Construction Completion Report

Sandblast Grit Removal Interim Remedial Action

Northlake Shipyard Site
Seattle, Washington

Prepared for
Washington State
Department of Ecology

June 26, 2014
17800-26

HARTCROWSER

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ACRONYMS AND ABBREVIATIONS

BE	Biological Evaluation
BMP	best management practice
CCR	Construction Completion Report
COC	constituent of concern
cPAHs	carcinogenic polycyclic aromatic hydrocarbons
CY	cubic yard
DNR	Washington Department of Natural Resources
Ecology	Washington State Department of Ecology
eTrac	eTrac, Inc.
IAWP	Interim Action Work Plan
mg/kg	milligrams per kilogram
MTCA	Model Toxics Control Act
NLSY	Northlake Shipyard, Inc.
NWP	Nationwide Permit
POC	point of compliance
PPCD	prospective purchaser consent decree
ppm	parts per million
QA	quality assurance
QC	quality control
Redside	Redside Construction, Inc.
SAP	Sampling and Analysis Plan
site	Northlake Shipyard Site
SMP	Shoreline Master Program
SMS	Sediment Management Standards
TCP	Toxics Cleanup Program, Washington State Department of Ecology
TESC	temporary erosion and sedimentation control
USACE	US Army Corps of Engineers
WAC	Washington Administrative Code
WQMP	Water Quality Monitoring Plan
WW21	Waterway 21

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EXECUTIVE SUMMARY

This Construction Completion Report summarizes and documents the environmental construction activities completed as part of an interim remedial action at the Northlake Shipyard Site in Seattle, Washington. The work was completed under the direction of the Washington State Department of Ecology (Ecology) following the provisions of the Washington State Model Toxics Control Act (Chapter 173-340 WAC) and the Sediment Management Standards (Chapter 173-204 WAC) and their implementing regulations, through the Ecology Toxics Cleanup Program (TCP) and in accordance with a prospective purchaser consent decree (PPCD) with Northlake Shipyard, Inc. (NLSY). NLSY is the property owner and has contributed to a trust fund to be used for the cleanup of sandblast grit deposited in site sediment during legacy operations at the site prior to NLSY purchasing the property. Construction took place from December 2013 through March 2014 under the oversight of Hart Crowser.

The Northlake Shipyard Site is one of several Seattle-area priority sites for Lake Union being addressed by the TCP. NLSY operates as a self-service ship repair facility. The shipyard consists of offices, several covered storage areas, and over-water structures (a wharf, piers, and two dry docks) that host the facility's industrial activities.

The site was once used as a ship loading facility, primarily for coal, operated by Pacific Coast Coal. Since the 1950s, the property has been used as a ship repair and hull painting facility. Marine Power and Equipment was the operator of the shipyard during the 1980s and was the subject of a federal criminal investigation for making illegal discharges to Lake Union including sandblast grit. Allegations were resolved in a consent decree entered into by Marine Power, Ecology, and the United States Environmental Protection Agency. The successor to Marine Power and Equipment, United Marine International, owned and operated the site until filing for bankruptcy protection in 1994. NLSY purchased the shipyard in August 1994 under the PPCD, which required Northlake to make payments to a trust fund established for the cleanup of contamination caused by past activities at the site.

Sediment containing sandblast grit has been an ongoing source of contamination in the aquatic environment at the site. Previous investigations estimated the sandblast grit accumulation at the site near overwater structures at up to 3.5 feet thick. The impacted sediment at the site contains heavy metals including arsenic from the sandblast grit and carcinogenic polycyclic aromatic hydrocarbon (cPAHs) contamination.

The remedial action was developed to address the aquatic impacts in sediment at the site, which combined removal of sandblast-grit-impacted sediment and debris followed by placement of clean backfill. A target volume of 8,000 cubic yards of contaminated sediment was planned to be removed and disposed of at an upland landfill. The final combined dredging volume was approximately 8,320 cubic yards of impacted sediment. Approximately 3,300 tons of clean sand was imported and placed in the dredged areas. A total of 23 tons of scrap steel and 20 timber piles were removed and disposed of off site.

The primary objective for the interim remedial action at the site focused on eliminating or substantially reducing unacceptable risks to the environment posed by constituents of concern (COCs), arsenic and cPAHs, found in sandblast grit. Applicable exposure pathways and receptors of interest for human health included current and future site users exposed to sediment via direct contact pathways and consumption of freshwater biota and water. Applicable ecological exposure pathways and receptors included organisms in the biologically active zone exposed to sediment by direct contact and food chain uptake.

Previous investigations had identified the areas around the pier and underneath the dry docks as having the greatest accumulation of sandblast grit. The overall extent of the interim action area was defined by the objective to remove as much of the sandblast grit as possible with the funds allowed by the PPCD.

Necessary permits were obtained for the interim action work. The US Army Corps of Engineers issued a Nationwide Permit 38 permit for the site through the Joint Aquatic Resources Permit Application submitted by Hart Crowser on behalf of Ecology. Additionally, Ecology received a Shoreline Exemption Permit from the City of Seattle due to the site's priority status under the consent decree.

Detailed plans and specifications and a bid package prepared for selection of a contractor to complete the construction were prepared to implement the interim action. The contract was awarded to the lowest responsive bidder, Redside Construction, Inc. (Redside). Redside subcontracted with eTrac, Inc., to perform the hydrographic surveys for the project and to provide quality assurance and control support. Hart Crowser served as Ecology's on-site representative to observe and document the interim remedial action.

The overall scope of work, deemed substantially complete on April 1, 2014, for the interim remedial action, is summarized below:

- In-water debris was removed. The debris consisted of scrap metal, wood, steel cables, tires, battery casings, dry dock blocks, compressed gas cylinders, timber piles and logs, and various other materials.

- Two suspected derelict vessels were attempted to be removed using standard dredging equipment. These vessels, as well as a large suspected sunken float at the northeast corner east of the pier, the northern edge of the bulkhead east of the pier, and a section around the southwest corner of the pier were noted and left undredged because of the inability to be removed with the equipment on hand or concerns about damaging the integrity of the pier.

- Sediment containing contaminated sandblast grit was dredged to native material. Approximately 8,320 cubic yards of contaminated sediment was removed from the site.

- Sediment dredged from the site was loaded onto barges to dewater and then onto trucks for transport to rail transloading facilities operated by Waste Management and Regional Disposal in

Seattle, Washington. From the transfer facility, the material was transported to the Roosevelt Regional Landfill by rail for off-site disposal.

- Clean material was used to backfill dredged areas. The fill material benefits aquatic habitat and provides a cap to reduce bioavailability of remaining impacted sediment to potential receptors.

