CENWP-EC-HR December 2, 2013

**Memorandum for:** Portland District, Operations Division, Regulatory Branch (LaDouceur)

**Subject:** Portland Sediment Evaluation Team (PSET) review of the July 19, 2013 revised *Preliminary Data Review Port of St. Helens* (SCR), and supplemental information submittals received from Northern Resources Consulting (NRC) up to September 25, 2013. The proposed dredging project is located in Scappoose Bay, near Columbia River Mile (RM) 88.5, St. Helens, Columbia County, Oregon.

**Reviewers:** The Portland Sediment Evaluation Team (PSET) includes the US Army Corps of Engineers (Corps), Environmental Protection Agency (EPA), National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife (USFWS), Washington Department of Ecology (Ecology), and Oregon Department of Environmental Quality (ODEQ). The reviewers included James McMillan and James Holm (Corps), Pete Anderson (ODEQ), Laura Inouye (Ecology), Jeff Lockwood (NMFS), Jonathan Freedman (EPA), and Bridgette Lohrman (EPA). USFWS did not review the document.

This memorandum documents the consensus of the reviewing agencies regarding the usability of the Port's sediment quality data and the suitability of the dredge prism material and new surface material (NSM) for unconfined, aquatic exposure per the 2009 *Sediment Evaluation Framework for the Pacific Northwest* (2009 SEF).

Review Summary: The sediment sampling and analysis plan (SAP) for the project was received on March 25, 2013, from the Port's contractor, NRC. The PSET provided comments on this version of the SAP to NRC on April 25, 2013. The SAP was revised by NRC, and the SAP (Revision C) was resubmitted to the PSET on May 3, 2013; the PSET approved the SAP (with proposed modifications) on May 31, 2013. Three dredged material management units (DMMUs) were approved for sampling: two marina DMMUs and one access channel DMMU. NSM sampling was also planned.

The Corps received the SCR from NRC on July 19, 2013. Preliminary results indicated that zinc and arsenic were above the SEF screening levels in the channel NSM composite sample; polychlorinated biphenyls (PCB Aroclors) concentrations increased with depth in the access channel, i.e, the NSM had higher concentrations than the dredge prism. However, core logs were not provided with the SCR.

On the PSET's July 24, 2013 conference call, the Port and NRC discussed the preliminary results and analysis of the archived dredge prism and NSM samples from the channel. The PSET requested that the core logs be provided prior to analyzing the archived channel subsamples. The subsamples were analyzed by the lab on July 31-August 1, 2013, even though the PSET had not received the core logs.

Results from the archived NSM subsamples (from the access channel) were submitted to the PSET on August 30, 2013. However, the PSET could not interpret the results without the core logs. Core logs were provided to the PSET on September 4, 2013, without vertical corrections (to National Geodetic Vertical Datum 1929). Additionally, the vertical division between the dredge prism and NSM subsamples were not recorded in the core logs. The corrected core logs were received by the PSET on September 25, 2013, enabling the PSET to proceed with the project review. The subsequent federal government shutdown delayed the review through the first half of October. After the shutdown, it became evident to the PSET that cores were not taken from the appropriate depths (as described in the SAP). The PSET had to carefully examine all eight core logs and evaluate the usability of the data from the incorrectly collected samples and subsamples.

**Project Authorities:** Section 10 of the Rivers and Harbors Act; Sections 401 and 404 of the Clean Water Act; Section 7 of the Endangered Species Act; Section 305 of the Magnuson-Stevens Act; et al.

**Project Description:** The Port is seeking permission to dredge their public marina and access channel, located in Scappoose Bay (Figures 1-3). Approximately 61,000 cubic yards (cy) would be dredged from the 6.25-acre marina, to a depth of -7 feet National Geodetic Vertical Datum 1929 (NGVD29). Approximately 42,000 cy would be dredged from the 9.64-acre access channel, to a depth of -5 feet NGVD29. Shoaling in the marina and access channel are impeding navigation and moorage opportunities. The proposed action also includes maintenance dredging up to 255,000 cy over the life of the 10-year permit (including the initially proposed amount).

Dredging Methods: The proposed dredging will be completed with a mechanical dredge and dump scows, a hydraulic dredge and booster pump system, or a combination of the two.

Dredged Material Transport and Placement: Material determined suitable for unconfined, aquatic placement would be placed in the Columbia River flow lane over a period of 20 to 30 dredging days.

**Management Area Ranking/Recency**: In the SAP, multiple, potential sources of contamination were identified in or near the project area. Current recreational boating may also contribute contaminants to sediments in the project area. Per the SEF guidance, a "moderate" management area ranking was assigned to the site.

However, after reviewing the results of the June 19-20, 2013 sampling event, the PSET has determined that a "high" management area ranking is appropriate for the east part of the marina access channel, downstream of sample station SB-C-2 (Figure 3).

**Sampling and Analysis Description:** NRC split the project into three dredged material management units (DMMUs) for sampling (Figures 1-3). NRC used a 3-inch outer diameter vibracore sampler to collect the sediment samples. The compositing scheme and the proposed versus actual sediment sampling sampling depths appear in Table 1. The project was sampled on June 19-20, 2013.

Marina: The marina was split into two equal-volume DMMUs (DMMUs 1 and 2; Figures 1 and 2). The planned dredge prism sample interval extends from the mudline to -7 feet NGVD29; the planned NSM sample interval in the marina extends from -7 to -9 feet NGVD29.

