CENWS-OD-TS-DMMO

MEMORANDUM FOR: RECORD November 28, 2012

SUBJECT: DMMP DETERMINATION REGARDING THE COMPLIANCE OF THE SEDIMENT SURFACE TO BE EXPOSED BY THE DREDGING OF DMMU 15 - PART OF THE DUWAMISH WATERWAY FEDERAL NAVIGATION PROJECT, SEATTLE, WASHINGTON (Public Notice CENWS-OD-TS-NS-39) - WITH THE WASHINGTON STATE ANTIDEGRADATION STANDARD.

1. Introduction. This memorandum reflects the consensus determination of the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers, Washington Department of Ecology, and the Environmental Protection Agency) regarding the compliance of sediment to be exposed by dredging of DMMU 15 with the Washington State Antidegradation Standard.

2. Background. In 2011, the Army Corps of Engineers conducted sediment testing for maintenance dredging of the Duwamish Waterway federal navigation channel (DMMP, 2011). See Figure 1 for a vicinity map. All dredged material management units (DMMUs), except one, were found suitable for open-water disposal and have already been dredged and disposed of at the DMMP open-water disposal site in Elliott Bay. The remaining management unit – DMMU 15 – failed bioassays and was found unsuitable for open-water disposal. This DMMU was left in place, with a 1-foot cover to prevent its exposure. The Corps of Engineers now plans to dredge DMMU 15 and the overlying sediment and dispose of this material in a Subtitle D landfill. However, before dredging may occur, the sediment surface that will be exposed by dredging must be assessed to ensure it meets the Washington State Antidegradation Standard (Ecology, 1995).

   The DMMP agencies implemented updated guidance in 2008 to facilitate antidegradation assessments (DMMP, 2008). These guidelines were used in assessing the material to be exposed by the dredging of DMMU 15.

3. Sampling and Testing Requirements. For this assessment, the DMMP agencies required the sampling and testing of the existing surface sediment (mudline to one foot below mudline) and the sediment directly underlying DMMU 15 (-16 to -17 feet MLLW). In the testing conducted in 2011, DMMU 15 had no exceedances of DMMP screening levels, but failed biological testing. Therefore, for the antidegradation assessment, chemical testing (other than sediment conventionals) was not required and the DMMP agencies agreed to use the results from biological testing only. The assessment was to be two-tiered. The bioassay results for the sediment to be exposed by dredging (also known as the z-layer) were to be compared to the sediment quality standards (SQS). For bioassay results not meeting SQS, the toxicity of the z-layer was to be directly compared to that of the existing surface sediment. See Table

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

Table 1. Project Summary

Proposed dredging volume	Approximately 6,000 cubic yards
Proposed disposal site	Roosevelt Regional Landfill
Project ranking	High
SAP received	July 17, 2012

SAP approved	August 6, 2012
Sampling dates	August 14, 2012
Data report submitted	November 28, 2012
DAIS Tracking number	DUW12-1-B-O-330
USACE Public Notice Number	CENWS-OD-TS-NS-39

4. Sediment Sampling. Sediment core samples were collected from five locations using a vibracore sampler (Figure 2). Sediment samples were taken from two depth intervals at each sampling station. Samples representing the existing surface were taken from the top foot of sediment and composited for analysis. Samples representing the sediment to be exposed by dredging were taken from the -16 to -17 foot (MLLW) stratum and composited for analysis. Table 2 includes the sampling data. A reference sediment sample for bioassay testing was collected from Carr Inlet (Table 3).

5. Sediment Conventional Analysis. Results of the sediment conventional analyses for the composited surface sample, z-sample and Carr Inlet reference sample are provided in Table 4. The surface and z-sample composites had similar physical characteristics. Both samples were principally fine-grained material (57.7% and 66.5% fines respectively). The total organic carbon (TOC) fractions were 2.7% and 2.4%. Sulfide was high in both samples, with concentrations of 1,490 mg/kg in the surface sample and 2,940 mg/kg in the z-sample.

   The Carr Inlet reference sample was not as good a match to the test samples as the field grain size results predicted, but the fines content was still within 20% of both test samples.

6. Bioassays. The standard suite of three bioassay tests (amphipod mortality, larval development, and polychaete growth) was performed. The negative controls and reference sediment met the DMMP performance criteria for all three bioassays. Except for minor exceptions, the quality control requirements for water chemistry and temperature were met. Reference toxicant results were all within laboratory control limits.

   Following are summaries of the bioassay results. The sediment quality standards for these tests can be found in Table 5.

