CENWS-OD-TS-DMMO

MEMORANDUM FOR: RECORD July 22, 2011

SUBJECT: DETERMINATION REGARDING THE SUITABILITY OF FEDERAL OPERATION AND MAINTENANCE DREDGED MATERIAL FROM THE DUWAMISH RIVER, SEATTLE, KING COUNTY, WASHINGTON (*Public Notice CENWS-OD-TS-NS-39*) EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT FOR BENEFICIAL USE OR UNCONFINED OPEN-WATER DISPOSAL AT THE ELLIOTT BAY 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 127,093 cubic yards (cy) of dredged material from the Duwamish River federal navigation channel and turning basin for beneficial use or for disposal at the Elliott Bay nondispersive open-water site.

   The Lower Duwamish Waterway, including the federal navigation channel and turning basin, has been the focus of an investigation by the EPA Superfund program since September 2001. The DMMP characterization of proposed dredged material for this project was conducted in consultation with EPA Superfund.

2. Background. As authorized by Congress in the Rivers and Harbors Acts of 1925 and 1930, the Seattle District, Corps of Engineers (Corps) conducts maintenance dredging of the Seattle Harbor Federal Navigation Project in the lower Duwamish River in Seattle, Washington (see Figure 1 for a project and vicinity map). The authorized depth of the channel is minus 15-feet (mean lower low water, MLLW) with a 2-foot allowable overdepth (to minus 17-feet, MLLW). The authorized dimension for the channel bottom width is 150 feet. The authorized dimensions for the channel's turning basin include a width of 250 feet and a length of 500 feet. This suitability determination covers the authorized project between stations 242+00 and 275+56.

   This section of the channel and turning basin were last characterized in 2008-2009. The turning-basin material was determined to be suitable for open-water disposal and was dredged and disposed at the Elliott Bay site early in 2010. In the navigation channel, seven of 14 dredged material management units (DMMUs) were found to be unsuitable for open-water disposal based on bioassay testing results. Only one DMMU – consisting of the upper portion of a major shoal impeding navigation – was dredged from the channel. Material in this DMMU was taken to the Roosevelt Regional Landfill in Klickitat County in February 2010. The remaining DMMUs in the channel, both those found suitable for open-water disposal and those found unsuitable, were left in place.

   For the 2008-2009 characterization, the turning basin (stations 270+56 to 275+56) and adjacent navigation channel (stations 254+00 to 270+56) were jointly identified as "Section A". The navigation channel from stations 242+00 to 254+00 was identified as "Section B". For the

2011 characterization, the turning basin was treated as a separate entity. Section A included only the navigation channel from stations 254+00 to 270+56. Section B remained the same (see Figure 2).

During the 2008-2009 characterization, dioxin concentrations in the z-samples (-17 to -18 feet MLLW) in Section B were higher than in the overlying sediment. Exposure of this sediment would violate the State of Washington antidegradation standard. Therefore, for the 2011 characterization, the Corps elected to leave a one-foot buffer of overlying sediment (-16 to -17 feet MLLW) in place in Section B to isolate the elevated dioxin concentrations. Thus, sampling and testing of potential dredged material in Section B was restricted to a maximum depth of -16 feet MLLW. Dredged material in the turning basin and Section A was sampled and tested to a depth of -17 feet MLLW.

One final difference between the 2008-2009 characterization and that of 2011 was the overall sampling and testing strategy. In 2008-2009, the majority of DMMUs in Section B included dredged material from the mudline all the way down to -16 feet MLLW. Failure of some of these DMMUs created a situation in which removal of the suitable material became problematic from a logistical and environmental perspective, and in the end would leave stretches of sediment undredged and an impediment to navigation. In 2011 an alternative sampling strategy was employed in which layers of sediment (typically 2-feet thick) would be characterized, thus improving the probability of being able to remove at least the top layer or two of sediment.

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

Table 1. Project Summary

Project ranking: - stations 242+00 to 254+00 (Section B) - stations 254+00 to 270+56 (Section A) - stations 270+56 to 275+56 (Turning Basin)	 High Moderate Low-Moderate
Proposed dredging volume	127,093 cubic yards
Proposed dredging depth (Section B)	-16 feet MLLW (including overdepth)
Proposed dredging depth (Turning Basin and Section A)	-17 feet MLLW (including overdepth)
Draft SAP received	March 31, 2011
Draft SAP returned for revisions	April 8, 2011
Revised SAP received	April 13, 2011
Revised SAP approved	April 15, 2011
Sampling dates	April 18-20, 2011
Draft data report received	June 16, 2011
Comments provided on draft report	June 21, 2011
Final data report received	July 18, 2011
DAIS Tracking number	DUW11-1-B-F-308

USACE Public Notice Number	CENWS-OD-TS-NS-39
Recency Determination: - Section B = 2 years (high-ranked) - Turning Basin and Section A = 5 to 7 years	 April 2013 April 2016-2018

4. Project Ranking and Sampling Requirements. The turning basin (stations 270+56 to 275+56) is ranked as "low-moderate" concern for potential contamination (DMMP, 2008a). In 2008, prior to the last characterization effort, the channel between stations 254+00 and 270+56 (Section A) was also ranked low-moderate. However, due to the bioassay failures exhibited in 2008-2009 in Section A, the DMMP agencies agreed to increase the level of concern for this stretch of the navigation channel to "moderate" for this characterization event. The channel between stations 242+00 and 254+00 (Section B) continues to be ranked by the DMMP agencies as "high" concern for potential contamination.

   The sediment in the turning basin (low-moderate) was considered homogeneous due to rapid shoaling and routine maintenance. The numbers of required samples and dredged material management units (DMMUs) for this area were calculated using the following guidelines (DMMP, 2008a):
   - Maximum volume of sediment represented by each field sample = 8,000 cubic yards
   - Maximum volume of sediment represented by each DMMU = 40,000 cubic yards

   The estimated dredged material volume in the turning basin was 14,834 cubic yards. This volume was characterized using a single DMMU, represented by a composite of samples from two locations. See Figures 3 and 4.

   In Section A (moderate), where the sediment was considered heterogeneous, the number of samples and DMMUs were calculated using the following guidelines:
   - Maximum volume of sediment represented by each field sample = 4,000 cubic yards
   - Maximum volume of sediment represented by each DMMU in the upper 4 feet of the dredging prism (surface sediment) = 16,000 cubic yards
   - Maximum volume of sediment represented by each DMMU in the subsurface portion of the dredging prism (deeper than 4 feet) = 24,000 cubic yards

   The estimated dredged material volume in Section A was 74,587 cubic yards. For this characterization effort, the entire volume in Section A was considered to be surface sediment for the purpose of determining the number of DMMUs. Section A was divided into six DMMUs, each represented by a composite of sediment samples from two to four locations. See Figures 4 through 7.

   In Section B (high) – also heterogeneous – the number of samples and DMMUs were calculated using the following guidelines:
   - Maximum volume of sediment represented by each field sample = 4,000 cubic yards
   - Maximum volume of sediment represented by each DMMU in the upper 4 feet of the dredging prism (surface sediment) = 4,000 cubic yards
   - Maximum volume of sediment represented by each DMMU in the subsurface portion of

the dredging prism (deeper than 4 feet) = 12,000 cubic yards

The estimated volume in Section B was 37,672 cubic yards. The entire volume in Section B was considered to be surface sediment for the purpose of determining the number of DMMUs. Ten DMMUs were allocated to this section, with each DMMU represented by sediment samples from one or two locations. See Figures 4, 8 and 9.

Table 2 provides details for the DMMUs, including volumes, depths and stationing.

5. Sampling. Field sampling took place April 18-20, 2011 using a vibracore sampler deployed from Seattle District's M/V Puget. Multiple cores were collected at the majority of sampling locations in order to collect sufficient volumes of sediment for physical and chemical testing, bioassays and archiving. Two-foot long z-samples were collected and archived from each location. The z-samples were taken from the -17 to -19 foot (MLLW) depth interval in the turning basin and Section A. In Section B, the z-samples were taken from the -16 to -18 foot (MLLW) depth interval. Table 3 includes sampling coordinates and depths. Figure 3 and Figures 5 through 9 show both target and actual sampling locations.

6. Chemical Analysis. Table 4 provides a cross-reference between DMMU and lab sample IDs. It also indicates which analyses were conducted for each DMMU. The sediment conventional results (Table 5) show that the proposed dredged material was predominantly sand in the turning basin and Section A, with an increasing silt component in Section B. Total organic carbon ranged from a low of 1.4 percent in the turning basin to a high of 3.6 percent in DMMU 6. Total sulfides concentrations were elevated in many of the DMMUs, ranging as high as 4,290 mg/kg in DMMU 17.

   Table 6 includes the results from the analysis of standard chemicals of concern. Benzyl alcohol exceeded the DMMP screening level (SL) of 57 ug/kg in 10 of 17 DMMUs. The SL of 6.9 ug/kg for total DDT was exceeded in DMMU 11. It should be noted that a number of SLs were eliminated, added or modified by the DMMP agencies (DMMP, 2011) subsequent to approval of the SAP for this project. However, the DMMP agencies agreed to use the SLs identified in the approved SAP (SAIC, 2011a) for the evaluation of the chemistry data, instead of the revised list of SLs.

   The DMMP agencies did not require dioxin analysis for this round of testing, because it had just been evaluated in 2008. However, because of the potential beneficial use of turning-basin and Section-A material, the Corps opted to do some limited dioxin testing to verify the suitability of the material for this purpose. Dioxin was analyzed in the turning basin and for a subset of DMMUs in Section A. Table 7 includes the results of this analysis. Dioxin concentrations ranged from 0.70 to 1.73 ng/kg toxic equivalents (TEQ) with nondetects set equal to half the detection limit.

   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, 2011), the Corps agreed to conduct limited analysis of polybrominated diphenyl ethers (PBDEs) for federal dredging projects. For the

Duwamish O&M project, three DMMUs were analyzed for PBDEs. Results from this analysis are included in Table 8.

All chemistry data were validated by EcoChem. Validation included all EPA Stage 4 verification and validation checks for organics methods and Stage 3 validation for metals and conventional parameters. Only minor QA/QC issues were reported. Data qualifiers assigned by EcoChem can be found in the columns labeled "VQ" in Tables 5, 6, 7 and 8. All data were considered acceptable for use.

7. Bioassays. Concurrent bioassays were run on all DMMUs. Three reference sediment samples were collected from Carr Inlet on April 22, 2011.

The standard suite of three bioassay tests (amphipod mortality, larval development, and polychaete growth) was performed. The DMMP interpretation guidelines for non-dispersive disposal sites were used to assess the bioassay results. The interpretation guidelines are found in Table 9. Negative control and reference sediments met the DMMP performance criteria for all three bioassays (Table 10). Test sediments were matched with the reference sediments on the basis of grain-size distribution. Table 11 provides the match-ups between test and reference sediment samples.

Amphipod Mortality. The amphipod bioassay was run using *Eohaustorius estuarius* as the test species. Test results are shown in Table 12. The test sediments performed well and there were no hits for any DMMU.

The water temperature was slightly low on Day 3 in all treatments; the temperature in the water bath was adjusted and all subsequent temperatures were within recommended limits. Some initial total ammonia concentrations in interstitial waters were above 30 mg NH4/L, triggering ammonia reference-toxicant tests. The median lethal concentration (LC50) in the ammonium reference toxicant test was 96.78 mg NH4/L and the no observed effect concentration (NOEC) level was 39.8 mg NH4/L. Initial interstitial ammonia in two test samples (DMMU 7 and DMMU 12) and one reference sample (CR24W) were above the NOEC; all other initial and final overlying and interstitial ammonia concentrations were below NOEC levels. Survival in the samples was such that it does not appear ammonia was a significant contribution to any observed toxicity. In addition, the LC50 for the cadmium reference-toxicant test was 4.49 mg Cd/L, which was below the control chart limits (5.12 to11.55 mg Cd/L), indicating that the test organisms used in this study may have been more sensitive than those previously tested at NewFields (NewFields, 2011). But again, survival was such that any increased sensitivity did not negatively impact the outcome of the test.

Polychaete Growth. The juvenile polychaete growth test - using *Neanthes arenaceodentata* as the test species - was run with two endpoints, the standard dry-weight endpoint and the ash-free dry-weight endpoint. Results for these two endpoints are displayed in Tables 13 and 14 respectively. All test sediments had mean individual growth rates greater than 80% of that of the control. Therefore, there were no hits for any DMMU.

Temperature in one sample was recorded below recommended limits on Day 1, and all samples were measured above 21 °C on Day 17. The water bath temperature was adjusted and remained within target parameters for the remainder of the test. Five samples had dissolved oxygen readings (ranging from 5.0 to 5.8 mg/L) below the recommended level of 6 mg/L on one day (NewFields, 2011). These minor water quality variations did not negatively impact the outcome of the test.

Larval Development. The larval development bioassay - using *Mytilus galloprovincialis* - was also run with two endpoints. The standard endpoint involves carefully decanting the overlying water at the end of the test so as not to disturb the sediment, while for the resuspension endpoint the sediment and overlying water are thoroughly mixed and allowed to settle for eight to twelve hours prior to decanting. The results are shown in Tables 15 and 16 for the standard and resuspension endpoints respectively.

DMMU 15 scored a hit under the one-hit rule for both endpoints, making it unsuitable for open-water disposal. Several other DMMUs scored hits under the 2-hit rule, but without corroborating hits in other bioassays, these DMMUs are suitable for open-water disposal.

Water quality parameters remained within the target limits throughout the 48-hour test, with the singular exception of temperature on Day 4 for one sample (NewFields, 2011).

See Table 17 for the overall interpretation of the bioassay results.

8. Sediment Exposed by Dredging. Sediment exposed by dredging must either meet the State of Washington Sediment Quality Standards (SQS) (Ecology, 1995) or the State's antidegradation standard (DMMP, 2008b). The DMMP agencies used a weight-of-evidence approach in deciding whether or not z-samples needed to be tested to make this determination.

Turning Basin. There were no detected exceedances of SQS for the dredged material in the turning basin (see Table 18 for a comparison to SMS criteria). The turning-basin dredged material has always been found suitable for open-water disposal. There is no reason to believe that sediment to be exposed by dredging would exceed SQS for any chemical.

Section A. Four of the DMMUs in Section A had detected exceedances of SQS for benzyl alcohol and concentrations of this chemical increased with depth. However, all DMMUs passed biological testing, despite the elevated concentrations of benzyl alcohol. Since all DMMUs passed bioassays and the one chemical – benzyl alcohol – that might be expected to be found in the newly exposed sediment did not result in bioassay failures in the overlying sediment, the DMMP agencies determined that the newly-exposed sediment would present little risk to the environment.

Section B. Six of the DMMUs in Section B had detected exceedances of SQS for benzyl alcohol. However, unlike Section A, the concentration of benzyl alcohol generally

decreased with depth in Section B. Therefore, with regard to chemicals of concern, there is little reason to believe that the newly exposed sediment would have any SQS exceedances. Further evidence for this comes from the sediment characterization that was done in 2008 (DMMP, 2009). As part of that effort, the -16 to -17 foot stratum was tested in Section B. There were no SQS exceedances for any chemicals of concern. The concentration of benzyl alcohol was very low (2.4 and 3.5 ug/kg for the two DMMUs in that stratum). So, from a chemical standpoint, the newly-exposed sediment would be expected to meet the antidegradation guidelines.

The salient issue then becomes one of biological toxicity. All DMMUs in Section B passed biological testing with the exception of DMMU 15, which is located in the -14 to -16 foot stratum. The DMMP antidegradation guidelines stipulate that a z-sample should be tested if the overlying sediment is found unsuitable for aquatic disposal. Therefore, while there is no reason to believe that the newly exposed sediment would exceed the SQS chemical criteria, the sediment underlying DMMU 15 must be tested biologically to determine the relative toxicity of the newly exposed sediment.

One further issue needs to be addressed. If DMMU 15 is not dredged with the rest of the DMMUs, but is left in place, then it itself would represent a degraded surface relative to the sediment surface prior to dredging. This can be remedied by leaving a foot of suitable material from DMMU 11 in place to isolate DMMU 15 from the environment. This would mean dredging DMMU 11 to an elevation of -13 feet.

1,2,4-Trichlorobenzene. While undetected in all DMMUs, the reporting limit for this chemical marginally exceeded the carbon-normalized SQS for 11 of the 17 DMMUs (see table 17 for comparisons to SQS). However, this chemical has never been detected at a concentration above the SL or SQS for past federal dredging projects on the Duwamish River. Therefore, there is no reason to believe that the newly exposed sediment would have concentrations of 1,2,4-trichlorobenzene above SQS.

9. Beneficial-Use Analysis. Dredged material in the turning basin and Section A (DMMUs 1 through 7) was evaluated for beneficial use. As indicated previously, there were four DMMUs in Section A that exceeded the SQS for benzyl alcohol. But all DMMUs were subjected to bioassays and passed. With regard to dioxin, all concentrations were below the DMMP screening level of 4 ng/kg. Therefore, the dredged material is suitable for beneficial use in a marine environment.

   If upland beneficial use is contemplated, the local health district must be contacted for guidance.

10. Suitability Determination. This memorandum documents the evaluation of the suitability of sediment proposed for dredging from the federal navigation project on the Duwamish River for in-water beneficial use or open-water disposal. The approved sampling and analysis plan was followed and the data gathered were deemed sufficient and acceptable for regulatory decision-making under the DMMP program.

Based on the results of the previously described testing, the DMMP agencies concluded that the 3,630 cubic yards of sediment in DMMU 15 are unsuitable for open-water disposal, while the 123,463 cubic yards in the other 16 DMMUs are suitable for open-water disposal at the Elliott Bay non-dispersive site. The dredged material in the turning basin and Section A (DMMUs 1 to 7) are also suitable, from a chemical and toxicity standpoint, for beneficial use in a marine environment. Upland beneficial use would require consultation with the local health department.

If DMMU 15 is dredged and disposed upland, the underlying material must first be tested to determine its toxicity. If DMMU 15 is not dredged during the same dredging season as DMMU 11, then the sediment in DMMU 11 in the -13 to -14 foot stratum must be left in place to isolate DMMU 15 from the environment.

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.

11. References.

DMMO, 2011. *Response Letter from Seattle District to the National Marine Fisheries Service Regarding the Endangered Species Act Section 7 Formal Consultation for the Continued Use of Puget Sound Dredged Disposal Analysis Program Dredged Material Disposal Sites, Puget Sound, Washington (HUCs, 1711200306 Lower Dungeness River, 171100200403 Ennis/Tumwater Creek, 171100020204 Anacortes, 171100020104 Lower Whatcom Creek, 17100110202 Lower Snohomish River, 171100130399 Lower Green River, 171100140599 Lower Puyallup River, 171100190503 Anderson Island). NMFS Consultation Number: 2010/04249.* Prepared by the Seattle District Dredged Material Management Office, January 2011.

DMMP, 2008a. *Dredged Material Evaluation and Disposal Procedures (Users Manual)*. Prepared by the Seattle District Dredged Material Management Office for the Dredged Material Management Program, July 2008.

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NewFields, 2011. *Biological Testing of Sediment for Duwamish River Federal Navigation Channel Dredged Material Characterization, Seattle, Washington*. Prepared by NewFields, June 2011.

SAIC, 2009c. Dredged Material Characterization for the Duwamish River Navigation Channel, Seattle, Washington – Data Report. Prepared by Science Applications International Corporation for the U.S. Army Corps of Engineers Seattle District. October 2009.