- Documentation sampling and analysis was conducted to characterize the concentration of arsenic and cPAHs remaining in the sediment after dredging work was completed. Nine sediment sampling points were selected throughout the site, six of which were collected from within the dredge prism and three samples were collected outside the dredge prism. Arsenic was detected in four of the samples collected from within the dredge prism, with concentrations ranging from non-detect to 140 ppm; cPAHs were detected in four of the samples collected from within the dredge prism, with total concentrations ranging from non-detect to 17.8 ppm. All three samples collected from outside the dredge prism at the completion of dredging work had detections of arsenic and cPAHs with concentrations ranging from 11 to 50 ppm and 1.47 to 2.379 ppm, respectively.

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Construction Completion Report

Sandblast Grit Removal Interim Remedial Action

Northlake Shipyard Site

Seattle, Washington

1.0 INTRODUCTION

This Construction Completion Report (CCR) summarizes and documents the environmental cleanup construction activities completed as part of a sandblast grit removal interim remedial action at the Northlake Shipyard Site (site) in Seattle, Washington. The work was completed under the direction of the Washington State Department of Ecology (Ecology) following the provisions of the Washington State Model Toxics Control Act (MTCA) and its implementing regulations (Chapter 173-340 WAC), through the Ecology Toxics Cleanup Program (TCP) and in accordance with a prospective purchaser consent decree (PPCD) with Northlake Shipyard, Inc. (NLSY). Construction activities were performed from December 2013 through March 2014 under the oversight of Hart Crowser.

Interim action construction described in this CCR involved the following:

- Dredging and off site disposal of sediment containing arsenic-contaminated sandblast grit and/or affected by carcinogenic polycyclic aromatic hydrocarbon (cPAHs) contamination;
- Removing and disposing of debris off site; and
- Backfilling the dredged area with clean fill material (sand).

The basis for the completed interim action is documented in the Northlake Shipyard Interim Action Work Plan (IAWP) that was prepared for the site by Ecology. The IAWP consists of the following documents:

- Prospective Purchaser Consent Decree RE: Northlake Shipyard, Inc. 94-2 20115 8 (PPCD) dated August 12, 1994 (Ecology 1994);
- Northlake Shipyard Sandblast Grit Study Project Report prepared by Ecology and Environment for Ecology, June 2009 (E&E 2009); and
- Biological Evaluation Northlake Shipyards Sand Blast Grit Dredging-Interim Action (BE) prepared by Hart Crowser for Ecology, May 23, 2012 (Hart Crowser 2012a).

Ecology and Environment completed the sandblast grit study as directed by Ecology in response to the PPCD to identify areas of sandblast grit accumulation. The study results were used to define the dredging limits outlined in the IAWP.

1.1 Report Organization

This CCR is organized into the following primary sections:

- Section 2.0 Site Background;
- Section 3.0 Cleanup Requirements;
- Section 4.0 Overview of the Interim Remedial Action;
- Section 5.0 Interim Action Construction Details;
- Section 6.0 Sediment Documentation Sampling and Analysis;
- Section 7.0 Limitations; and
- Section 8.0 References.

Tables and figures are included at the end of the CCR. Table 1 summarizes the quantities of material exported from and imported to the site, and Table 2 presents the laboratory analytical results for the sediment documentation samples collected during the interim action.

Figure 1 presents a vicinity map showing the location of the site, and Figure 2 shows pre-construction site features and conditions. Figures 3 and 4 are drawings from the interim action project plans that show planned dredging locations and capping areas and approximate extent of the sandblast grit. Figure 5 shows the locations of the sediment documentation samples.

The appendices after the tables and figures in this CCR provide additional information on the completed interim action work. Appendix A contains contractor-provided, pre-construction and progress surveys and as-built drawings. Appendix B presents selected representative photographs of the cleanup work. Appendix C includes Hart Crowser daily field reports submitted as part of construction observation. Appendix D contains summary tables of the scale tickets for material exported from the site for disposal and capping materials imported to the site. Laboratory reports and chemical data quality reviews are provided in Appendix E. Contractor-provided weekly progress reports are provided in Appendix F. Water quality analytical data are provided in Appendix G.

2.0 SITE BACKGROUND

2.1 Site Location and History

The Northlake Shipyard Site is one of several Seattle-area priority sites for Lake Union being addressed by the TCP. The site includes property owned by NLSY covering approximately 2.5 acres of shoreline and aquatic areas and 34 acres of aquatic land leased from the Washington Department of Natural Resources (DNR).

Northlake Shipyard, Inc., operates as a self-service ship repair facility on the northeast shore of Lake Union (Figure 1). The shipyard consists of offices, a covered storage area, a used paint storage area located along the shoreline, and over-water structures (a wharf, piers, and two dry docks) that host the facility's industrial activities.

The site was once used as a ship loading facility, primarily for coal, operated by Pacific Coast Coal. Since the 1950s, the property has been used as a ship repair and hull painting facility. Marine Power and Equipment was the operator of the shipyard during the 1980s and was the subject of a federal criminal investigation for making illegal discharges to Lake Union including sandblast grit. Allegations were resolved in a consent decree entered into by Marine Power, Ecology, and the United States Environmental Protection Agency. In 1986, Marine Power and Equipment and its parent corporation declared bankruptcy. Its successor, United Marine International, owned and operated the site until filing for Chapter 11 bankruptcy protection in 1994. Northlake Shipyard, Inc., purchased the shipyard in August 1994 under a prospective purchaser consent decree (PPCD). The primary component of the PPCD was to require Northlake to make cash payments to a trust fund established for the cleanup of contamination caused by past activities at the site. NLSY entered into the PPCD to avoid incurring potential liability for the contamination before purchasing the site through bankruptcy proceedings.

2.2 Previous Investigations

Numerous investigations have been conducted at the site over the past 35 years. In 1991, a study conducted by GeoEngineers for United Marine International (GeoEngineers 1991) estimated that 6,500 cubic yards (CY) of sandblasting grit-impacted sediment was present at the site. A second study to determine the extent of the sandblast grit was performed for Ecology (E&E 2009) and was used to develop the current IAWP. Further information on previous investigations can be found in the 2009 Sandblast Grit Study Report.

2.3 Site Environmental Conditions

The site is located on the north shore of Lake Union. The shoreline consists of a steep slope falling to a relatively flat lake bottom. Lake bottom depths at the site range from 0 to approximately 40 feet below ordinary high water. Other studies in Lake Union have characterized native sediment as brown to black silt with scattered deteriorating organic material such as leaves and wood fibers. The lake is fed by the Montlake Cut from Lake Washington and discharges to Puget Sound through the Ship Canal. The lake's water level is kept between approximately 20 and 22 feet above sea level by the Hiram M. Chittenden Locks in Ballard at the west end of the Ship Canal.