Two cores per DMMU were collected. Dredge prism material and NSM subsamples within each DMMU were composited separately for a total of two dredge prism and two NSM samples for the marina. The NSM and dredge prism subsamples were archived for future analysis, pending the composite sample results.

The core logs provided by NRC on September 25, 2013, indicate that the SAP was not followed. Both the dredge prism and NSM subsamples were collected from the wrong depths. The following issues were observed with the Port's marina sediment samples:

- Only one dredge prism subsample (SB-M-2-A), of four dredge prism subsamples captured the complete interval of sediment proposed in the SAP (Table 1; Figures 4 and 5).
- Three of the 4 NSM subsamples were 1 foot thick (a 2-foot thick sample was proposed in the SAP), and none of the NSM subsamples included the complete interval of material from -7 to -9 feet NGVD29.
- In one instance (core SB-M-1), the core barrel never penetrated into the NSM interval; the NSM sample from this core was composed entirely of dredge prism material.

| Table 1. Port of St. Helens Sediment Sampling Summary and Sample Usability Review (Sampled June 19-20, 2013). | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Core Sampling Summary | | | | | Laboratory Analytical Sample ID and Data Usability | |
| **DMMU** | **Core ID (Core Length [ft.])** | **DP/NSM Subsample ID** | **Proposed Sampling Interval (ft. NGVD29)** | **Actual Sampling Interval (ft. NGVD29)** | **Subsample Notes** | **DP/NSM Analytical Sample ID** | **Data Usability** |
| ***Marina*** | | | | | | | |
| DMMU1 | SB-M-1 (4.0) | SB-M-1-A | mudline to -7 | -2.1 to -5.1 | Incomplete dredge prism sample | Dredge Prism: **SB-M-1 Comp** (Subsamples 1-A + 2-A) | SB-M-1 Comp used for dredge prism suitability. |
| | | SB-M-1-Z | -7 to -9 | -5.1 to -6.1 | "NSM" subsample entirely composed of dredge prism material | | |
| | SB-M-2 (4.5) | SB-M-2-A | mudline to -7 | -3.5 to -7.0 | Dredge prism sampled to correct depth | NSM: **SB-M-Z1 Comp** (Subsamples 1-Z + 2-Z) | SB-M-Z1 Comp included dredge prism material and NSM material. Data from SB-M-Z1 Comp used for the NSM evaluation and Oregon's anti-degradation evaluation. |
| | | SB-M-2-Z | -7 to -9 | -7.0 to -8.0 | Incomplete NSM sample; 1-ft. NSM subsample | | |
| DMMU2 | SB-M-3 (8.5 [bottom 0.5 ft. discarded]) | SB-M-3-A | mudline to -7 | -1.9 to -7.9 | Dredge prism sample extends 0.9 ft. into NSM interval | Dredge Prism: **SB-M-2 Comp** (Subsamples 3-A + 4-A) | Used for dredge prism and NSM suitability. Dredge prism composite included dredge prism material, NSM material, and material from beneath the NSM. |
| | | SB-M-3-Z | -7 to -9 | -7.9 to -9.9 | NSM sample extends 0.9 ft. below NSM interval | | |
| | SB-M-4 (6.0) | SB-M-4-A | mudline to -7 | -4.4 to -9.4 | Sample includes dredge prism + 2 ft. of NSM interval + 0.4 ft. of material from below the NSM interval | NSM: **SB-M-Z2 Comp** (Subsamples 3-Z + 4-Z) | NSM composite included NSM material and material from beneath the NSM. PSET used the dredge prism sample to determine NSM suitability. Data from SB-M-Z2 Comp used for Oregon's anti-degradation evaluation. |
| | | SB-M-4-Z | -7 to -9 | -9.4 to -10.4 | "NSM" sample 0.4 to 1.4 ft. below the NSM interval; material sampled entirely below the dredge limit | | |

| Table 1. Port of St. Helens Sediment Sampling Summary and Sample Usability Review (Sampled June 19-20, 2013). | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Core Sampling Summary | | | | | Laboratory Analytical Sample ID and Data Usability | | |
| **DMMU** | **Core ID (Core Length [ft.])** | **DP/NSM Subsample ID** | **Proposed Sampling Interval (ft. NGVD29)** | **Actual Sampling Interval (ft. NGVD29)** | **Subsample Notes** | **DP/NSM Analytical Sample ID** | | **Data Usability** |
| ***Access Channel*** | | | | | | | | |
| DMMU3 | SB-C-1 (3.0) | SB-C-1-A | mudline to -5 | -4.8 to -5.8 | Dredge prism sample extends 0.8 ft. into NSM | Dredge Prism: **SB-C-1 Comp** (Subsamples 1-A + 2-A + 3-A + 4-A) | | Used dredge prism composite data for dredge prism suitability at stations SB-C-1 and SB-C-2. Used dredge prism composite data and archived NSM sample data to assess dredge prism suitability at stations SB-C-3 and SB-C-4. |
| | | SB-C-1-Z* | -5 to -7 | -5.8 to -7.8 | NSM subsample extends 0.8 ft. below NSM interval | | | |
| | SB-C-2 (7.5** [bottom 1.5 ft. discarded]) | SB-C-2-A | mudline to -5 | -1.5 to -4.5 | Subsample composed entirely of dredge prism material | | | |
| | | SB-C-2-Z* | -5 to -7 | -4.5 to -6.5 | NSM subsample includes 0.5 ft. of dredge prism material | | | |
| | SB-C-3 (6.0) | SB-C-3-A | mudline to -5 | -0.6 to -3.6 | Subsample does not include entire dredge prism | NSM: **SB-C-Z1 Comp** (Subsamples 1-Z + 2-Z+ 3-Z+ 4-Z) | **SB-C-1Z*** | SB-C-1Z mostly composed of NSM material. Used for NSM suitability and Oregon anti-degradation evaluation. |
| | | SB-C-3-Z* | -5 to -7 | -3.6 to -6.6 | NSM sample includes 1.4 ft. dredge prism and 1.6 ft. of NSM material | | **SB-C-2Z*** | SB-C-2Z mostly composed of NSM material. Used for NSM suitability and Oregon anti-degradation evaluation. |
| | SB-C-4 (5.0) | SB-C-4-A | mudline to -5 | -0.1 to -2.1 | Incomplete subsample does not include entire dredge prism | | **SB-C-3Z*** | SB-C-3Z composed of both dredge prism and NSM material. Used for dredge prism and NSM suitability; used for Oregon anti-degradation evaluation. |
| | | SB-C-4-Z* | -5 to -7 | -2.1 to -5.1 | Incomplete NSM sample contains 2.9 ft. of dredge prism material and 0.1 ft. of NSM material | | **SB-C-4Z*** | SB-C-4Z mostly composed of dredge prism material. Sample cannot be used for NSM evaluation or Oregon's anti-degradation evaluation. **Post-dredge grab sample and full suite chemical analysis required at station SB-C-4.** |