SAIC, 2011a. Duwamish River Federal Navigation Channel – Dredged Material Characterization, Seattle, Washington, Sampling and Analysis Plan. Prepared by Science Applications International Corporation and NewFields for the U.S. Army Corps of Engineers Seattle District. April 2011.

SAIC, 2011b. Dredged Material Characterization for the Duwamish River Navigation Channel, Seattle, Washington – Data Report. Prepared by Science Applications International Corporation and NewFields for the U.S. Army Corps of Engineers Seattle District. July 2011.

12. Agency Signatures.

Concur:

7/22/11 David Fox
Date David Fox, P.E. - Seattle District Corps of Engineers

7/25/11
Date Erika Hoffman - Environmental Protection Agency

07/25/2011 Laura Inouye
Date Laura Inouye, Ph.D. - Washington Department of Ecology

7/25/11
Date Lionel Klikoff - Washington Department of Natural Resources

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John Hicks, CENWS-OD-TS-NV
Steve Martin, CENWS-PM-PL-ER
Alison Hiltner, EPA Superfund

Table 2. Dredged Material Management Units (from SAIC, 2011b)

Section	DMMU	Stations	Depth (feet MLLW)	DMMU volume (cy)	Section Volume (cy)
Turning Basin	1	270+56 to 275+56	mudline to -17	14,834	14,834
Section A	2	254+00 to 270+56	mudline to -11	14,346	74,587
	3	254+00 to 270+56	-11 to -13	15,851	
	4	262+00 to 270+56	-13 to -15	11,072	
	5	254+00 to 262+00	-13 to -15	10,016	
	6	262+00 to 270+56	-15 to -17	12,327	
	7	254+00 to 262+00	-15 to -17	10,975	
Section B	8	249+00 to 254+00	mudline to -12	4,744	37,672
	9	242+00 to 249+00	mudline to -12	4,116	
	10	251+00 to 254+00	-12 to -14	3,320	
	11	248+00 to 251+00	-12 to -14	3,433	
	12	245+00 to 248+00	-12 to -14	3,624	
	13	242+00 to 245+00	-12 to -14	3,498	
	14	251+00 to 254+00	-14 to -16	3,695	
	15	248+00 to 251+00	-14 to -16	3,630	
	16	245+00 to 248+00	-14 to -16	3,839	
	17	242+00 to 245+00	-14 to -16	3,773	

cy = cubic yards; DMMU = Dredged Material Management Unit: MLLW = mean lower low water

Table 3. Sample Coordinates and Depths (from SAIC, 2011b)

Sampling Location	Core Number	DMMU	Latitude	Longitude	Northing	Easting	Depth to Mudline (ft)	Sampler Penetration (ft)	Sediment Recovery (ft)
C01	1	1	47 30.7694 N	122 18.1944 W	190532.08	1277182.24	-3.3	20	13.2
C02	1	1	47 30.7575 N	122 18.2167 W	190461.49	1277089.01	-4	19.6	9.6
C03	1	2,3,4,6	47 30.8194 N	122 18.2520 W	190840.02	1276951.12	-5.1	20	10.6
	2		47 30.8187 N	122 18.2521 W	190836.32	1276950.36	-5.1	20	14
C04	1	2,3,4,6	47 30.8565 N	122 18.2911 W	191068.83	1276794.21	-5.6	20	12.5
	2		47 30.8586 N	122 18.2936 W	191082.14	1276784.23	-5.6	20	14.1
C05	1	2,3,5,7	47 30.9263 N	122 18.3227 W	191495.89	1276672.21	-5.8	20	14.9
	2		47 30.9247 N	122 18.3244 W	191485.94	1276664.99	-5.4	20	15.7
C06	1	3,5,7	47 30.9964 N	122 18.3334 W	191922.47	1276636.15	-10.5	20	12.6
	2		47 30.9979 N	122 18.3324 W	191931.60	1276640.63	-10.6	20	16
C07	1	8,10,14	47 31.0722 N	122 18.3608 W	192385.24	1276532.18	-9.4	20	18
	2		47 31.0721 N	122 18.3607 W	192384.58	1276532.82	-9.4	20	16.9
	3		47 31.0722 N	122 18.3646 W	192386.07	1276516.79	-9.4	20	17
C08	1	8,11,15	47 31.1137 N	122 18.3882 W	192639.85	1276424.51	-9.3	20	17.3
	2		47 31.1146 N	122 18.3873 W	192645.57	1276428.24	-9.4	20	14.4
	3		47 31.1143 N	122 18.3895 W	192643.83	1276418.72	-9.6	20	15.4
C09	1	9,12,16	47 31.1751 N	122 18.4111 W	193014.97	1276337.22	-10	16	14
	2		47 31.1751 N	122 18.4102 W	193014.93	1276340.80	-9.9	20	13
	3		47 31.1734 N	122 18.4087 W	193004.55	1276346.80	-10	20	14.4
C10	1	9,13,17	47 31.2083 N	122 18.4236 W	193217.82	1276289.41	-10.1	20	11.8
	2		47 31.2068 N	122 18.4237 W	193208.34	1276289.13	-11.1	20	14.7
	3		47 31.2046 N	122 18.4190 W	193194.67	1276308.11	-10.4	17	12.7
CR20	--	Reference	47 19.9990 N	122 40.2395 W	127023.59	1184838.91	--	--	--
CR21	--	Reference	47 19.9420 N	122 40.7270 W	126725.33	1182818.01	--	--	--
CR24W	--	Reference	47 19.9970 N	122 40.4150 W	127028.72	1184115.14	--	--	--

DMMU = Dredged Material Management Unit; MLLW = mean lower low water

Table 4. Samples Collected for Dredged Material Characterization (from SAIC, 2011b)

Sample ID	DMMU/ Sampling Location	Sediment Conventional Parameters	Grain Size	SVOCs	VOCs	PCB Aroclors	Pesticides	Metals	Dioxin/ Furan Congeners	Sediment Archive	PBDEs	Biological Testing
Testing Laboratory		ARI	ARI	ARI	ARI	ARI	ARI	ARI	ARI	ARI	Axys	NewFields
Turning Basin												
DR11-TB-D01-17-C	DMMU 1	√	√	√	√	√	√	√	√	A	√	√
Section A												
DR11-A-D02-11-C	DMMU 2	√	√	√	√	√	√	√	√	A	√	√
DR11-A-D03-13-C	DMMU 3	√	√	√	√	√	√	√		A		√
DR11-A-D04-15-C	DMMU 4	√	√	√	√	√	√	√	√	A		√
DR11-A-D05-15-C	DMMU 5	√	√	√	√	√	√	√		A		√
DR11-A-D06-17-C	DMMU 6	√	√	√	√	√	√	√		A		√
DR11-A-D07-17-C	DMMU 7	√	√	√	√	√	√	√	√	A		√
Section B												
DR11-B-D08-12-C	DMMU 8	√	√	√	√	√	√	√		A	√	√
DR11-B-D09-12-C	DMMU 9	√	√	√	√	√	√	√		A		√
DR11-B-D10-14-C	DMMU 10	√	√	√	√	√	√	√		A		√
DR11-B-D11-14-C	DMMU 11	√	√	√	√	√	√	√		A		√
DR11-B-D12-14-C	DMMU 12	√	√	√	√	√	√	√		A		√
DR11-B-D13-14-C	DMMU 13	√	√	√	√	√	√	√		A		√
DR11-B-D14-16-C	DMMU 14	√	√	√	√	√	√	√		A		√
DR11-B-D15-16-C	DMMU 15	√	√	√	√	√	√	√		A		√
DR11-B-D16-16-C	DMMU 16	√	√	√	√	√	√	√		A		√
DR11-B-D17-16-C	DMMU 17	√	√	√	√	√	√	√		A		√
Z-Samples												
DR11-TB-C01#1-19-Z	1									A		
DR11-TB-C02#1-19-Z	2									A		
DR11-A-C03#1-19-Z	3									A		
DR11-A-C04#1-19-Z	4									A		
DR11-A-C05#1-19-Z	5									A		
DR11-A-C06#1-19-Z	6									A		
DR11-B-C07#1-18-Z	7									A		
DR11-B-C08#1-18-Z	8									A		
DR11-B-C09#1-18-Z	9									A		
DR11-B-C10#2-18-Z	10									A		
QA/QC Samples												
DR11-A-D02-11-D	DMMU 2	√	√	√	√	√	√	√				
DR11-A-D02-11-T	DMMU 2	√	√									
Reference Samples												
DR11-CR20	Carr Inlet	√	√									√
DR11-CR21	Carr Inlet	√	√									√
DR11-CR24W	Carr Inlet	√	√									√
Total Sample Number		**22**	**22**	**18**	**18**	**18**	**18**	**18**	**4**	**27**	**3**	**20**

Notes:

SVOC = semi-volatile organic compound; VOC = volatile organic compound

√ Sample collected for analysis

A Sample collected and archived

Table 5. Sediment Conventional and Grain-Size Results (from SAIC, 2011b)

Parameter	DMMU 1		DMMU 2		DMMU 3		DMMU 4		DMMU 5	
	Result	LQ	Result	LQ	Result	LQ	Result	LQ	Result	LQ
Conventionals										
Ammonia (mg N/kg dw)	17.3		8.44		20.9		61.5		78.5	
Sulfide (mg/kg dw)	1.21	U	132		273		1520		2360	
Total Organic Carbon (% dw)	1.42		1.89		2.41		1.96		2.49	
Total Solids (% ww)	78.40		74.50		70.30		71.10		61.90	
Total Volatile Solids (% dw)	2.67		2.27		3.26		3.90		5.82	
Grain size (% dw)										
Total Clay	2.9		3.1		4.1		6.2		7.4	
Total Silt	6.2		8.2		12.5		18.6		31.5	
Total Fines (silt and clay)	9.1		11.3		16.6		24.8		38.9	
Total Sand	88.8		88.2		83.1		75.1		61.0	
Total Gravel	2.1		0.4		0.3		0.2		0.1	U

Parameter	DMMU 6		DMMU 7		DMMU 8		DMMU 9		DMMU 10	
	Result	LQ	Result	LQ	Result	LQ	Result	LQ	Result	LQ
Conventionals										
Ammonia (mg N/kg dw)	70.8		86.5		33.9		30.3		91.5	
Sulfide (mg/kg dw)	1820		741		1390		802		2040	
Total Organic Carbon (% dw)	3.58		2.94		1.67		2.59		3.16	
Total Solids (% ww)	67.60		60.80		52.80		55.70		50.50	
Total Volatile Solids (% dw)	6.11		6.20		7.09		6.91		7.99	
Grain size (% dw)										
Total Clay	5.7		6.8		10.1		10.2		11.2	
Total Silt	19.4		31.3		47.1		46.4		56.3	
Total Fines (silt and clay)	25.1		38.1		57.2		56.6		67.5	
Total Sand	74.7		62.0		42.9		43.4		32.4	
Total Gravel	0.2		0.1	U	0.1	U	0.1	U	0.1	U

ww = wet weight
dw = dry weight
LQ = laboratory qualifier

Note: the sediment conventional and grain-size data were subjected to EPA Stage 3 validation; no additional validation qualifiers were assigned.

DMMU
bioassay reference sample

Table 5. Sediment Conventional and Grain-Size Results (from SAIC, 2011b)

Parameter	DMMU 11		DMMU 12		DMMU 13		DMMU 14		DMMU 15	
	Result	LQ	Result	LQ	Result	LQ	Result	LQ	Result	LQ
Conventionals										
Ammonia (mg N/kg dw)	66.1		85.4		60.0		67.0		81.5	
Sulfide (mg/kg dw)	3670		4150		1150		2640		1560	
Total Organic Carbon (% dw)	2.08		1.88		1.75		1.92		2	
Total Solids (% ww)	56.90		53.40		54.70		59.60		56.60	
Total Volatile Solids (% dw)	6.85		7.38		7.04		6.21		7.26	
Grain size (% dw)										
Total Clay	9.3		10.0		9.4		9.3		10.3	
Total Silt	48.9		57.3		56.1		47.3		54.6	
Total Fines (silt and clay)	58.2		67.3		65.5		56.6		64.9	
Total Sand	41.8		32.5		34.5		43.5		35.0	
Total Gravel	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U

Parameter	DMMU 16		DMMU 17		CR20		CR21		CR24W	
	Result	LQ	Result	LQ	Result	LQ	Result	LQ	Result	LQ
Conventionals										
Ammonia (mg N/kg dw)	87.9		67.8		3.83		1.64		4.38	
Sulfide (mg/kg dw)	444		4290		242		1.36	U	11.4	
Total Organic Carbon (% dw)	1.9		1.99		0.64		0.383		0.487	
Total Solids (% ww)	55.80		53.90		59.20		75.40		65.10	
Total Volatile Solids (% dw)	7.28		7.42		3.12		1.23		2.66	
Grain size (% dw)										
Total Clay	11.1		10.2		7.5		4.0		6.7	
Total Silt	61.8		56.3		69.9		10.2		40.9	
Total Fines (silt and clay)	72.9		66.5		77.4		14.2		47.6	
Total Sand	27.0		33.6		22.6		85.7		52.4	
Total Gravel	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U

ww = wet weight
dw = dry weight
LQ = laboratory qualifier

DMMU
bioassay reference sample

Table 6. Chemistry Results (from SAIC, 2011b)

Chemical	Unit	DMMP Guidelines			DMMU 1			DMMU 2			DMMU 3			DMMU 4			DMMU 5			DMMU 6		
		SL	ML	BT	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Metals																						
Antimony	mg/kg dw	150	200	--	7	U	UJ	7	U	UJ	7	U	UJ	7	U	UJ	7	U	UJ	7	U	UJ
Arsenic	mg/kg dw	57	700	507.1	10			7			8			10			11			10		
Cadmium	mg/kg dw	5.1	14	11.3	0.3			0.3	U		0.3			0.3			0.3			0.3		
Chromium	mg/kg dw	--	--	267	16.4			13.8			15.6			17.5			22.4			17.5		
Copper	mg/kg dw	390	1300	1027	18.4			14.3			17.9			21.8			26.5			21.5		
Lead	mg/kg dw	450	1200	975	6			5			6			6			8			6		
Mercury	mg/kg dw	0.41	2.3	1.5	0.03	U		0.03	U		0.03			0.04			0.06			0.04		
Nickel	mg/kg dw	140	370	370	16			13			14			16			20			16		
Selenium	mg/kg dw	--	--	3	0.7	U		0.7	U		0.7	U		0.7	U		0.7	U		0.7	U	
Silver	mg/kg dw	6.1	8.4	6.1	0.4	U		0.4	U		0.4	U		0.4	U		0.4	U		0.4	U	
Zinc	mg/kg dw	410	3800	2783	61			50			52			57			76			57		
PAHs																						
Acenaphthene	µg/kg dw	500	2000	--	18	U		18	U		19	U		19	U		19	U		19	U	
Acenaphthylene	µg/kg dw	560	1300	--	18	U		18	U		19	U		19	U		19	U		19	U	
Anthracene	µg/kg dw	960	13000	--	18	U		18	U		19	U		19	U		19	U		9.5	J	
Benzo(a)anthracene	µg/kg dw	1300	5100	--	18	U		10	J		19	U		9.6	J		15	J		26		
Benzofluoranthene	µg/kg dw	3200	9900	--	20			26			21			26			43			70		
Benzo(g,h,i)perylene	µg/kg dw	670	3200	--	18	U		13	J		10	J		19	U		16	J		26		
Benzo(a)pyrene	µg/kg dw	1600	3600	--	18	U		10	J		19	U		12	J		16	J		26		
Chrysene	µg/kg dw	1400	21000	--	15	J		14	J		13	J		16	J		29			44		
Dibenzo(a,h)anthracene	µg/kg dw	230	1900	--	18	U		18	U		19	U		19	U		19	U		19	U	
Dibenzofuran	µg/kg dw	540	1700	--	18	U		18	U		19	U		19	U		20			11	J	
Fluoranthene	µg/kg dw	1700	30000	4600	23	Q		27	Q		24	Q		27	Q		34	Q		72	Q	
Fluorene	µg/kg dw	540	3600	--	18	U		18	U		19	U		19	U		19	U		19	U	
Indeno(1,2,3-cd)pyrene	µg/kg dw	600	4400	--	18	U		18	U		19	U		19	U		12	J		19		
1-Methylnaphthalene	µg/kg dw	--	--	--	11	J		18	U		19	U		19	U		10	J		21		
2-Methylnaphthalene	µg/kg dw	670	1900	--	12	J		18	U		19	U		19	U		13	J		23		
Naphthalene	µg/kg dw	2100	2400	--	18	U		18	U		19	U		19	U		10	J		13	J	
Phenanthrene	µg/kg dw	1500	21000	--	34			13	J		14	J		24			24			48		
Pyrene	µg/kg dw	2600	16000	11980	23			29			26			29			37			68		
Total HPAHs	µg/kg dw	12000	69000	--	81	J		130	J		94	J		120	J		200	J		350	J	
Total LPAHs	µg/kg dw	5200	29000	--	34			13	J		14	J		24			34	J		71	J	
Phenols																						
2,4-Dimethylphenol	µg/kg dw	29	210	--	18	U	UJ	18	U	UJ	19	U	UJ	19	U	UJ	19	U	UJ	19	U	UJ
2-Methylphenol	µg/kg dw	63	77	--	18	U		18	U		19	U		19	U		19	U		19	U	
4-Methylphenol	µg/kg dw	670	3600	--	64			18	U		10	J		26			36			51		
Pentachlorophenol	µg/kg dw	400	690	504	93	U		92	U		94	U		96	U		95	U		95	U	
Phenol	µg/kg dw	420	1200	--	23			11	J		19	U		13	J		17	J		57		
Phthalates																						
Butyl benzyl phthalate	µg/kg dw	63	970	--	18	U		18	U		19	U		19	U		19	U		11	J	
Dibutyl phthalate	µg/kg dw	1400	5100	--	18	U		18	U		19	U		19	U		19	U		19	U	
Di-n-Octyl phthalate	µg/kg dw	6200	6200	--	18	U		18	U		19	U		19	U		19	U		19	U	
Diethyl phthalate	µg/kg dw	200	1200	--	18	U		18	U		19	U		19	U		19	U		19	U	
Dimethyl phthalate	µg/kg dw	71	1400	--	18	U		18	U		19	U		19	U		19	U		19	U	
Bis(2-Ethylhexyl) Phthalate	µg/kg dw	1300	8300	--	46			48			40			54			71			88		