Before completion of the interim action construction, the aquatic portions of the site were known to contain debris and trash piles, and at least two suspected derelict vessels intermixed with sandblast grit. During past site operations contaminated sandblast grit was used during dry docked vessel repairs and repainting. The grit was uncontained and was allowed to fall into the lake around the ends of the dry docks.

2.3.1 Contaminant Sources and Affected Media

Before completion of the interim action construction, sediment containing sandblast grit was known to be an ongoing source of contamination at the site. The grit contains heavy metals and cPAHs. Metals detected in sediment samples near the site included antimony up to 420 parts per million (ppm), arsenic up to 2,920 ppm, cadmium up to 9 ppm, copper up to 4,180 ppm, lead up to 2,550 ppm, mercury up to 3 ppm, nickel up to 131 ppm, silver up to 8 ppm, and zinc up to 9,440 ppm. Additionally, total PAH concentrations, which includes the cPAH subset, ranged from 9 to 3,749 ppm. Before implementation of the interim action, GeoEngineers estimated the sandblast grit accumulation in and around the pier at up to 3.5 feet thick (GeoEngineers 1991). Both arsenic and cPAHs are listed as deleterious substances per criteria in the Sediment Management Standards (SMS) (WAC 173-240-200(17)).

3.0 REMEDIAL ACTION OBJECTIVES

The primary objective for the interim action at the site focused on eliminating or substantially reducing unacceptable risks to the environment posed by constituents of concern (COCs) found in sediment containing sandblast grit. Applicable exposure pathways and receptors of interest for human health include current and future site users potentially exposed to sediment via direct contact pathways and consumption of freshwater biota and water. Additionally, the interim action described herein removed nautical hazards and debris at the site that are the result of decades of industrial use.

Applicable ecological exposure pathways and receptors include organisms in the biologically active zone exposed to sediment by direct contact and food chain uptake. Related ecologically focused cleanup objectives for remediation also include providing suitable substrate for promoting recovery/recruitment of aquatic organisms in remediated areas, and minimizing habitat and water quality impacts during construction.

3.1 Definition of Aquatic Remediation Areas

The area(s) of concern were identified based on the known or inferred extent of contaminated media following review of historical and analytical data. The overall extent of the interim action area was defined by the extent of sandblast grit shown on boring logs in the 2009 sandblast grit study (E&E 2009). The dredge prism defined by this interim action was maximized to the extent practicable to target the areas of highest sandblast grit accumulation with the funds available through the PPCD trust fund.

3.2 Applicable Permits

Necessary permits were obtained to facilitate the interim action work. The US Army Corps of Engineers (USACE) issues nationwide permits (NWPs) to authorize certain activities that require Department of the Army permits under Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act of 1899, which includes work in streams, wetlands, and other waters of the United States. The USACE authorized the interim action construction through a NWP 38 permit for cleanup of hazardous and toxic waste (dated October 16, 2012), as proposed through the Joint Aquatic Resources Permit Application and BE submitted by Hart Crowser on behalf of Ecology.

Given the project's status as an Ecology cleanup site under a Consent Decree, the project was exempt from procedural requirements of certain state and local government laws and related permitting requirements and approvals. This included the Shoreline Management Act (Chapter 90.58 RCW) and the City of Seattle Shoreline Master Program (SMP). However, pertinent substantive compliance requirements remained applicable, including requirements outlined in Chapter 9 of the SMP for a Shoreline Exemption Permit from the City of Seattle. MTCA regulatory provisions formed the primary basis for evaluating and implementing in-water cleanup alternatives for remediation at the site.

3.3 Habitat Improvements

Although the selected alternative would impact existing freshwater habitat, much of the affected habitat was not optimal substrate because of the sandblast grit and debris. Thin-layer capping materials were selected to provide an additional barrier to affected source media and provide a habitat enhancement measure that can be readily implemented as part of the site remediation. The goal and function of these habitat improvement features are detailed in the BE.

4.0 OVERVIEW OF THE INTERIM REMEDIAL ACTION

The selected remedy for the site, as put forth in the IAWP, combined dredging and off-site disposal of contaminated sediment and placement of a thin-layer cap. A target volume of 8,000 CY of contaminated sediment was planned to be dredged and disposed of at an upland landfill. The final dredging volume of impacted material was approximately 8,320 CY (10,115 tons). Approximately 3,300 tons of clean backfill material were imported for placement in the dredge prism. A summary of the material import and export quantities is provided in Table 1.

The scope of work completed is summarized below.

4.1 Plans, Specifications, and Contractor Selection

Detailed plans and specifications were prepared to implement the interim action based on the information provided in the IAWP. A bid package including the plans and specifications was prepared for selection of a contractor to complete the construction phase of the interim action. The contract was awarded to the lowest responsive bidder, Redside Construction, Inc. (Redside). Redside subcontracted with eTrac, Inc., (eTrac) to perform the hydrographic survey portions of the project.

4.2 Summary of the Completed Scope of Work

The overall scope of work completed for the interim action is summarized below.

- In-water debris consisting of scrap metal, wood, steel cables, tires, battery casings, dry dock blocks, compressed gas cylinders, timber piles and logs, and various other materials was removed. Approximately 23 tons of scrap steel material and 20 timber piles were removed, processed, and sent for off-site disposal.

- Two suspected derelict vessels were attempted to be removed using standard dredging equipment. These vessels, as well as three other areas (as described in section 5.2.2) were noted and left

undredged because of the inability to be removed with the equipment on hand or concerns about damaging the integrity of the pier.

- Sediment dredged from the site was loaded into a barge and allowed to dewater. After the sediment had dewatered to meet a paint filter test, the material was loaded onto trucks for transport to the transfer facility operated by Waste Management (5400 West Marginal Way SW, Seattle) and Regional Disposal (2733 Third Avenue South, Seattle). From the transfer facility, the material was transported to the Roosevelt Regional Landfill by rail for off-site disposal.

- Clean fill material was used to backfill dredged areas. The fill material benefits aquatic habitat and provides a cap to reduce bioavailability of remaining impacted sediment from potential receptors.

4.3 Construction Management

Hart Crowser was retained by Ecology to serve as construction manager during implementation of the interim action. Our role was to ensure execution of the project in accordance with the contract documents and the plans and specifications, and to document and verify the construction work. Construction management involved both on-site and off-site duties, consisting of daily construction observation and off-site engineering and managerial support. Specific construction management tasks included:

- Monitoring construction performance and documenting field observations, which included keeping a daily log of field activities, taking photographs, and completing daily field reports. Selected representative photographs are shown in Appendix B. Our daily field reports are provided in Appendix C.

- Tracking contractor construction quality assurance and quality control to ensure compliance with the plans and specifications.

- Communicating and coordinating with Ecology and the contractor, and serving as Ecology's representative in the field. This included communicating all deviations from the contract documents, change requests, field directives, and information requests from the contractor to Ecology.