* - Archived sample analyzed

** - The SB-C-2 core log indicates the recovered core length was 7.5 ft. However, the vertically corrected strata account for only 6.5 ft. of material.

Access Channel: The access channel was designated as a single DMMU (DMMU 3; Figure 3). Within the access channel, the planned dredge prism sample interval extended from the mudline to -5 feet NGVD29; the NSM sample interval extended from -5 to -7 feet NGVD29. Four cores were collected along the length of the access channel. Dredge prism material subsamples from each of the four cores were composited into a single dredge prism composite sample for laboratory analysis. Similarly, four NSM subsamples were also composited into a single NSM composite sample. The individual NSM and dredge prism subsamples were archived for future analysis, pending the composite sample results.

The core logs provided by NRC on September 25, 2013, indicate that the SAP was not followed. Both the dredge prism and NSM subsamples from the access channel were collected from the wrong depths. The following issues were observed with the Port's access channel sediment samples:

- Dredge prism and NSM subsamples were not collected from the intervals proposed in the SAP (Table 1, Figure 6).
- NSM subsamples were either 2 or 3 feet thick, none of the NSM subsamples included the complete interval of material from -5 to -7 feet NGVD29, and each NSM subsample also contained material from the dredge prism or below the NSM interval.
- NSM subsample SB-C-3Z was composed of nearly equal parts dredge prism material and NSM material.
- Core SB-C-4 only penetrated 0.1 foot into the NSM; subsample SB-C-4Z was mostly composed of dredge prism material.

Laboratory Analyses: The contract laboratory (Apex) analyzed the dredge prism and NSM composite samples for the following parameters:

- Conventional parameters (total organic carbon [TOC], total solids, ammonia, sulfides, and grain size)
- SEF Full Suite:
    - Metals (Ag, As, Cd, Cr, Cu, Ni, Pb, Sb, Zn & Hg) by methods 6010/6020/7471
    - Semi-volatile compounds (SVOCs), including polynuclear aromatic hydrocarbons (PAHs) by method 8270
    - Pesticides by method 8081
    - Polychlorinated biphenyls (PCBs) by method 8082
- SEF Chemicals of Special Occurrence: Petroleum hydrocarbons by method NWTPH-Dx/Rx

The access channel NSM composite sample exceeded the freshwater benthic toxicity screening levels for arsenic and zinc. The contract laboratory analyzed the archived NSM samples from the access channel (samples SB-C-1Z to -4Z) for the following parameters:

- Total Solids
- Arsenic
- Zinc
- PCBs

**Results:** The chemical testing results were compared to the 2006 SEF freshwater benthic toxicity screening levels (SLs) when samples were determined to be usable (per Table 1). PCBs were compared to the freshwater fish screening level value published in ODEQ's 2007 *Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment*. Additional characterization will be required in locations where the PSET determined samples were not usable. Sediment chemistry results for the usable samples are briefly summarized below. Arsenic, zinc, and PCBs results appear in Table 2 (under "Suitability Determination").

Marina (Composite Samples): Dredge prism material in the marina is fine-grained; fines (silt + clay) were >90% in both DMMUs. TOC ranged from 0.44 to 2.0%. Heavy metals concentrations were well below the SLs in both DMMUs. SVOCs concentrations, including PAHs were below the SEF SLs as well. Pesticides were not detected in any of the marina samples. PCBs were detected in DMMU 1 (SB-M-1 Comp = 10.8 ppb; SL = 60 ppb total Aroclors) but were not detected in the DMMU 2 composite sample. PCBs were detected below the SL in the NSM composite samples (SB-M-Z1 = 10.3ppb; SB-M-Z2 = 12.1 ppb). Archived material from the marina was not analyzed.

Access Channel (Composite Samples): Dredge prism material in the access channel is also fine-grained; the silt + clay fraction was >90% in DMMU 3. TOC was 2.8% in the dredge prism composite sample and 3.3% in the NSM composite.

Heavy metals concentrations were below the SLs in the dredge prism composite sample. However, arsenic and zinc exceeded their respective toxicity screening levels in the NSM composite sample (As = **63.0 ppm**, As SL = 20 ppm; **Zn = 149 ppm**, Zn SL = 130 ppm). SVOCs, including PAHs were all below the SEF SLs. Pesticides were not detected in either of the access channel composite samples. PCBs were detected in the dredge prism composite sample (SB-C-1 Comp = 10.6 ppb) and in the NSM composite sample (SB-C-Z1 Comp = 34.6 ppb).