Chemical	Unit	DMMP Guidelines			DMMU 1			DMMU 2			DMMU 3			DMMU 4			DMMU 5			DMMU 6		
		SL	ML	BT	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Other SVOCs																						
Benzoic Acid	µg/kg dw	650	760	--	64	J		38	J		37	J		290			94	J		290		
Benzyl Alcohol	µg/kg dw	57	870	--	24			16	J		14	J		60			82			200		
1,2-Dichlorobenzene	µg/kg dw	35	110	--	18	U		18	U		19	U		19	U		19	U		19	U	
1,3-Dichlorobenzene	µg/kg dw	170	--	--	18	U		18	U		19	U		19	U		19	U		19	U	
1,4-Dichlorobenzene	µg/kg dw	110	120	--	18	U		18	U		19	U		19	U		19	U		19	U	
Hexachlorobenzene	µg/kg dw	22	230	168	0.94	U		0.95	U		0.98	U		0.93	U		0.94	U		0.95	U	
Hexachlorobutadiene	µg/kg dw	29	270	--	0.94	U		0.95	U		0.98	U		0.93	U		0.94	U		0.95	U	
Hexachloroethane	µg/kg dw	1400	14000	--	18	U		18	U		19	U		19	U		19	U		19	U	
N-Nitrosodiphenylamine	µg/kg dw	28	130	--	18	U		18	U		19	U		19	U		19	U		19	U	
1,2,4-Trichlorobenzene	µg/kg dw	31	64	--	18	U		18	U		19	U		19	U		19	U		19	U	
PCB Aroclors																						
Aroclor 1016	µg/kg dw	--	--	--	19	U		19	U		19	U		19	U		19	U		19	U	
Aroclor 1221	µg/kg dw	--	--	--	19	U		19	U		19	U		19	U		19	U		19	U	
Aroclor 1232	µg/kg dw	--	--	--	19	U		19	U		19	U		19	U		19	U		19	U	
Aroclor 1242	µg/kg dw	--	--	--	19	U		19	U		19	U		19	U		19	U		19	U	
Aroclor 1248	µg/kg dw	--	--	--	19	U		14	J		19	U		19	U		19	U		11	J	
Aroclor 1254	µg/kg dw	--	--	--	19	U		19	U		19	U		19	U		19	U		19	U	
Aroclor 1260	µg/kg dw	--	--	--	19	U		19	U		19	U		19	U		19	U		19	U	
Aroclor 1262	µg/kg dw	--	--	--	19	U		19	U		19	U		19	U		19	U		19	U	
Aroclor 1268	µg/kg dw	--	--	--	19	U		19	U		19	U		19	U		19	U		19	U	
Total PCBs	µg/kg dw	130	3100	--	19	U		14	J		19	U		19	U		19	U		11	J	
Total PCBs	mg/kg OC			38	1.3	U		0.74	J		0.79	U		0.97	U		0.76	U		0.31	J	
Pesticides																						
Aldrin	µg/kg dw	10	--	--	0.94	U		0.95	U		0.98	U		0.93	U		0.94	U		0.95	U	
Lindane	µg/kg dw	10	--	--	0.94	U		0.95	U		0.98	U		0.93	U		0.94	U		0.95	U	
cis-Chlordane	µg/kg dw	--	--	--	0.94	U		0.95	U		0.98	U		0.93	U		0.94	U		0.95	U	
trans-Chlordane	µg/kg dw	--	--	--	0.94	U		1.8			1.4			0.93	U		0.94	U		0.95	U	
Total chlordane	µg/kg dw	--	--	--	0.94	U		1.8			1.4			0.93	U		0.94	U		0.95	U	
4,4'-DDD	µg/kg dw	--	--	--	1.9	U		1.9	U		2.0	U		1.8	U		1.9	U		1.9	U	
4,4'-DDE	µg/kg dw	--	--	--	1.9	U		1.9	U		2.0	U		1.8	U		1.9	U		1.9	U	
4,4'-DDT	µg/kg dw	--	--	--	1.9	U		1.9	U		2.0	U		1.8	U		1.9	U		1.9	U	UJ
Total DDTs	µg/kg dw	6.9	69	50	1.9	U		1.9	U		2.0	U		1.8	U		1.9	U		1.9	U	UJ
Dieldrin	µg/kg dw	10	--	--	1.9	U		1.9	U		2.0	U		1.8	U		1.9	U		1.9	U	
Heptachlor	µg/kg dw	10	--	--	0.94	U		0.95	U		0.98	U		0.93	U		0.94	U		0.95	U	
cis-Nonachlor	µg/kg dw	--	--	--	1.9	U		1.9	U		2.0	U		1.8	U		1.9	U		1.9	U	
trans-Nonachlor	µg/kg dw	--	--	--	1.9	U		1.9	U		2.0	U		1.8	U		1.9	U		1.9	U	
Oxychlordane	µg/kg dw	--	--	--	1.9	U		1.9	U		2.0	U		1.8	U		1.9	U		1.9	U	
VOCs																						
Ethylbenzene	µg/kg dw	10	50	--	1.3	U		1.4	U		1.4	U		1.5	U		1.5	U		1.5	U	
m, p-Xylene	µg/kg dw	--	--	--	1.3	U		1.4	U		1.4	U		1.5	U		1.5	U		1.5	U	
o-Xylene	µg/kg dw	--	--	--	1.3	U		1.4	U		1.4	U		1.5	U		1.5	U		1.5	U	
Total xylenes	µg/kg dw	--	--	--	1.3	U		1.4	U		1.4	U		1.5	U		1.5	U		1.5	U	
Tetrachloroethene	µg/kg dw	57	210	--	1.3	U		1.4	U		1.4	U		1.5	U		1.5	U		1.5	U	
Trichloroethene	µg/kg dw	160	1600	--	1.3	U		1.4	U		1.4	U		1.5	U		1.5	U		1.5	U	

Table 6. Chemistry Results (from SAIC, 2011b)

Chemical	Unit	DMMP Guidelines			DMMU 7			DMMU 8			DMMU 9			DMMU 10			DMMU 11			DMMU 12		
		SL	ML	BT	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Metals																						
Antimony	mg/kg dw	150	200	--	8	U	UJ	10	U	UJ	9	U	UJ	10	U	UJ	8	U	UJ	9	U	UJ
Arsenic	mg/kg dw	57	700	507.1	11			10			12			10			11			13		
Cadmium	mg/kg dw	5.1	14	11.3	0.3			0.5			0.4			0.5			0.5			0.5		
Chromium	mg/kg dw	--	--	267	22.1			25			24.3			28			24.5			27.4		
Copper	mg/kg dw	390	1300	1027	27.3			33.6			32.0			39.4			34.5			38.7		
Lead	mg/kg dw	450	1200	975	8			11			10			15			14			16		
Mercury	mg/kg dw	0.41	2.3	1.5	0.05			0.09			0.07			0.09			0.11			0.09		
Nickel	mg/kg dw	140	370	370	19			20			20			22			20			22		
Selenium	mg/kg dw	--	--	3	0.8	U		0.9	U		0.9	U		1	U		0.8	U		0.9	U	
Silver	mg/kg dw	6.1	8.4	6.1	0.5	U		0.6	U		0.5	U		0.6	U		0.5	U		0.5	U	
Zinc	mg/kg dw	410	3800	2783	68			75			72			89			84			87		
PAHs																						
Acenaphthene	µg/kg dw	500	2000	--	19	U		19	U		19	U		19	U		20	U		20	U	
Acenaphthylene	µg/kg dw	560	1300	--	19	U		19	U		19	U		19	U		20	U		20	U	
Anthracene	µg/kg dw	960	13000	--	19	U		19	U		19	U		9.6	J		13	J		9.9	J	
Benzo(a)anthracene	µg/kg dw	1300	5100	--	20			33			23			34			40			48		
Benzofluoranthene	µg/kg dw	3200	9900	--	57			91			67			100			120			140		
Benzo(g,h,i)perylene	µg/kg dw	670	3200	--	22			33			25			38			44			48		
Benzo(a)pyrene	µg/kg dw	1600	3600	--	22			33			25			41			46			66		
Chrysene	µg/kg dw	1400	21000	--	35			53			36			56			65			80		
Dibenzo(a,h)anthracene	µg/kg dw	230	1900	--	19	U		19	U		19	U		19	U		9.9	J		13	J	
Dibenzofuran	µg/kg dw	540	1700	--	12	J		19	U		19	U		19	U		20	U		20	U	
Fluoranthene	µg/kg dw	1700	30000	4600	53	Q		85	Q		60	Q		91	Q		98	Q		100	Q	
Fluorene	µg/kg dw	540	3600	--	19	U		19	U		19	U		19	U		20	U		20	U	
Indeno(1,2,3-cd)pyrene	µg/kg dw	600	4400	--	16	J		25			19			29			34			41		
1-Methylnaphthalene	µg/kg dw	--	--	--	30			19	U		19	U		19	U		20	U		20	U	
2-Methylnaphthalene	µg/kg dw	670	1900	--	23			19	U		9.4	J		9.6	J		20	U		20	U	
Naphthalene	µg/kg dw	2100	2400	--	11	J		19	U		19	U		19	U		9.9	J		20	U	
Phenanthrene	µg/kg dw	1500	21000	--	39			42			38			47			51			50		
Pyrene	µg/kg dw	2600	16000	11980	54			84			57			90			100			110		
Total HPAHs	µg/kg dw	12000	69000	--	280	J		440	J		310	J		480	J		560	J		650	J	
Total LPAHs	µg/kg dw	5200	29000	--	50	J		42			38			57	J		74	J		60	J	
Phenols																						
2,4-Dimethylphenol	µg/kg dw	29	210	--	19	U	UJ	19	U	UJ	19	U	UJ	19	U	UJ	20	U	UJ	20	U	UJ
2-Methylphenol	µg/kg dw	63	77	--	19	U		19	U		19	U		19	U		20	U		20	U	
4-Methylphenol	µg/kg dw	670	3600	--	25			13	J		14	J		10	J		11	J		20	U	
Pentachlorophenol	µg/kg dw	400	690	504	94	U		96	U		94	U		96	U		99	U		99	U	
Phenol	µg/kg dw	420	1200	--	23			33			31			33			29			24		
Phthalates																						
Butyl benzyl phthalate	µg/kg dw	63	970	--	19	U		12	J		19	U		12	J		11	J		9.9	J	
Dibutyl phthalate	µg/kg dw	1400	5100	--	19	U		19	U		19	U		19	U		9.9	J		20	U	
Di-n-Octyl phthalate	µg/kg dw	6200	6200	--	19	U		19	U		19	U		19	U		20	U		20	U	
Diethyl phthalate	µg/kg dw	200	1200	--	19	U		19	U		19	U		23	B	U	20	U		20	U	
Dimethyl phthalate	µg/kg dw	71	1400	--	19	U		19	U		19	U		19	U		20	U		20	U	
Bis(2-Ethylhexyl) Phthalate	µg/kg dw	1300	8300	--	62			88			68			85			99			67		

Chemical	Unit	DMMP Guidelines			DMMU 7			DMMU 8			DMMU 9			DMMU 10			DMMU 11			DMMU 12		
		SL	ML	BT	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Other SVOCs																						
Benzoic Acid	µg/kg dw	650	760	--	110	J		210			220			180	J		110	J		94	J	
Benzyl Alcohol	µg/kg dw	57	870	--	86			140			140			91			72			66		
1,2-Dichlorobenzene	µg/kg dw	35	110	--	19	U		19	U		19	U		19	U		20	U		20	U	
1,3-Dichlorobenzene	µg/kg dw	170	--	--	19	U		19	U		19	U		19	U		20	U		20	U	
1,4-Dichlorobenzene	µg/kg dw	110	120	--	19	U		19	U		19	U		19	U		20	U		20	U	
Hexachlorobenzene	µg/kg dw	22	230	168	0.94	U		1.2	U		0.97	U		0.97	U		0.96	U		0.98	U	
Hexachlorobutadiene	µg/kg dw	29	270	--	0.94	U		1.2	U		0.97	U		0.97	U		0.96	U		0.98	U	
Hexachloroethane	µg/kg dw	1400	14000	--	19	U		19	U		19	U		19	U		20	U		20	U	
N-Nitrosodiphenylamine	µg/kg dw	28	130	--	19	U		19	U		19	U		19	U		20	U		20	U	
1,2,4-Trichlorobenzene	µg/kg dw	31	64	--	19	U		19	U		19	U		19	U		20	U		20	U	
PCB Aroclors																						
Aroclor 1016	µg/kg dw	--	--	--	93	U		19	U		19	U		19	U		19	U		19	U	
Aroclor 1221	µg/kg dw	--	--	--	93	U		19	U		19	U		19	U		19	U		19	U	
Aroclor 1232	µg/kg dw	--	--	--	93	U		19	U		19	U		19	U		19	U		19	U	
Aroclor 1242	µg/kg dw	--	--	--	93	U		19	U		19	U		19	U		19	U		19	U	
Aroclor 1248	µg/kg dw	--	--	--	93	U		15	J		15	J		13	J		30			32		
Aroclor 1254	µg/kg dw	--	--	--	93	U		14	J		19	U		16	J		30			33		
Aroclor 1260	µg/kg dw	--	--	--	93	U		19	U		19	U		14	J		16	J		17	J	
Aroclor 1262	µg/kg dw	--	--	--	93	U		19	U		19	U		19	U		19	U		19	U	
Aroclor 1268	µg/kg dw	--	--	--	93	U		19	U		19	U		19	U		19	U		19	U	
Total PCBs	µg/kg dw	130	3100	--	93	U		29	J		15	J		43	J		76	J		82	J	
Total PCBs	mg/kg OC			38	3.2	U		1.7	J		0.60	J		1.4	J		3.7	J		4.4	J	
Pesticides																						
Aldrin	µg/kg dw	10	--	--	0.94	U		1.2	U		0.97	U		0.97	U		0.96	U		0.98	U	
Lindane	µg/kg dw	10	--	--	0.94	U		1.2	U		0.97	U		0.97	U		0.96	U		0.98	U	
cis-Chlordane	µg/kg dw	--	--	--	0.94	U		1.2	U		0.97	U		0.97	U		0.96	U		0.98	U	
trans-Chlordane	µg/kg dw	--	--	--	0.94	U		1.2	U		0.97	U		0.97	U		0.96	U		0.98	U	
Total chlordane	µg/kg dw	--	--	--	0.94	U		1.2	U		0.97	U		0.97	U		0.96	U		0.98	U	
4,4'-DDD	µg/kg dw	--	--	--	1.9	U		2.3	U		1.9	U		1.9	U		3.9		NJ	2.0	U	
4,4'-DDE	µg/kg dw	--	--	--	1.9	U		2.3	U		1.9	U		1.9	U		1.3	J	NJ	2.0	U	
4,4'-DDT	µg/kg dw	--	--	--	1.9	U	UJ	2.3	U	UJ	2.1	Y	UJ	4.1	Y	UJ	10		J	4.1	Y	UJ
Total DDTs	µg/kg dw	6.9	69	50	1.9	U	UJ	2.3	U	UJ	2.1	U	UJ	4.1	U	UJ	15	J	NJ	4.1	U	UJ
Dieldrin	µg/kg dw	10	--	--	1.9	U		2.3	U		1.9	U		1.9	U		1.9	U		2.0	U	
Heptachlor	µg/kg dw	10	--	--	0.94	U		1.2	U		0.97	U		0.97	U		0.96	U		0.98	U	
cis-Nonachlor	µg/kg dw	--	--	--	1.9	U		2.3	U		1.9	U		1.9	U		1.9	U		2.0	U	
trans-Nonachlor	µg/kg dw	--	--	--	1.9	U		2.3	U		1.9	U		1.9	U		1.9	U		2.0	U	
Oxychlordane	µg/kg dw	--	--	--	1.9	U		2.3	U		1.9	U		1.9	U		1.9	U		2.0	U	
VOCs																						
Ethylbenzene	µg/kg dw	10	50	--	1.5	U		1.9	U		1.4	U		2.0	U		1.8	U		1.6	U	
m, p-Xylene	µg/kg dw	--	--	--	1.5	U		1.9	U		1.4	U		2.0	U		1.8	U		1.6	U	
o-Xylene	µg/kg dw	--	--	--	1.5	U		1.9	U		1.4	U		2.0	U		1.8	U		1.6	U	
Total xylenes	µg/kg dw	--	--	--	1.5	U		1.9	U		1.4	U		2.0	U		1.8	U		1.6	U	
Tetrachloroethene	µg/kg dw	57	210	--	1.5	U		1.9	U		1.4	U		2.0	U		1.8	U		1.6	U	
Trichloroethene	µg/kg dw	160	1600	--	1.5	U		1.9	U		1.4	U		2.0	U		1.8	U		1.6	U	

Table 6. Chemistry Results (from SAIC, 2011b)

Chemical	Unit	DMMP Guidelines			DMMU 13			DMMU 14			DMMU 15			DMMU 16			DMMU 17		
		SL	ML	BT	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Metals																			
Antimony	mg/kg dw	150	200	--	9	U	UJ	8	U	UJ	8	U	UJ	8	U	UJ	9	U	UJ
Arsenic	mg/kg dw	57	700	507.1	12			11			13			12			13		
Cadmium	mg/kg dw	5.1	14	11.3	0.4			0.4			0.4			0.5			0.6		
Chromium	mg/kg dw	--	--	267	26.2			26.3			26.9			26.9			26.8		
Copper	mg/kg dw	390	1300	1027	35.6			33.5			36.4			36.0			36.6		
Lead	mg/kg dw	450	1200	975	14			14			15			13			13		
Mercury	mg/kg dw	0.41	2.3	1.5	0.08			0.08			0.09			0.09			0.09		
Nickel	mg/kg dw	140	370	370	21			21			23			22			21		
Selenium	mg/kg dw	--	--	3	0.9	U		0.8	U		0.8	U		0.8	U		0.9	U	
Silver	mg/kg dw	6.1	8.4	6.1	0.5	U		0.5	U		0.5	U		0.5	U		0.5	U	
Zinc	mg/kg dw	410	3800	2783	83			77			83			78			84		
PAHs																			
Acenaphthene	µg/kg dw	500	2000	--	20	U		19	U		19	U		20	U		19	U	
Acenaphthylene	µg/kg dw	560	1300	--	20	U		19	U		19	U		20	U		19	U	
Anthracene	µg/kg dw	960	13000	--	20	U		12	J		12	J		11	J		9.7	J	
Benzo(a)anthracene	µg/kg dw	1300	5100	--	33			43			44			46			35		
Benzofluoranthene	µg/kg dw	3200	9900	--	94			130			120			140			98		
Benzo(g,h,i)perylene	µg/kg dw	670	3200	--	30			41			44			47			34		
Benzo(a)pyrene	µg/kg dw	1600	3600	--	35			50			48			53			39		
Chrysene	µg/kg dw	1400	21000	--	53			64			72			78			55		
Dibenzo(a,h)anthracene	µg/kg dw	230	1900	--	20	U		19	U		11	J		20	U		19	U	
Dibenzofuran	µg/kg dw	540	1700	--	20	U		19	U		19	U		20	U		19	U	
Fluoranthene	µg/kg dw	1700	30000	4600	85	Q		110	Q		110	Q		120	Q		92	Q	
Fluorene	µg/kg dw	540	3600	--	20	U		19	U		19	U		20	U		19	U	
Indeno(1,2,3-cd)pyrene	µg/kg dw	600	4400	--	24			32			35			37			28		
1-Methylnaphthalene	µg/kg dw	--	--	--	20	U		12	J		11	J		20	U		19	U	
2-Methylnaphthalene	µg/kg dw	670	1900	--	20	U		10	J		14	J		11	J		19	U	
Naphthalene	µg/kg dw	2100	2400	--	20	U		19	U		19	U		20	U		19	U	
Phenanthrene	µg/kg dw	1500	21000	--	41			58			51			60			42		
Pyrene	µg/kg dw	2600	16000	11980	86			110			110			120			91		
Total HPAHs	µg/kg dw	12000	69000	--	440	J		580	J		590	J		640	J		470	J	
Total LPAHs	µg/kg dw	5200	29000	--	41			70	J		63	J		71	J		52	J	
Phenols																			
2,4-Dimethylphenol	µg/kg dw	29	210	--	20	U	UJ	19	U	UJ	19	U	UJ	20	U	UJ	19	U	UJ
2-Methylphenol	µg/kg dw	63	77	--	20	U		19	U		19	U		20	U		19	U	
4-Methylphenol	µg/kg dw	670	3600	--	20	U		19	U		11	J		14	J		14	J	
Pentachlorophenol	µg/kg dw	400	690	504	98	U		95	U		97	U	UJ	98	U	UJ	97	U	UJ
Phenol	µg/kg dw	420	1200	--	21			23			41			20			19		
Phthalates																			
Butyl benzyl phthalate	µg/kg dw	63	970	--	12	J		19	U		19	U		20	U		19	U	
Dibutyl phthalate	µg/kg dw	1400	5100	--	20	U		19	U		12	J		20	U		19	U	
Di-n-Octyl phthalate	µg/kg dw	6200	6200	--	20	U		19	U		19	U		20	U		19	U	
Diethyl phthalate	µg/kg dw	200	1200	--	20	U		19	U		19	U		20	U		19	J	U
Dimethyl phthalate	µg/kg dw	71	1400	--	20	U		19	U		19	U		20	U		19	U	
Bis(2-Ethylhexyl) Phthalate	µg/kg dw	1300	8300	--	74			76			99			110			100		

