHANNEL, EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT, FOR UNCONFINED OPEN-WATER DISPOSAL AT THE ELLIOTT BAY DISPOSAL SITE OR FOR BENEFICIAL USE.

1. Introduction. This memorandum reflects the consensus determination of the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers, Washington State Department of Ecology, Washington State Department of Natural Resources, and the Environmental Protection Agency) regarding the suitability of up to 30,000 cubic yards (cy) of dredged material from the Kenmore Federal Navigation Channel for open-water disposal at the Elliott Bay nondispersive site, and for compliance with the State of Washington Antidegradation Policy.

2. Background. The authorized federal navigation channel in Kenmore, WA runs approximately 2,900 feet from deep water in Lake Washington to the Kenmore industrial area, see Figure 1. The channel has an authorized width of 100 to 120 feet wide and a depth of -15 ft Lake Washington Low Water (LWLW) datum.

   The Kenmore federal navigation channel was previously characterized for 60,000 cy of maintenance dredging in 1996. Results of that characterization are presented in the DMMP suitability determination dated July 8, 1996 (DMMP, 1996). Briefly, fifteen DMMUs were characterized and three had SL exceedances of DY1996 PSDDA screening levels (acenapthene, anthracene, fluorene, phenanthrene, TBT, and total DDT). These three DMMUs were subjected to bioassay testing, resulting in only one DMMU passing the bioassay tests. 8,000 cy of material did not pass for open water disposal at Elliott Bay disposal site. Less than 50,000 cy of material was dredged from the navigation channel in the winter of 1997-1998.

   Since 1998, sediment has accumulated within the navigation channel above the authorized depth, resulting in impacts to the ability of vessels to use the navigation channel.

3. Project Summary. Table 1 includes project summary and tracking information.

Table 1. Project Summary

Project ranking	High
Proposed dredging volume	30,000 cy, including 1 ft of overdepth and 1 ft of advance maintenance and 30% contingency factor
Proposed dredging depth	-17 ft LWLW, including 1 ft of overdepth and 1 ft of advance maintenance
1st draft SAP received	June 23, 2014

Comments provided on 1st draft SAP	July 3, 2014
Final SAP received	July 8, 2014
SAP approved	July 8, 2014
Sampling dates	July 10-12, 2014
Draft data report received	December 2, 2013
Comments provided on draft report	December 15, 2014
2nd Draft data report received	January 5, 2015
Comments provided on 2nd draft	January 8 and 14, 2015
Final data report received	January 21, 2015
EIM Study ID	KENMO14
Recency Determination (high rank = 3 years)	July 2017

4. Project Ranking and Sampling Requirements. This project was ranked "high" by the DMMP agencies according to the guidelines set out in the DMMP User Manual. In a high-ranked area the number of samples and analyses are calculated using the following guidelines (DMMP, 2014):
    - Maximum volume of sediment represented by each field sample = 4,000 cubic yards
    - Maximum volume of sediment represented by each analysis in the upper 4-feet of the dredging prism (surface sediment) = 4,000 cubic yards
    - Maximum volume of sediment represented by each analysis in the subsurface portion of the dredging prism = 12,000 cubic yards

    According to the guidelines outlined above, the Kenmore navigation channel characterization was divided into 8 DMMUs. Sediment accumulation within the channel was less than 4 feet within most areas of the channel. Therefore, in conjunction with the conceptual dredging plan, the project was characterized as surface DMMUs only. Figure 2 shows the configuration of the DMMUs, with DMMU 1 furthest inland and DMMU 8 furthest out into Lake Washington. Table 2 provides the compositing information for all DMMUs.

5. Sampling. Sampling took place July 10-12 aboard the *R/V Peter R* using a hydraulically actuated vibracore sampler. Figure 2 shows the target and actual coring locations. Sample locations were collected using a differential GPS with the receiver mounted directly on top of the A-frame used to lower the Vibracore into the water. Actual sampling coordinates are in Table 3.

    Vertical control was established using a lead-line measurement of the water depth at each station and the lake level as maintained by the Corps at the Kenmore gauge. The mudline elevations were converted to Lake Washington Low Water (LWLW) datum using the formula:

    Mudline elevation (LWLW) = Reported Lake Level (Corps' Datum) – measured water depth (ft) – 20 ft.

    Multiple sampling attempts were needed at many of the sample stations to collect an acceptable core. Woody debris and native glacial clays were encountered at some locations, causing difficulty in collecting a core with acceptable penetration and percent recovery. In total, 32 coring attempts were made, and 18 cores were collected. The following changes to the SAP were made in coordination with DMMO:

- After three attempts at stations 3 and 4, acceptable cores were not able to be collected, likely due to matted woody debris encountered at depth. These sample locations were moved and cores were collected with improved recovery (71 and 69%, respectively). These cores were retained. On the final day of sampling a fifth attempt at stations 3 and 4 was attempted, and recoveries were again improved (94 and 73% respectively), these cores were also retained.
- Cores from both the fourth and fifth attempts at stations 3 and 4 were retained and composited into the sample for DMMU 2. A field duplicate from this composite was submitted to the laboratory under the label DMMU 9. For clarity, results from the field duplicate are discussed in this suitability determination as DMMU2-Dup.
- After four attempts at station 10, the core was retained with only 66% recovery. Difficulty sampling at this location was likely due to a hard native glacial clay layer that was encountered at approximately 3.85 ft. See Figure 3 for core photos showing the blue clay layer.
- After three attempts at station 16, the core was retained with only 66% recovery. Difficulty sampling at this location was likely due to a layer of woody material (estimated 20-30% by volume) that was encountered at approximately 2.2 ft.
- For some z-samples, there was insufficient sediment from the z-layer composite for all the required analyses. The DMMO determined that subsamples for the composite z-layer chemistry archive and the wood waste sample should not be collected in these samples since both of these samples/analyses could be approximated using sediment collected from the individual core z-sample archives. The z-sample composite archive was not collected for DMMUs 3 through 8 and the wood waste sample was also not collected for z-samples from DMMUs 5,6 and 8.

In addition to the above approved changes, the following changes were made without DMMO coordination and approval:

- At station 7, the first attempt was retained with only 67% recovery, less than the required 75% recovery and with less than the required three attempts. A sharp contact with the native blue clay layer was encountered at 4.3 ft.
- At station 13, the second attempt was retained with only 67% recovery, less than the required 75% recovery and with less than the required three attempts. Presumed to be native, a blue clay layer was found at the very bottom of the core in the core catcher.
- At station 4, cores 4a and 4b, station 7, and station 15 cores were retained which did not reach full penetration to the bottom of the z-layer: Actual penetration reached -18.4, -18.6, -17.9 and -18.9 ft LWLW, respectively.
- PBDE archive samples were not collected from DMMUs 7 and 8 and z-samples 7 and 8.

The DMMP agencies evaluated the above listed deviations from the approved sampling and analysis plan, and concluded that changes made did not significantly alter the representativeness of the samples collected. The samples collected adequately represent the proposed dredge material and z-layers.

6. Chemical Analysis Results. Analyses of conventionals, standard DMMP marine and freshwater COCs, TBT and dioxin were conducted by Analytical Resources Inc (ARI) of Tukwila, WA. All data was validated by an independent third-party data reviewer. The data validation reports are available as an appendix to the Kenmore Sediment Characterization Report (DOF, 2015).

The conventional results showed that the dredged material is predominantly silt, with 45-58% silt. The dredged material is classified under the USCS as sandy silt. Total organic carbon (TOC) was high, ranging from 1.7 to 5% in the dredged material. Ammonia concentrations ranged from 218 to 433 mg N/kg, and individual core bulk sulfides concentrations ranged from 195 – 390 mg/kg.

Dredged material is compared to the standard DMMP list of marine COCs. Results of this comparison are presented in Table 4. There were multiple exceedances of DMMP marine SLs and maximum levels (MLS). DMMUs with exceedances above the ML are above the threshold where bioassay test-out is an option, therefore DMMUs with ML exceedances are automatically considered unsuitable for open-water disposal.

Benzyl alcohol was found above the SL in all 8 DMMUs. Benzoic acid was found above the SL in DMMU 8 and above the ML in DMMU 3. DMMU 2 and DMMU2-Dup are field duplicates. Benzyl alcohol results from these duplicates are inconsistent – one result is below the DMMP marine SL and the other result is above the DMMP marine ML. Although this result is confusing, it has no impact on the final suitability determination for this DMMU, which is driven by the dioxin results.

DDT and its breakdown products DDD and DDE were found at highly elevated levels in DMMU 2. The field duplicate of DMMU 2, DMMU2-Dup, did not corroborate these high levels of DDT, DDD and DDE (hereafter referred to as DDx). Additional analyses were conducted to try to elucidate this difference. See the discussion in the DDT section below.

Dioxin/Furans

Dioxin/furan results for all DMMUs are presented in Table 5. Dioxin concentrations were elevated in all DMMUs, with all results above the DMMP volume-weighted average limit of 4 ng/kg toxic equivalents (TEQ) summed with non-detects equal to ½ the estimated detection limit. In addition, DMMUs 1, 2, 3 and 5 were above the bioaccumulation trigger of 10 ng/kg TEQ (DMMP, 2010). Bioaccumulation testing would be required in order to take any of this material to open-water disposal.

The Corps has chosen to not pursue bioaccumulation testing to evaluate dioxin.