Access Channel (Archived NSM Samples): The archived NSM samples were analyzed for total solids, zinc, arsenic, and PCB Aroclors. As discussed earlier, NSM sample SB-C-3Z contained approximately equal portions of dredge prism material and NSM, and NSM sample SB-C-4Z contained only 0.1 ft. of NSM sediment; the remainder of the sample was composed of dredge prism material (Table 1; Figure 3).

Sample SB-C-4Z exceeded the SLs for arsenic (As = **203 ppm**; As SL = 20 ppm) and zinc (**203 ppm**; Zn SL = 130 ppm). The other archived samples from the channel (samples SB-C-1Z thru -3Z) were below the SEF SLs for arsenic and zinc. From upstream (sample SB-C-1Z) to downstream (sample SB-C-4Z), PCBs concentrations in the archived NSM samples were 30.9 ppb, 33.6 ppb, 38.9 ppb, and **104.3 ppb** (SL = 60 ppb). Since sample SB-C-4Z was nearly entirely composed of dredge prism material, it was used for the dredge prism suitability determination and was not used to assess NSM suitability.

**Discussion:**

Vertical Correction of Core Samples: When conducting stratified sampling with composited subsamples, the subsample intervals must come from the same target depth. If subsamples intended to represent a particular stratum do not come from the same depth, and they are composited, then the interpretation of data from the resulting composite sample can be difficult or impossible.

Based on the PSET's review of materials, NRC did not thoroughly adhere to the SAP. The core logs received on September 25, 2013, indicate that vertical corrections (for tidal/river fluctuations) were made after core processing and laboratory analysis had already occurred.

Dredge Prism Data Interpretation: Even though dredge prism subsamples from the marina sometimes contained NSM and material from beneath the NSM, three of the four cores penetrated the entire dredge prism thickness. Since the SEF SLs were not exceeded in the two dredge prism composite samples, the PSET was able determine the suitability of the marina dredge prism material (DMMUs 1 and 2).

The suitability of the access channel dredge prism (DMMU 3) was more complicated to determine. Sample SB-C-1 Comp was intended to characterize DMMU 3. However, based on the way the access channel samples were collected, the PSET found it necessary to split DMMU 3 into two units: a west unit and an east unit (Figure 3).

The dredge prism subsamples from stations SB-C-3 and SB-C-4 that were incorporated into sample SB-C-1 Comp did not entirely capture the dredge prism interval. Since the NSM samples SB-C-3Z and SB-C-4Z contained a predominance of dredge prism material, they were used in combination with SB-C-1 Comp to determine the dredge prism suitability for the east part of the access channel. SB-C-1 Comp was used to determine the suitability of the dredge prism in the west part of the access channel. A summary of the access channel chemical results appears in Table 2, below.

NSM Data Interpretation: Generally, the NSM subsamples were taken from the bottom 1, 2, or 3 ft. of the core. The NSM subsamples in each NSM composite sample were not taken from the target NSM interval. The depth of NSM subsamples was inconsistent within each composite sample. For example, the NSM composite sample, SB-C-Z1 Comp, the proposed NSM sample interval was -5 to -7 ft. NGVD 29. However, the NSM subsamples collected to form this composite sample spanned a 5.7 ft. interval (from -2.1 to -7.8 ft. NGVD 29). Additionally, the thickness of subsamples composing SB-C-Z1 Comp (the access channel) was inconsistent: two NSM subsamples were 2 feet thick and the other two subsamples were 3 feet thick.

The PSET was able to use most of the NSM sample data in spite of the sample collection errors, but the data were not always used as planned in the SAP. NSM composite samples in the marina and west part of the access channel were used to establish vertical contamination trends in the dredge area for ODEQ's anti-degradation evaluation. However, in the east part of the access channel (sample station SB-C-4, Figure 7), the core penetrated the NSM interval by only 0.1 ft.; the 3-foot NSM sample was actually composed of dredge prism material. Determinations of the NSM suitability and site degradation could not be made at this location.

**Suitability Determination:** Table 2 summarizes the project decision units (i.e., the proposed project DMMUs and underlying NSM), the chemical results used determine the suitability of each unit of material, the suitability of each unit (when it can be determined), and the rationale for the suitability determinations. Suitable and unsuitable materials are delineated in Figures 1, 2, 3, and 7.

Dredge prism material from the marina and the west part of the access channel is suitable for unconfined, aquatic placement without additional characterization. **Due to contamination by arsenic, zinc, and PCBs, the dredge prism material in the east part of the marina access channel is unsuitable for unconfined, aquatic placement.** Material must be placed in an upland location, or positive biological testing results (bioassays and bioaccumulation studies) must occur prior to dredging to override the sediment chemistry review.

The NSM in the marina is suitable for unconfined, aquatic exposure without additional characterization and meets ODEQ's anti-degradation policy. **Due to arsenic contamination, the entire access channel NSM is unsuitable for unconfined, aquatic exposure.** The access channel NSM will require post-dredge monitoring and/or management by the Port. **It is the Port's responsibility to identify how they will manage contamination in the access channel NSM. Prior to dredging, the Port must provide a project-wide dredging plan to the PSET which includes options to manage contamination in the access channel NSM.** Alternatively, biological testing of contaminated sediments with positive results (bioassays and bioaccumulation studies) must occur prior to dredging to override the sediment chemistry review.