   Amphipod Mortality. The amphipod bioassay was run using *Eohaustorius estuarius* as the test species. Test results are shown in Table 6. The test sediments both outperformed the reference sediment, thereby meeting SQS.

   Polychaete Growth. The juvenile polychaete growth test - using *Neanthes arenaceodentata* as the test species - was run with two endpoints, the dry-weight endpoint and the ash-free dry-weight endpoint. Results for these two endpoints are displayed in Tables 7 and 8 respectively. Both test sediments had individual growth rates for both endpoints that were greater than 70% of that of the reference. Therefore, both test sediments met SQS.

   Larval Development. The larval development bioassay - using *Mytilus galloprovincialis* - was also run with two endpoints. The standard termination protocol involves carefully decanting the overlying water at the end of the test so as not to disturb the sediment, while for the resuspension protocol the sediment and overlying water are thoroughly mixed at the end of the test and allowed to settle prior to

decanting. The results are shown in Tables 9 and 10 for the standard and resuspension protocols respectively.

In the standard test, normal survivorship in the surface sediment was less than 70% of reference and statistically different from reference; therefore, the surface sediment failed to meet SQS. In contrast, normal survivorship in the z-sample was greater than 70% of reference and was not statistically different from reference; therefore, the z-sample met SQS.

In the resuspension test, normal survivorship in both the surface sediment and z-sample was less than 70% of reference and statistically different from reference; therefore, both the surface sediment and z-sample failed to meet SQS for this endpoint.

With the z-sample failing to meet SQS in the resuspension test, a direct comparison of normal survivorship for the surface sediment and z-sample was made. Table 11 includes the results of that comparison. For both the standard and resuspension protocols, normal survivorship for the z-sample was statistically greater than for the surface sediment.

7. Antidegradation Determination. In summary, the z-sample met SQS for both the amphipod mortality bioassay and the juvenile polychaete growth test. In the larval development test, normal survivorship was statistically greater for the z-sample when compared to the surface sediment. Therefore, the DMMP agencies determined that the surface to be exposed by dredging meets the State of Washington antidegradation standard.

8. References.

DMMP, 2008. *Quality of Post-Dredge Sediment Surfaces (Updated)* – a 2008 Sediment Management Annual Review Meeting Clarification Paper. Prepared by David Fox, Erika Hoffman and Tom Gries for the Dredged Material Management Program. June 10, 2008.

DMMP, 2011. *Determination Regarding the Suitability of Federal Operation and Maintenance Dredged Material from the Duwamish River, Seattle, King County, Washington, Evaluated under Section 404 of the Clean Water Act for Beneficial Use or Unconfined Open-Water Disposal at the Elliott Bay Nondispersive Site.* Prepared by the Dredged Material Management Office for the Dredged Material Management Program. July 22, 2011.

Ecology, 1995. *Sediment Management Standards – Chapter 173-204 WAC*. Washington State Department of Ecology, December 1995.

SEE, 2011a. *Sampling and Analysis Plan, Lower Duwamish Waterway – Dredged Material Management Unit 15 Sediment Sampling and Antidegradation Testing, Seattle, Washington.*
Prepared for the US Army Corps of Engineers, Seattle District by Science and Engineering for the Environment, Seattle, Washington. August 12, 2012.

SEE, 2011b. *Data Report, Lower Duwamish Waterway – Dredged Material Management Unit 15 Sediment Sampling and Antidegradation Testing, Seattle, Washington.*
Prepared for the US Army Corps of Engineers, Seattle District by Science and Engineering for the Environment, Seattle, Washington. November 28, 2012.