DDT, DDD, and DDE

To further evaluate the nature and extent of the apparent DDx exceedances in the dredged material layer in DMMU 2 the Corps, in consultation with the DMMP agencies, elected to conduct additional investigations, including chemical analyses on the archived samples. Results for all analyses of DDx at KEN02 are presented in Table 6.

As mentioned above, the field duplicate results from DMMU2-Dup did not corroborate the elevated levels of DDx in the dredged material. The sum of DDTs (4,4'-DDDT; 4,4'-DDE; and 4,4'-DDD) at KEN02 (5,960 μg/kg) is nearly three orders of magnitude greater than that measured in DMMU2-Dup (7 μg/kg). Prior to additional chemical analyses, the analytical laboratory reviewed the results of the elevated levels of DDx in KEN02, and concluded that the compounds were present in the samples (ARI, 2015). In addition to the standard QA review of the data, the laboratory analyzed the same sample extract used in the original analyses of DMMU 2 using a GC-MS method, which confirmed the presence of the DDx compounds in the sample.

With this information which appeared to confirm the elevated DDx detections in the original sample, additional pesticide analyses on two of the individual cores from within DMMU KEN02 were performed to determine if DDx was found throughout the DMMU or if it was concentrated on either the northern or southern side of the DMMU. Two cores were analyzed on 9/16/2014 for the DMMP suite of chlorinated pesticides, one from the northern side (KEN02-3b) and one from the southern side (KEN02-4b) of the DMMU. Results from the individual archive analyses for KEN02-3b and KEN02-4b showed low levels of DDx, with the highest value 4 μg/kg. These results did not corroborate the original elevated results, but are similar to the results reported for the field duplicate DMMU2-Dup.

The DMMP then elected to analyze the other two archived individual core samples (KEN02-3a and KEN02-4a) and re-analyze in duplicate the dredged material composite sample KEN02. For re-analysis of the KEN02 composite sample, two separate sediment aliquots were subjected to extraction, cleanup, and chemical analysis on 11/15/2014. Results from the second two individual cores and the duplicate analyses of the composite were all low, below the DMMP SLs and similar to the original results from the field duplicate (Table 6).

The aforementioned composite re-analysis samples were not taken from the original jar with the high DDx results, but were instead taken from the composite chemistry archive jar. Therefore, ARI undertook one additional set of analyses on the composite sample from the same jar as the original high results and on the archived samples for KEN02-3b and KEN02-4b (Table 4-6). Four separate extractions were conducted on the composite sample that was taken from the same sample jar for which the high DDx levels were first reported. Three of the composite extracts were subject to cleanup by gel permeation chromatography to exactly replicate the initial analysis, and one of the composite extracts was subjected to acid cleanup. The two individual core archive samples were extracted and also subject to acid cleanup the purpose of which was to remove any labile interference in the samples. Acid cleanup will not affect the DDx, but in ARI's experience for some sediment samples these cleanups can improve peak shape and result in closer correlation between dual column results. Results from all replicates were low, between 0.98 and 6.3 μg/kg, below the DMMP SLs and in line with all the previous re-analysis and re-extraction results. Again, these results did not corroborate the high values reported from the original analysis of KEN02.

Laboratory contamination by accidentally spiking the sample with a spiking solution was eliminated as a possible explanation of the original elevated results for the following reasons: 1) the pesticide spiking solution contains mixtures of target pesticides, not just DDT, and no other pesticides were reported at elevated levels in the original sediment sample; 2) the pesticide breakdown standard, which contains DDD and DDE, also contains other breakdown products such as pentachlorophenol (PCP) and decafluorotriphenylphosphine (DFTPP), neither of which were detected in the GC/MS re-run of the original elevated extract; and 3) spiking solutions that are used are not concentrated enough to give the reported results.

In conclusion, a total of 14 separate analyses were conducted for DDx on the samples from DMMU KEN02. Eight were done on the composite sample. Of those, only the initial analysis for KEN02 showed the elevated levels of DDx. In the field duplicate (DMMU2-Dup), and the subsequent 6 re-analyses of the composite samples all levels of DDx were similarly low; the individual isomers were at or below 4.7 µg/kg. Six separate analyses were conducted on the individual cores that made up the composite samples; the individual isomers were at or below 7.6 µg/kg. The initial reported levels were not corroborated by any subsequent analysis.

7. Sediment Exposed by Dredging. The sediment to be exposed by dredging must either meet the State of Washington Sediment Quality Standards (SQS) or the State's Antidegradation standard (Ecology, 2013) as outlined by DMMP guidance (DMMP, 2008). Because this project is located in Lake Washington which is a freshwater environment, compliance with the antidegradation standard is determined by comparing the z-sample results with the 2013 Freshwater SMS chemical numeric standards (Ecology, 2013). See Table 7 for z-sample results.

   Nickel was above the SL1 in all z-samples and phenol was above the SL1 in DMMU 7 z-sample. Therefore, bioassays were required to determine if the z layer sediments would pass antidegradation.

   In accordance with the DMMP User Manual, three freshwater bioassays were conducted, including one longer term test and both a lethal and sublethal endpoints. The bioassays used for this project were: 10-day *Hyalella azteca* survival and 20-day *Chironomus dilutus* survival and growth tests. Bioassay tests were conducted by Northwest Aquatic Science of Newport, OR and were initiated on September 5, 2014, within the 56-day holding time requirement. Freshwater bioassay test interpretation criteria for each test are shown in the column headings of Tables 8-10. Freshwater bioassay interpretive criteria test results are compared to the control sediment. Clean sand collected from Beaver Creek was used as the control for these tests.

   Hyalella azteca 10-day mortality. Test results are shown in Table 8. Percent mortality in the control sediment was below the relevant performance criteria, therefore the test is considered valid. All test sediments performed well and there were no hits for any z-samples.

   Chironomus dilutus 20-day mortality. Test results are shown in Table 9. Percent mortality in the control sediment was below the relevant performance criteria, therefore the test is considered valid. In DMMU 2 z-sample, test mortality was 19.5% greater than that observed in the control sediment. Following the guidelines in the DMMP User Manual, the USACE program Biostat was used to stastically compare the mortality results from DMMU 2 z-sample with the control. An arcsin transformation was used to normalize the percent mortality data, and DMMU 2 z-sample was determined to be statistically different from control (p=0.05). Therefore, there was a hit under the 2-hit rule for the 20-day *Chironomus* mortality test for DMMU 2 z-sample.

   Chironomus dilutus 20-day growth. Test results are shown in Table 10. The mean individual growth rate, as ash free dry weight, was greater than the control performance criteria; therefore the test is considered valid. All test sediments performed well and there were no hits for any z-samples.

   In summary, there was only one minor hit (a single hit under the two-hit rule) in the DMMU 2 z-sample (see Table 11). In the absence of a corroborating hit from one of the other bioassay, this sample passes freshwater bioassay. Thus, all bioassays pass the DMMP freshwater interpretive criteria.

Dioxin. Due to the bioaccumulative nature of dioxin and the fact that aquatic organisms exposed to dioxin live within an area larger than a single DMMU, the DMMP agencies determined that it was appropriate to use the average z-sample dioxin concentration from all samples to evaluate antidegradation. Dioxin results from z-samples were less than in the overlying dredged material for all DMMUs except DMMU 7. The average z-sample dioxin concentration is 6.7 pptr TEQ, which is less than the DMMP bioaccumulation trigger of 10 pptr TEQ, and is significantly less than the average dioxin concentration of the dredged material, 11.6 pptr TEQ.

Therefore, based on the results of the bioassay testing and the dioxin evaluation discussed above, the sediment to be exposed by dredging is not considered to be degraded relative to the currently exposed sediment surface. On this basis the DMMP agencies conclude that this project is in compliance with the State of Washington anti-degradation policy.

8. Suitability Determination. This memorandum documents the evaluation of the suitability of sediment proposed for dredging from the Kenmore federal navigation channel for open-water disposal at the Elliott Bay open-water disposal site. The approved sampling and analysis plan was generally followed and the data gathered were deemed sufficient and acceptable for regulatory decision-making under the DMMP program.

In summary, based on the results of the previously described testing, the DMMP agencies conclude that **all 30,000 cy are unsuitable** for open-water disposal at the Elliott Bay non-dispersive site.

A determination regarding the suitability of the material for upland disposal must be coordinated with the local Health Department.

This suitability determination does ***not*** constitute final agency approval of the project. A final decision will be made after full consideration of agency input, and after an alternatives analysis is done under section 404(b)(1) of the Clean Water Act.

9. References.

ARI, 2015. Email from Cheronne Oreiro and Sue Dunnihoo to Kelsey van der Elst. "Re: Kenmore DDT Analyses." January 12, 2015.

DMMP, 2014. *Dredged Material Evaluation and Disposal Procedures (Users Manual)*. Prepared by the Seattle District Dredged Material Management Office for the Dredged Material Management Program, December 2014.

DMMP, 2010. *Dredged Material Management Program New Interim Guidelines for Dioxins*. December 6, 2010.

DMMP, 2008. *Quality of Post-Dredge Sediment Surfaces (Updated).* A Clarification Paper Prepared by David Fox (USACE), Erika Hoffman (EPA) and Tom Gries (Ecology) for the Dredged Material Management Program, June 2008.

DMMP, 1996. *Determination of the Suitability of Dredged Material Tested Under PSDDA Evaluation Procedures for USACE Kenmore Maintenance Dredging for Disposal at the PSDDA Elliott Bay Open Water Disposal Site*. Prepared by the Seattle District Dredged Material Management Office for the Dredged Material Management Program. July 8, 1996.