- Providing recommendations to Ecology on contractor submittals, contractor pay applications, requests for information, and change requests.

5.0 INTERIM ACTION CONSTRUCTION DETAILS

Specific details of the interim action construction work are described in this section. The work was completed by Redside and its subcontractor, eTrac.

The in-water construction work was permitted from October 1, 2013, through April 15, 2014, in observance of the fish window requirement of the NWP authorization for the project. Contractor mobilization and setup at the site began December 2, 2013. Ecology deemed the construction work substantially complete as of April 1, 2014, per contract requirements.

5.1 Mobilization, Site Preparation, and Demobilization

Contractor mobilization and site preparation activities included:

- Surveying pre-construction site elevations, subcontracted to and completed by eTrac;
- Establishing necessary traffic control and temporary erosion and sediment controls (TESC);
- Mobilizing in-water based construction equipment to the site;
- Preparing the barges for dredged material and for managing water drained from sediment;
- Staging turbidity curtains and debris booms for in-water work; and
- Installing and configuring the water quality monitoring system.

Contractor demobilization after construction consisted of removing all temporary facilities and equipment from the site and cleaning the site of any remaining construction materials, debris, scrap, or waste. Demobilization began on March 25, 2014.

5.1.1 Site Coordination

In accordance with the PPCD, Northlake Shipyard was allowed to remain an active shipyard during construction operations. However, NLSY was required to allow site access for completion of the interim action, including underneath the dry docks and around the pier. In general, NLSY work for site preparation included furnishing a space to be used as an office within the NLSY offices and moving any necessary vessels that were moored at the pier. The dry docks remained in operation and were moved at appropriate times during the construction.

As designated on the plan drawing C3.0, site coordination with neighbors included working with Divers Institute of Technology and Yacht Masters Northwest to allow access to Waterway 21 (WW21). In general, this required Redside to move the turbidity curtain throughout the day to allow vessels to enter and leave their moorage spaces while work was being performed in WW21.

5.1.2 Temporary Erosion and Sedimentation Controls

TESC measures included best management practices (BMPs) to prevent pollution of air and water and to control erosion and turbid water during construction. Redside was required to implement a stormwater pollution prevention plan and to follow the substantive requirements of the Construction Stormwater General Permit.

BMPs that were employed included filtering water draining from stockpiled sediment on the barges to reduce suspended solids content and measures to reduce dirt and sediment from being tracked onto the street by trucks. This was accomplished by lining the trucks with filtration media, installing lock-down pins on the truck gates, and manually washing the truck wheels and sides after they were loaded with sediment. Additionally, the pier was cleaned between truck loads.

5.2 Dredging and Debris Removal

In accordance with the NWP 38 and effective October 16, 2012, in-water work was permitted to begin on October 1, 2013. After preparation of the barges, dredging work commenced on December 5, 2013, and ran through February 28, 2014.

Dredging was performed using a crawler crane (Manitowoc M80) equipped with a 3.5-CY clamshell bucket or 3.8-CY environmental bucket on a barge (barge Whitehorse) with two spuds. A separate barge (barge WD-40) was used for receiving dredged sediment, draining and managing free water, and off-site transport for disposal.

5.2.1 General Construction Sequencing and Schedule

Redside scheduled construction work based on a 5-day workweek, from 7:30 AM to 3:30 PM. Due to the site constraints and allowance for NLSY to remain operational, the dredging schedule was sequenced into two phases (Figure 3). The Phase I pre-dredge survey was completed on November 12, 2013.. Dredging work began December 5, 2013 at the northwest portion of the site, near the public overlook of WW21 and proceeded waterward. At the completion of Phase I, NLSY was able to relocate Dry Dock 9, and Redside was able to move their equipment and water quality controls to the east side of the pier to begin Phase II. Before beginning Phase II, the second part of the pre-dredge survey was accomplished and Redside resumed dredging. During Phase II, NLSY relocated Dry Dock 2 into WW21 to allow Redside access to the south end of the pier. At the completion of dredging, a post-dredging survey was completed for the site. During placement of the thin-layer cap, the sequence was reversed, with capping beginning at the south end of the pier and moving to the east side of the pier. Dry Dock 2 was then allowed to return to its home position and Redside returned to WW21. A final post-capping survey was completed before Dry Dock 9 returned to its home position.

5.2.2 Debris Removal

The interim action work included removing debris, which was considered incidental to the dredging. Debris encountered during dredging included scrap metal, wood, steel cables, tires, battery casings, bottles, dry dock blocks, compressed gas cylinders, timber piles and logs, and various boat parts and materials. Approximately 23 tons of scrap steel material was recovered, processed, and sent for off-site disposal. However, most of the debris was too small to be recovered and was disposed of off site with the dredging spoils.

Dredging depths were not obtained in several areas because of debris that the contractor could not recover with standard dredging equipment. These areas included the two suspected derelict vessels, a large suspected sunken float at the northeast corner east of the pier; the northern edge of the bulkhead east of the pier; and a section around the southwest corner of the pier. Debris around the southwest corner of the pier appeared to be intertwined within the supporting piles. This area was not dredged to avoid compromising the structural integrity of the pier. Material that was too difficult to raise with standard dredging equipment was noted and left in place, as allowed by the contract.

5.2.3 Dredging

Planned dredging limits were given to eTrac (see plan sheet C.1.0) and imported into dredge tracking software (DredgePack) installed on the crane computer. The software allowed the crane operator to see the bucket position in real time as determined by a differential global positioning system on the crane boom. Horizontal placement of the bucket could be tracked by the crane operator by taking a 'bucket print' to the computer screen before lowering the bucket in to the water. This allowed the operator to see areas that had already been dredged before moving on to the next section. Dredged material was placed on barge WD-40 and allowed to dewater through filtration media before being loaded onto trucks for shipment to the transfer facility. A map of the "bucket prints" is provided in Appendix A.

The original extent of the dredge prism was modified by Work Authorization Amendment #1 issued by Ecology on January 30, 2014. The Work Authorization Amendment changed the scope of the dredging work to maximize the amount of sandblast grit material removed. This included a revision to the target dredging depth from the 2-foot target depth in the specifications to achieve the depth of native material. In general, native material was encountered at greater depths around the pier and underneath the dry docks. The Work Authorization Amendment also allowed areas where sandblast grit was not observed to remain undredged. As a result, dredging did not extend to the limits specified in the plans in the southwest corner of the site because no sandblast grit was observed in dredge spoils in that area. Figure 4 shows the approximate extent of the sandblast grit encountered at the site, as observed during construction performance monitoring by Ecology's representative.