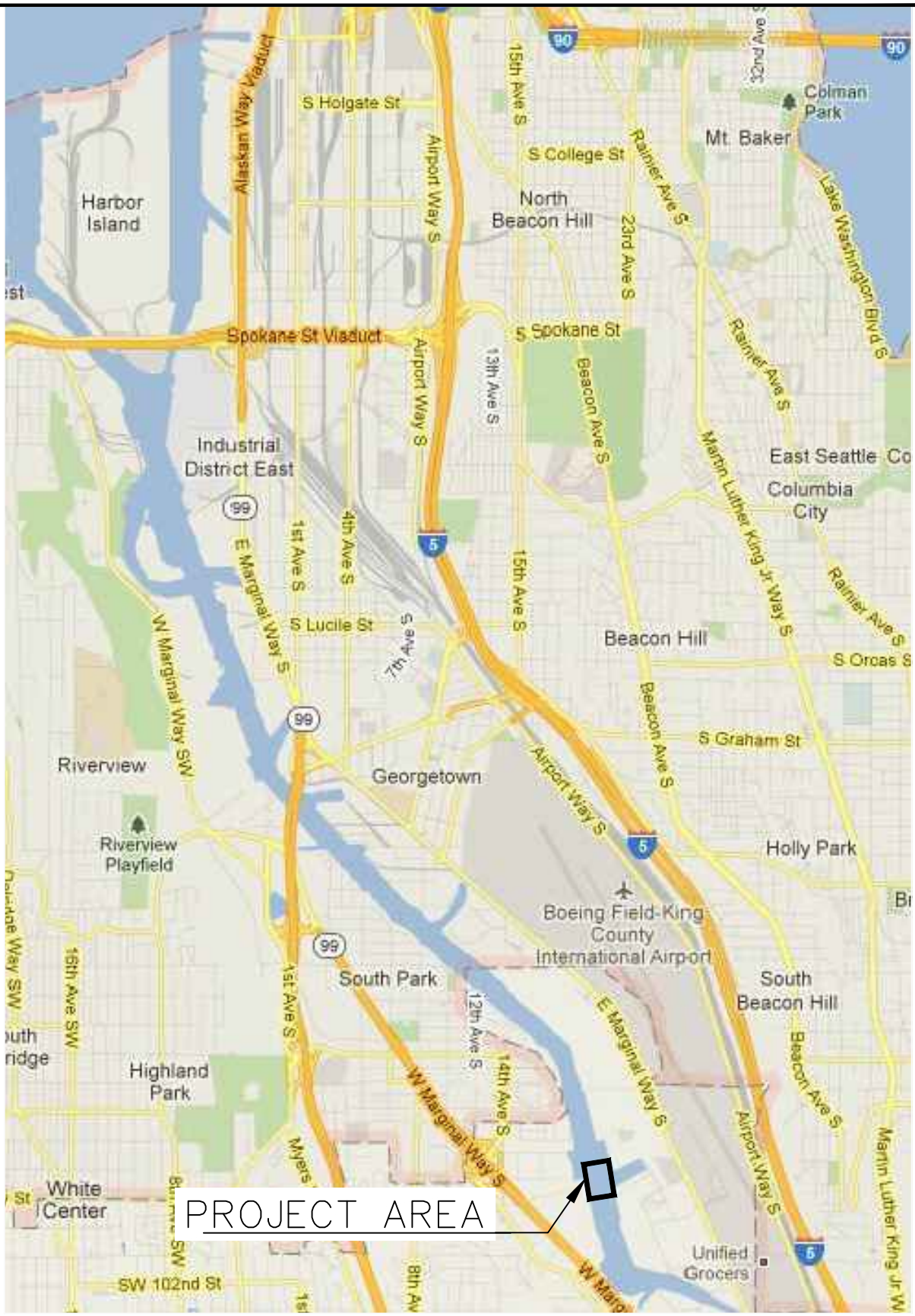
Concur:

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

_____	_____
Date	David Fox, P.E. - Seattle District Corps of Engineers
_____	_____
Date	Erika Hoffman - Environmental Protection Agency
_____	_____
Date	Laura Inouye, PhD - Washington Department of Ecology
_____	_____
Date	Celia Barton - Washington Department of Natural Resources

Copies furnished:

DMMP Signatories
John Hicks, Corps Navigation Section
DMMO file



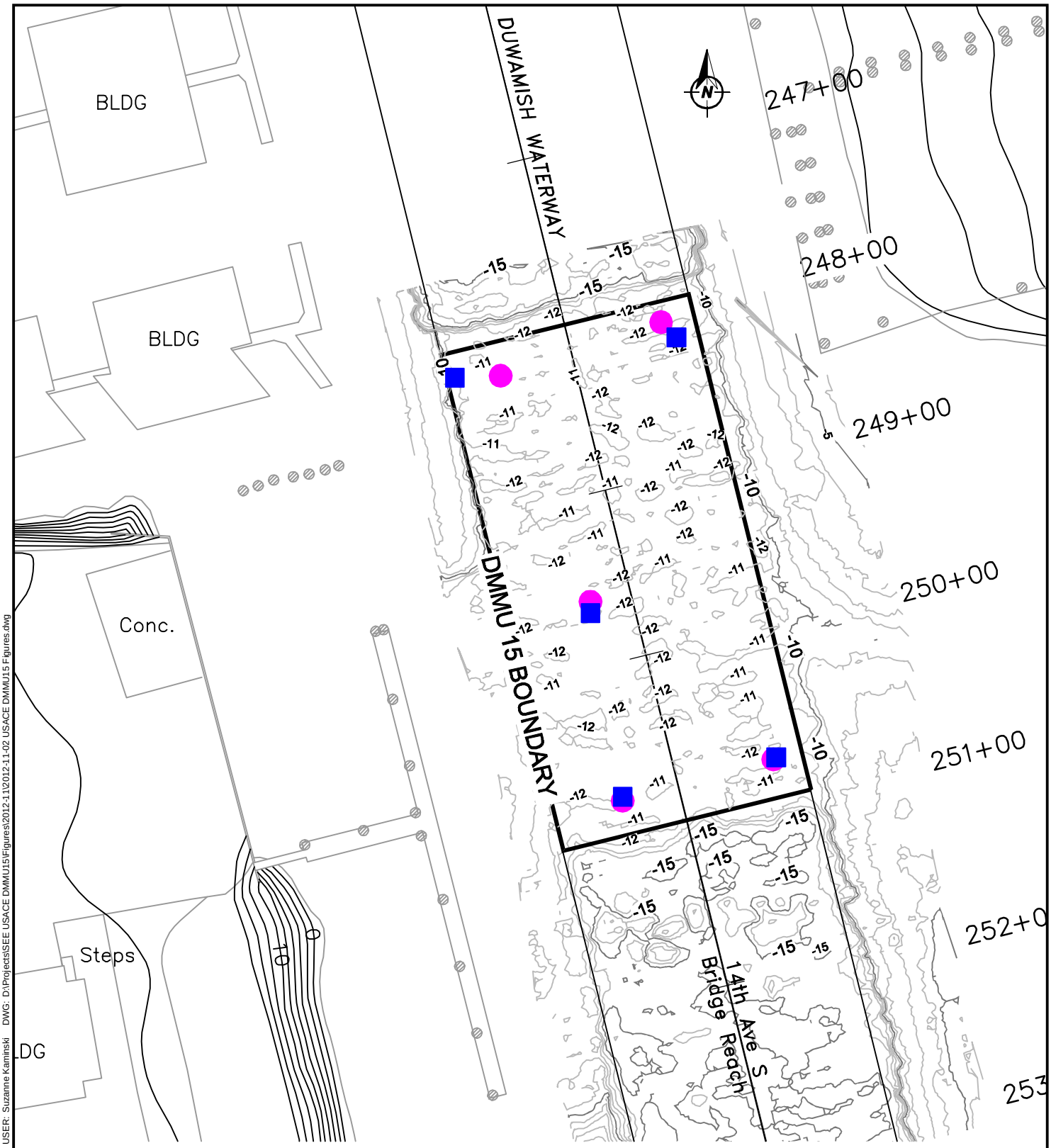
NOT TO SCALE

USACE

LDW Vicinity Map
Dredged Material Mangement Unit 15

Figure 1

JULY 16, 2012



NOTE:

1. HYDROGRAPHIC CONTOURS GENERATED FROM USACE SURVEY DATED 1 APR 2012.
2. ACTUAL SAMPLE LOCATIONS FROM MARINE SAMPLING SERVICES, DATA COLLECTED 08/14/2012.

USACE

DMMU 15 Actual Coring Locations

Figure **2**

November 02, 2012

PLOT TIME: 11/2/2012 8:13 PM MOD TIME: 11/2/2012 8:12 PM USER: Suzanne Kaminski DWG: D:\Projects\SEE USACE DMMU15\Figures\2012-11\2012-11-02 USACE DMMU15 Figures.dwg

Table 2. DMMU 15 Sampling Data (from SEE, 2012b)

Core	Latitude (North)	Longitude (West)	Measured Mudline (ft)	Tide Height (ft MLLW)	Tide Time	Station Elevation (ft MLLW)	Penetration (ft)	Final Hole Depth (ft MLLW)	Acquisition (ft)	Percent Recovery
1	47.518543	-122.306468	-15.1	1.7	11:32:00 AM	-13.4	7.0	-20.4	6.5	92.8
2	47.518918	-122.306802	-14.4	1.3	11:14:00 AM	-13.1	7.0	-20.1	6.5	92.8
3	47.518990	-122.306277	-13.3	0.3	10:20:00 AM	-13.1	7.0	-20.1	6.5	92.8
4	47.518317	-122.306020	-15.8	3.3	12:22:00 PM	-12.5	7.0	-19.5	6.8	97.1
5	47.518248	-122.306383	-16.0	2.4	11:55:00 AM	-12.6	7.0	-18.7	6.1	87.1

Note:
Station Coordinates in NAD 1983
ft = feet; MLLW = mean lower low water

Table 3. Reference Sediment Location and 2012 Physical Characteristics (from SEE, 2012b)