DOF, 2015. *Final Data Report Kenmore Federal Navigation Channel Dredged Material Characterization*. Prepared by Dalton, Olmsted and Fuglevand, Inc. for the Seattle District Army Corps of Engineers. January 19, 2015.

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

10. Agency Signatures.

The signed document is on file in the Dredged Material Management Office.

Concur:

Date Kelsey van der Elst - Seattle District Corps of Engineers

Date Erika Hoffman - Environmental Protection Agency

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

Date Celia Barton - Washington Department of Natural Resources

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Table 2. Sampling and Compositing.

		DMMU 1	DMMU 2	DMMU 3	DMMU 4	DMMU 5	DMMU 6	DMMU 7	DMMU 8	Total
SAP volume (CY):		3,750	3,700	3,800	3,750	3,700	3,800	3,750	3,750	30,000
Station	S-1	-14.4 to -17.0	---	---	---	---	---	---	---	
	S-2	-14.0 to -17.0	---	---	---	---	---	---	---	
	S-3a	---	-16.5 to -17.0	---	---	---	---	---	---	
	S-3b	---	-13.1 to -17.0	---	---	---	---	---	---	
	S-4a	---	-13.6 to -17.0	---	---	---	---	---	---	
	S-4b	---	-13.5 to -17.0	---	---	---	---	---	---	
	S-5	---	---	-13.7 to -17.0	---	---	---	---	---	
	S-6	---	---	-13.3 to -17.0	---	---	---	---	---	
	S-7	---	---	---	-11.9 to -17.0	---	---	---	---	
	S-8	---	---	---	-14.5 to -17.0	---	---	---	---	
	S-9	---	---	---	---	-15.0 to -17.0	---	---	---	
	S-10	---	---	---	---	-13.3 to -17.0	---	---	---	
	S-11	---	---	---	---	---	-14.6 to -17.0	---	---	
	S-12	---	---	---	---	---	-12.8 to -17.0	---	---	
	S-13	---	---	---	---	---	---	-14.5 to -17.0	---	
	S-14	---	---	---	---	---	---	-13.8 to -17.0	---	
	S-15	---	---	---	---	---	---	---	-12.5 to -17.0	
	S-16	---	---	---	---	---	---	---	-14.5 to -17.0	

Notes:

1) The design depth is -17 feet LWLW, including 1 ft of advance maintenance and 1 ft of overdredge

2) DMMU volumes include a 30% contingency factor

Table 3. Station Coordinates

		Coordinates (NAD83)	
		Latitude	Longitude
Station	S-1	47° 45.33528	122° 15.54705
	S-2	47° 45.30376	122° 15.62796
	S-3a	47° 45.28485	122° 15.65951
	S-3b	47° 45.28747	122° 15.66454
	S-4a	47° 45.26290	122° 15.64437
	S-4b	47° 45.26895	122° 15.63707
	S-5	47° 45.26392	122° 15.69121
	S-6	47° 45.24994	122° 15.66757
	S-7	47° 45.23729	122° 15.68710
	S-8	47° 45.22396	122° 15.73117
	S-9	47° 45.20996	122° 15.74528
	S-10	47° 45.20220	122° 15.73010
	S-11	47° 45.19392	122° 15.76004
	S-12	47° 45.17992	122° 15.75057
	S-13	47° 45.16760	122° 15.78793
	S-14	47° 45.15474	122° 15.77536
	S-15	47° 45.13618	122° 15.79274
	S-16	47° 45.11386	122° 15.84511

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Table 4. Chemical results compared to DMMP regulatory guidelines.

CHEMICAL	DMMP Guidelines			DMMU 1		DMMU 2		DMMU 2 - Replicate		DMMU 3		DMMU 4		DMMU 5		DMMU 6		DMMU 7		DMMU 8	
	SL	BT	ML																		
CONVENTIONALS				conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ
Gravel, %				9.9		0.3		2.2		4.4		0.8		0.6		0.6		0.2		3.3	
Sand, %				26		29		43.2		26.7		28.1		28.9		28.1		37		38.1	
Silt, %				49		54.8		43.1		54.5		55.3		55.9		57.8		50.8		45.6	
Clay, %				15.1		15.9		11.3		14.5		15.8		14.5		13.4		12.1		13	
Fines (Silt + Clay), %				64.1		70.7				69		71.1		70.4		71.2		62.9		58.6	
Total Solids, %				63.2		35.8		35.18		37.5		40.9		33		39.7		46.5		43.1	
Volatile Soilids, %				12.8		14.3		15.13		12.5		11.8		12.9		10.8		9.3		10.5	
Total Organic Carbon, %				3.57		2.77	J	5.37	J	2.71		2.07		4.63		2.45		2.46		1.7	
Total Sulfides, composite - mg/kg				389.5		319		307		290		195		273		226.5		199.5		201.5	
Total Sulfides, single core - mg/kg				500		456		n.a.		309		166		350		349		216		360	
Total Ammonia, mg N/kg				226		218.5		220		242		258.5		432.5		297		238.5		302.5	
METALS (mg/kg dry)																					
Antimony	150	---	200	2.1	J	10	UJ	1.4	J	1	J	1	J	1.3	J	0.9	J	1.5	J	1.7	J
Arsenic	57	507	700	7.2	J	9.4	J	8.8	J	8.9	J	7.4	J	9.2	J	8.3	J	6.3	J	8.6	J
Cadmium	5.1	11.3	14.0	0.8		0.8		0.8		0.8		0.7		0.8		0.8		0.6		0.8	
Chromium	260	260	---	46		49		46		61		48		49		53		45		48	
Copper	390	1,027	1,300	35.1		34.2	J	33.8	J	33.5	J	28.9	J	32.9	J	34.5	J	26.7		31.1	
Lead	450	975	1,200	28		29		27		31		22		26		23		23		24	
Mercury	0.41	1.5	2.3	0.1	J	0.11		0.1		0.09		0.09		0.09		0.09		0.08	J	0.09	J
Selenium	---	3	---	0.48	J	0.66	J	0.61	J	0.69	J	0.68	J	0.68	J	0.62	J	0.38	J	0.47	J
Silver	6.1	6.1	8.4	0.106	J	0.106	J	0.105	J	0.12	J	0.086	J	0.117	J	0.132	J	0.105	J	0.113	J
Zinc	410	2,783	3,800	140		160		130		120		102		129		129		110		125	
ORGANOMETALLIC COMPOUNDS (ug/L interstitial water)																					
Tributyltin (ion)	0.15	0.15	---	0.017		0.01		0.005	U	0.014	J	0.006		0.005	U	0.005	U	0.005	U	0.005	U
PAHs (ug/kg dry)																					
Total LPAH	5,200	---	29,000	50.6		48.7				77.1		94.4		64.4		82.7		70	J	81.5	J
Naphthalene	2,100	---	2,400	4.1	J	5.4		7.8		6.5		5.5		4.4	J	7		4.6	J	3.8	J
Acenaphthylene	560	---	1,300	4.8	U	4.9	U	4.8	U	4.8	U	4.9	U	4.9		5	U	4.7	U	4.9	U
Acenaphthene	500	---	2,000	5.1		2.7	J	4.2	J	5		4.9		6.1		4.1	J	2.7	J	3.7	J
Fluorene	540	---	3,600	4.5	J	4.4	J	5.8	J	8.6	J	8	J	8.4	J	6.6	J	5	J	6.3	J
Phenanthrene	1,500	---	21,000	30	J	30		44	J	49	J	65	J	39	J	55	J	49	J	59	J
Anthracene	960	---	13,000	6.9	J	6.2		8.7	J	8	J	11	J	6.5	J	10	J	8.7	J	8.7	J

Table 4. Chemical results compared to DMMP regulatory guidelines.