Chemical	Unit	DMMP Guidelines			DMMU 13			DMMU 14			DMMU 15			DMMU 16			DMMU 17		
		SL	ML	BT	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Other SVOCs																			
Benzoic Acid	µg/kg dw	650	760	--	70	J		82	J		83	JQ		90	JQ		92	JQ	
Benzyl Alcohol	µg/kg dw	57	870	--	53			34			19	U		52			68		
1,2-Dichlorobenzene	µg/kg dw	35	110	--	20	U		19	U		19	U		20	U		19	U	
1,3-Dichlorobenzene	µg/kg dw	170	--	--	20	U		19	U		19	U		20	U		19	U	
1,4-Dichlorobenzene	µg/kg dw	110	120	--	20	U		19	U		19	U		20	U		19	U	
Hexachlorobenzene	µg/kg dw	22	230	168	0.96	U		2.6	Y	U	0.98	U		0.97	U		0.96	U	
Hexachlorobutadiene	µg/kg dw	29	270	--	0.96	U		0.94	U		0.98	U		0.97	U		0.96	U	
Hexachloroethane	µg/kg dw	1400	14000	--	20	U		19	U		19	U		20	U		19	U	
N-Nitrosodiphenylamine	µg/kg dw	28	130	--	20	U		19	U		19	U		20	U		19	U	
1,2,4-Trichlorobenzene	µg/kg dw	31	64	--	20	U		19	U		19	U		20	U		19	U	
PCB Aroclors																			
Aroclor 1016	µg/kg dw	--	--	--	19	U		19	U		19	U		19	U		19	U	
Aroclor 1221	µg/kg dw	--	--	--	19	U		19	U		19	U		19	U		19	U	
Aroclor 1232	µg/kg dw	--	--	--	19	U		19	U		19	U		19	U		19	U	
Aroclor 1242	µg/kg dw	--	--	--	19	U		19	U		19	U		19	U		19	U	
Aroclor 1248	µg/kg dw	--	--	--	17	J		39			33			23			26		
Aroclor 1254	µg/kg dw	--	--	--	25			24			24			23			29		
Aroclor 1260	µg/kg dw	--	--	--	15	J		10	J		12	J		12	J		16	J	
Aroclor 1262	µg/kg dw	--	--	--	19	U		19	U		19	U		19	U		19	U	
Aroclor 1268	µg/kg dw	--	--	--	19	U		19	U		19	U		19	U		19	U	
Total PCBs	µg/kg dw	130	3100	--	57	J		73	J		69	J		58	J		71	J	
Total PCBs	mg/kg OC			38	3.3	J		3.8	J		3.5	J		3.1	J		3.6	J	
Pesticides																			
Aldrin	µg/kg dw	10	--	--	0.96	U		0.94	U		0.98	U		0.97	U		0.96	U	
Lindane	µg/kg dw	10	--	--	0.96	U		0.94	U		0.98	U		0.97	U		0.96	U	
cis-Chlordane	µg/kg dw	--	--	--	0.96	U		0.94	U		0.98	U		0.97	U		0.96	U	
trans-Chlordane	µg/kg dw	--	--	--	0.96	U		0.94	U		0.98	U		0.97	U		0.96	U	
Total chlordane	µg/kg dw	--	--	--	0.96	U		0.94	U		0.98	U		0.97	U		0.96	U	
4,4'-DDD	µg/kg dw	--	--	--	1.9	U		1.9	U		2.0	U		1.9	U		1.9	U	
4,4'-DDE	µg/kg dw	--	--	--	1.9	U		1.9	U		2.0	U		1.9	U		1.9	U	
4,4'-DDT	µg/kg dw	--	--	--	3.3	Y	UJ	3.1	Y	UJ	4.0	Y	UJ	2.8	Y	UJ	3.6	Y	UJ
Total DDTs	µg/kg dw	6.9	69	50	3.3	U	UJ	3.1	U	UJ	4.0	U	UJ	2.8	U	UJ	3.6	U	UJ
Dieldrin	µg/kg dw	10	--	--	1.9	U		1.9	U		2.0	U		1.9	U		1.9	U	
Heptachlor	µg/kg dw	10	--	--	0.96	U		0.94	U		0.98	U		0.97	U		0.96	U	
cis-Nonachlor	µg/kg dw	--	--	--	1.9	U		1.9	U		2.0	U		1.9	U		1.9	U	
trans-Nonachlor	µg/kg dw	--	--	--	1.9	U		1.9	U		2.0	U		1.9	U		1.9	U	
Oxychlordane	µg/kg dw	--	--	--	1.9	U		1.9	U		2.0	U		1.9	U		1.9	U	
VOCs																			
Ethylbenzene	µg/kg dw	10	50	--	1.8	U		1.7	U		1.7	U		1.8	U		1.9	U	UJ
m, p-Xylene	µg/kg dw	--	--	--	1.8	U		1.7	U		1.7	U		1.8	U		1.9	U	UJ
o-Xylene	µg/kg dw	--	--	--	1.8	U		1.7	U		1.7	U		1.8	U		1.9	U	UJ
Total xylenes	µg/kg dw	--	--	--	1.8	U		1.7	U		1.7	U		1.8	U		1.9	U	UJ
Tetrachloroethene	µg/kg dw	57	210	--	1.8	U		1.7	U		1.7	U		1.8	U		1.9	U	UJ
Trichloroethene	µg/kg dw	160	1600	--	1.8	U		1.7	U		1.7	U		1.8	U		1.9	U	UJ

Table 6 - Legend

BT = bioaccumulation trigger
cPAHs = carcinogenic polycyclic aromatic hydrocarbons
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
DMMP = dredged material management program
dw = dry weight
HPAHs = high molecular weight polycyclic aromatic hydrocarbons
LPAHs = low molecular weight polycyclic aromatic hydrocarbons
LQ = laboratory qualifier
ML = maximum level
na = not analyzed
nd = nondetect
OC = organic carbon normalized
PCBs = polychlorinated biphenyls
RL = reporting limit
SL = screening level
SVOCs = semi-volatile organic compounds
TEQ = toxic equivalent
VOC = volatile organic compound
VQ = validation qualifier

exceeds SL

J = estimated value less than reporting limit and/or QC parameter out of control limits
Q = calibration or calibration verification out of QC limits
U = nondetect

Table 7. Dioxin/Furan Congener Results (pg/g) (from SAIC, 2011b)

Chemical	DMMU 1			DMMU 2			DMMU 4			DMMU 7		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
1,2,3,4,6,7,8-HpCDD	21.9		J	17.2		J	18.0		J	35.2		J
1,2,3,4,6,7,8-HpCDF	3.61	J		3.47	J		3.34	J		5.77		
1,2,3,4,7,8,9-HpCDF	0.282	J		0.152	JEMPC	U	0.182	U		0.511	J	
1,2,3,4,7,8-HxCDD	0.324	J		0.259	JEMPC	U	0.352	J		0.477	JEMPC	U
1,2,3,4,7,8-HxCDF	0.483	J		0.435	J		0.263	JEMPC	U	0.904	J	
1,2,3,6,7,8-HxCDD	1.07	J	J	0.820	J	J	0.928	J	J	1.72	J	J
1,2,3,6,7,8-HxCDF	0.234	J		0.229	J		0.139	JEMPC	U	0.407	JEMPC	U
1,2,3,7,8,9-HxCDD	0.642	J		0.517	J		0.584	J		1.14	J	
1,2,3,7,8,9-HxCDF	0.110	JEMPC	U	0.130	JEMPC	U	0.0778	U		0.275	JEMPC	U
1,2,3,7,8-PeCDD	0.305	JEMPC	U	0.241	JEMPC	U	0.255	J	J	0.472	J	J
1,2,3,7,8-PeCDF	0.155	J		0.113	J		0.0889	JEMPC	U	0.498	J	
2,3,4,6,7,8-HxCDF	0.344	J	J	0.175	J	J	0.0775	U		0.537	J	J
2,3,4,7,8-PeCDF	0.176	JEMPC	U	0.165	J		0.126	J		0.410	J	
2,3,7,8-TCDD	0.0878	JEMPC	U	0.0661	JEMPC	U	0.102	JEMPC	U	0.176	JEMPC	U
2,3,7,8-TCDF	0.163	JEMPC	U	0.130	JEMPC	U	0.187	J		0.492	J	
OCDD	167		J	148		J	155		J	262		J
OCDF	7.72	J		8.01	J		8.71	J		15.4		
Total HpCDD	49.2			38.2			44.3			80.7		
Total HpCDF	10.3			10.0			9.45			18.3		
Total HxCDD	8.41			5.27			5.39			13.2		
Total HxCDF	7.04			6.24			3.63			11.2		
Total PeCDD	2.16			1.26			1.18			3.25		
Total PeCDF	3.07			2.02			2.61			4.79		
Total TCDD	1.22			1.15			0.599			2.12		
Total TCDF	2.85			1.61			1.74			6.04		
Dioxin/Furan TEQ, nd SDL*0	0.625	J		0.524	J		0.760	J		1.59	J	
Dioxin/Furan TEQ, nd SDL*0.5	0.861	J		0.704	J		0.842	J		1.73	J	
Dioxin/Furan TEQ, nd SDL*1	1.10	J		0.885	J		0.923	J		1.88	J	

NOTE: EMPC qualified results are treated as non-detects.
dw = dry weight
LQ = laboratory qualifier
nd = nondetect
SDL = sample detection limit
TEQ = toxic equivalent
VQ = validation qualifier

EMPC = estimated maximum possible concentration
J = estimated value less than reporting limit and/or QC parameter out of control limits
U = undetected

Table 8. PBDE Results (pg/g) (from SAIC, 2011b)

Chemical Name	PBDE	DMMU 1			DMMU 2			DMMU 8		
		Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
2,4-DIBDE	BDE-007	1.95	J		8.00			4.81	J	
2,4'-DIBDE	BDE-008	0.935	CKJ	U	2.65	CJ		12.3	C	
2,6-DIBDE	BDE-010	0.113	U		0.143	U		0.166	U	
3,3'-DIBDE	BDE-011	C8			C8			C8		
3,4-DIBDE	BDE-012	0.227	CJ		0.556	CJ		1.71	CJ	
3,4'-DIBDE	BDE-013	C12			C12			C12		
4,4'-DIBDE	BDE-015	1.07	KJ	U	1.18	J		3.34		
2,2',4-TRIBDE	BDE-017	6.20			41.3	C		83.9	C	
2,3',4-TRIBDE	BDE-025	C17			C17			C17		
2,4,4'-TRIBDE	BDE-028	1.80	CJ		10.2	CJ		11.7	CJ	
2,4,6-TRIBDE	BDE-030	0.211	U		0.31	U		0.438	U	
2,4',6-TRIBDE	BDE-032	0.172	U		0.44	U		1.05	J	
2',3,4-TRIBDE	BDE-033	C28			C28			C28		
3,3',4-TRIBDE	BDE-035	0.126	U		0.185	U		0.262	U	
3,4,4'-TRIBDE	BDE-037	0.167	KJ	U	0.44	KJ	U	0.476	J	
2,2',4,4'-TEBDE	BDE-047	39.4	B		265	B		231	B	
2,2',4,5'-TEBDE	BDE-049	10.7			81.9			134		
2,2',4,6'-TEBDE	BDE-051	1.06	J		7.88			16.8		
2,3',4,4'-TEBDE	BDE-066	2.39	KJ	U	16.4			12.9		
2,3',4',6-TEBDE	BDE-071	0.740	J		6.74			5.97	K	U
2,4,4',6-TEBDE	BDE-075	0.150	KJ	U	1.00	J		0.589	KJ	U
3,3',4,4'-TEBDE	BDE-077	0.0996	U		0.114	KJ	U	0.182	KJ	U
3,3',4,5'-TEBDE	BDE-079	0.600	U		0.0995	U		0.69	KJ	U
2,2',3,4,4'-PEBDE	BDE-085	1.67	KJ	U	15.2			12.5		J
2,2',4,4',5-PEBDE	BDE-099	39.6	B		391	B		284	B	
2,2',4,4',6-PEBDE	BDE-100	9.66	B		91.9	B		74.3	B	
2,3,3',4,4'-PEBDE	BDE-105	0.274	U		1.61	U		3.21	U	
2,3,4,5,6-PEBDE	BDE-116	0.583	KJ	U	2.19	U		4.37	U	
2,3',4,4',6-PEBDE	BDE-119	0.196	CU		2.10	CKJ	U	2.29	CU	
2,3',4,5,5'-PEBDE	BDE-120	C119			C119			C119		
3,3',4,4',5-PEBDE	BDE-126	0.115	U		0.740	U		1.44	U	
2,2',3,3',4,4'-HXBDE	BDE-128	0.481	U		2.90	U		5.56	U	
2,2',3,4,4',5'-HXBDE	BDE-138	0.746	CKJ	U	5.78	CJ		7.03	CKJ	U
2,2',3,4,4',6'-HXBDE	BDE-140	0.232	KJ	U	2.38	KJ	U	2.73	J	
2,2',4,4',5,5'-HXBDE	BDE-153	4.01	BJ		41.9	B		36.9	B	
2,2',4,4',5,6'-HXBDE	BDE-154	3.84	BJ		39.5	B		32.8	B	
2,2',4,4',6,6'-HXBDE	BDE-155	0.326	KJ	U	3.04	J		3.19	KJ	U
2,3,4,4',5,6-HXBDE	BDE-166	C138			C138			C138		
2,2',3,4,4',5,6-HPBDE	BDE-181	0.204	U		2.36	KJ	U	2.66	U	
2,2',3,4,4',5',6-HPBDE	BDE-183	3.42	BJ		14.0	B		25.4	B	
2,3,3',4,4',5,6-HPBDE	BDE-190	1.16	KJ	U	4.03	U		9.58	K	U
2,2',3,4,4',5,5',6-OCBDE	BDE-203	4.23	BJ		25.3	B		41.4	B	
2,2',3,3',4,4',5,5',6-NOBDE	BDE-206	22.0	B		235	B		514	B	
2,2',3,3',4,4',5,6,6'-NOBDE	BDE-207	32.6	K	U	180			337		
2,2',3,3',4,5,5',6,6'-NOBDE	BDE-208	16.8	B		114	B		244	B	
2,2',3,3',4,4',5,5',6,6'-DEBDE	BDE-209	365	B		4960	B		8790	B	

Note: K-qualified results should be treated as non-detects.
dw = dry weight
LQ = laboratory qualifier
PBDE = polybrominated diphenyl ether

B = method blank contamination
C = coelution;
J = estimated value less than reporting limit and/or QC parameter out of control limits
K = method required criteria not met, therefore value represents an estimated maximum possible concentration
U = undetected

Table 9. Solid Phase Bioassay Performance Standards and Evaluation Guidelines.

Bioassay	Negative Control Performance Standard	Reference Sediment Performance Standard	Dispersive Disposal Site Interpretation Guidelines		Nondispersive Disposal Site Interpretation Guidelines	
			1-hit rule	2-hit rule	1-hit rule	2-hit rule
Amphipod	$M_C \leq 10\%$	$M_R - M_C \leq 20\%$	$M_T - M_C > 20\%$ and M_T vs. M_R SS (p=.05) and		$M_T - M_C > 20\%$ and M_T vs. M_R SS (p=.05) and	
			$M_T - M_R > 10\%$	NOCN	$M_T - M_R > 30\%$	NOCN
Larval	$N_C \div I \geq 0.70$	$N_R \div N_C \geq 0.65$	$N_T \div N_C < 0.80$ and N_T/N_C vs. N_R/N_C SS (p=.10) and		$N_T \div N_C < 0.80$ and N_T/N_C vs. N_R/N_C SS (p=.10) and	
			$N_R/N_C - N_T/N_C > 0.15$	NOCN	$N_R/N_C - N_T/N_C > 0.30$	NOCN
Neanthes growth	$M_C \leq 10\%$ and $MIG_C \geq 0.38$	$M_R \leq 20\%$ and $MIG_R \div MIG_C \geq 0.80$	$MIG_T \div MIG_C < 0.80$ and MIG_T vs. MIG_R SS (p=.05) and		$MIG_T \div MIG_C < 0.80$ and MIG_T vs. MIG_R SS (p=.05) and	
			$MIG_T/MIG_R < 0.70$	NOCN	$MIG_T/MIG_R < 0.50$	$MIG_T/MIG_R < 0.70$

M = mortality, N = normal larvae, I = initial count, MIG = mean individual growth rate mg/individual/day)
SS = statistically significant, NOCN = no other conditions necessary, N/A = not applicable
Subscripts: R = reference sediment, C = negative control, T = test sediment

Table 10. Negative Control and Reference Sediment Performance Standards and Test Results

Test (Test Species)	Negative Control Performance Standard	Negative Control Results	Reference Sediment Performance Standard	Reference Sediment Results
Amphipod Mortality (E. estuarius)	$M_C \leq 10\%$	2.00%	$M_R - M_C \leq 20\%$	CR20 = 3% CR21 = 0% CR24W = 2%
Larval Development (M. galloprovincialis)	$N_C \div I \geq 0.70$	0.9	$N_R \div N_C \geq 0.65$	CR20 = 0.84 CR21 = 0.86 CR24W = 0.92
Juvenile Polychaete Growth (N. arenaceodentata)	$M_C \leq 10\%$ and $MIG_C \geq 0.38$	0.0%; 0.64	$M_R \leq 20\%$ and $MIG_R \div MIG_C \geq 0.80$	CR20 = 0%; 1.37 CR21 = 0%; 1.18 CR24W = 0%; 1.22

M = mortality
N = normal development; N_C = 292; N_R = 245 (CR-20), 254 (CR-21), 272 (CR-24W)
I = initial count (stocking density) = 323
MIG = mean individual growth rate (mg/individual/day)
Subscripts: R = reference; C = negative control

Table 11. Grain Size and TOC Results for Determining Reference Sediment Comparisons

Dredged Material Sediment			Reference Sediment		
			CR20	CR21	CR24W
		TOC (%)	0.64	0.38	0.49
Composite Sample	TOC (%)	Fines (%)	77.4	14.3	47.7
DMMU 1	1.42	9.2		X	
DMMU 2	1.89	11.3		X	
DMMU 3	2.41	16.6		X	
DMMU 4	1.96	24.8		X	
DMMU 5	2.49	38.9			X
DMMU 6	3.58	25.1		X	
DMMU 7	2.94	38.1			X
DMMU 8	1.67	57.2			X
DMMU 9	2.59	56.6			X
DMMU 10	3.16	67.5	X		
DMMU 11	2.08	58.2			X
DMMU 12	1.88	67.3	X		
DMMU 13	1.75	65.5	X		
DMMU 14	1.92	56.6			X
DMMU 15	2	64.9	X		
DMMU 16	1.9	72.9	X		
DMMU 17	1.99	66.5	X		