5.2.4 Thin-Layer Cap Placement

Thin-layer cap material was specified as a 6-inch layer of sandy gravel to be placed in the dredge prism following the completion of dredging. Material was selected to provide a barrier to any contaminants remaining at the site. Additional objectives of the cap material included improving substrate habitat for juvenile salmonids and other aquatic species on and adjacent to the site. Post-construction elevations are shown on the as-built drawings provided in Appendix A.

Cap material was supplied by CalPortland from the DuPont, Washington, quarry. Material arrived by barge on March 10, 2014, and capping operations began on March 11, 2014. A second barge load of sand arrived on March 18, 2014, and capping was completed on March 25, 2014. Approximately 3,300 tons of thin-layer cap material was placed throughout the site.

Redside placed material by barge using the environmental clamshell bucket. The placement of material was tracked using the same positioning and software system that was used in dredging operations. Per the requirements in the Water Quality Monitoring Plan (WQMP), turbidity was closely monitored during placement of the material. While turbidity was noted during placement, it remained contained by the silt curtain and within water quality criteria.

5.3 Sediment and Debris Management and Disposal

Dredging during the interim action removed approximately 10,115 tons of sandblast-grit-contaminated sediment and debris. Waste was qualified for disposal at a subtitle D landfill by a toxic characteristic

leaching procedure (TCLP) test for arsenic, which was taken from a sediment stockpile sample prior to off-site disposal. The material was transported off site by truck and received at either the Waste Management transfer facility in Seattle (5400 West Marginal Way SW) or the Republic Services transfer facility (2733 Third Avenue South, Seattle), where it was transferred to holding cells to await transport by rail to the Republic Services Roosevelt Regional Landfill (500 Roosevelt Grade Road, Roosevelt, Washington).

The sediment encountered during dredging consisted primarily of native silty lake bottom overlain by a variably thick layer of sandblast grit. The sandblast grit layer occurred primarily in areas around the pier and off the ends of the dry docks. The sandblast grit layer thickness ranged from trace accumulation towards the edges of the dredge prism to as much as 5 feet in the area south of the pier. A strong petroleum odor as well as oily sheen was noted emanating from the removed sandblast grit. Surficial debris within the dredge prism generally consisted of timber piles, tires, trash, and various boat and shipyard parts and equipment.

Sediment was temporarily stockpiled on the barge to await transport off site. Water was allowed to drain from the sediment on the barge and directed to pass through filter media before discharging into Lake Union. Dewatered sediment was required to pass a paint filter test before being loaded onto trucks for transport to holding cells at a rail transfer facility.

Transportation and disposal costs were based on the tonnage of material received at the transfer facility. Appendix D provides a summary of scale tickets for the material that was transported off site.

5.5 Construction Performance Monitoring

Monitoring of the interim action was conducted by Ecology's representative and the contractor. This included construction performance monitoring and monitoring the effects of the construction work on the environment in the project area (WAC 173-340-410). Construction performance monitoring included observing and documenting the work performed, checking compliance with the project plans and specifications and with permit requirements, monitoring water quality, and collecting performance monitoring samples. As part of quality control measures, the contractor provided progress hydrographic surveys at certain milestones during the work, as outlined in the project specifications, for Ecology's review and approval before proceeding to subsequent stages of work. Water quality monitoring was performed to assure compliance with the established water quality criteria described below.

5.5.1 Water Quality Monitoring and Controls

The interim action contract documents included a Water Quality Monitoring Plan (WQMP), which described the objectives, procedures, and criteria of the water quality monitoring program to be implemented during construction (Hart Crowser 2012b). The WQMP was designed to gather information to assess potential detrimental impacts on water quality during this work.

The objectives of the water quality monitoring program were to:

- Assess potential impacts on water quality caused by in-water dredging and backfilling;

- Help the contractor ensure compliance with water quality criteria; and
- Provide information to evaluate the effectiveness of operational controls to achieve compliance with water quality criteria during dredging.

The WQMP established the following criteria:

Water Quality Criteria

Parameter	Criteria
Turbidity	5 NTU over background when background is 50 NTU or less; or a 10% increase in turbidity when background turbidity is more than 50 NTU
Arsenic[a]	190 ug/L (chronic), 360 ug/L (acute)[b]
Copper[c]	$\leq (0.960)(e^{0.8545[\ln(\text{hardness})]-1.465})$ (chronic)[b] $\leq (0.960)(e^{0.9422[\ln(\text{hardness})]-1.464})$ (acute)[b]

Notes:
NTU – Nephelometric Turbidity unit
a – WQC are for the dissolved fraction.
b – Chronic standards are 4-day average, acute is 1-hour standard.
c – Copper criteria are calculated based on the measurement of hardness, in mg/L CaCO3.

The point of compliance for water column monitoring during in-water work was to be met at a maximum distance of 150 feet from the edge of in-water activity.

5.5.1.1 Monitoring Methodology

To monitor water quality during in-water work activities, the contractor used two automated turbidity monitoring sensors attached to a monitoring buoy equipped with wireless telemetry. The sensors were placed at two depths, one 3 feet below the water surface, the second 3 feet above the lake bottom. The buoys were anchored near in-water work areas, within the compliance boundary. As the work moved to different parts of the site, the contractor moved the buoys and re-anchored them at the desired locations. The buoy's wireless communications were set to transmit turbidity data at a set interval of 15 minutes to an onshore data collection terminal. The collected data were accessible by both the contractor and Ecology at remote terminals and could be monitored in real time. The contractor supplemented the automated turbidity monitoring with manual measurement of an approved background location upstream of the work area and outside of the area of influence.

The monitoring buoys presented occasional operational difficulties because they required frequent battery replacement by the contractor. When the power supply ran low, the buoys no longer transmitted data. However, data could still be collected and stored in the buoys' memory and would be transmitted once batteries were replaced.

In addition to monitoring the turbidity, Redside collected water samples for chemical analysis. Samples were collected by hand at the same location as the monitoring buoy and delivered to Fremont Analytical Labs at 3600 Fremont Avenue North in Seattle. Analytical results from the water quality monitoring

samples are provided in Appendix G. In the event of a detection above the established threshold criteria, daily monitoring would resume and further corrective actions would be introduced. These actions include:

- Inspect turbidity curtain integrity;
- Increase dredging cycle time;
- Check for conformance to dredging BMPs; and
- Check for/remove debris that may be interfering with dredging operations.

5.5.1.2 Water Quality Controls

Ecology asked that measures to control sheens on the water's surface be implemented, which could potentially arise from extraction of cPAH-contaminated sediment. In addition to the turbidity curtain, BMPs such as hard boom and absorbent materials, were required to be on site for immediate deployment if a sheen was observed outside of the containment.