**Since the NSM was not characterized at station SB-C-4, pre- or post-dredge, full-suite SEF chemical characterization of this area is required.** Recommended sample stations appear in Figure 7.

**NOTE:** The PSET will no longer accept piecemeal submittals of project data. The project proponent or their authorized agent are obligated to collate all field sampling information, laboratory data, and recommended interpretations into a cohesive sediment characterization report.
**Contact:** This memorandum was prepared by James McMillan, PSET Lead. If you have questions regarding the content of this memorandum, please contact him by telephone at (503) 808.4376 or email at james.m.mcmillan@usace.army.mil.

**References:**

Oregon Department of Environmental Quality. 2007. *Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment*. Published January 31, 2007; updated April 3, 2007, by the Environmental Cleanup Program, 18 pp + Appendices.

U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, Washington Department of Ecology, Washington Department of Natural Resources, Oregon Department of Environmental Quality, Idaho Department of Environmental Quality, National Marine Fisheries Service, and U.S. Fish and Wildlife Service. 2006. *Interim Final Sediment Evaluation Framework for the Pacific Northwest*. Published September 30, 2006, by the U.S. Army Corps of Engineers, Northwestern Division, 194 pp + Appendices.

U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, Washington Department of Ecology, Washington Department of Natural Resources, Oregon Department of Environmental Quality, Idaho Department of Environmental Quality, National Marine Fisheries Service, and U.S. Fish and Wildlife Service. 2009. *Sediment Evaluation Framework for the Pacific Northwest*. Published May 2009, by the U.S. Army Corps of Engineers, Northwestern Division, 128 pp + Appendices.

**Table 2. Summary of Sediment Chemistry and Dredge Prism/NSM Suitability**

KEY: **Bold red** = SL exceeded/unsuitable; U = undetected below the method reporting limit; NA = not analyzed; ND = cannot be determined

| Decision Unit | Associated Sample(s) | Arsenic (ppm) SEF SL = 20 | Zinc (ppm) SEF SL = 130 | PCBs (ppb) SEF SL = 60 DEQ SLV = 22 | Suitability/ Degradation* (Y/N) | Rationale |
|---|---|---|---|---|---|---|
| ***Dredge Prism Material* Suitability (for unconfined, aquatic placement)** | | | | | | |
| Marina DMMU 1 | SB-M-1 Comp | 13.2 | 96.6 | 12.64 | Suitable/ -- | DMMU 1 composite sample composed entirely of dredge prism material. DMMU 1 is suitable. |
| Marina DMMU 2 | SB-M-2 Comp | 11.3 | 68.6 | 1.86 U | Suitable/ -- | DMMU 2 composite sample composed dredge prism material, NSM, and material from beneath the NSM. However, no SLs exceeded in the composite sample. DMMU 2 assumed suitable. |
| Access Channel DMMU 3 (west part) | SB-C-1 Comp | 13.2 | 112 | 12.34 | Suitable/ -- | No SLs were exceeded in the DMMU 3 composite sample. Arsenic SL slightly exceeded in NSM sample SB-C-2Z, and sample encroached 0.5 ft. into the dredge prism. Considered as a whole, the west part of DMMU 3 is suitable. |
| Access Channel DMMU 3 (east part) | SB-C-1 Comp | 13.2 | 112 | 12.34 | **Unsuitable**/ -- | Sample SB-C-3Z is composed of nearly 50% dredge prism material; SB-C-4Z is nearly all dredge prism material. These samples were considered in combination with sample SB-C-1 Comp to assess the dredge prism for the east part of DMMU 3. |
| | SB-C-3Z | **33.3** | 122 | **38.9** | | |
| | SB-C-4Z | **203** | **203** | **104.3** | | |
| ***NSM* Suitability (for unconfined, aquatic exposure)** | | | | | | |
| Marina NSM (M-Z1) | SB-M-Z1 Comp | 18.8 | 85.4 | 12.36 | Suitable/ N | The NSM composite sample was composed of dredge prism material and NSM. No SLs were exceeded; NSM assumed suitable. |
| Marina NSM (M-Z2) | SB-M-2 Comp | 11.3 | 68.6 | 1.86 U | Suitable/ N | Sample SB-M-2 was partially composed of NSM. Sample SB-M-Z2 contained some NSM. SEF SLs were not exceeded in either sample. |
| | SB-M-Z2 Comp | 15.7 | 105 | 14.04 | | |
| Access Channel NSM (west) | SB-C-1Z | **32.9** | 116 | **30.88** | **Unsuitable/ Y** | NSM samples are in the proposed NSM sample interval (-5 to -7 ft. NGVD 29); arsenic concentrations exceed the SEF SL. |
| | SB-C-2Z | **25.4** | 109 | **33.58** | | |
| Access Channel NSM (east, sta. SB-C-3) | SB-C-3Z | **33.3** | 122 | **38.9** | **Unsuitable/ Y** | NSM sample SB-C-3Z is in the proposed NSM sample interval (-5 to -7 ft. NGVD 29); arsenic concentrations exceed the SEF SL. |
| Access Channel NSM (east, sta. SB-C-4) | None | NA | NA | NA | ND/ ND | Suitability and anti-degradation cannot be evaluated. Sample SB-C-4Z was mostly composed of dredge prism material. No usable NSM data were collected. Post-dredge grab sample(s) required. |

* - Degradation was assessed by comparing the dredge prism composite samples to respective NSM samples/subsamples.