Table 12. Amphipod Mortality Bioassay Results and Evaluation Guidelines (from SAIC, 2011b)

Sample ID	% Mortality	Mean Mortality	Reference	1-Hit Rule[1,2]		2-Hit Rule[1,2]	
				$M_T - M_C > 20\%$; M_T vs M_R SD ($p = 0.05$); $M_T - M_R > 30\%$	Hit/ No-Hit	$M_T - M_C > 20\%$; M_T vs M_R SD ($p = 0.05$); NOCN	Hit/ No-Hit
Control	0, 0, 5, 5, 0	2.0 ± 2.7	N/A	N/A	N/A	N/A	N/A
CR20	0, 5, 5, 5, 0	3.0 ± 2.7	N/A	N/A	N/A	N/A	N/A
CR21	0, 0, 0, 0, 0	0.0 ± 0	N/A	N/A	N/A	N/A	N/A
CR24W	0, 5, 0, 5, 0	2.0 ± 2.7	N/A	N/A	N/A	N/A	N/A
DMMU 1	5, 0, 0, 0, 0	1.0 ± 2.2	CR21	-1% No (Rankits t-test) 1%	No Hit	-1% No (Rankits t-test)	No Hit
DMMU 2	0, 5, 0, 10, 0	3.0 ± 4.5	CR21	1% No (Rankits t-test) 3%	No Hit	1% No (Rankits t-test)	No Hit
DMMU 3	0, 0, 5, 0, 0	1.0 ± 2.2	CR21	-1 No (Rankits t-test) 1	No Hit	-1% No (Rankits t-test)	No Hit
DMMU 4	10, 0, 5, 0, 5	4.0 ± 4.2	CR21	2% Yes (Approximate t-test) 4%	No Hit	2% Yes (Approximate t-test)	No Hit
DMMU 5	0, 0, 10, 0, 5	3.0 ± 4.5	CR24W	1% No (Mann-Whitney) 1%	No Hit	1% No (Mann-Whitney)	No Hit
DMMU 6	5, 0, 0, 0, 5	2.0 ± 2.7	CR21	0% No (Rankits t-test) 2%	No Hit	0% No (Rankits t-test)	No Hit
DMMU 7	0, 0, 10, 0, 5	3.0 ± 4.5	CR24W	1% No (Mann-Whitney) 1%	No Hit	1% No (Mann-Whitney)	No Hit
DMMU 8	0, 5, 10, 0, 5	4.0 ± 4.2	CR24W	2% No (Students t-test) 2%	No Hit	2% No (Students t-test)	No Hit
DMMU 9	5, 0, 5, 0, 20	6.0 ± 8.2	CR24W	4% No (Students t-test) 4%	No Hit	4% No (Students t-test)	No Hit
DMMU 10	10, 5, 10, 5, 20	10.0 ± 6.1	CR20	8% No (Mann-Whitney) 7%	No Hit	8% No (Mann-Whitney)	No Hit
DMMU 11	20, 5, 15, 10, 0	10.0 ± 7.9	CR24W	8% Yes (Students t-test) 8%	No Hit	8% Yes (Students t-test)	No Hit
DMMU 12	35, 20, 15, 0, 10	16.0 ± 12.9	CR20	14% Yes (Students t-test) 13%	No Hit	14% Yes (Students t-test)	No Hit
DMMU 13	0, 10, 0, 0, 5	3.0 ± 4.5	CR20	1% No (Mann-Whitney) 0%	No Hit	1% No (Mann-Whitney)	No Hit
DMMU 14	10, 5, 25, 0, 5	9.0 ± 9.6	CR24W	7% No (Students t-test) 7%	No Hit	7% No (Students t-test)	No Hit
DMMU 15	10, 5, 20, 15, 5	11.0 ± 6.5	CR20	9% Yes (Mann-Whitney) 8%	No Hit	9% Yes (Mann-Whitney)	No Hit
DMMU 16	15, 10, 25, 5, 5	12.0 ± 8.4	CR20	10% Yes (Students t-test) 9%	No Hit	10% Yes (Students t-test)	No Hit
DMMU 17	15, 20, 15, 5, 10	13.0 ± 5.7	CR20	11% Yes (Mann-Whitney) 10%	No Hit	11% Yes (Mann-Whitney)	No Hit

M = mortality
SD = statistically different
NOCN = no other conditions necessary
N/A = not applicable
Subscripts: R = reference; C = negative control; T = test sediment
1. Non-dispersive disposal site interpretation guidelines
2. Comparison to reference includes the numeric result for the comparative criteria, the result of the statistical test, and the statistical test used. All statistics were conducted using SAS® routines verified with BioStat (DMMP/SMS Bioassay Statistics Program; Beta v4.1). All amphipod mortality data were arcsine transformed for statistical analysis.

Table 13. Juvenile Polychaete Growth Bioassay Results and Evaluation Guidelines Based on Dry Weight (from SAIC, 2011b)

Sample ID	Individual Growth Rate[1]	Mean Individual Growth Rate[1]	Reference	1-Hit Rule[1,2,3]		2-Hit Rule[1,2,3]	
				$MIG_T \div MIG_C < 0.80$; MIG_T vs MIG_R SD ($p = 0.05$); $MIG_T/MIG_R < 0.50$	Hit/ No-Hit	$MIG_T \div MIG_C < 0.80$; MIG_T vs MIG_R SD ($p = 0.05$); $MIG_T/MIG_R < 0.70$	Hit/ No-Hit
Control	0.667, 0.469, 0.694, 0.653, 0.695	0.64 ± 0.09	N/A	N/A	N/A	N/A	N/A
CR20	0.947, 0.895, 0.753, 0.845, 0.904	0.87 ± 0.07	N/A	N/A	N/A	N/A	N/A
CR21	0.768, 0.772, 0.721, 0.647, 0.834	0.75 ± 0.07	N/A	N/A	N/A	N/A	N/A
CR24W	0.919, 0.691, 0.714, 0.745, 0.803	0.77 ± 0.09	N/A	N/A	N/A	N/A	N/A
DMMU 1	0.711, 1.40, 0.815, 0.736, 0.779	0.89 ± 0.29	CR21	1.4; No (Rankits t-test); 1.19	No Hit	1.4; No (Rankits t-test); 1.19	No Hit
DMMU 2	0.836, 0.813, 0.871, 0.962, 0.764	0.85 ± 0.07	CR21	1.34; No (Student's t-test); 1.13	No Hit	1.34; No (Student's t-test); 1.13	No Hit
DMMU 3	0.653, 0.551, 0.56, 2.025, 0.587	0.88 ± 0.64	CR21	1.38; No (Rankits t-test); 1.17	No Hit	1.38; No (Rankits t-test); 1.17	No Hit
DMMU 4	0.719, 0.714, 0.934, 0.736, 0.690	0.76 ± 0.10	CR21	1.19; No (Student's t-test); 1.01	No Hit	1.19; No (Student's t-test); 1.01	No Hit
DMMU 5	0.876, 0.810, 0.757, 0.69, 0.644	0.76 ± 0.09	CR24W	1.19; No (Student's t-test); 0.98	No Hit	1.19; No (Student's t-test); 0.98	No Hit
DMMU 6	0.882, 0.695, 0.844, 2.169, 0.770	1.07 ± 0.62	CR21	1.69; No (Rankits t-test); 1.43	No Hit	1.69; No (Rankits t-test); 1.43	No Hit
DMMU 7	0.624, 1.028, 0.819, 0.704, 0.863	0.81 ± 0.16	CR24W	1.27; No (Student's t-test); 1.04	No Hit	1.27; No (Student's t-test); 1.04	No Hit
DMMU 8	0.606, 0.806, 0.616, 0.768, 0.611	0.68 ± 0.10	CR24W	1.07; No (Mann-Whitney); 0.88	No Hit	1.07; No (Mann-Whitney); 0.88	No Hit
DMMU 9	0.697, 0.58, 1.565, 0.723, 0.700	0.85 ± 0.40	CR24W	1.34; No (Rankits t-test); 1.1	No Hit	1.34; No (Rankits t-test); 1.1	No Hit
DMMU 10	0.423, 0.515, 0.588, 0.442, 0.628	0.52 ± 0.09	CR20	0.82; Yes (Student's t-test); 0.6	No Hit	0.82; Yes (Student's t-test); 0.6	No Hit
DMMU 11	0.642, 0.649, 0.613, 0.709, 0.65	0.65 ± 0.03	CR24W	1.03; Yes (Approximate t-test); 0.84	No Hit	1.03; Yes (Approximate t-test); 0.84	No Hit
DMMU 12	0.528, 0.843, 0.592, 0.715, 0.522	0.64 ± 0.14	CR20	1.01; Yes (Student's t-test); 0.74	No Hit	1.01; Yes (Student's t-test); 0.74	No Hit
DMMU 13	0.69, 0.804, 0.684, 0.677, 0.866	0.74 ± 0.09	CR20	1.17; Yes (Student's t-test); 0.86	No Hit	1.17; Yes (Student's t-test); 0.86	No Hit
DMMU 14	0.573, 0.508, 0.46, 0.52, 0.926	0.6 ± 0.19	CR24W	0.94; No (Mann-Whitney); 0.77	No Hit	0.94; No (Mann-Whitney); 0.77	No Hit
DMMU 15	0.452, 0.733, 0.757, 1.553, 0.664	0.83 ± 0.42	CR20	1.31; No (Rankits t-test); 0.96	No Hit	1.31; No (Rankits t-test); 0.96	No Hit
DMMU 16	0.566, 0.591, 0.708, 0.47, 0.749	0.62 ± 0.11	CR20	0.97; Yes (Student's t-test); 0.71	No Hit	0.97; Yes (Student's t-test); 0.71	No Hit
DMMU 17	0.661, 0.683, 0.85, 0.656, 1.015	0.77 ± 0.16	CR20	1.22; No (Approximate t-test); 0.89	No Hit	1.22; No (Approximate t-test); 0.89	No Hit

MIG = mean individual growth rate (mg/individual/day)
SD = statistically different
N/A = not applicable
Subscripts: R = reference; C = negative control; T = test sediment
1. mg/individual/day
2. Non-dispersive disposal site interpretation guidelines
3. Comparison to reference includes the numeric result for the comparative criteria, the result of the statistical test, and the statistical test used.
All statistics were conducted using SAS® routines verified with BioStat (DMMP/SMS Bioassay Statistics Program; Beta v4.1).

Table 14. Juvenile Polychaete Growth Bioassay Results and Evaluation Guidelines Based on Ash-Free Dry Weight (from SAIC, 2011b)

Sample ID	Individual Growth Rate[1]	Mean Individual Growth Rate[1]	Reference	1-Hit Rule[1,2,3]		2-Hit Rule[1,2,3]	
				$MIG_T \div MIG_C < 0.80$; MIG_T vs MIG_R SD ($p = 0.05$); $MIG_T/MIG_R < 0.50$	Hit/ No-Hit	$MIG_T \div MIG_C < 0.80$; MIG_T vs MIG_R SD ($p = 0.05$); $MIG_T/MIG_R < 0.70$	Hit/ No-Hit
Control	0.507, 0.386, 0.484, 0.596, 0.525	0.50 ± 0.08	N/A	N/A	N/A	N/A	N/A
CR20	0.765, 0.780, 0.619, 0.738, 0.760	0.73 ± 0.07	N/A	N/A	N/A	N/A	N/A
CR21	0.665, 0.648, 0.611, 0.520, 0.738	0.64 ± 0.08	N/A	N/A	N/A	N/A	N/A
CR24W	0.800, 0.611, 0.629, 0.554, 0.677	0.65 ± 0.09	N/A	N/A	N/A	N/A	N/A
DMMU 1	0.620, 1.284, 0.726, 0.632, 0.684	0.79 ± 0.28	CR21	1.58; No (Mann-Whitney); 1.24	No Hit	1.58; No (Mann-Whitney); 1.24	No Hit
DMMU 2	0.725, 0.680, 0.744, 0.793, 0.661	0.72 ± 0.05	CR21	1.44; No (Student's t-test); 1.13	No Hit	1.44; No (Student's t-test); 1.13	No Hit
DMMU 3	0.565, 0.434, 0.471, 1.855, 0.485	0.76 ± 0.61	CR21	1.53; No (Rankits t-test); 1.2	No Hit	1.53; No (Rankits t-test); 1.2	No Hit
DMMU 4	0.563, 0.509, 0.765, 0.599, 0.521	0.59 ± 0.10	CR21	1.18; No (Student's t-test); 0.93	No Hit	1.18; No (Student's t-test); 0.93	No Hit
DMMU 5	0.712, 0.630, 0.594, 0.560, 0.540	0.61 ± 0.07	CR24W	1.21; No (Student's t-test); 0.93	No Hit	1.21; No (Student's t-test); 0.93	No Hit
DMMU 6	0.669, 0.570, 0.701, 2.009, 0.599	0.91 ± 0.62	CR21	1.82; No (Rankits t-test); 1.43	No Hit	1.82; No (Rankits t-test); 1.43	No Hit
DMMU 7	0.490, 0.773, 0.642, 0.591, 0.641	0.63 ± 0.10	CR24W	1.26; No (Student's t-test); 0.96	No Hit	1.26; No (Student's t-test); 0.96	No Hit
DMMU 8	0.516, 0.713, 0.528, 0.675, 0.524	0.59 ± 0.09	CR24W	1.18; No (Student's t-test); 0.9	No Hit	1.18; No (Student's t-test); 0.9	No Hit
DMMU 9	0.608, 0.515, 1.455, 0.621, 0.592	0.76 ± 0.39	CR24W	1.52; No (Rankits t-test); 1.16	No Hit	1.52; No (Rankits t-test); 1.16	No Hit
DMMU 10	0.369, 0.449, 0.497, 0.380, 0.564	0.45 ± 0.08	CR20	0.90; Yes (Student's t-test); 0.62	No Hit	0.90; Yes (Student's t-test); 0.62	No Hit
DMMU 11	0.564, 0.555, 0.542, 0.621, 0.567	0.57 ± 0.03	CR24W	1.14; Yes (Student's t-test); 0.87	No Hit	1.14; Yes (Student's t-test); 0.87	No Hit
DMMU 12	0.438, 0.746, 0.506, 0.600, 0.463	0.55 ± 0.13	CR20	1.10; Yes (Student's t-test); 0.75	No Hit	1.10; Yes (Student's t-test); 0.75	No Hit
DMMU 13	0.627, 0.734, 0.606, 0.617, 0.745	0.67 ± 0.07	CR20	1.33; No (Student's t-test); 0.91	No Hit	1.33; No (Student's t-test); 0.91	No Hit
DMMU 14	0.517, 0.457, 0.377, 0.44, 0.840	0.53 ± 0.18	CR24W	1.05; No (Student's t-test); 0.8	No Hit	1.05; No (Student's t-test); 0.8	No Hit
DMMU 15	0.387, 0.623, 0.608, 1.478, 0.599	0.74 ± 0.42	CR20	1.48; No (Rankits t-test); 1.01	No Hit	1.48; No (Rankits t-test); 1.01	No Hit
DMMU 16	0.455, 0.474, 0.595, 0.396, 0.647	0.51 ± 0.10	CR20	1.03; Yes (Student's t-test); 0.7	No Hit	1.03; Yes (Student's t-test); 0.7	No Hit
DMMU 17	0.575, 0.581, 0.785, 0.576, 0.906	0.68 ± 0.15	CR20	1.37; No (Approximate t-test); 0.93	No Hit	1.37; No (Approximate t-test); 0.93	No Hit

MIG = mean individual growth rate (mg/individual/day)
SD = statistically different
N/A = not applicable
Subscripts: R = reference; C = negative control; T = test sediment
1. mg/individual/day
2. Non-dispersive disposal site interpretation guidelines
3. Comparison to reference includes the numeric result for the comparative criteria, the result of the statistical test, and the statistical test used.
All statistics were conducted using SAS® routines verified with BioStat (DMMP/SMS Bioassay Statistics Program; Beta v4.1).

Table 15. Larval Development Bioassay Results and Evaluation Guidelines; Standard Test Endpoint (from SAIC, 2011b)

Sample ID	Normal Survival[1] (%)	Mean Normal Survival[1] (%)	Reference	1-Hit Rule[2,3]		2-Hit Rule[2,3]	
				$N_T \div N_C < 0.80$; N_T/N_C vs N_R/N_C SD ($p = 0.10$); $N_R/N_C - N_T/N_C > 0.30$	Hit/ No-Hit	$N_T \div N_C < 0.80$; N_T/N_C vs N_R/N_C SD ($p = 0.10$); NOCN	Hit/ No-Hit
Control	87.7, 84, 96.1, 85.2, 98.9	90.4 ± 6.7	N/A	N/A	N/A	N/A	N/A
CR20	75.8, 91.2, 78.9, 82.3, 91.2	83.9 ± 7.1	N/A	N/A	N/A	N/A	N/A
CR21	100, 88.1, 82.3, 78.5, 80.9	86.0 ± 8.6	N/A	N/A	N/A	N/A	N/A
CR24W	81.3, 86.8, 97.1, 100, 96.7	92.4 ± 8.0	N/A	N/A	N/A	N/A	N/A
DMMU 1	100, 81.3, 77.8, 84.4, 83.0	85.3 ± 8.6	CR21	0.85; No (Mann-Whitney); 0.01	No Hit	0.85; No (Mann-Whitney)	No Hit
DMMU 2	85.0, 80.6, 62.4, 93.3, 58.6	76.0 ± 14.9	CR21	0.76; No (Student's t-test); 0.1	No Hit	0.76; No (Student's t-test)	No Hit
DMMU 3	94.7, 85.0, 77.5, 79.9, 91.2	85.7 ± 7.3	CR21	0.86; No (Mann-Whitney); 0	No Hit	0.86; No (Mann-Whitney)	No Hit
DMMU 4	94.0, 66.9, 94.7, 80.2, 87.1	84.6 ± 11.5	CR21	0.85; No (Student's t-test); 0.01	No Hit	0.85; No (Student's t-test)	No Hit
DMMU 5	60.7, 89.2, 97.7, 65.2, 80.6	78.7 ± 15.7	CR24W	0.79; Yes (Student's t-test); 0.14	No Hit	0.79; Yes (Student's t-test)	Hit
DMMU 6	48.0, 90.9, 38.1, 71.3, 90.5	67.8 ± 24.2	CR21	0.68; Yes (Student's t-test); 0.18	No Hit	0.68; Yes (Student's t-test)	Hit
DMMU 7	78.2, 91.9, 87.4, 53.2, 78.2	77.8 ± 15.0	CR24W	0.78; Yes (Student's t-test); 0.15	No Hit	0.78; Yes (Student's t-test)	Hit
DMMU 8	96.0, 94.3, 92.9, 93.6, 68.9	89.2 ± 11.4	CR24W	0.89; No (Student's t-test); 0.03	No Hit	0.89; No (Student's t-test)	No Hit
DMMU 9	70.0, 100, 89.8, 67.9, 96.4	84.8 ± 15.0	CR24W	0.85; No (Student's t-test); 0.08	No Hit	0.85; No (Student's t-test)	No Hit
DMMU 10	76.8, 78.9, 79.9, 72.7, 99.5	81.6 ± 10.4	CR20	0.82; No (Mann-Whitney); 0.02	No Hit	0.82; No (Mann-Whitney)	No Hit
DMMU 11	43.6, 79.6, 92.9, 54.5, 98.8	73.9 ± 24.0	CR24W	0.74; Yes (Student's t-test); 0.18	No Hit	0.74; Yes (Student's t-test)	Hit
DMMU 12	71.7, 49.0, 100, 90.5, 96.7	81.6 ± 21.2	CR20	0.82; No (Approximate t-test); 0.02	No Hit	0.82; No (Approximate t-test)	No Hit
DMMU 13	83.0, 85.0, 74.1, 80.9, 79.2	80.5 ± 4.2	CR20	0.81; No (Approximate t-test); 0.03	No Hit	0.81; No (Approximate t-test)	No Hit
DMMU 14	76.5, 78.5, 70.6, 77.8, 86.4	78.0 ± 5.6	CR24W	0.78; Yes (Approximate t-test); 0.14	No Hit	0.78; Yes (Approximate t-test)	Hit
DMMU 15	15.8, 34.3, 14.4, 73.0, 77.5	43.0 ± 30.5	CR20	0.43; Yes (Approximate t-test); 0.41	Hit	0.43; Yes (Approximate t-test)	Hit
DMMU 16	65.2, 48.7, 82.3, 53.5, 59.3	61.8 ± 13.0	CR20	0.62; Yes (Student's t-test); 0.22	No Hit	0.62; Yes (Student's t-test)	Hit
DMMU 17	79.6, 80.2, 70.0, 75.1, 60.4	73.0 ± 8.2	CR20	0.73; Yes (Student's t-test); 0.11	No Hit	0.73; Yes (Student's t-test)	Hit

M = mortality
N = normal development; N_C = 292; N_R = 245 (CR-20), 254 (CR-21), 272 (CR-24W)
I = initial count (stocking density) = 323
SD = statistically different
NOCN = no other conditions necessary
N/A = not applicable
Subscripts: R = reference; C = negative control; T = test sediment
1. Normal survival for reference and test sediments are normalized to mean normal survival in seawater control
2. Non-dispersive disposal site interpretation guidelines
3. Comparison to reference includes the numeric result for the comparative criteria, the result of the statistical test, and the statistical test used.
All statistics were conducted using SAS® routines verified with BioStat (DMMP/SMS Bioassay Statistics Program; Beta v4.1). All larval development data were arcsine transformed for statistical analysis.