While the containment measures did a relatively good job of controlling sheen, there were several instances were a sheen was noticed outside of containment and reported to the Ecology Oil Response Unit. Releases were most commonly due to a piece of debris catching on the turbidity curtain during removal, or sheens bubbling up to the surface outside of the control booms from sediment that was disturbed by dredging. To rectify this problem, Redside installed secondary booms outside of the work areas. The releases were immediately responded to by Redside in accordance with their spill response plan. Crew members deployed absorbent "sausage" booms and pads to skim the surface of the water and contain the release.

5.5.2 Construction Progress Surveys

The contractor was required to perform progress surveys at specific stages of the work for Ecology's review and approval. Hydrographic surveys were completed to control the work and verify compliance with contract documents. The progress surveys were specified to be completed at the following stages of work:

- Before construction to confirm baseline conditions.
- After completion of dredging but before backfilling. These surveys were used to confirm that specified target depths had been achieved.
- After completion of placement of fill material. These surveys were used to confirm that specified grades and layer thicknesses had been achieved.

The pre-construction survey, post-dredging progress survey, post-capping survey, and as-built drawings are provided in Appendix A.

5.6 Deviations from Plans and Specifications

Design modifications were made as the work progressed for various reasons. These design modifications were made to adapt design elements to existing or unanticipated conditions, to increase efficiency, or to improve construction methodology. The deviations from plans and specifications are discussed in detail in the respective construction element sections above and are summarized as follows:

- **Revision to dredging requirements/dredge prism (Work Authorization Amendment 1, January 30, 2014).** Dredging depth within the dredge prism was modified to achieve a target depth of native material as observed in the field. Native material was easily identifiable as moist to wet, brown silt as compared to the sandblast grit which was oily, wet, black, sand. Additionally, the horizontal extent of the dredge prism was modified to eliminate areas within the dredge prism where sandblast grit was not observed. Therefore, the southwest corner of the dredge prism was left as-is because of the lack of sandblast grit seen during dredging operations in the area.

- **Dredging depth.** Dredging depths were not attained in several areas throughout the dredge prism because of the inability of the contractor to raise the material with standard dredging techniques or concerns for the structural integrity of the pier. These areas included the two suspected derelict vessels, a large suspected sunken float at the northeast corner east of the pier, the northern edge of the bulkhead east of the pier, and a section around the southwest corner of the pier.

6.0 SEDIMENT DOCUMENTATION SAMPLING AND ANALYSIS

The purpose of documentation sampling and analysis was to characterize the concentration of COCs remaining in the sediment after dredging work was completed. Nine sediment sampling points were selected throughout the site for chemical analysis, as outlined in the Sampling and Analysis Plan (Hart Crowser 2014). Six documentation samples were collected within the dredge prism after obtaining target depths; three samples were collected outside of the dredge prism. The sample locations and coordinates are shown on Figure 5.

Hart Crowser provided sample coordinates to Redside before dredging work began. Redside uploaded the coordinates to their dredge tracking software, which allowed the dredge operator to see the sample point locations in real time on an onboard display. A Hart Crowser representative was given notice when dredging operations were approaching a sample location. Redside then accommodated sediment sampling by providing transport and access to the dredging barge and using the barge to collect sediment for sampling from the target location on the dredging prism floor. Sediment was collected using the dredging bucket and brought to the barge deck where the representative collected and processed the sample for laboratory analysis. Sediment samples were collected and processed using a decontaminated stainless steel spoon and bowl. Non-disposable sampling equipment was decontaminated after each sampling event.

The samples were submitted to OnSite Environmental, Inc., for chemical analysis of arsenic, copper, lead, zinc, and cPAHs. Arsenic was detected in four of the samples collected from within the dredge prism, with concentrations ranging from non-detect to 140 ppm; cPAHs were detected in four of the samples collected

from within the dredge prism, with total concentrations ranging from non-detect to 17.8 ppm. All three samples collected from outside the dredge prism at the completion of dredging work had detections of arsenic and cPAHs, with concentrations ranging from 11 to 50 ppm and 1.47 to 2.379 ppm, respectively.

While the intent of the interim action construction was not to obtain SMS cleanup objectives or screening levels, the results indicate that the work largely met this criteria. The one exception is sample SS-04, which had detected concentrations of arsenic at 140 ppm, which is above the SMS screening level of 120 ppm. In contrast, the maximum reported concentration for arsenic from samples analyzed prior to implementation of the interim action construction was 4,070 ppm (E&E 2009), representing a reduction of approximately 97 percent. Sample SS-04 also exhibited the highest observed concentration for total cPAHs of samples collected from within the dredge prism at 17.8 ppm. However, this is below the SMS screening level of 30 ppm.

Table 2 summarizes the laboratory analytical results for the collected samples. The chemical data quality review and full laboratory report packages are provided in Appendix E.

7.0 LIMITATIONS

Work for this project was performed, and this report prepared, in general accordance with generally accepted professional practices for the nature and conditions of the work completed in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of the Washington State Department of Ecology for specific application to the Northlake Shipyard Site. This report is not meant to represent a legal opinion. No other warranty, express or implied, is made.

8.0 REFERENCES

E&E 2009. Northlake Shipyard Sandblast Grit Study, Final Project Report, Seattle, Washington. Prepared by Ecology and Environment, Inc. and Herrera Environmental Consultants, for Washington State Department of Ecology. June 2009.

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GeoEngineers 1991. Report of Environmental Sampling, UNIMAR Yard 1 Dry Dock Facility, Lake Union, Seattle, Washington for United Marine International, Inc., September 19, 1991.

Hart Crowser 2012a. Biological Evaluation, Northlake Shipyard Sand Blast Grit Dredging - Interim Action, Seattle, Washington. Prepared by Hart Crowser, Inc., for the Washington State Department of Ecology. May 23, 2012.

Hart Crowser 2012b. Water Quality Monitoring Plan, Northlake Shipyards Interim Action, Seattle, Washington. Prepared by Hart Crowser, Inc., for the Washington State Department of Ecology. November 19, 2012.

Hart Crowser 2013. Sampling and Analysis Plan Northlake Shipyard Sand Blast Grit Dredging - Interim Action, Northlake Shipyard Site, Seattle, Washington. Prepared by Hart Crowser, Inc., for the Washington State Department of Ecology. January 7, 2014.