CHEMICAL	DMMP Guidelines SL	BT	ML	DMMU 1		DMMU 2		DMMU 2 - Replicate		DMMU 3		DMMU 4		DMMU 5		DMMU 6		DMMU 7		DMMU 8	
2-Methylnaphthalene	670	---	1,900	4.8	U	4.2	J	6.1		5.6		3.8	J	5.3		5.6		4.6	J	3.6	J
Total HPAH	12,000	---	69,000	369.8		312.6				476.4		649.8		421.4		731.7		576.4		639.2	
Fluoranthene	1,700	4,600	30,000	69		66	J	96	J	100		140		82		140		120		140	
Pyrene	2,600	11,980	16,000	100	J	65	J	110	J	100	J	140	J	100	J	140	J	140	J	170	J
Benzo(a)anthracene	1,300	---	5,100	26	J	22	J	30	J	33	J	44	J	27	J	47	J	39	J	40	
Chrysene	1,400	---	21,000	40		40		50		56		72		46		77		62		70	
Total benzofluoranthenes	3,200	---	9,900	62		50		67		88		110		72		180		94		100	
Benzo[a]pyrene	1,600	---	3,600	26		22		31		40		51		30		57		42		44	
Indeno(1,2,3-c,d)pyrene	600	---	4,400	16	J	17	J	20	J	21	J	33	J	22	J	32	J	28	J	27	J
Dibenzo(a,h)anthracene	230	---	1,900	4.8	J	4.6	J	6.7	J	6.4	J	9.8	J	6.4	J	8.7	J	9.4	J	9.2	J
Benzo(g,h,i)perylene	670	---	3,200	26	J	26	J	34	J	32	J	50	J	36	J	50	J	42	J	39	J
CHLORINATED BENZENES (ug/kg dry)																					
1,2-Dichlorobenzene	35	---	110	19	U	19	U	19	U	19	U	19	U	20	U	20	U	19	U	20	U
1,4-Dichlorobenzene	110	---	120	19	U	19	U	19	U	19	U	19	U	20	U	20	U	19	U	20	U
1,2,4-Trichlorobenzene	31	---	64	19	U	19	U	19	U	19	U	19	U	20	U	20	U	19	U	20	U
Hexachlorobenzene	22	168	230	0.99	U	0.99	U	0.99	U	1	U	0.98	U	0.97	U	1	U	0.97	U	0.99	U
PHTHALATE ESTERS (ug/kg dry)																					
Dimethyl phthalate	71	---	1,400	15	J	19	U	19	U	19	U	19	U	20	U	20	U	19	U	20	U
Diethyl phthalate	200	---	1,200	19	U	37		19	U	19	U	22		20	U	20	U	19	U	33	
Di-n-butyl phthalate	1,400	---	5,100	19	U	26		19	U	19	U	19	U	20	U	110		19	U	20	U
Butyl benzyl phthalate	63	---	970	14	J	9.6	J	19	U	19	U	18	J	19	J	12	J	28		20	
Bis(2-ethylhexyl)phthalate	1,300	---	8,300	160		120		210		290		280		140		200		230		260	
Di-n-octyl phthalate	6,200	---	6,200	19	U	19	UJ	68	J	19	U	19	U	20	U	20	U	19	U	11	J
PHENOLS (ug/kg dry)																					
Phenol	420	---	1,200	86		51		81		110		37		41		24		72		110	
2 Methylphenol	63	---	77	19	U	19	U	19	U	19	U	19	U	20	U	20	U	19	U	20	U
4 Methylphenol	670	---	3,600	31		25		39		54		22		19	J	16	J	19		35	
2,4-Dimethylphenol	29	---	210	24	U	24	U	24	U	24	U	24	U	25	U	25	U	24	U	24	U
Pentachlorophenol	400	504	690	96	UJ	96	UJ	97	UJ	96	UJ	97	UJ	98	UJ	98	UJ	96	UJ	97	UJ
MISCELLANEOUS EXTRACTABLES (ug/kg dry)																					
Benzoic acid	650	---	760	580		560	J	900	J	950		460	J	500	J	310	J	600		730	
Benzyl alcohol	57	---	870	82		120		190		130		91		100		64	U	150		110	
Dibenzofuran	540	---	1,700	14	J	19	U	19	U	19	U	19	U	20	U	20	U	19	U	20	U
Hexachlorobutadiene	11	---	270	0.99	U	0.99	U	0.99	U	1	U	0.98	U	0.97	U	1	U	0.97	U	0.99	U
N-Nitrosodiphenylamine	28	---	130	19	U	19	U	19	U	19	UJ	19	U	20	U	20	U	19	U	20	U

Table 4. Chemical results compared to DMMP regulatory guidelines.

CHEMICAL	DMMP Guidelines SL	BT	ML	DMMU 1	DMMU 2	DMMU 2 - Replicate	DMMU 3	DMMU 4	DMMU 5	DMMU 6	DMMU 7	DMMU 8
PESTICIDES (ug/kg dry)												
Aldrin	10	---	---	0.49 U	0.49 U	0.49 U	0.5 U	0.49 U	1 Y	0.5 U	0.48 U	0.5 U
Total Chlordane	3	37	---	1.7 J	2.8	2.2 J	1.4	1.1	2.6	2.1	1.5 J	1.6
Dieldrin	2	---	---	0.99 U	0.99 U	0.99 U	1 U	0.98 U	0.97 U	1 U	0.97 U	0.99 U
Heptachlor	2	---	---	0.49 U	0.49 U	0.49 U	0.5 U	0.49 U	1.5 U	0.5 U	0.48 U	0.5 U
4,4'-DDE	9	---	---	2.5	see Table 6	2.7 J	2.6	2.5 J	2.8	2.4	2.1	2.9
4,4'-DDD	16	---	---	3.3		4.3 J	4.3	2.9	4.4	3.4	3	3.6
4,4'-DDT	12	---	---	3 U		1.8 UJ	2.6 U	1.9 U	3.2 U	1 U	1.9 U	1.6 U
Total DDT		50	69	5.8		7 J	6.9	5.4 J	7.2	5.8	5.1	6.5
PCBs (ug/kg dry)												
Total PCBs	130	---	3,100	25.6 J	29.9	33	23.7 J	21.1	26.8	45.3 J	22	26.2
Total PCBs (mg/kg OC)	---	38	---	0.717	1.079	0.615	0.875	1.019	0.579	1.849	0.894	1.541
DIOXINS/FURANS (pptr TEQ, U=1/2 RL)												
Dioxins/Furans	4	10		12.95	23.17	14.68	12.93	9.51	10.02	8.76	7.36	8.16
SUMMARY												
DMMP Determination				FAIL	FAIL		FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
DMMU volume				3750	3700		3800	3750	3700	3800	3750	3750
Rank				High	High		High	High	High	High	High	High
Mean sample depth (ft)				1.4	1.4		1.75	1.9	1.4	1.65	1.4	1.75
Maximum sampling depth (ft)				3	3.9		3.7	5.1	3.7	4.2	3.2	4.5

J = estimated concentration
U = undetected
OC = organic carbon
SL = screening level
BT = bioaccumulation trigger
ML = maximum level
SL exceedance
ML exceedance

Table 5a. Dioxin/Furan Results in the Dredged Material (ng/kg)

CHEMICAL	TEF	DMMU 1				DMMU 2				DMMU2-Dup				DMMU 3				DMMU 4			
DIOXINS/FURANS		conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)
2,3,7,8-TCDD	1	0.582	U	0	0.291	0.778	U	0	0.389	0.14	U	0	0.07	0.658	U	0	0.329	0.513	U	0	0.2565
1,2,3,7,8-PeCDD	1	3.05		3.05	3.05	5.02	J	5.02	5.02	2.79	J	2.79	2.79	3.28		3.28	3.28	2.39		2.39	2.39
1,2,3,4,7,8-HxCDD	0.1	4.52		0.452	0.452	8.04	J	0.804	0.804	4.11	J	0.411	0.411	4.58		0.458	0.458	3.3		0.33	0.33
1,2,3,6,7,8-HxCDD	0.1	16.8		1.68	1.68	29.9	J	2.99	2.99	14.8	J	1.48	1.48	16.3		1.63	1.63	11.7		1.17	1.17
1,2,3,7,8,9-HxCDD	0.1	9.52		0.952	0.952	16.3	J	1.63	1.63	8.98	J	0.898	0.898	9.88		0.988	0.988	7.29		0.729	0.729
1,2,3,4,6,7,8-HpCDD	0.01	347		3.47	3.47	656	J	6.56	6.56	300	J	3	3	327		3.27	3.27	227		2.27	2.27
OCDD	0.0003	2610		0.783	0.783	5380	J	1.614	1.614	2260	J	0.678	0.678	2500		0.75	0.75	1680		0.504	0.504
2,3,7,8-TCDF	0.1	1.65		0.165	0.165	1.79		0.179	0.179	1.61		0.161	0.161	1.65		0.165	0.165	1.26		0.126	0.126
1,2,3,7,8-PeCDF	0.03	1.31		0.0393	0.0393	1.54		0.0462	0.0462	1.25	U	0	0.01875	1.35		0.0405	0.0405	1.1		0.033	0.033
2,3,4,7,8-PeCDF	0.3	1.52		0.456	0.456	1.79		0.537	0.537	1.49		0.447	0.447	1.65	U	0	0.2475	1.31		0.393	0.393
1,2,3,4,7,8-HxCDF	0.1	3.26		0.326	0.326	5.15		0.515	0.515	3.26		0.326	0.326	3.62		0.362	0.362	2.93		0.293	0.293
1,2,3,6,7,8-HxCDF	0.1	2.9		0.29	0.29	4.35		0.435	0.435	2.78		0.278	0.278	3.11		0.311	0.311	2.36		0.236	0.236
1,2,3,7,8,9-HxCDF	0.1	1.29	U	0	0.0645	1.66		0.166	0.166	1.22		0.122	0.122	1.49		0.149	0.149	1.21		0.121	0.121
2,3,4,6,7,8-HxCDF	0.1	3.78		0.378	0.378	5.71	J	0.571	0.571	3.66	J	0.366	0.366	3.95		0.395	0.395	2.86		0.286	0.286
1,2,3,4,6,7,8-HpCDF	0.01	48.3		0.483	0.483	143	J	1.43	1.43	44.6	J	0.446	0.446	48.5		0.485	0.485	32.6		0.326	0.326
1,2,3,4,7,8,9-HpCDF	0.01	2.92		0.0292	0.0292	6.92	J	0.0692	0.0692	291	J	2.91	2.91	3.14		0.0314	0.0314	2.29		0.0229	0.0229
OCDF	0.0003	149		0.0447	0.0447	718	J	0.2154	0.2154	127	J	0.0381	0.0381	125		0.0375	0.0375	80.5		0.02415	0.02415
TOTAL TEQ				12.60	12.95			22.78	23.17			14.35	14.44			12.35	12.93			9.25	9.51