Sample	Latitude (North)	Longitude (West)	Field Grain Size % Fines	Measured Grain Size % Fines	Measured TOC%
DMMU 15 Surface Composite	—	—	68	57.7	2.71
DMMU 15 Z-sample Composite	—	—	69	66.5	2.42
CR24	47.334395	-122.830323	65	76.4	1.05

Note:
Station Coordinates in NAD 1983
CR24 = Carr Inlet Station 24; DMMU = Dredged Material Management Unit; N = north; TOC = total organic carbon; W = west

Table 4. Results of Conventional Analyses (from SEE, 2012b)

Conventionals	DMMU 15 Surface		DMMU 15 Z-Layer		CR24-Reference	
	Value	Q	Value	Q	Value	Q
Total Solids (%)	50.1		56.1		54.8	
Total Volatile Solids (%)	7.6		7.3		3.7	
N-Ammonia (mg-N/kg)	40.4		77.3		5.6	
Sulfide (mg/kg)	1490		2940		247	
Total Organic Carbon (%)	2.7		2.4		1.1	
Gravel (%)	0.1		0.1		0.1	
Sand (%)	42.1		33.4		23.7	
Silt (%)	47.1		54.4		66.3	
Clay (%)	10.6		12.1		10.1	

Table 5. Sediment Quality Standards (Ecology, 1995)

Bioassay	SQS
Amphipod Mortality	The test sediment has a higher (statistically significant, t-test, p=0.05) mean mortality than the reference sediment and the test sediment mean mortality exceeds twenty-five percent, on an absolute basis.
Juvenile Polychaete Growth	The test sediment has a mean individual growth rate of less than seventy percent of the reference sediment mean individual growth rate and the test sediment mean individual growth rate is statistically different (t-test, p=0.05) from the reference sediment mean individual growth rate.
Larval Development	The test sediment has a mean survivorship of normal larvae that is less (statistically significant, t-test, p=0.05) than the mean normal survivorship in the reference sediment and the test sediment mean normal survivorship is less than eighty-five percent of the mean normal survivorship in the reference sediment (i.e., the test sediment has a mean combined abnormality and mortality that is greater than fifteen percent relative to time-final in the reference sediment).

Table 6. Amphipod Mortality Test Results

Station	% Mortality	Interpretation
SW Control	1	---
CR24	5	---
Surface Sediment	4	meets SQS
Z-Sample	4	meets SQS

Table 7. Juvenile Polychaete Growth Test Results – Dry-Weight Protocol

Station	Mean Individual Growth Rate (mg/d)	% Test Growth Rate Relative to Reference	Interpretation
SW Control	0.85	---	---
CR24	0.84	---	---
Surface Sediment	0.72	85.7	meets SQS
Z-Sample	0.77	91.7	meets SQS

Table 8. Juvenile Polychaete Growth Test Results – Ash-Free Dry-Weight Protocol

Station	Mean Individual Growth Rate (mg/d)	% Test Growth Rate Relative to Reference	Interpretation
SW Control	0.65	---	---
CR24	0.68	---	---
Surface Sediment	0.62	91.2	meets SQS
Z-Sample	0.65	95.6	meets SQS

Table 9. Larval Development Test Results – Standard Protocol

Station	Mean Number Normal Larvae	% Test Normal Survivors Relative to Reference	Statistically less than reference (p = 0.5)?	Interpretation
SW Control	261.4	---	---	---
CR24	178.4	---	---	---
Surface Sediment	116.0	65.0	yes	does not meet SQS
Z-Sample	161.6	90.6	no	meets SQS

NA = not applicable

Table 10. Larval Development Test Results – Resuspension Protocol

Station	Mean Number Normal Larvae	% Test Normal Survivors Relative to Reference	Statistically less than reference (p = 0.5)?	Interpretation
SW Control	261.2	---	---	---
CR24	200.8	---	---	---
Surface Sediment	111.2	55.4	yes	does not meet SQS
Z-Sample	164.6	82.0	yes	does not meet SQS

Table 11. Larval Development Test – Comparison of Z-sample to Surface Sediment

Station	Mean Number Normal Larvae Surface Sediment	Mean Number Normal Larvae Z-Sample	Results of Statistical Comparison	Interpretation
Standard Protocol	116.0	161.6	Normal survivorship in the z-sample statistically greater than in the surface sediment	z-sample meets antidegradation standard
Resuspension Protocol	111.2	164.6	Normal survivorship in the z-sample statistically greater than in the surface sediment	z-sample meets antidegradation standard