Marina Area is 272,250 SF
Approximately 6.25 acres
West Marina (DMMU 1)
(Dredge prism and NSM suitable)
SB-M-1
SB-M-3
SB-M-2
N

FIGURE 1


East Marina (DMMU 2)
(Dredge prism and NSM suitable)
SB-M-4
SB-M-3
NORTH

FIGURE 2

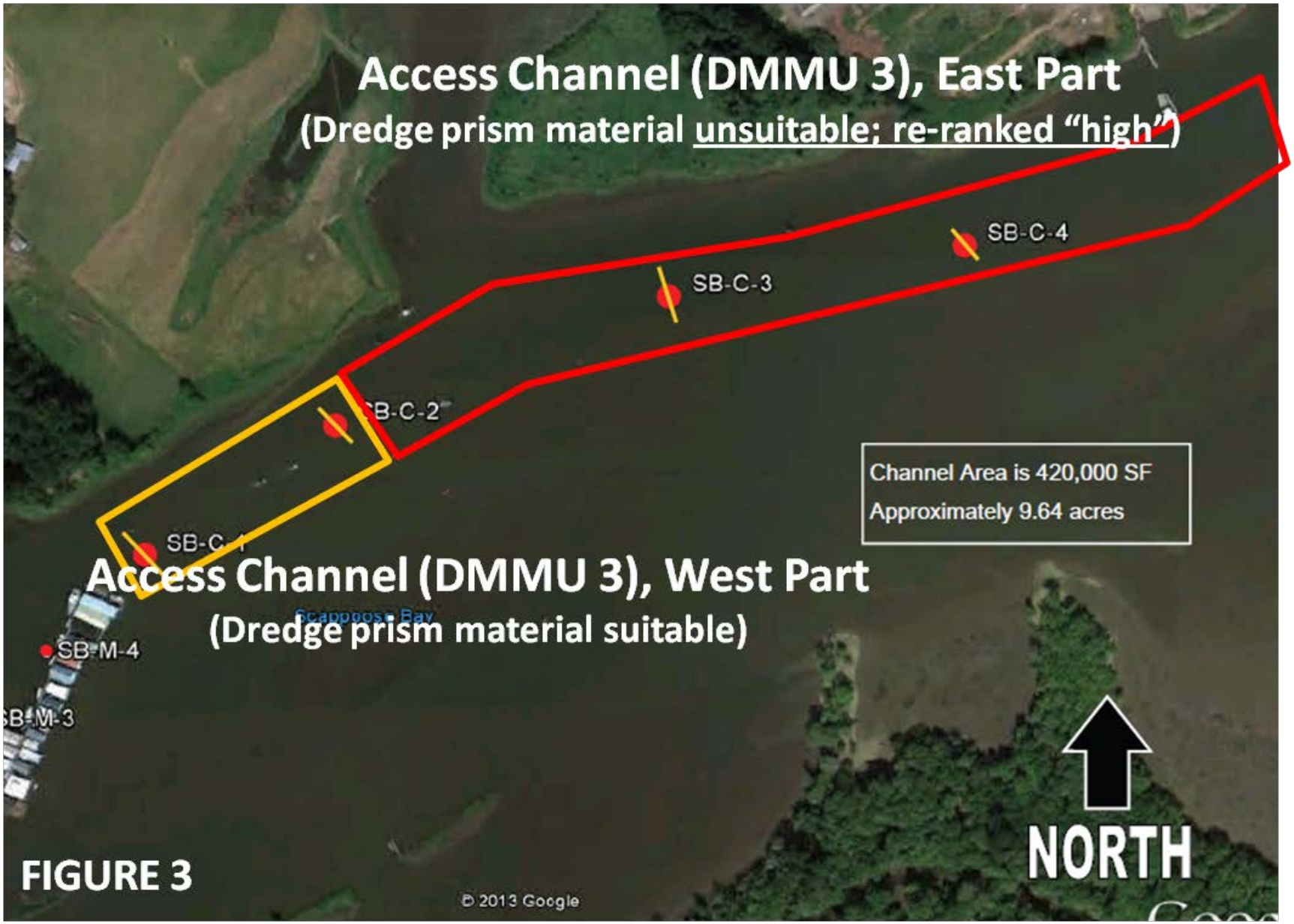
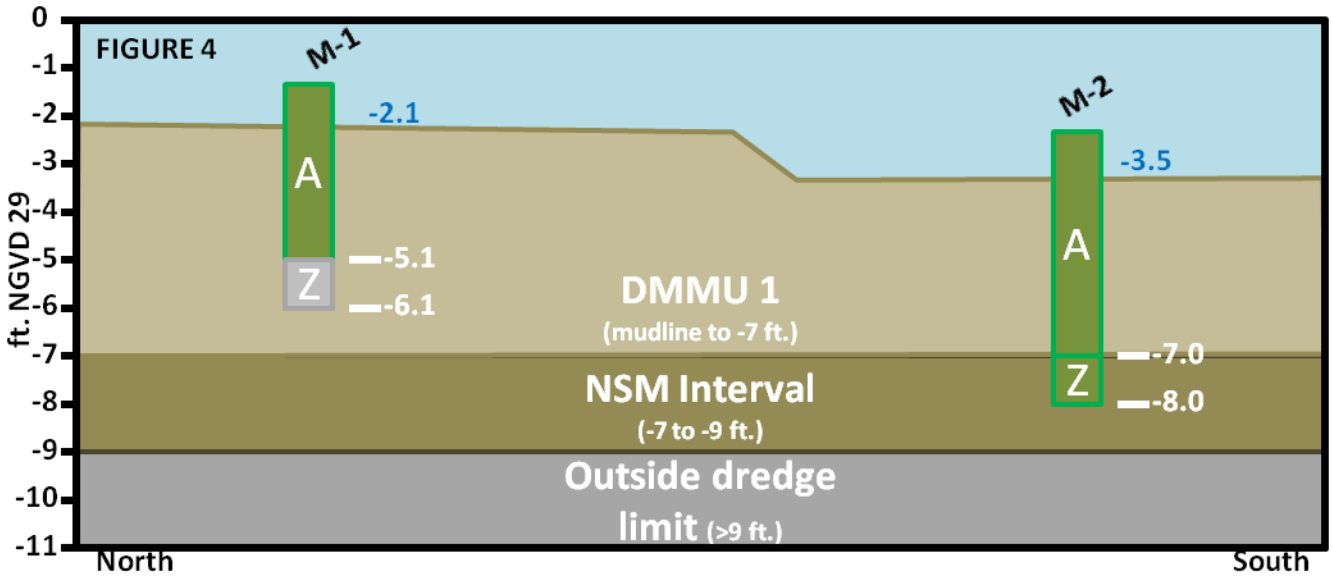
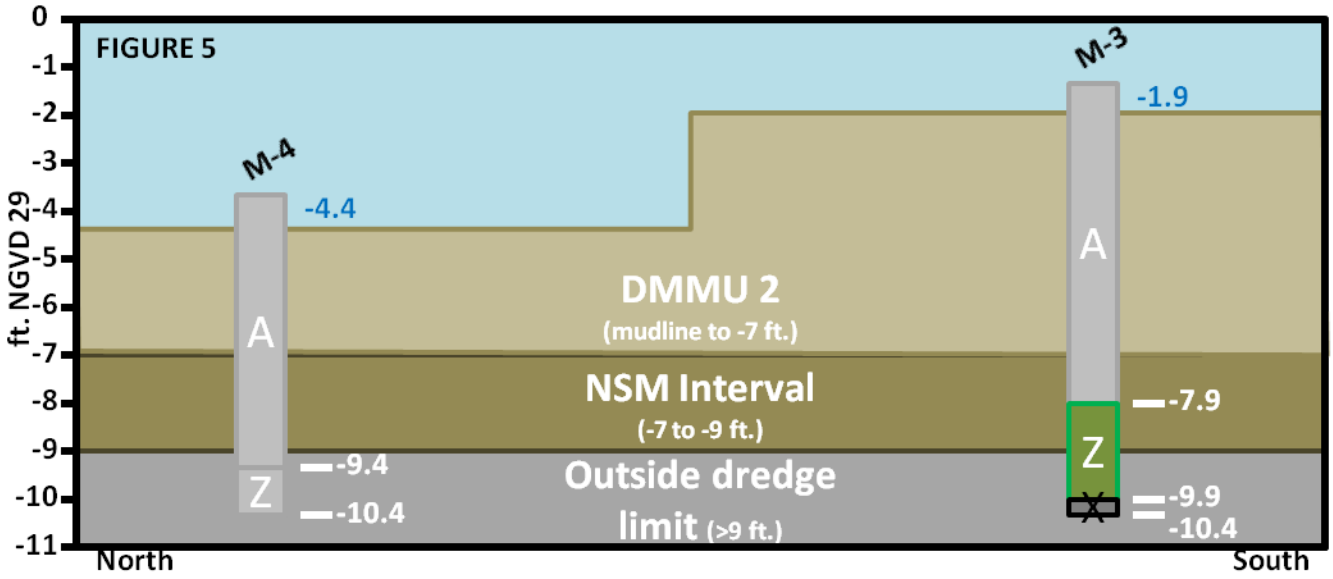
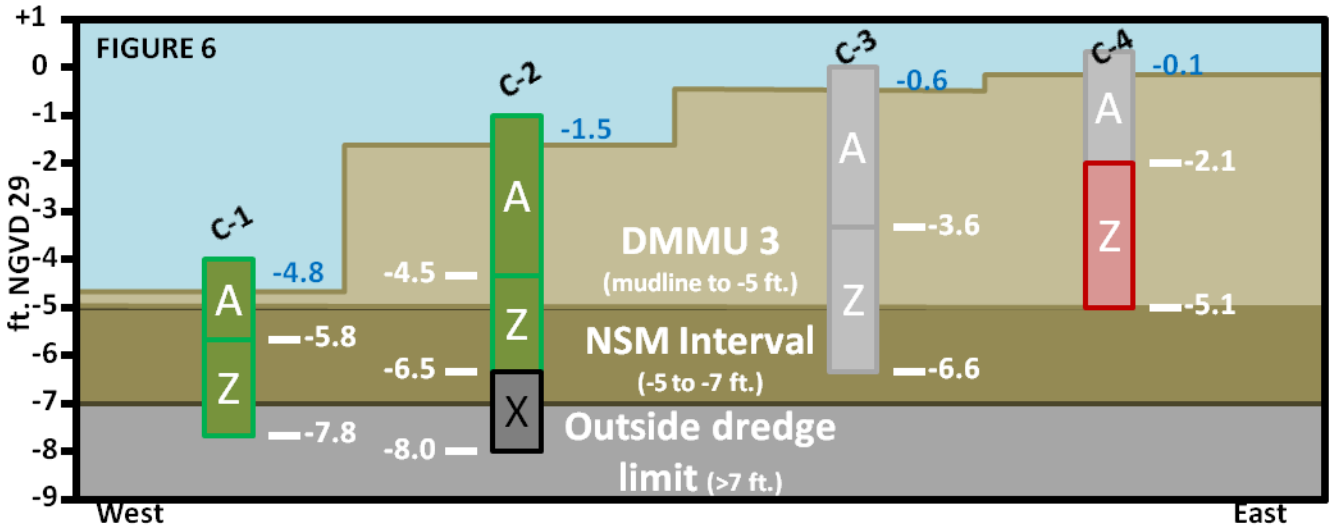