CHEMICAL	TEF	DMMU 5				DMMU 6				DMMU 7				DMMU 8			
DIOXINS/FURANS		conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)
2,3,7,8-TCDD	1	0.631	U	0	0.3155	0.557	U	0	0.2785	0.463	U	0	0.2315	0.548	U	0	0.274
1,2,3,7,8-PeCDD	1	2.53		2.53	2.53	2.29		2.29	2.29	1.85		1.85	1.85	2.06		2.06	2.06
1,2,3,4,7,8-HxCDD	0.1	3.59		0.359	0.359	3.11		0.311	0.311	2.54		0.254	0.254	2.8		0.28	0.28
1,2,3,6,7,8-HxCDD	0.1	11.6		1.16	1.16	9.97		0.997	0.997	8.72		0.872	0.872	9.05		0.905	0.905
1,2,3,7,8,9-HxCDD	0.1	7.71		0.771	0.771	6.8		0.68	0.68	5.36		0.536	0.536	6.15		0.615	0.615
1,2,3,4,6,7,8-HpCDD	0.01	234		2.34	2.34	208		2.08	2.08	175		1.75	1.75	193		1.93	1.93
OCDD	0.0003	1790		0.537	0.537	1710		0.513	0.513	1330		0.399	0.399	1530		0.459	0.459
2,3,7,8-TCDF	0.1	1.4		0.14	0.14	1.26		0.126	0.126	1.02		0.102	0.102	1.14		0.114	0.114
1,2,3,7,8-PeCDF	0.03	1.05		0.0315	0.0315	0.946	J	0.02838	0.02838	0.839	J	0.02517	0.02517	0.895	U	0	0.013425
2,3,4,7,8-PeCDF	0.3	1.37		0.411	0.411	1.16		0.348	0.348	1.01		0.303	0.303	1.07		0.321	0.321
1,2,3,4,7,8-HxCDF	0.1	3.06		0.306	0.306	2.52	U	0	0.126	2.17		0.217	0.217	2.47		0.247	0.247
1,2,3,6,7,8-HxCDF	0.1	2.45		0.245	0.245	2.16		0.216	0.216	1.77		0.177	0.177	2.21		0.221	0.221
1,2,3,7,8,9-HxCDF	0.1	1.13		0.113	0.113	0.93	J	0.093	0.093	0.917	J	0.0917	0.0917	0.901	J	0.0901	0.0901
2,3,4,6,7,8-HxCDF	0.1	3.17		0.317	0.317	2.8		0.28	0.28	2.3		0.23	0.23	2.86		0.286	0.286
1,2,3,4,6,7,8-HpCDF	0.01	38.4		0.384	0.384	33.7		0.337	0.337	28.5		0.285	0.285	30.3		0.303	0.303
1,2,3,4,7,8,9-HpCDF	0.01	2.61		0.0261	0.0261	2.21		0.0221	0.0221	1.85		0.0185	0.0185	2.16		0.0216	0.0216
OCDF	0.0003	105		0.0315	0.0315	97.2		0.02916	0.02916	73.9		0.02217	0.02217	82.9		0.02487	0.02487
TOTAL TEQ				9.70	10.02			8.35	8.76			7.13	7.36			7.88	8.16

Qualifiers
J - the reported concentration is an estimated value
U - the analyte was not detected at the estimated detection limit (EDL)

Table 5b. Dioxin/Furan Results in the Z-samples (ng/kg)

CHEMICAL	TEF	DMMU 1 Z-sample				DMMU 2 Z-sample				DMMU 3 Z-sample				DMMU 4 Z-sample			
DIOXINS/FURANS		conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)
2,3,7,8-TCDD	1	0.26	U	0	0.13	0.633	J	0.633	0.633	0.655	U	0	0.3275	0.425	U	0	0.2125
1,2,3,7,8-PeCDD	1	0.478	J	0.478	0.478	2.42		2.42	2.42	2.51		2.51	2.51	1.14		1.14	1.14
1,2,3,4,7,8-HxCDD	0.1	0.613	J	0.0613	0.0613	3.28		0.328	0.328	3.4		0.34	0.34	1.37		0.137	0.137
1,2,3,6,7,8-HxCDD	0.1	2.04		0.204	0.204	13.6		1.36	1.36	14.3		1.43	1.43	5.72		0.572	0.572
1,2,3,7,8,9-HxCDD	0.1	1.34		0.134	0.134	7.5		0.75	0.75	7.77		0.777	0.777	3.35		0.335	0.335
1,2,3,4,6,7,8-HpCDD	0.01	40	J	0.4	0.4	258		2.58	2.58	273		2.73	2.73	93.6		0.936	0.936
OCDD	0.0003	321	J	0.0963	0.0963	2030		0.609	0.609	2200		0.66	0.66	649		0.1947	0.1947
2,3,7,8-TCDF	0.1	0.4	J	0.04	0.04	1.61		0.161	0.161	1.7		0.17	0.17	0.92	U	0	0.046
1,2,3,7,8-PeCDF	0.03	0.246	J	0.00738	0.00738	1.21		0.0363	0.0363	1.28		0.0384	0.0384	0.615	J	0.01845	0.01845
2,3,4,7,8-PeCDF	0.3	0.314	J	0.0942	0.0942	1.54		0.462	0.462	1.6		0.48	0.48	0.695	J	0.2085	0.2085
1,2,3,4,7,8-HxCDF	0.1	0.551	J	0.0551	0.0551	2.91		0.291	0.291	3.29		0.329	0.329	1.45		0.145	0.145
1,2,3,6,7,8-HxCDF	0.1	0.523	J	0.0523	0.0523	2.5		0.25	0.25	2.77		0.277	0.277	1.2		0.12	0.12
1,2,3,7,8,9-HxCDF	0.1	0.262	J	0.0262	0.0262	1.16		0.116	0.116	1.28		0.128	0.128	0.609	U	0	0.03045
2,3,4,6,7,8-HxCDF	0.1	0.364	J	0.0364	0.0364	3.27		0.327	0.327	3.44		0.344	0.344	1.46		0.146	0.146
1,2,3,4,6,7,8-HpCDF	0.01	6.44		0.0644	0.0644	35.7		0.357	0.357	37.4		0.374	0.374	12.8		0.128	0.128
1,2,3,4,7,8,9-HpCDF	0.01	0.388	U	0	0.00194	2.26		0.0226	0.0226	2.57		0.0257	0.0257	0.85	J	0.0085	0.0085
OCDF	0.0003	14.4		0.00432	0.00432	98.2		0.02946	0.02946	102		0.0306	0.0306	24.4		0.00732	0.00732
TOTAL TEQ				1.75	1.89			10.73	10.73			10.64	10.97			4.10	4.39

CHEMICAL	TEF	DMMU 5 Z-sample				DMMU 6 Z-sample				DMMU 7 Z-sample				DMMU 8 Z-sample			
DIOXINS/FURANS		conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)
2,3,7,8-TCDD	1	0.423	U	0	0.2115	0.459	U	0	0.2295	0.539	U	0	0.2695	0.463	U	0	0.2315
1,2,3,7,8-PeCDD	1	1.43		1.43	1.43	1.44		1.44	1.44	2.03		2.03	2.03	1.55		1.55	1.55
1,2,3,4,7,8-HxCDD	0.1	1.85		0.185	0.185	1.76		0.176	0.176	2.91		0.291	0.291	1.84		0.184	0.184
1,2,3,6,7,8-HxCDD	0.1	6.62		0.662	0.662	7.08		0.708	0.708	9.5		0.95	0.95	6.25		0.625	0.625
1,2,3,7,8,9-HxCDD	0.1	4.32		0.432	0.432	4.05		0.405	0.405	6.44		0.644	0.644	3.94	U	0	0.197
1,2,3,4,6,7,8-HpCDD	0.01	130		1.3	1.3	138		1.38	1.38	195		1.95	1.95	127		1.27	1.27
OCDD	0.0003	997		0.2991	0.2991	1100		0.33	0.33	1290		0.387	0.387	943		0.2829	0.2829
2,3,7,8-TCDF	0.1	0.856	J	0.0856	0.0856	0.964	J	0.0964	0.0964	1.02		0.102	0.102	1.17		0.117	0.117
1,2,3,7,8-PeCDF	0.03	0.653	J	0.01959	0.01959	0.772	J	0.02316	0.02316	1.02		0.0306	0.0306	0.816	J	0.02448	0.02448
2,3,4,7,8-PeCDF	0.3	0.721	J	0.2163	0.2163	0.918	J	0.2754	0.2754	1.16		0.348	0.348	0.909	J	0.2727	0.2727
1,2,3,4,7,8-HxCDF	0.1	1.53		0.153	0.153	2.05		0.205	0.205	3.59		0.359	0.359	1.91		0.191	0.191
1,2,3,6,7,8-HxCDF	0.1	1.41		0.141	0.141	1.68		0.168	0.168	2.58		0.258	0.258	1.65		0.165	0.165
1,2,3,7,8,9-HxCDF	0.1	0.619	J	0.0619	0.0619	0.816	U	0	0.0408	1.83		0.183	0.183	0.714	U	0	0.0357
2,3,4,6,7,8-HxCDF	0.1	1.79		0.179	0.179	1.99		0.199	0.199	3.21		0.321	0.321	2.06		0.206	0.206
1,2,3,4,6,7,8-HpCDF	0.01	18.1		0.181	0.181	20.6		0.206	0.206	38.1		0.381	0.381	19.8		0.198	0.198
1,2,3,4,7,8,9-HpCDF	0.01	1.28		0.0128	0.0128	1.48		0.0148	0.0148	2.58		0.0258	0.0258	1.44		0.0144	0.0144
OCDF	0.0003	49.4		0.01482	0.01482	41.9		0.01257	0.01257	69		0.0207	0.0207	47.1		0.01413	0.01413
TOTAL TEQ				5.37	5.58			5.64	5.91			8.28	8.55			5.11	5.58