Table 16. Larval Development Bioassay Results and Evaluation Guidelines; Resuspension Endpoint (from SAIC, 2011b)

Sample ID	Normal Survival[1] (%)	Mean Normal Survival[1] (%)	Reference	1-Hit Rule[2,3]		2-Hit Rule[2,3]	
				$N_T \div N_C < 0.80$; N_T/N_C vs N_R/N_C SD ($p = 0.10$); $N_R/N_C - N_T/N_C > 0.30$	Hit/ No-Hit	$N_T \div N_C < 0.80$; N_T/N_C vs N_R/N_C SD ($p = 0.10$); NOCN	Hit/ No-Hit
Control	89.6, 92.1, 90.8, 100, 100	94.5 ± 5.1	N/A	N/A	N/A	N/A	N/A
CR20	81.5, 83.8, 67.3, 85.4, 93.8	82.3 ± 9.6	N/A	N/A	N/A	N/A	N/A
CR21	82.2, 78.0, 84.4, 70.9, 81.2	79.3 ± 5.3	N/A	N/A	N/A	N/A	N/A
CR24W	78.9, 85.7, 78, 80.5, 85.1	81.6 ± 3.5	N/A	N/A	N/A	N/A	N/A
DMMU 1	100, 100, 100, 92.8, 100	98.6 ± 3.2	CR21	0.99; No (Mann-Whitney); -0.19	No Hit	0.99; No (Mann-Whitney)	No Hit
DMMU 2	89.6, 94.7, 73.1, 62.8, 90.2	82.1 ± 13.5	CR21	0.82; No (Approximate t-test); -0.03	No Hit	0.82; No (Approximate t-test)	No Hit
DMMU 3	76.0, 87.0, 86.7, 82.2, 79.3	82.2 ± 4.7	CR21	0.82; No (Student's t-test); -0.03	No Hit	0.82; No (Student's t-test)	No Hit
DMMU 4	84.1, 59.6, 86.7, 86.3, 85.1	80.3 ± 11.6	CR21	0.80; No (Mann-Whitney); -0.01	No Hit	0.80; No (Mann-Whitney)	No Hit
DMMU 5	54.4, 83.1, 71.2, 72.8, 75.1	71.3 ± 10.5	CR24W	0.71; Yes (Student's t-test); 0.1	No Hit	0.71; Yes (Student's t-test)	Hit
DMMU 6	47.7, 78.9, 52.5, 67.0, 70.2	63.3 ± 12.9	CR21	0.63; Yes (Approximate t-test); 0.16	No Hit	0.63; Yes (Approximate t-test)	Hit
DMMU 7	63.5, 73.8, 57, 53.2, 62.2	61.9 ± 7.8	CR24W	0.62; Yes (Student's t-test); 0.2	No Hit	0.62; Yes (Student's t-test)	Hit
DMMU 8	82.2, 72.5, 70.6, 87, 54.1	73.3 ± 12.7	CR24W	0.73; No (Student's t-test); 0.08	No Hit	0.73; No (Student's t-test)	No Hit
DMMU 9	68.3, 98.3, 100, 67.3, 96.0	86.0 ± 16.6	CR24W	0.86; No (Approximate t-test); -0.04	No Hit	0.86; No (Approximate t-test)	No Hit
DMMU 10	68.3, 71.5, 64.8, 78.3, 70.9	70.7 ± 5.0	CR20	0.71; Yes (Student's t-test); 0.12	No Hit	0.71; Yes (Student's t-test)	Hit
DMMU 11	59.3, 90.2, 100, 96.3, 72.2	83.6 ± 17.3	CR24W	0.84; No (Approximate t-test); -0.02	No Hit	0.84; No (Approximate t-test)	No Hit
DMMU 12	90.9, 63.1, 64.1, 16.1, 97.3	66.3 ± 32.0	CR20	0.66; No (Student's t-test); 0.16	No Hit	0.66; No (Student's t-test)	No Hit
DMMU 13	80.9, 100, 97.6, 100, 78.9	91.5 ± 10.6	CR20	0.92; No (Approximate t-test); -0.09	No Hit	0.92; No (Approximate t-test)	No Hit
DMMU 14	78.9, 39.0, 65.7, 90.2, 74.4	69.7 ± 19.3	CR24W	0.70; No (Approximate t-test); 0.12	No Hit	0.70; No (Approximate t-test)	No Hit
DMMU 15	7.1, 54.4, 13.5, 35.4, 44.1	30.9 ± 20.1	CR20	0.31; Yes (Approximate t-test); 0.51	Hit	0.31; Yes (Approximate t-test)	Hit
DMMU 16	67.3, 41.9, 83.8, 75.1, 59.9	65.6 ± 15.9	CR20	0.66; Yes (Student's t-test); 0.17	No Hit	0.66; Yes (Student's t-test)	Hit
DMMU 17	75.1, 89.6, 67.3, 86.0, 67.7	77.1 ± 10.3	CR20	0.77; No (Student's t-test); 0.05	No Hit	0.77; No (Student's t-test)	No Hit

M = mortality
N = normal development; NC = 292; NR = 245 (CR-20), 254 (CR-21), 272 (CR-24W)
I = initial count (stocking density) = 323
SD = statistically different
NOCN = no other conditions necessary
N/A = not applicable
Subscripts: R = reference; C = negative control; T = test sediment
1. Normal survival for reference and test sediments are normalized to mean normal survival in seawater control
2. Non-dispersive disposal site interpretation guidelines
3. Comparison to reference includes the numeric result for the comparative criteria, the result of the statistical test, and the statistical test used.
All statistics were conducted using SAS® routines verified with BioStat (DMMP/SMS Bioassay Statistics Program; Beta v4.1). All larval development data were arcsine transformed for statistical analysis.

Table 17. Summary of Bioassay Interpretive Criteria (from SAIC, 2011b)

Location ID	Amphipod Mortality		Larval Development			Juvenile Polychaete Growth		Overall Interpretation
			standard and resuspension	standard protocol	resuspension protocol	DW and AFDW endpoints	DW and AFDW endpoints	
	1-Hit Rule	2-Hit Rule	1-Hit Rule	2-Hit Rule	2-Hit Rule	1-Hit Rule	2-Hit Rule	
DR11-TB-D01-17-C	No Hit	No Hit	No Hit	No Hit	No Hit	No Hit	No Hit	PASS
DR11-A-D02-11-C	No Hit	No Hit	No Hit	No Hit	No Hit	No Hit	No Hit	PASS
DR11-A-D03-13-C	No Hit	No Hit	No Hit	No Hit	No Hit	No Hit	No Hit	PASS
DR11-A-D04-15-C	No Hit	No Hit	No Hit	No Hit	No Hit	No Hit	No Hit	PASS
DR11-A-D05-15-C	No Hit	No Hit	No Hit	Hit	Hit	No Hit	No Hit	PASS
DR11-A-D06-17-C	No Hit	No Hit	No Hit	Hit	Hit	No Hit	No Hit	PASS
DR11-A-D07-17-C	No Hit	No Hit	No Hit	Hit	Hit	No Hit	No Hit	PASS
DR11-B-D08-12-C	No Hit	No Hit	No Hit	No Hit	No Hit	No Hit	No Hit	PASS
DR11-B-D09-12-C	No Hit	No Hit	No Hit	No Hit	No Hit	No Hit	No Hit	PASS
DR11-B-D10-14-C	No Hit	No Hit	No Hit	No Hit	Hit	No Hit	No Hit	PASS
DR11-B-D11-14-C	No Hit	No Hit	No Hit	Hit	No Hit	No Hit	No Hit	PASS
DR11-B-D12-14-C	No Hit	No Hit	No Hit	No Hit	No Hit	No Hit	No Hit	PASS
DR11-B-D13-14-C	No Hit	No Hit	No Hit	No Hit	No Hit	No Hit	No Hit	PASS
DR11-B-D14-16-C	No Hit	No Hit	No Hit	Hit	No Hit	No Hit	No Hit	PASS
DR11-B-D15-16-C	No Hit	No Hit	**Hit**	Hit	Hit	No Hit	No Hit	FAIL
DR11-B-D16-16-C	No Hit	No Hit	No Hit	Hit	Hit	No Hit	No Hit	PASS
DR11-B-D17-16-C	No Hit	No Hit	No Hit	Hit	No Hit	No Hit	No Hit	PASS

DW = dry-weight

AFDW = ash-free dry-weight

DR11-B-D15-16C (DMMU 15) found unsuitable for open-water disposal due to a hit under the 1-hit rule.

Denotes a difference in interpretation under the 2-hit rule between the two protocols; these differences were inconsequential to the overall evaluation.

Chemical	Unit	SMS Criteria		DMMU 1			DMMU 2			DMMU 3			DMMU 4			DMMU 5			DMMU 6			DMMU 7			DMMU 8			DMMU 9		
		SQS	CSL	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Metals																														
Arsenic	mg/kg dw	57	93	10			7			8			10			11			10			11			10			12		
Cadmium	mg/kg dw	5.1	6.7	0.3			0.3	U		0.3			0.3			0.3			0.3			0.3			0.5			0.4		
Chromium	mg/kg dw	260	270	16.4			13.8			15.6			17.5			22.4			17.5			22.1			25			24.3		
Copper	mg/kg dw	390	390	18.4			14.3			17.9			21.8			26.5			21.5			27.3			33.6			32.0		
Lead	mg/kg dw	450	530	6			5			6			6			8			6			8			11			10		
Mercury	mg/kg dw	0.41	0.59	0.03	U		0.03	U		0.03			0.04			0.06			0.04			0.05			0.09			0.07		
Silver	mg/kg dw	6.1	6.1	0.4	U		0.4	U		0.4	U		0.4	U		0.4	U		0.4	U		0.5	U		0.6	U		0.5	U	
Zinc	mg/kg dw	410	960	61			50			52			57			76			57			68			75			72		
PAHs																														
Acenaphthene	mg/kg OC	16	57	1.3	U		1.0	U		0.8	U		1.0	U		0.8	U		0.5	U		0.6	U		1.1	U		0.7	U	
Acenaphthylene	mg/kg OC	66	66	1.3	U		1.0	U		0.8	U		1.0	U		0.8	U		0.5	U		0.6	U		1.1	U		0.7	U	
Anthracene	mg/kg OC	220	1200	1.3	U		1.0	U		0.8	U		1.0	U		0.8	U		0.3	J		0.6	U		1.1	U		0.7	U	
Benzo(a)anthracene	mg/kg OC	110	270	1.3	U		0.5	J		0.8	U		0.5	J		0.6	J		0.7			0.7			2.0			0.9		
Benzofluoranthenes	mg/kg OC	230	450	1.4			1.4			0.9			1.3			1.7			2.0			1.9			5.4			2.6		
Benzo(g,h,i)perylene	mg/kg OC	31	78	1.3	U		0.7	J		0.4	J		1.0	U		0.6	J		0.7			0.7			2.0			1.0		
Benzo(a)pyrene	mg/kg OC	99	210	1.3	U		0.5	J		0.8	U		0.6	J		0.6	J		0.7			0.7			2.0			1.0		
Chrysene	mg/kg OC	110	460	1.1	J		0.7	J		0.5	J		0.8	J		1.2			1.2			1.2			3.2			1.4		
Dibenzo(a,h)anthracene	mg/kg OC	12	33	1.3	U		1.0	U		0.8	U		1.0	U		0.8	U		0.5	U		0.6	U		1.1	U		0.7	U	
Dibenzofuran	mg/kg OC	15	58	1.3	U		1.0	U		0.8	U		1.0	U		0.8			0.3	J		0.4	J		1.1	U		0.7	U	
Fluoranthene	mg/kg OC	160	1200	1.6	Q		1.4	Q		1.0	Q		1.4	Q		1.4	Q		2.0	Q		1.8	Q		5.1	Q		2.3	Q	
Fluorene	mg/kg OC	23	79	1.3	U		1.0	U		0.8	U		1.0	U		0.8	U		0.5	U		0.6	U		1.1	U		0.7	U	
Indeno(1,2,3-cd)pyrene	mg/kg OC	34	88	1.3	U		1.0	U		0.8	U		1.0	U		0.5	J		0.5			0.5	J		1.5			0.7		
2-Methylnaphthalene	mg/kg OC	38	64	0.8	J		1.0	U		0.8	U		1.0	U		0.5	J		0.6			0.8			1.1	U		0.4	J	
Naphthalene	mg/kg OC	99	170	1.3	U		1.0	U		0.8	U		1.0	U		0.4	J		0.4	J		0.4	J		1.1	U		0.7	U	
Phenanthrene	mg/kg OC	100	480	2.4			0.7	J		0.6	J		1.2			1.0			1.3			1.3			2.5			1.5		
Pyrene	mg/kg OC	1000	1400	1.6			1.5			1.1			1.5			1.5			1.9			1.8			5.0			2.2		
Total HPAHs	mg/kg OC	960	5300	5.7	J		6.9	J		3.9	J		6.1	J		8.0	J		9.8	J		9.5	J		26.3	J		12.0	J	
Total LPAHs	mg/kg OC	370	780	2.4			0.7	J		0.6	J		1.2			1.4	J		2.0	J		1.7	J		2.5			1.5		
Phenols																														
2,4-Dimethylphenol	µg/kg dw	29	210	18	U	UJ	18	U	UJ	19	U	UJ	19	U	UJ	19	U	UJ	19	U	UJ	19	U	UJ	19	U	UJ	19	U	UJ
2-Methylphenol	µg/kg dw	63	77	18	U		18	U		19	U		19	U		19	U		19	U		19	U		19	U		19	U	
4-Methylphenol	µg/kg dw	670	3600	64			18	U		10	J		26			36			51			25			13	J		14	J	
Pentachlorophenol	µg/kg dw	400	690	93	U		92	U		94	U		96	U		95	U		95	U		94	U		96	U		94	U	
Phenol	µg/kg dw	420	1200	23			11	J		19	U		13	J		17	J		57			23			33			31		
Phthalates																														
Butyl benzyl phthalate	mg/kg OC	4.9	64	1.3	U		1.0	U		0.8	U		1.0	U		0.8	U		0.3	J		0.6	U		0.7	J		0.7	U	
Di-n-butyl phthalate	mg/kg OC	220	1700	1.3	U		1.0	U		0.8	U		1.0	U		0.8	U		0.5	U		0.6	U		1.1	U		0.7	U	
Di-n-Octyl phthalate	mg/kg OC	58	4500	1.3	U		1.0	U		0.8	U		1.0	U		0.8	U		0.5	U		0.6	U		1.1	U		0.7	U	
Diethyl phthalate	mg/kg OC	61	110	1.3	U		1.0	U		0.8	U		1.0	U		0.8	U		0.5	U		0.6	U		1.1	U		0.7	U	
Dimethyl phthalate	mg/kg OC	53	53	1.3	U		1.0	U		0.8	U		1.0	U		0.8	U		0.5	U		0.6	U		1.1	U		0.7	U	
Bis(2-Ethylhexyl) Phthalate	mg/kg OC	47	78	3.2			2.5			1.7			2.8			2.9			2.5			2.1			5.3			2.6		
Other SVOCs																														
Benzoic Acid	µg/kg dw	650	760	64	J		38	J		37	J		290			94	J		290			110	J		210			220		
Benzyl Alcohol	µg/kg dw	57	870	24			16	J		14	J		***60***			***82***			***200***			***86***			***140***			***140***		
1,2-Dichlorobenzene	mg/kg OC	2.3	2.3	1.3	U		1.0	U		0.8	U		1.0	U		0.8	U		0.5	U		0.6	U		1.1	U		0.7	U	
1,4-Dichlorobenzene	mg/kg OC	3.1	9	1.3	U		1.0	U		0.8	U		1.0	U		0.8	U		0.5	U		0.6	U		1.1	U		0.7	U	
Hexachlorobenzene	mg/kg OC	0.38	2.3	0.07	U		0.1	U		0.04	U		0.05	U		0.04	U		0.03	U		0.03	U		0.07	U		0.04	U	
Hexachlorobutadiene	mg/kg OC	3.9	6.2	0.07	U		0.05	U		0.04	U		0.05	U		0.04	U		0.03	U		0.03	U		0.07	U		0.04	U	
N-Nitrosodiphenylamine	mg/kg OC	11	11	1.3	U		1.0	U		0.8	U		1.0	U		0.8	U		0.5	U		0.6	U		1.1	U		0.7	U	
1,2,4-Trichlorobenzene	mg/kg OC	0.81	1.8	**1.27**	**U**		**1.0**	**U**		0.79	U		**0.97**	**U**		0.76	U		0.53	U		0.65	U		**1.14**	**U**		0.73	U	
PCB Aroclors																														
Total PCBs	mg/kg OC	12	65	1.3	U		0.74	J		0.79	U		0.97	U		0.76	U		0.31	J		3.2	U		1.7	J		0.60	J	