Access Channel (DMMU 3), East Part
(Dredge prism material unsuitable; re-ranked "high")
SB-C-4
SB-C-3
SB-C-2
Channel Area is 420,000 SF
Approximately 9.64 acres
SB-C-1
Access Channel (DMMU 3), West Part
(Dredge prism material suitable)
Scappoose Bay
SB-M-4
SB-M-3
NORTH
© 2013 Google

FIGURE 3



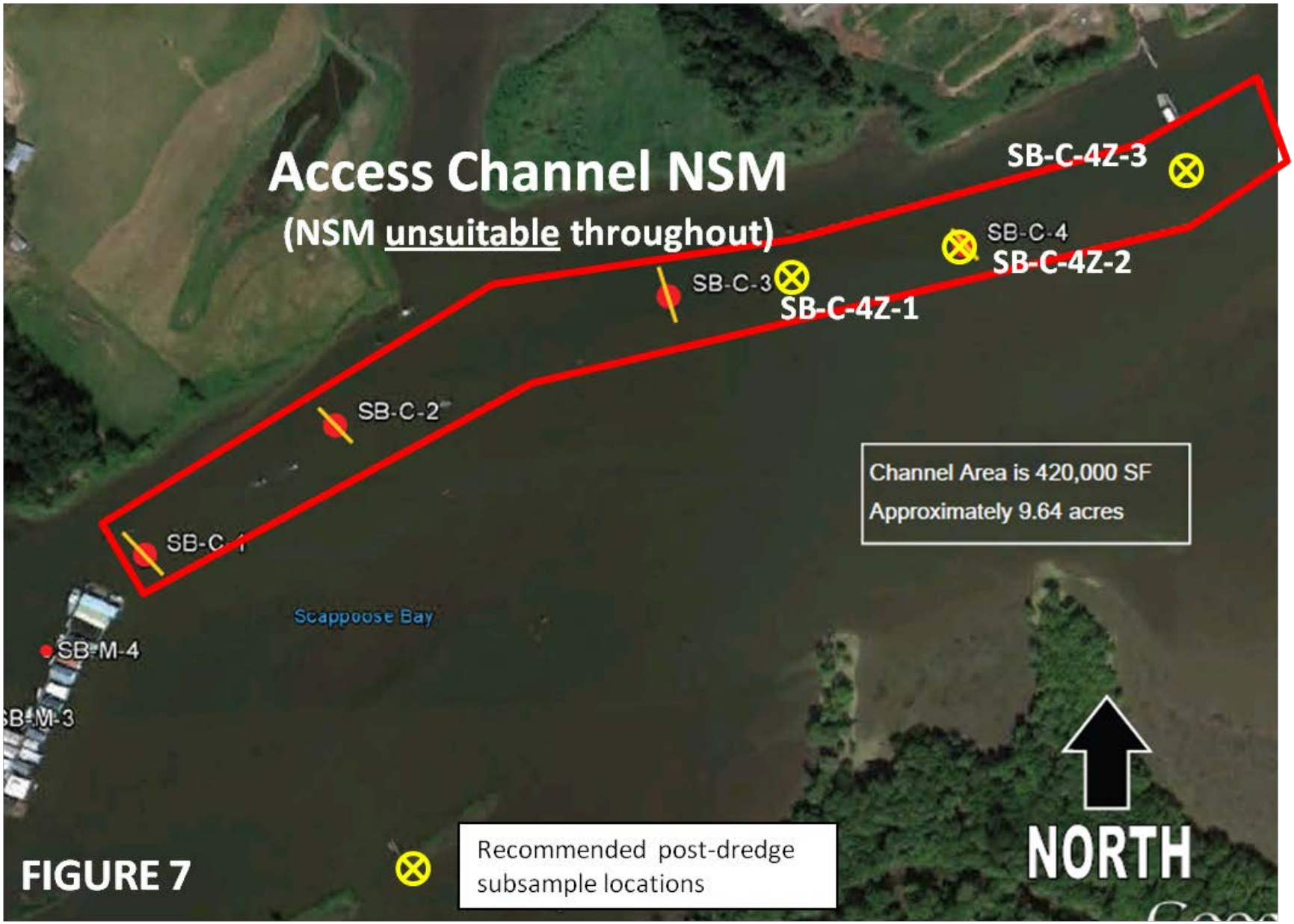

-1.5 Mudline elevation (ft. NGVD 29)

X Discarded core material

Z Dredge prism or NSM subsample located at or near the correct depth; data can be used to determine suitability

A Subsample may contain other units of material, but data can be used to determine dredge prism and/or NSM suitability

Z Subsample does not contain sufficient NSM sediment to determine NSM suitability at the sample location


Access Channel NSM
(NSM unsuitable throughout)
SB-C-4Z-3
SB-C-4
SB-C-4Z-2
SB-C-3
SB-C-4Z-1
SB-C-2
SB-C-1
Channel Area is 420,000 SF
Approximately 9.64 acres
Scappoose Bay
SB-M-4
SB-M-3
NORTH
Recommended post-dredge subsample locations
FIGURE 7