Qualifiers
J - the reported concentration is an estimated value
U - the analyte was not detected at the estimated detection limit (EDL)

Table 6. Results of DDT, DDD. And DDE supplemental evaluations of DMMU 2

CHEMICAL	DMMP Guidelines			DMMU Composite Results															
	SL	BT	ML	DMMU 2 - Original		DMMU 2 - Field Duplicate		DMMU 2 - Archive Replicate 1		DMMU 2 - Archive Replicate 2		DMMU 2 - Replicate 1 with GPC cleanup		DMMU 2 - Replicate 2 with GPC cleanup		DMMU 2 - Replicate 3 with GPC cleanup		DMMU 2 - Replicate 4 with Acid cleanup	
Lab Analysis Date				07/30/2014		07/30/2014		11/15/2014		11/15/2014		12/		09/16/2014		11/15/2014		09/16/2014	
PESTICIDES (µg/kg)				conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ
4,4'-DDD	16	---	---	290	J	4.3	J	4.7		4.2		4.6		4.4	J	5.5	J	5.0	
4,4'-DDE	9	---	---	170	J	2.7	J	2	J	1.9	J	2.3	J	2.5	J	2.5	J	4.2	J
4,4'-DDT	12	---	---	5500	J	1.8	UJ	2	U	2	U	3.1	U	0.99	U	3.3	U	2.9	UJ
Total DDT		50	69	5960	J	8.8	J	6.7		6.1		6.9		6.9		8.0		9.2	

CHEMICAL	DMMP Guidelines			Individual Core Results											
	SL	BT	ML	Core 3a		Core 3b		Core 3b - with Acid cleanup		Core 4a		Core 4b		Core 4b - with Acid cleanup	
Lab Analysis Date				11/15/2014		09/16/2014		12/16/2014		11/15/2014		09/16/2014		12/16/2014	
PESTICIDES (µg/kg)				conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ
4,4'-DDD	16	---	---	7.6		4		6.3		2.8		3.1		3.4	
4,4'-DDE	9	---	---	2.9		1.6	J	3.7		1.4	J	1.8	J	3.5	J
4,4'-DDT	12	---	---	2	U	0.99	U	2.3	UJ	2	U	2.4	U	0.98	UJ
Total DDT		50	69	10.5		6.6		10		4.2		4.9		6.9	

J = estimated concentration
U = undetected at the reporting limit
UJ = undetected at an estimated quantitation limit

SL = screening level
BT = bioaccumulation trigger
ML = maximum level
SL exceedance
ML exceedance

Table 7. Z-sample chemical results compared to SMS regulatory guidelines.

	2013 Freshwater Guidelines		DMMU 1 z-sample		DMMU 2 z-sample		DMMU 3 z-sample		DMMU 4 z-sample		DMMU 5 z-sample		DMMU 6 z-sample		DMMU 7 z-sample		DMMU 8 z-sample	
CHEMICAL	SCO/SL1	CSL/SL2	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ
CONVENTIONALS																		
Gravel, %			11.5		1.3		0.7		1.7		0.1		0.9		0.4		0.7	
Sand, %			45.9		42		47.9		26.6		44.2		53.4		48.2		52	
Silt, %			29.8		43.5		39.5		54.1		40.4		36.1		38.7		35.7	
Clay, %			12.9		13.1		11.9		17.6		15.4		9.7		12.9		11.6	
Total Solids, %			59.8		39.7		41.4		48.1		48.9		48.2		43.8		47.5	
Total Organic Carbon, %			1.8		2.4		2.7		2.7		1.8		3.1		1.5		2.4	
Total Ammonia, mg N/kg			75		156		159	J	157	J	211		113	J	259		198	
Total Sulfides, individual core - mg/kg			15.4		109		150		24.4		96.5		30.1		108		33.4	
Volatile Soilids, %			6.1		11.4		12.8		8.4		7.1		9.9		10.5		10.4	
METALS (mg/kg dry)																		
Arsenic	14	120	3.39	J	7.6	J	8.2	J	5.7	J	4.8	J	7.16	J	7.1	J	6.7	J
Cadmium	2.1	5.4	0.4		0.7		0.7		0.5		0.6		0.5		0.6		0.6	
Chromium	72	88	49		47		45		56		47		42.2		46		46	
Copper	400	1,200	22.7		27.5	J	26.7	J	23.6	J	21.9	J	19.6	J	24.6		24.9	
Lead	360	>1300	10		29		34		25		15		24		23		65	
Mercury	0.66	0.8	0.04	J	0.09		0.08		0.07		0.06		0.07		0.08	J	0.09	J
Nickel	38 [1]	110	45		42	J	40	J	44	J	39	J	38	J	41		43	
Selenium	11	>20	0.295	J	0.57	J	0.57	J	0.507	J	0.501	J	0.49	J	0.47	J	0.48	J
Silver	0.57	1.7	0.062	J	0.095	J	0.114	J	0.075	J	0.093	J	0.078	J	0.09	J	0.103	J
Zinc	3,200	>4200	61		100		94		78		82		77		96		85	
ORGANOTIN COMPOUNDS (mg/kg dry)																		
Monobutyltin	540	>4800	n.a		n.a		n.a		n.a		n.a		n.a		n.a		n.a	
Dibutyltin	910	130,000	n.a		n.a		n.a		n.a		n.a		n.a		n.a		n.a	
Tributyltin	47	320	n.a		n.a		n.a		n.a		n.a		n.a		n.a		n.a	
Tetrabutyltin	97	>97	n.a		n.a		n.a		n.a		n.a		n.a		n.a		n.a	
BULK PETROLEUM HYRDOCARBONS (mg/kg dry)																		
TPH - Diesel	340	510	25		40		41		37		32		42		22		47	
TPH - Residual	3,600	4,400	50		110		110		98		110		120		72		150	

Table 7. Z-sample chemical results compared to SMS regulatory guidelines.

CHEMICAL	2013 Freshwater Guidelines		DMMU 1 z-sample		DMMU 2 z-sample		DMMU 3 z-sample		DMMU 4 z-sample		DMMU 5 z-sample		DMMU 6 z-sample		DMMU 7 z-sample		DMMU 8 z-sample	
	SCO/SL1	CSL/SL2	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ
PAHs (ug/kg dry)																		
Total PAHs	17,000	30,000	889.9		414.9		694		300.2		619.5		408.7		539.2		416.4	
Naphthalene			26		5.8		12		6.6		4.3	J	6.6		6		5.9	
Acenaphthylene			4.7	U	4.8	UJ	2.8	J	4.8	UJ	4.3	J	4.9	UJ	4.8	U	4.8	U
Acenaphthene			160		2.8	J	8.3		5.2		3.7	J	4.3	J	3.5	J	2.7	J
Fluorene			24	J	4.4	J	8.4	J	5.8	J	5.4	J	7.1	J	5	J	5.1	J
Phenanthrene			400	J	36	J	70	J	36	J	44	J	45	J	47	J	38	J
Anthracene			33	J	7.4	J	12	J	5.5	J	8.1	J	8.3	J	6.4	J	6.3	J
1-Methylnaphthalene			4.7	U	4.8	UJ	3.1	J	4.8	UJ	4.8	U	4	J	4.8	U	4.8	U
2-Methylnaphthalene			13		4.1	J	7		5.7		3.2	J	6.5		3.7	J	4	J
Fluoranthene			75		72		130		48		140		60		92		73	
Pyrene			81	J	86	J	160	J	60	J	130	J	68	J	130	J	88	J
Benzo(a)anthracene			14	J	26	J	40	J	16	J	33	J	23	J	29	J	22	J
Chrysene			24		42		61		28		65		43		50		40	
Total benzofluoranthenes			24		58		83		36		83		58		72		55	
Benzo[a]pyrene			4.7	U	25		34		16		35		28		33		26	
Indeno(1,2,3-c,d)pyrene			6	J	16	J	22	J	12	J	24	J	17	J	22	J	18	J
Dibenzo(a,h)anthracene			4.7	UJ	5.4	J	6.2	J	3.4	J	6.8	J	4.9	J	6.6	J	5.4	J
Benzo(g,h,i)perylene			9.9	J	24	J	37	J	16	J	34	J	25	J	33	J	27	J
PHTHALATE ESTERS (ug/kg dry)																		
Di-n-butyl phthalate	380	1,000	19	U	19	U	20	U	19	U	19	U	19	U	20	U	19	U
Bis(2-ethylhexyl)phthalate	500	22,000	48		120		150		290		220		130		160		190	
Di-n-octyl phthalate	39	>1100	19	U	19	U	20	U	19	U	19	U	19	U	20	U	19	U
PHENOLS (ug/kg dry)																		
Phenol	120	210	46		42		88		47		21		64		130		92	
4 Methylphenol	260	2,000	19	U	19	U	20	U	19	UJ	19	U	19	U	20	U	19	U
Pentachlorophenol	1,200	>1200	24	U	24	U	25	U	24	UJ	24	U	24	U	25	U	24	U
MISCELLANEOUS EXTRACTABLES (ug/kg dry)																		
Benzoic acid	2,900	3,800	400		490	J	1000	J	720	J	280	J	729	J	1100		830	
Dibenzofuran	200	680	19	U	19	U	20	U	19	U	19	U	19	U	20	U	19	U

Table 7. Z-sample chemical results compared to SMS regulatory guidelines.