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Table 1 - Imported and Exported Material Quantities Summary

Exported Materials		
Material	**Quantity**	**Unit**
Dredged Sediment	10,115	tons
Scrap Steel	23	tons
Timber piles	20	each

Imported Materials		
Material	**Quantity**	**Unit**
Sand Backfill	3,357	tons

Table 2 - Sediment Documentation Sample Analytical Results

Sample ID	SMS Cleanup Objective	SMS Screening Level	Regional Ambeint Mean	Maximum Observed*	SS-01-2014-02-25	SS-02-2014-01-07	SS-03-2014-01-03	SS-04-2014-02-07
Sampling Date					2/25/2014	1/7/2014	1/3/2014	2/7/2014
Total Moisture in %					89	59	44	86.0
PAH in mg/kg								
naphthalene					0.062 U	0.8	1.2	0.046 U
2-methylnaphthalene					0.062 U	0.21	0.48	0.046 U
1-methylnaphthalene					0.062 U	0.095	0.22	0.046 U
Acenaphthylene					0.062 U	0.28	0.51	0.046 U
Acenaphthene					0.062 U	0.14	0.3	0.046 U
Fluorene					0.062 U	0.2	0.48	0.046 U
Phenanthrene					0.062 U	1.1	2.4	0.046 U
Anthracene					0.062 U	0.4	0.82	0.046 U
Fluoranthene					0.062 U	1.2	2.3	0.046 U
Pyrene					0.062 U	1.3	2.6	0.046 U
Benzo(a)anthracene			2.8		0.062 U	0.63	1.2	0.046 U
Chrysene			3.3		0.062 U	0.57	1.1	0.046 U
Benzo(b)fluoranthene			3.2		0.062 U	0.6	1.1	0.046 U
Benzo(j,k)fluoranthene			2.5		0.062 U	0.2	0.32	0.046 U
Benzo(a)pyrene			4.2		0.062 U	0.59	1.1	0.046 U
Ideno(1,2,3-c,d)pyrene			25		0.062 U	0.33	0.54	0.046 U
Dibenz[a,h]anthracene			0.72		0.062 U	0.086	0.2	0.046 U
Benzo[g,h,i]perylene					0.062 U	0.57	0.97	0.046 U
TPAH mg/kg	17	30	46		0.062 U	9.301	17.840	0.046 U
Metals mg/kg								
Arsenic	14	120	54	4070	14	19	44	140
Copper	400	1200		3580	24	48	67	250
Lead	360	1300	520	3400	46 U	56	89	130
Zinc	3200	4200		10600	35	130	240	360

U = Not detected at the reporting limit indicated.
PAH=Polycyclic Aromatic Hydrocarbons
SMS= Sediment Management Standards
TPAH= Total Polycyclic Aromatic Hydrocarbons
* = Data from 2009 E&E Sandblast Grit Study

Table 2 - Sediment Documentation Sample Analytical Results

Sample ID	SS-05-2014-02-17	SS-06-2014-01-28	SS-07-2014-03-25	SS-08-2014-03-17	SS-09-2014-03-17
Sampling Date	2/17/2014	1/28/2014	3/25/2014	3/17/2014	3/17/2014
Total Moisture in %	84	15	91	88.0	88.0
PAH in mg/kg					
naphthalene	0.13	0.0095	0.11	0.73	0.14
2-methylnaphthalene	0.083	0.0079 U	0.072 U	0.055 U	0.056 U
1-methylnaphthalene	0.11	0.0079 U	0.072 U	0.055 U	0.056 U
Acenaphthylene	0.041 U	0.0079 U	0.072 U	0.055 U	0.056 U
Acenaphthene	0.078	0.0079 U	0.072 U	0.055 U	0.064
Fluorene	0.063	0.0079 U	0.072 U	0.055 U	0.07
Phenanthrene	0.22	0.015	0.18	0.095	0.28
Anthracene	0.1	0.0079 U	0.078	0.055 U	0.097
Fluoranthene	0.19	0.014	0.33	0.15	0.37
Pyrene	0.21	0.016	0.37	0.15	0.39
Benzo(a)anthracene	0.066	0.0079 U	0.13	0.078	0.16
Chrysene	0.07	0.0079 U	0.12	0.072	0.17
Benzo(b)fluoranthene	0.041	0.0079 U	0.087	0.055	0.13
Benzo(j,k)fluoranthene	0.041 U	0.0079 U	0.076	0.055 U	0.12
Benzo(a)pyrene	0.063	0.0079 U	0.12	0.079	0.16
Ideno(1,2,3-c,d)pyrene	0.041 U	0.0079 U	0.073	0.055 U	0.098
Dibenz[a,h]anthracene	0.041 U	0.0079 U	0.072 U	0.055 U	0.056 U
Benzo[g,h,i]perylene	0.041	0.0086	0.11	0.061	0.13
TPAH mg/kg	1.465	0.063	1.784	1.470	2.379
Metals mg/kg					
Arsenic	15 U	12 U	35	11	50
Copper	21	9.3	48	21	63
Lead	31 U	5.9 U	54 U	41 U	42 U
Zinc	33	21	120	32	97

U = Not detected at the reporting limit indicated.
PAH=Polycyclic Aromatic Hydrocarbons
SMS= Sediment Management Standards
TPAH= Total Polycyclic Aromatic Hydrocarbons
* = Data from 2009 E&E Sandblast Grit Study

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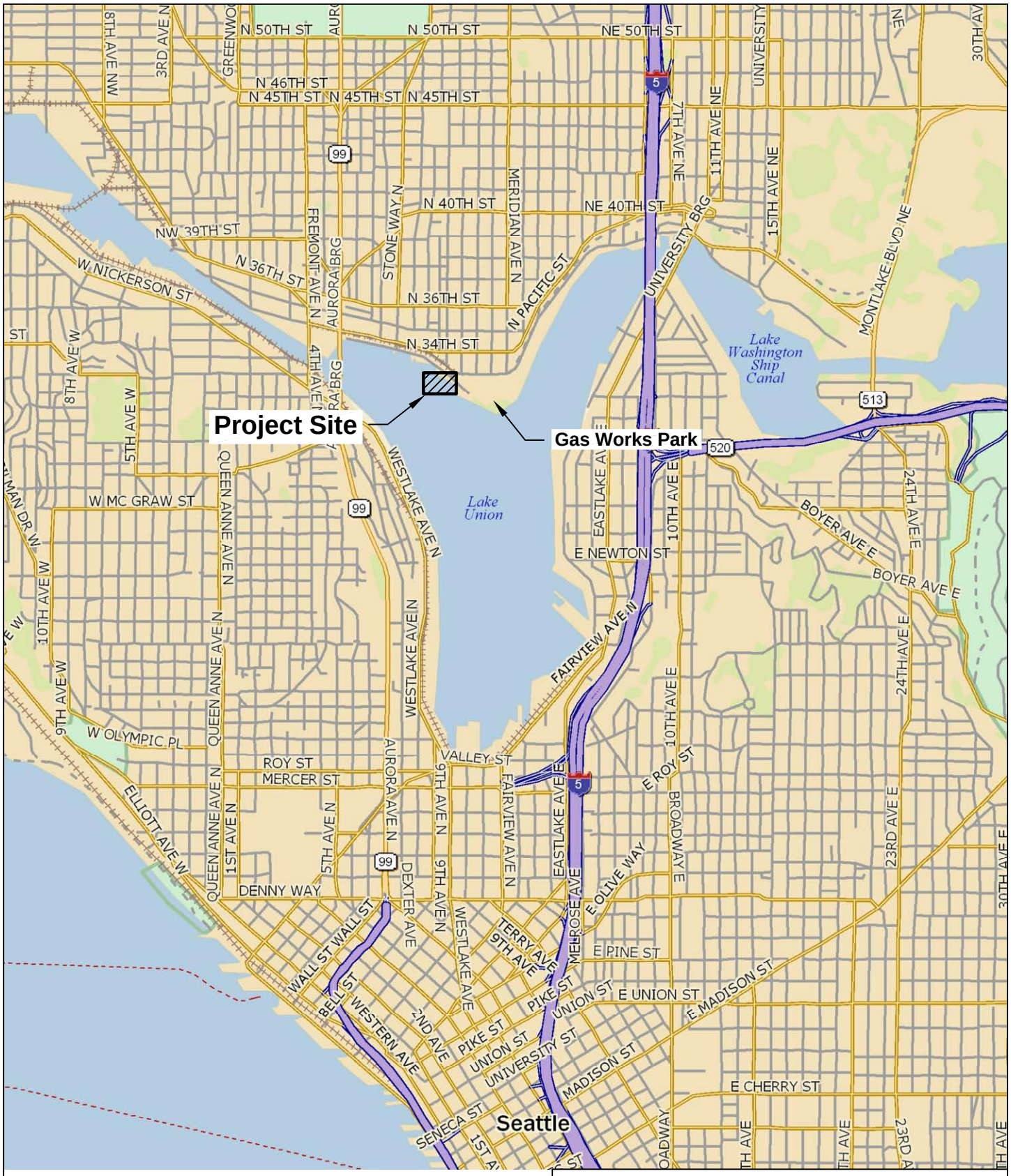