Chemical	Unit	SMS Criteria		DMMU 10			DMMU 11			DMMU 12			DMMU 13			DMMU 14			DMMU 15			DMMU 16			DMMU 17		
		SQS	CSL	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Metals																											
Arsenic	mg/kg dw	57	93	10			11			13			12			11			13			12			13		
Cadmium	mg/kg dw	5.1	6.7	0.5			0.5			0.5			0.4			0.4			0.4			0.5			0.6		
Chromium	mg/kg dw	260	270	28			24.5			27.4			26.2			26.3			26.9			26.9			26.8		
Copper	mg/kg dw	390	390	39.4			34.5			38.7			35.6			33.5			36.4			36.0			36.6		
Lead	mg/kg dw	450	530	15			14			16			14			14			15			13			13		
Mercury	mg/kg dw	0.41	0.59	0.09			0.11			0.09			0.08			0.08			0.09			0.09			0.09		
Silver	mg/kg dw	6.1	6.1	0.6	U		0.5	U		0.5	U		0.5	U		0.5	U		0.5	U		0.5	U		0.5	U	
Zinc	mg/kg dw	410	960	89			84			87			83			77			83			78			84		
PAHs																											
Acenaphthene	mg/kg OC	16	57	0.6	U		1.0	U		1.1	U		1.1	U		1.0	U		1.0	U		1.1	U		1.0	U	
Acenaphthylene	mg/kg OC	66	66	0.6	U		1.0	U		1.1	U		1.1	U		1.0	U		1.0	U		1.1	U		1.0	U	
Anthracene	mg/kg OC	220	1200	0.3	J		0.6	J		0.5	J		1.1	U		0.6	J		0.6	J		0.6	J		0.5	J	
Benzo(a)anthracene	mg/kg OC	110	270	1.1			1.9			2.6			1.9			2.2			2.2			2.4			1.8		
Benzofluoranthenes	mg/kg OC	230	450	3.2			5.8			7.4			5.4			6.8			6.0			7.4			4.9		
Benzo(g,h,i)perylene	mg/kg OC	31	78	1.2			2.1			2.6			1.7			2.1			2.2			2.5			1.7		
Benzo(a)pyrene	mg/kg OC	99	210	1.3			2.2			3.5			2.0			2.6			2.4			2.8			2.0		
Chrysene	mg/kg OC	110	460	1.8			3.1			4.3			3.0			3.3			3.6			4.1			2.8		
Dibenzo(a,h)anthracene	mg/kg OC	12	33	0.6	U		0.5	J		0.7	J		1.1	U		1.0	U		0.6	J		1.1	U		1.0	U	
Dibenzofuran	mg/kg OC	15	58	0.6	U		1.0	U		1.1	U		1.1	U		1.0	U		1.0	U		1.1	U		1.0	U	
Fluoranthene	mg/kg OC	160	1200	2.9	Q		4.7	Q		5.3	Q		4.9	Q		5.7	Q		5.5	Q		6.3	Q		4.6	Q	
Fluorene	mg/kg OC	23	79	0.6	U		1.0	U		1.1	U		1.1	U		1.0	U		1.0	U		1.1	U		1.0	U	
Indeno(1,2,3-cd)pyrene	mg/kg OC	34	88	0.9			1.6			2.2			1.4			1.7			1.8			1.9			1.4		
2-Methylnaphthalene	mg/kg OC	38	64	0.3	J		1.0	U		1.1	U		1.1	U		0.5	J		0.7	J		0.6	J		1.0	U	
Naphthalene	mg/kg OC	99	170	0.6	U		0.5	J		1.1	U		1.1	U		1.0	U		1.0	U		1.1	U		1.0	U	
Phenanthrene	mg/kg OC	100	480	1.5			2.5			2.7			2.3			3.0			2.6			3.2			2.1		
Pyrene	mg/kg OC	1000	1400	2.8			4.8			5.9			4.9			5.7			5.5			6.3			4.6		
Total HPAHs	mg/kg OC	960	5300	15.2	J		26.9	J		34.6	J		25.1	J		30.2	J		29.5	J		33.7	J		23.6	J	
Total LPAHs	mg/kg OC	370	780	1.8	J		3.6	J		3.2	J		2.3			3.6	J		3.2	J		3.7	J		2.6	J	
Phenols																											
2,4-Dimethylphenol	µg/kg dw	29	210	19	U	UJ	20	U	UJ	20	U	UJ	20	U	UJ	19	U	UJ	19	U	UJ	20	U	UJ	19	U	UJ
2-Methylphenol	µg/kg dw	63	77	19	U		20	U		20	U		20	U		19	U		19	U		20	U		19	U	
4-Methylphenol	µg/kg dw	670	3600	10	J		11	J		20	U		20	U		19	U		11	J		14	J		14	J	
Pentachlorophenol	µg/kg dw	400	690	96	U		99	U		99	U		98	U		95	U		97	U	UJ	98	U	UJ	97	U	UJ
Phenol	µg/kg dw	420	1200	33			29			24			21			23			41			20			19		
Phthalates																											
Butyl benzyl phthalate	mg/kg OC	4.9	64	0.4	J		0.5	J		0.5	J		0.7	J		1.0	U		1.0	U		1.1	U		1.0	U	
Di-n-butyl phthalate	mg/kg OC	220	1700	0.6	U		0.5	J		1.1	U		1.1	U		1.0	U		0.6	J		1.1	U		1.0	U	
Di-n-Octyl phthalate	mg/kg OC	58	4500	0.6	U		1.0	U		1.1	U		1.1	U		1.0	U		1.0	U		1.1	U		1.0	U	
Diethyl phthalate	mg/kg OC	61	110	0.7	B	U	1.0	U		1.1	U		1.1	U		1.0	U		1.0	U		1.1	U		0.7	J	U
Dimethyl phthalate	mg/kg OC	53	53	0.6	U		1.0	U		1.1	U		1.1	U		1.0	U		1.0	U		1.1	U		1.0	U	
Bis(2-Ethylhexyl) Phthalate	mg/kg OC	47	78	2.7			4.8			3.6			4.2			4.0			5.0			5.8			5.0		
Other SVOCs																											
Benzoic Acid	µg/kg dw	650	760	180	J		110	J		94	J		70	J		82	J		83	JQ		90	JQ		92	JQ	
Benzyl Alcohol	µg/kg dw	57	870	***91***			***72***			***66***			53			34			19	U		52			***68***		
1,2-Dichlorobenzene	mg/kg OC	2.3	2.3	0.6	U		1.0	U		1.1	U		1.1	U		1.0	U		1.0	U		1.1	U		1.0	U	
1,4-Dichlorobenzene	mg/kg OC	3.1	9	0.6	U		1.0	U		1.1	U		1.1	U		1.0	U		1.0	U		1.1	U		1.0	U	
Hexachlorobenzene	mg/kg OC	0.38	2.3	0.03	U		0.05	U		0.05	U		0.05	U		0.14	Y	U	0.05	U		0.05	U		0.05	U	
Hexachlorobutadiene	mg/kg OC	3.9	6.2	0.03	U		0.05	U		0.05	U		0.05	U		0.05	U		0.05	U		0.05	U		0.05	U	
N-Nitrosodiphenylamine	mg/kg OC	11	11	0.6	U		1.0	U		1.1	U		1.1	U		1.0	U		1.0	U		1.1	U		1.0	U	
1,2,4-Trichlorobenzene	mg/kg OC	0.81	1.8	0.60	U		**0.96**	**U**		**1.06**	**U**		**1.14**	**U**		**0.99**	**U**		**0.95**	**U**		**1.05**	**U**		**0.95**	**U**	
PCB Aroclors																											
Total PCBs	mg/kg OC	12	65	1.4	J		3.7	J		4.4	J		3.3	J		3.8	J		3.5	J		3.1	J		3.6	J	

Table 18 - Legend

CSL = cleanup screening level
dw = dry weight
HPAHs = high molecular weight polycyclic aromatic hydrocarbons
LPAHs = low molecular weight polycyclic aromatic hydrocarbons
LQ = laboratory qualifier
ML = maximum level
na = not analyzed
nd = nondetect
OC = organic carbon normalized
PCBs = polychlorinated biphenyls
RL = reporting limit
SQS = sediment quality standard
SMS = sediment management standards
SVOCs = semi-volatile organic compounds
VQ = validation qualifier

detected SQS exceedance
undetected SQS exceedance

J = estimated value less than reporting limit and/or QC parameter out of control limits
Q = calibration or calibration verification out of QC limits
U = nondetect