CHEMICAL	2013 Freshwater Guidelines		DMMU 1 z-sample		DMMU 2 z-sample		DMMU 3 z-sample		DMMU 4 z-sample		DMMU 5 z-sample		DMMU 6 z-sample		DMMU 7 z-sample		DMMU 8 z-sample	
	SCO/SL1	CSL/SL2	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ
PESTICIDES (ug/kg dry)																		
Beta-Hexachlorocyclohexane	7.2	11	0.49	U	0.49	U	0.5	U	0.49	U	0.49	U	0.5	U	0.49	U	0.5	U
Carbazole	900	1100	19	U	19	U	9.9	U	19	UJ	19	U	19	U	20	U	19	U
Endrin ketone	8.5	****	0.99	U	0.98	U	0.99	U	0.99	U	0.99	U	0.99	U	0.98	U	1	U
Dieldrin	4.9	9.3	0.99	U	0.98	U	0.99	U	0.99	U	0.99	U	0.99	U	0.98	U	1	U
Total DDE*	21	33	1.1	J	2.5		3.8		1.5		1.4		1.8		2.0		2.5	
Total DDD*	310	860	2.4		5.3		10		3.2		2.2		4.2		3.7		5.6	
Total DDT*	100	8,100	0.99	U	4.4		51		0.99	U	3.6	U	0.99	U	6.3	U	1	U
PCBs (ug/kg dry)																		
Total PCBs	110	2,500	8.7	J	25.6		33.9		15	J	19.5		19.9	J	21.8		23.3	J

J = estimated concentration
U = undetected
SCO = sediment cleanup objective
CSL = cleanup screening level
**** No value could be set due to limited data above the SQS/SL1 concentration
[1] Western WA background value for nickel adopted by DMMP at SMARM 2014
n.a. = not analyzed
* sum of 2,4' and 4,4' isomers
SCO exceedance
CSL exceedance

Table 8. Hyalella azteca 10-day mortality results

	Mean Mortality (%)	+/-	M_T - M_C	M_T - M_C > 25% ?	M_T - M_C	M_T - M_C > 15% ?	Statistically greater than control?	Transformation	1-Hit Criteria: M_T - M_C > 25% and M_T vs. M_C SS (p=0.05)	2-Hit Criteria: M_T - M_C > 15% and M_T vs. M_C SS (p=0.05)	Interpretation
Control	0.0	0.0	Negative control mortality ≤ 20%. Acceptable Test.		Control mortality ≤ 25%. Acceptable Test.		---	---	---	---	---
DMMU 1 z-sample	0.0	0.0	0.0	no	0.0	no	no	---	no	no	no hit
DMMU 2 z-sample	2.5	4.6	2.5	no	2.5	no	no	---	no	no	no hit
DMMU 3 z-sample	1.3	3.5	1.3	no	1.3	no	no	---	no	no	no hit
DMMU 4 z-sample *	1.7	4.1	1.7	no	1.7	no	no	---	no	no	no hit
DMMU 5 z-sample	1.3	3.5	1.3	no	1.3	no	no	---	no	no	no hit
DMMU 6 z-sample	0.0	0.0	0.0	no	0.0	no	no	---	no	no	no hit
DMMU 7 z-sample	1.3	3.5	1.3	no	1.3	no	no	---	no	no	no hit
DMMU 8 z-sample	1.3	3.5	1.3	no	1.3	no	no	---	no	no	no hit

* due to insufficient sample volume, six replicates were used

Table 9. Chironomus dilutus 20-day mortality results

	Mean Mortality (%)	+/-	M_T - M_C	M_T - M_C > 25% ?	M_T - M_C	M_T - M_C > 15% ?	Statistically greater than control?	Transformation	1-Hit Criteria: M_T - M_C > 25% and M_T vs. M_C SS (p=0.05)	2-Hit Criteria: M_T - M_C > 15% and M_T vs. M_C SS (p=0.05)	Interpretation
Control	14.3		Negative control mortality ≤ 32%. Acceptable Test.		Control mortality ≤ 35%. Acceptable Test.		---	---	---	---	---
DMMU 1 z-sample	26.3		12.0	no	12.0	no	no	---	no	no	no hit
DMMU 2 z-sample	33.8		19.5	no	19.5	yes	yes	arcsin	no	yes	hit
DMMU 3 z-sample	13.8		-0.5	no	-0.5	no	no	---	no	no	no hit
DMMU 4 z-sample *	23.8		9.5	no	9.5	no	no	---	no	no	no hit
DMMU 5 z-sample	21.3		70.0	no	70.0	no	no	---	no	no	no hit
DMMU 6 z-sample	21.3		7.0	no	7.0	no	no	---	no	no	no hit
DMMU 7 z-sample	10.0		-4.3	no	-4.3	no	no	---	no	no	no hit
DMMU 8 z-sample	13.8		-0.5	no	-0.5	no	no	---	no	no	no hit

* due to insufficient sample volume, six replicates were used

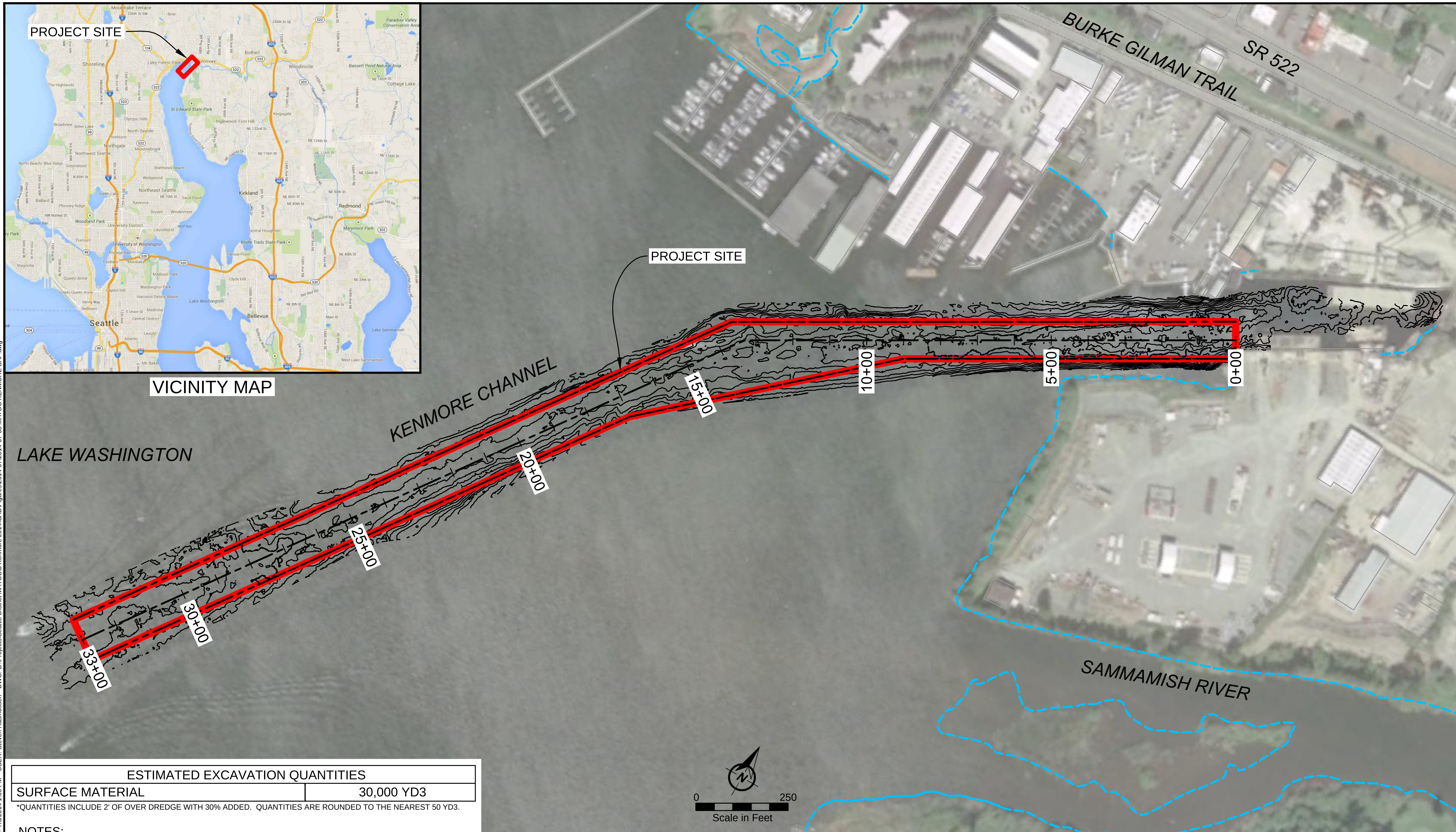
Table 10. Chironomus dilutus 20-day growth results