Figure 1. Lower Duwamish Worksite Location

N

0 155 310 620 Feet

NEWFIELDS

L. Delwiche, Mar 2011

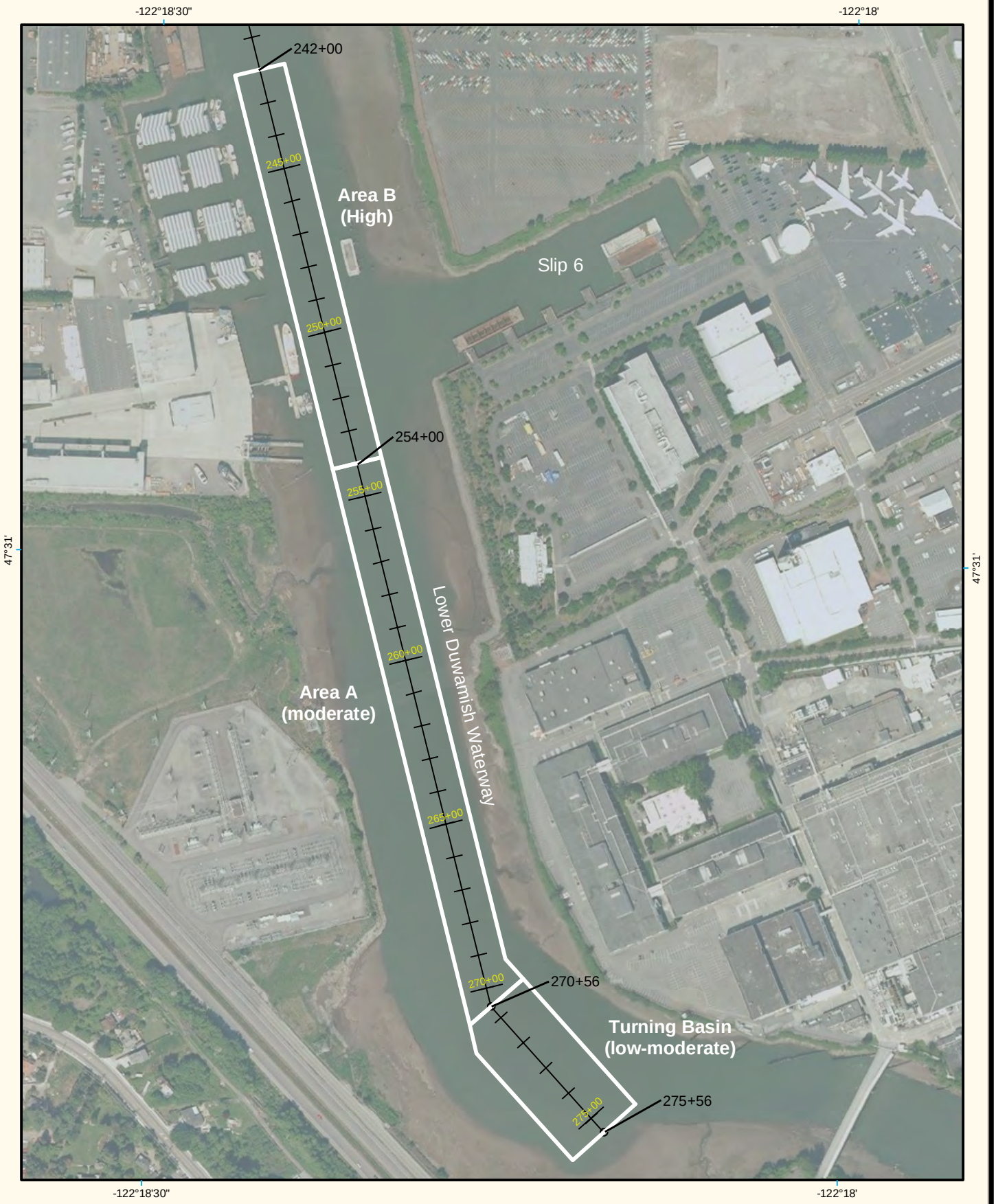

Figure 2. Area Designation for Sediment Sampling

N

0 125 250 500 Feet

NEWFIELDS

L. Delwiche, Mar 2011

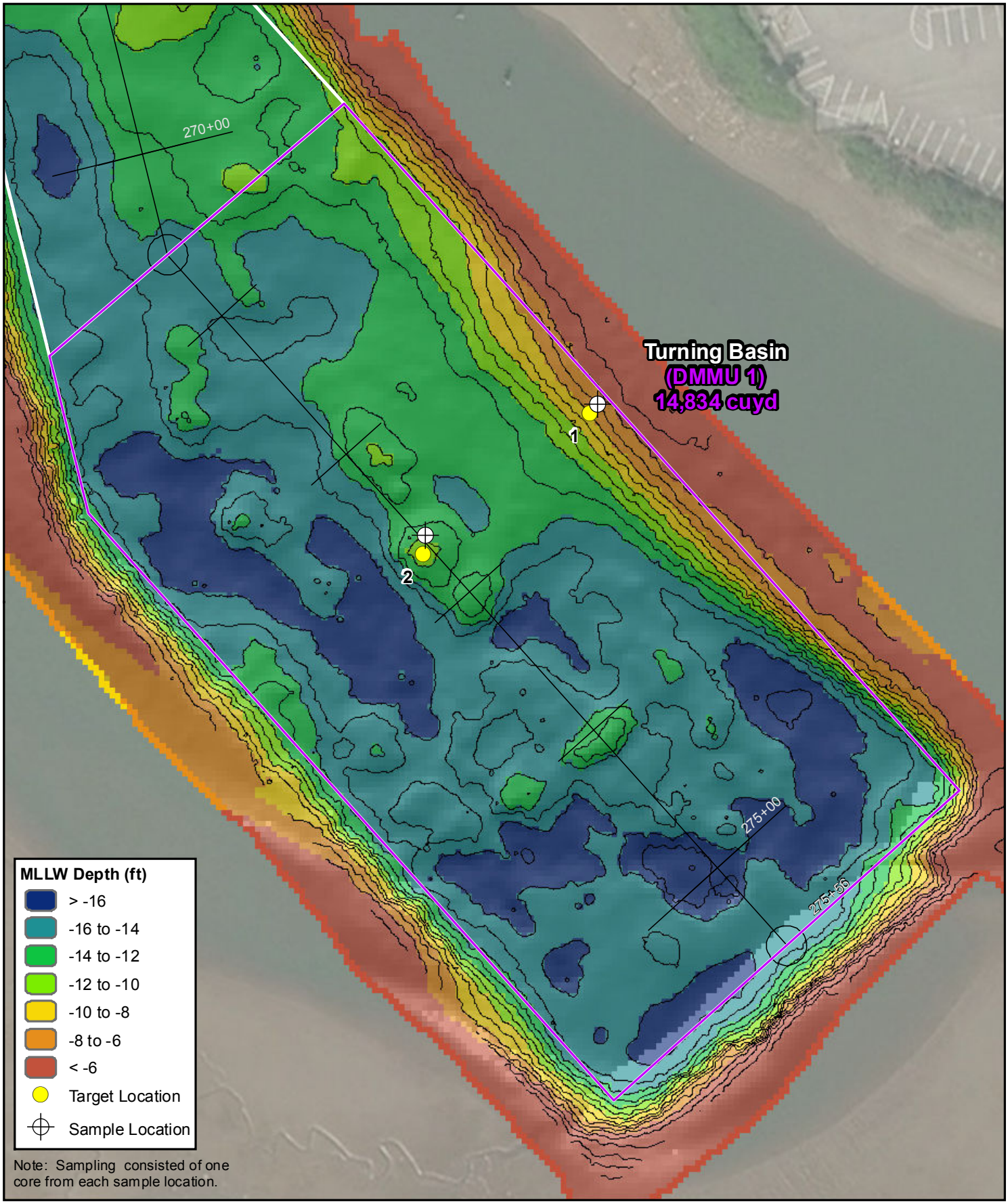

Figure 3. DMMU1 Target and Actual Sampling Locations

N

0 25 50 100 Feet

NEWFIELDS

J. Nuwer, June 2011

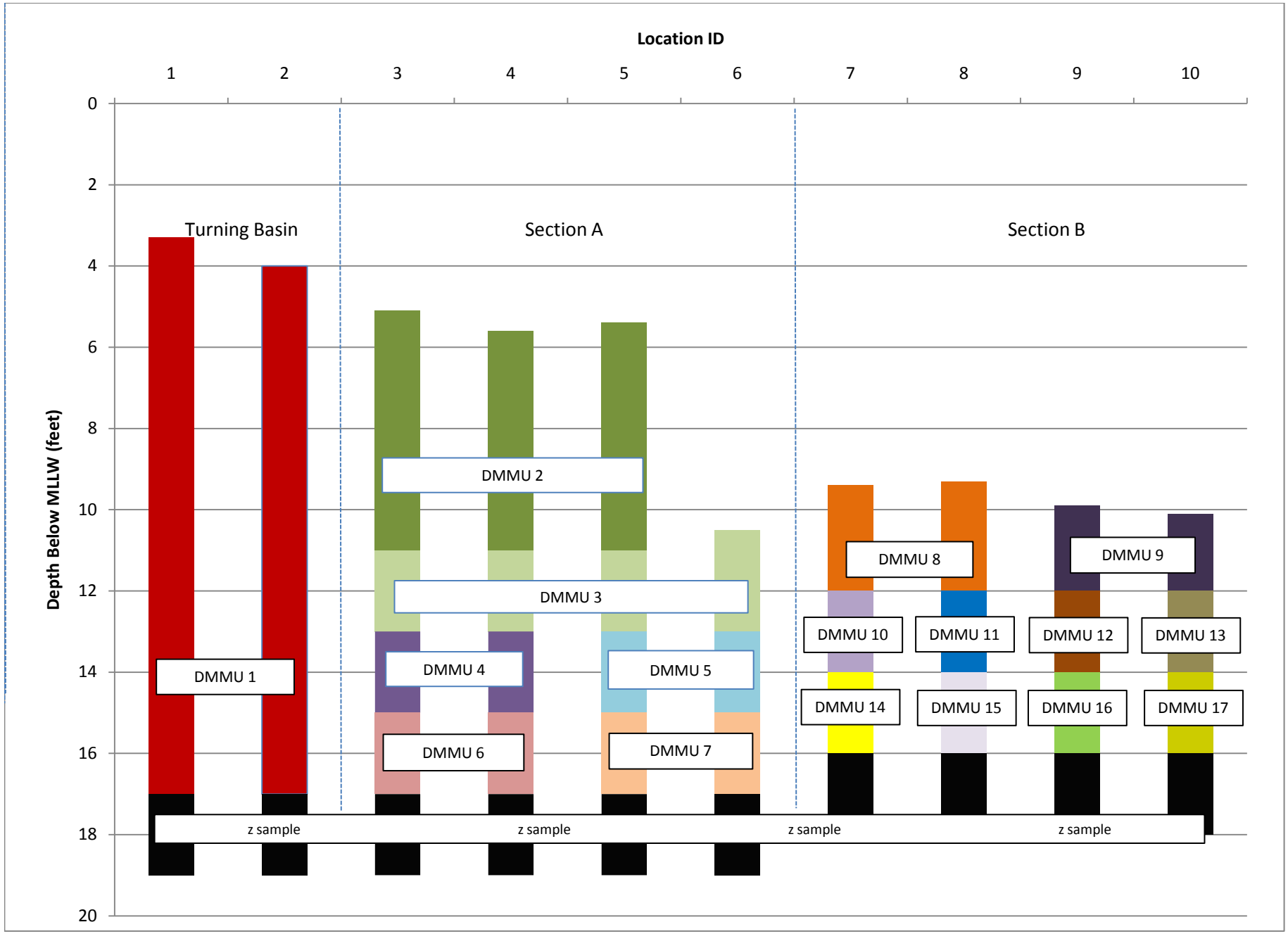

Figure 4. Sample Compositing Schematic

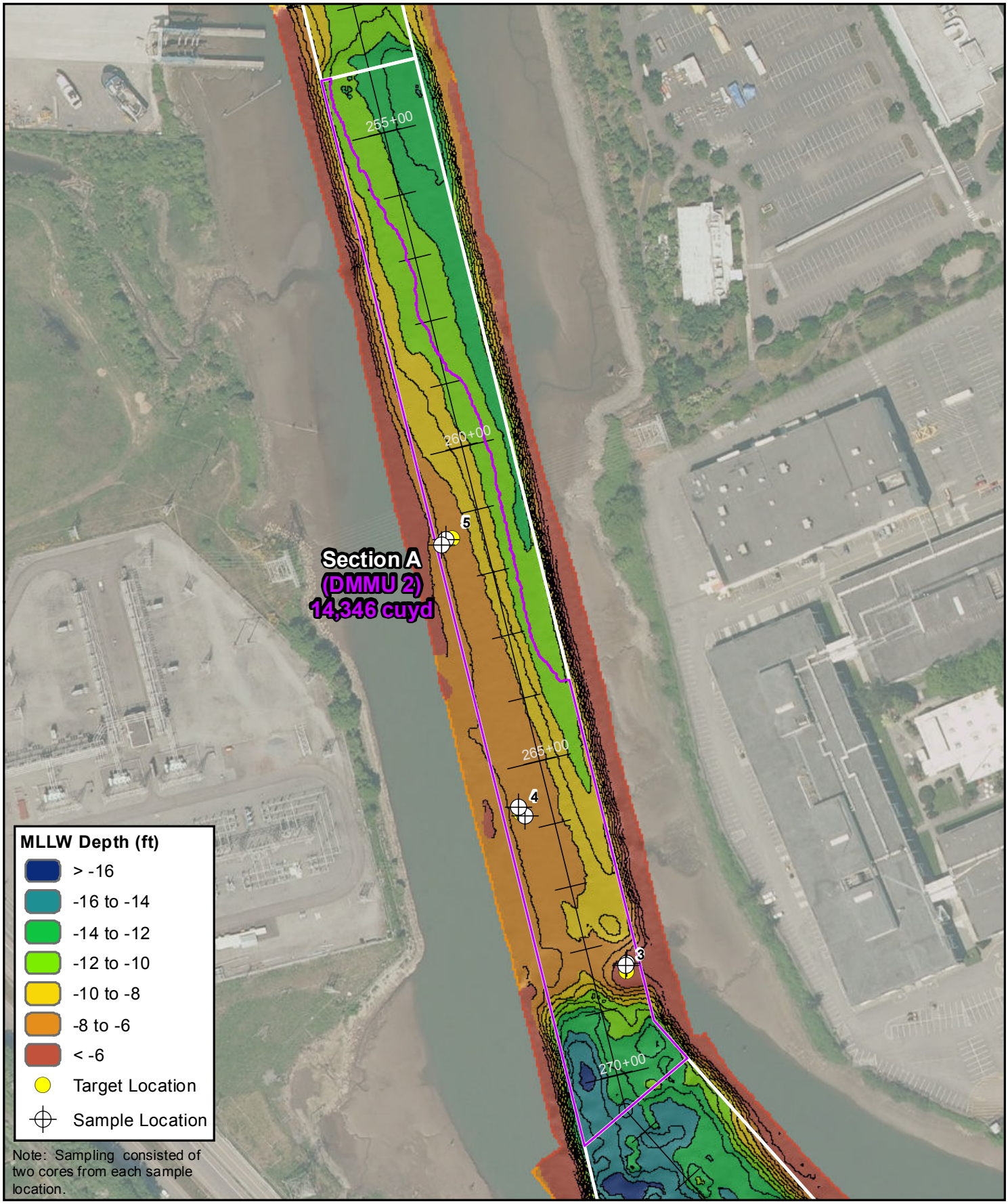

Figure 5. DMMU2 Target and Actual Sampling Locations

N

0 50 100 200 Feet

NEWFIELDS

J. Nuwer, June 2011

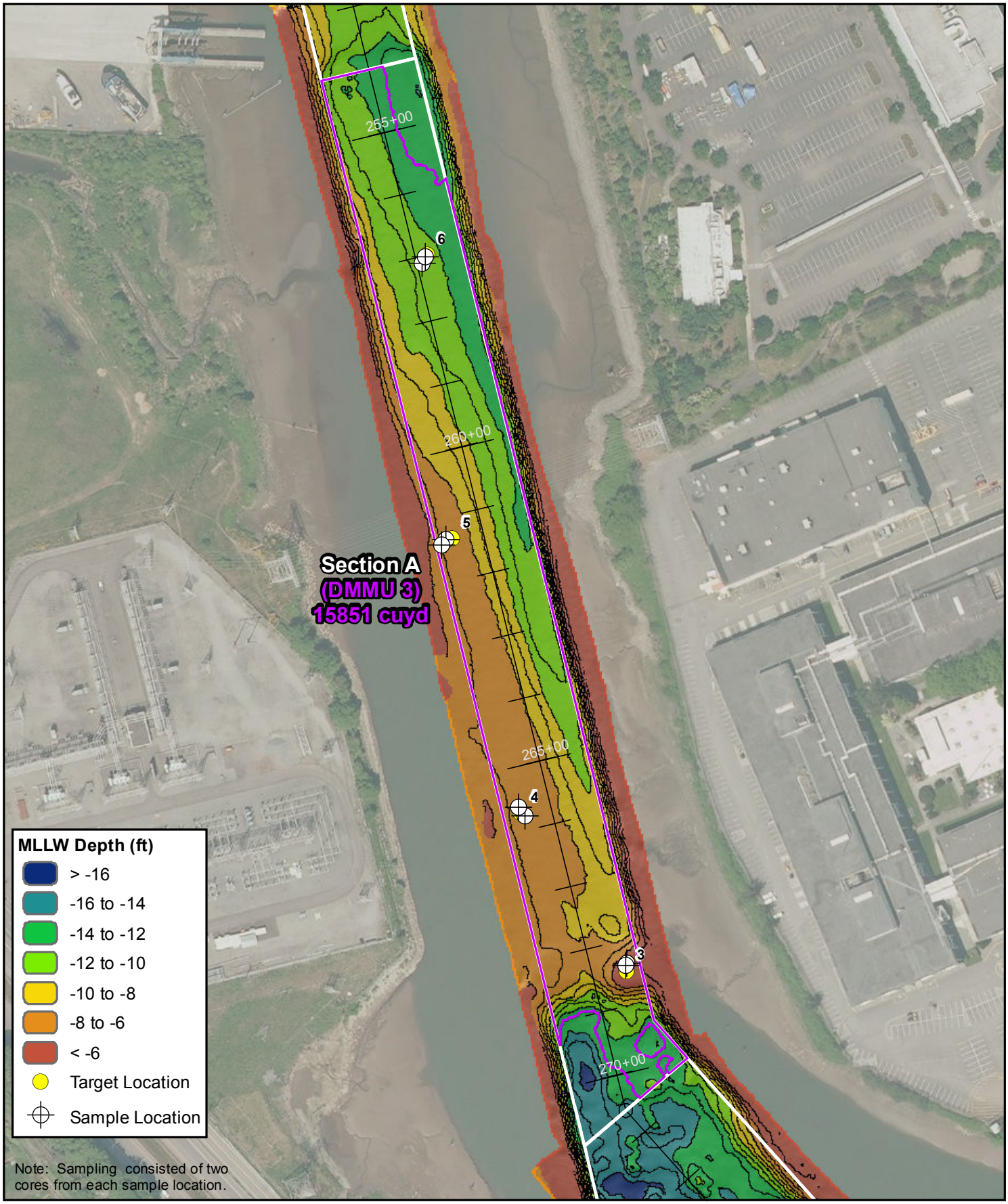

Figure 6. DMMU3 Target and Actual Sampling Locations

N

0 50 100 200 Feet

NEWFIELDS

J. Nuwer, June 2011

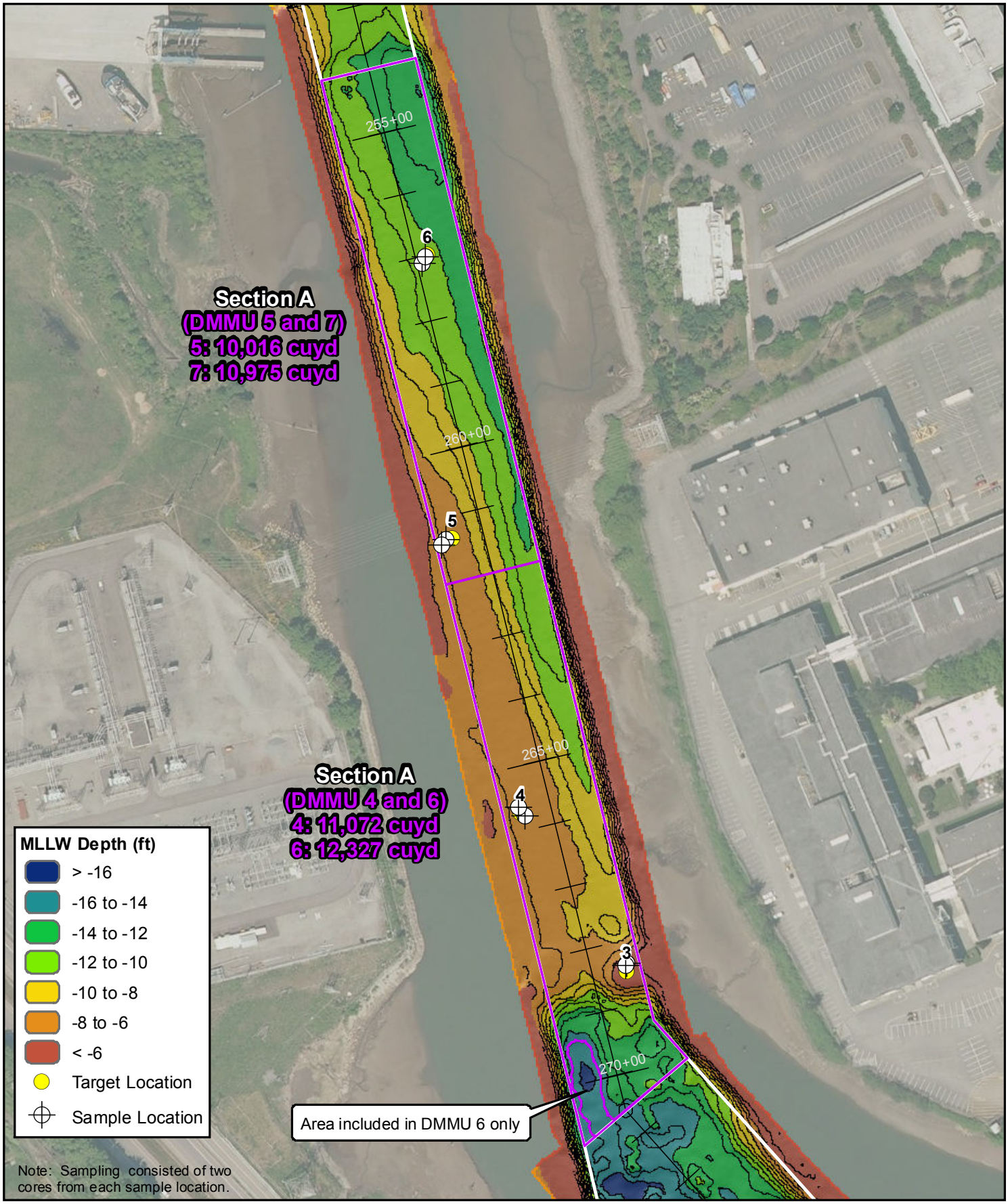

Figure 7. DMMU 4 through 7 Target and Actual Sampling Locations

N

0 50 100 200 Feet

NEWFIELDS

J. Nuwer, June 2011

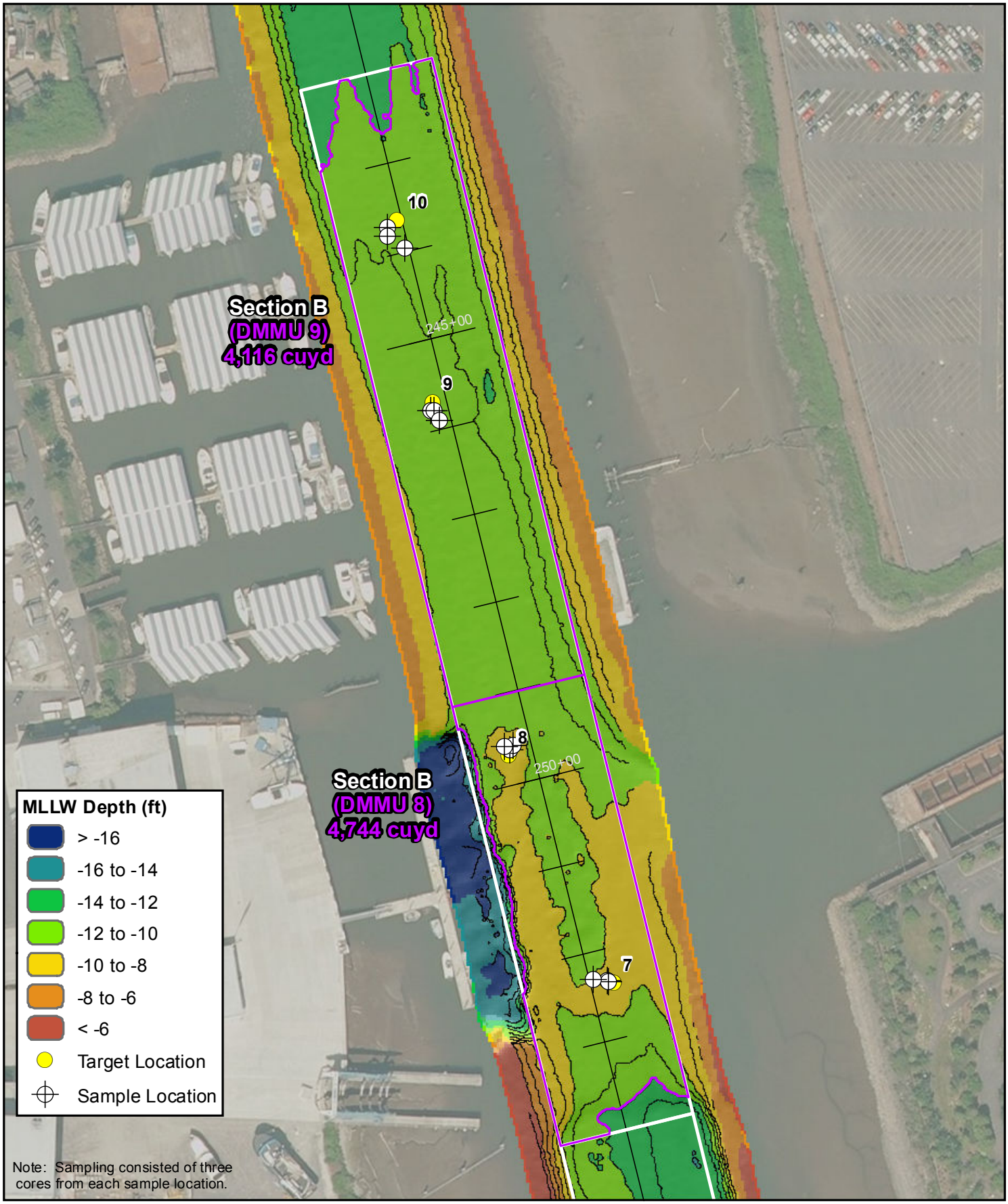

Figure 8. DMMU 8 and 9 Target and Actual Sampling Locations

N

0 50 100 200 Feet

NEWFIELDS

J. Nuwer, June 2011

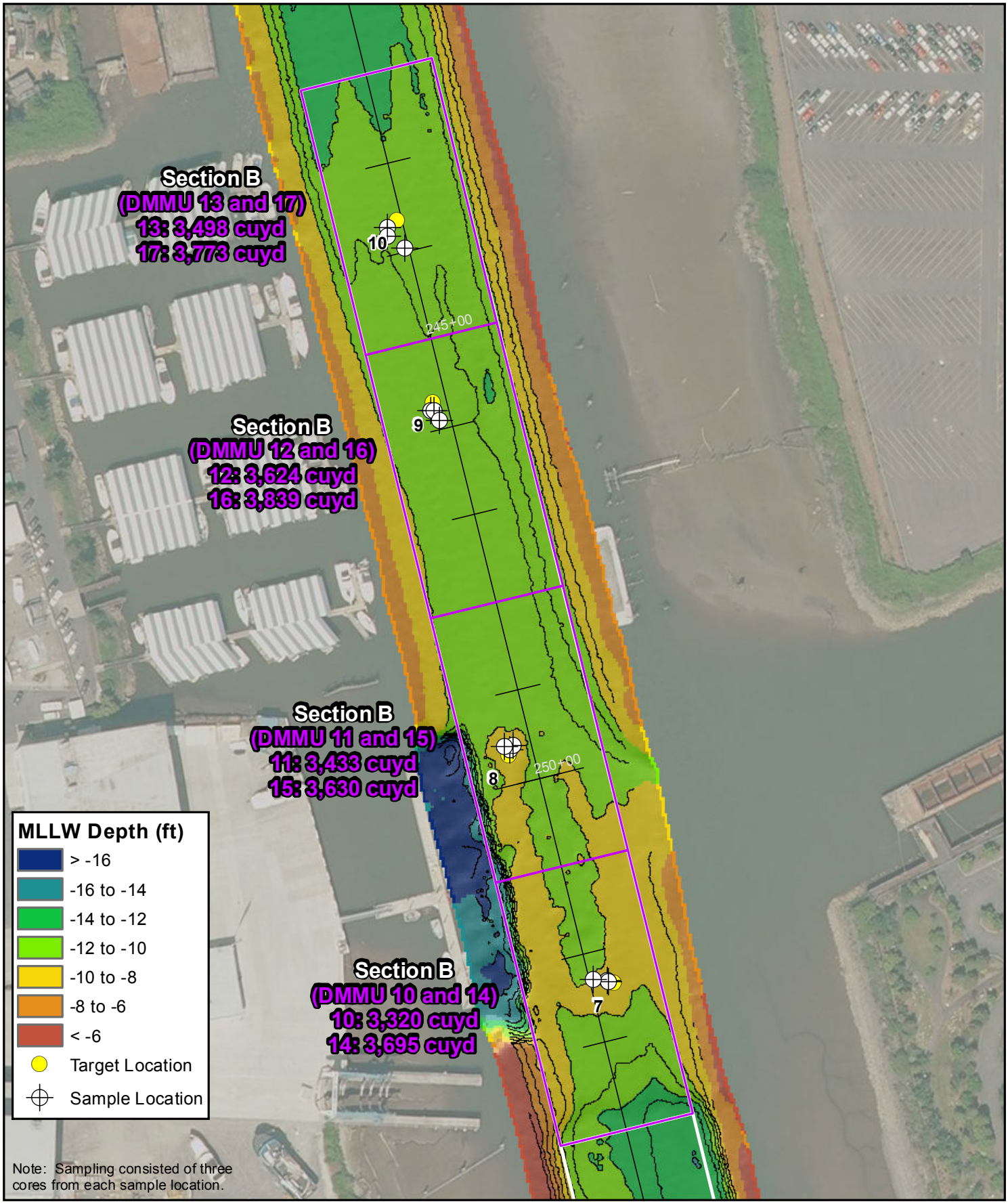

Figure 9. DMMU 10 through 17 Target and Actual Sampling Locations

N

0 50 100 200 Feet

NEWFIELDS

J. Nuwer, June 2011