	Growth - mean individual AFDW (mg)	Control Performance $MIG_C > 0.6$ (mg/individual)	Reference Performance $MIG_C/MIG_C \geq 0.8$ (mg/individual)	MIG_T - MIG_C	$MIG_{T\ SS}$ < MIG_C (p=0.05)	Transformation	1-Hit Criteria: $MIG_T/MIG_C < 0.6$ and $MIG_{T\ s}$s. < MIG_C (p=0.05)	2-Hit Criteria: $MIG_T/MIG_C < 0.75$ and $MIG_{T\ s}$s. < MIG_C (p=0.05)	Interpretation
Control	1.4	1.4	1.0	---	---	---	---	---	---
DMMU 1 z-sample	1.4	---	---	0.97	no	---	no	no	no hit
DMMU 2 z-sample	1.5	---	---	1.03	no	---	no	no	no hit
DMMU 3 z-sample	1.4	---	---	0.94	no	---	no	no	no hit
DMMU 4 z-sample	1.4	---	---	1.00	no	---	no	no	no hit
DMMU 5 z-sample	1.4	---	---	0.96	no	---	no	no	no hit
DMMU 6 z-sample	1.6	---	---	1.11	no	---	no	no	no hit
DMMU 7 z-sample	1.3	---	---	0.92	no	---	no	no	no hit
DMMU 8 z-sample	1.4	---	---	1.01	no	---	no	no	no hit

Table 11. Summary of bioassay results

Sample	*Hyallella* Survival	*Chironomus* survival	*Chironomus* growth	Summary interpretation
DMMU 1 z-sample	no hit	no hit	no hit	no hit
DMMU 2 z-sample	no hit	X	no hit	no hit
DMMU 3 z-sample	no hit	no hit	no hit	no hit
DMMU 4 z-sample	no hit	no hit	no hit	no hit
DMMU 5 z-sample	no hit	no hit	no hit	no hit
DMMU 6 z-sample	no hit	no hit	no hit	no hit
DMMU 7 z-sample	no hit	no hit	no hit	no hit
DMMU 8 z-sample	no hit	no hit	no hit	no hit

no hit = passes SMS guidelines
X = hit under the 2-hit rule (minor hit)
XX = hit under the 1-hit rule (major hit)



ESTIMATED EXCAVATION QUANTITIES	
SURFACE MATERIAL	30,000 YD3

*QUANTITIES INCLUDE 2' OF OVER DREDGE WITH 30% ADDED. QUANTITIES ARE ROUNDED TO THE NEAREST 50 YD3.

NOTES:

1. BATHYMETRIC CONTOURS GENERATED FROM HYDRO SURVEY DATA COLLECTED APRIL 7, 2014 BY USACE.
2. HORIZONTAL COORDINATE SYSTEM WASHINGTON STATE PLANE NORTH, VERTICAL LAKE WASHINGTON LOW WATER DATUM, US FOOT.
3. BASE MAP DRAWING INFORMATION PROVIDED BY USACE.
4. BACKGROUND IMAGE SOURCE: GOOGLE EARTH 5/4/2013

LEGEND

- PROJECT BOUNDARY
- NAVIGATION CHANNEL
- NAVIGATION CHANNEL CENTERLINE
- EXISTING CONTOURS
- EXISTING SHORELINE

U.S. ARMY CORPS OF ENGINEERS

SEATTLE DISTRICT MATOC
SEATTLE, WASHINGTON

VICINITY MAP FOR THE KENMORE FEDERAL NAVIGATION CHANNEL

DOF DALTON OLMSTED FUGLEVAND

FIGURE
1

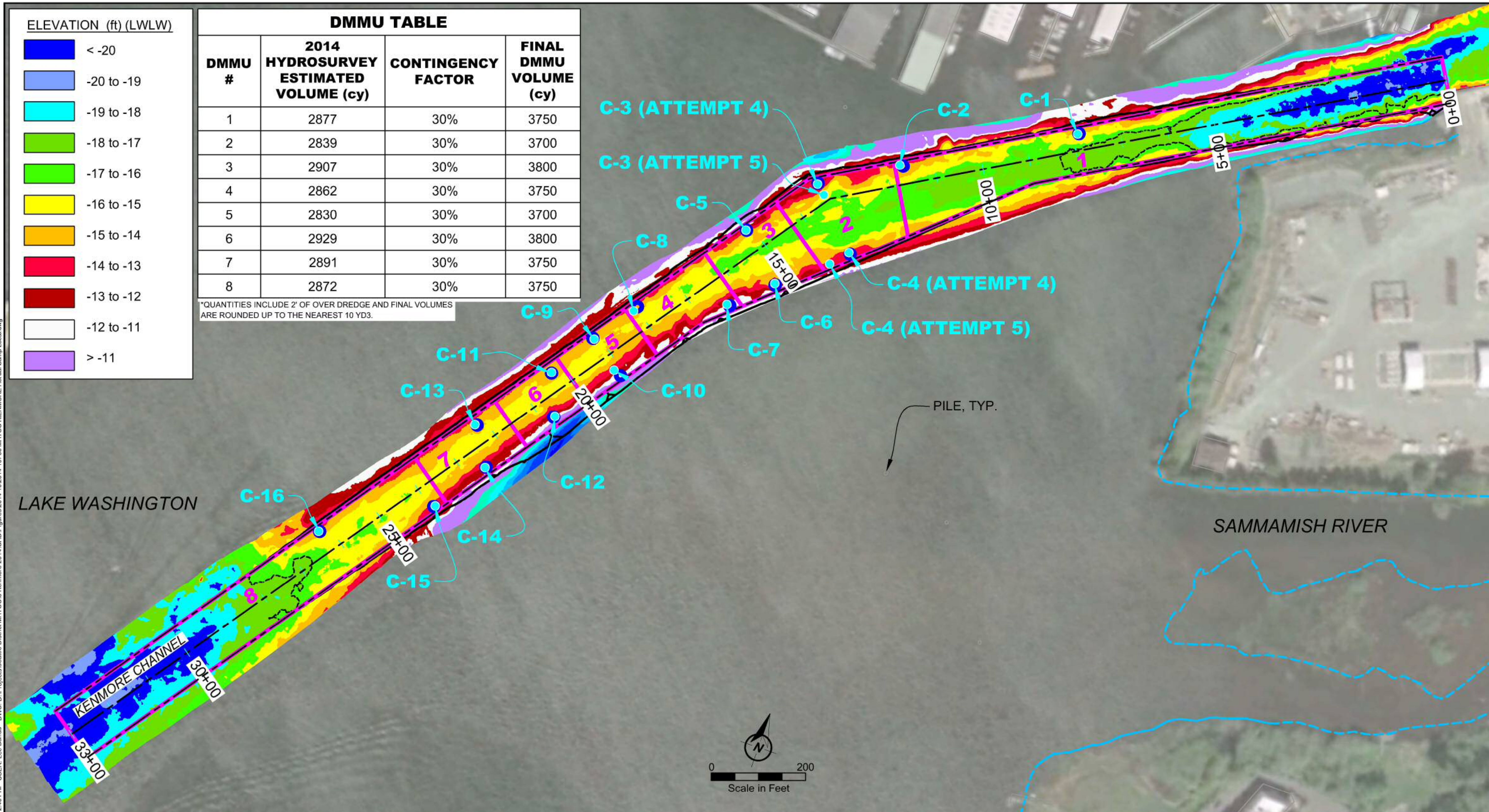
JULY 8, 2014

PLOT TIME: 7/8/2014 1:52 PM MOD TIME: 7/8/2014 1:50 PM USER: Steven Rasmussen DWG: D:\Projects\Seattle District MATOC\3 Kenmore 2014\CAD\Figures\2014-07\2014-07-08 MATOC KENMORE SAP.dwg

DMMU TABLE

DMMU #	2014 HYDROSURVEY ESTIMATED VOLUME (cy)	CONTINGENCY FACTOR	FINAL DMMU VOLUME (cy)
1	2877	30%	3750
2	2839	30%	3700
3	2907	30%	3800
4	2862	30%	3750
5	2830	30%	3700
6	2929	30%	3800
7	2891	30%	3750
8	2872	30%	3750

*QUANTITIES INCLUDE 2' OF OVER DREDGE AND FINAL VOLUMES ARE ROUNDED UP TO THE NEAREST 10 YD3.



NOTES:

1. BATHYMETRIC CONTOURS GENERATED FROM HYDRO SURVEY DATA COLLECTED APRIL 7, 2014 BY USACE.
2. HORIZONTAL COORDINATE SYSTEM WASHINGTON STATE PLANE NORTH, VERTICAL LAKE WASHINGTON LOW WATER DATUM, US FOOT.
3. BASE MAP DRAWING INFORMATION PROVIDED BY USACE.

LEGEND

- PROPOSED SAMPLE LOCATION
- C-x ACTUAL SAMPLE LOCATION (7/10-12/2014)
- X DMMU
- SURFACE SEDIMENT BEING DREDGED IN ORDER TO REACH CHARACTERIZATION DEPTH OF -17 LWLW
- NAVIGATION CHANNEL
- -15- CONTOUR MAJOR (5')
- -14- CONTOUR MINOR (1')
- SLOPE
- EXISTING SHORELINE

U.S. ARMY CORPS OF ENGINEERS

SEATTLE DISTRICT MATOC
SEATTLE, WASHINGTON

KENMORE FEDERAL NAVIGATION CHANNEL DMMUs AND ACTUAL SEDIMENT SAMPLING LOCATIONS

DOF DALTON OLMSTED FUGLEVAND

FIGURE 2

OCTOBER 6, 2014

Figure 3. Photograph of core 10, transition from accumulated dredge material to native clay below -17 ft LWLW.