Source: Base map prepared from DeLorme Topo 7.0, 2007.

0 0.5 1.0

Scale in Miles

N

Northlake Shipyard
Seattle, Washington

Vicinity Map

17800-26 1/14

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Figure **1**

EAL 01/7/14 1780026-015.dwg

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DNR Moorage

Northlake Shipyards
Property Boundary

8
4
0
-4
-8
-12
-16
-20

Waterway 21

Pier

Dry Dock 2

Dry Dock 9

Suspected Sunken Vessels

State-Owned
Aquatic Land

DNR Lease to
Northlake Shipyards

Notes:
1. Bathymetry from 2008 TetraTech report.

N

0 80 160
Scale in Feet

Northlake Shipyard
Seattle, Washington

Pre-Construction Conditions Plan

17800-26 6/14

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Figure
2

MAS 06/16/14 1780026-22.dwg

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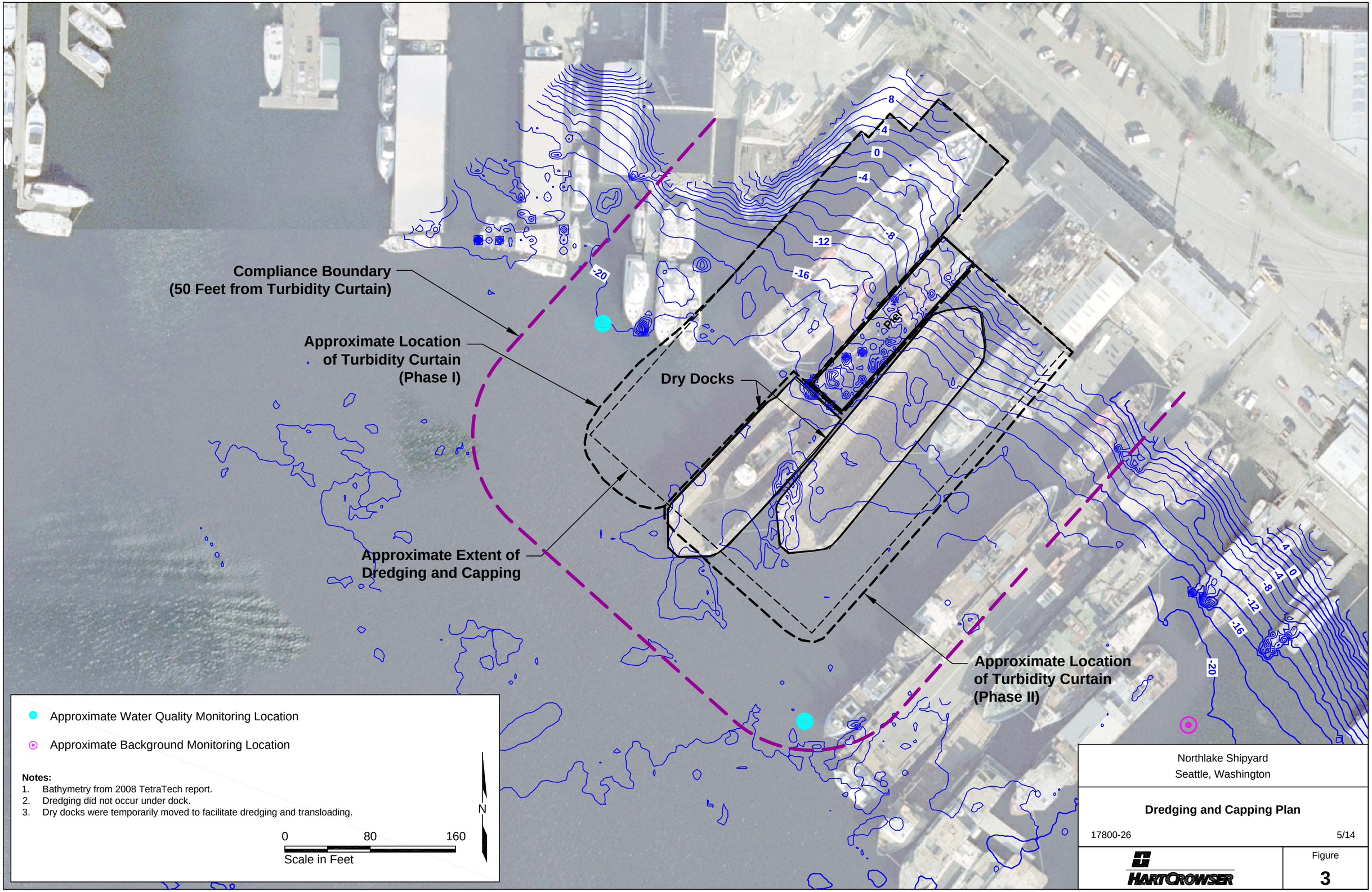

Northlake Shipyard
Seattle, Washington

Dredging and Capping Plan

17800-26 5/14

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Figure
3

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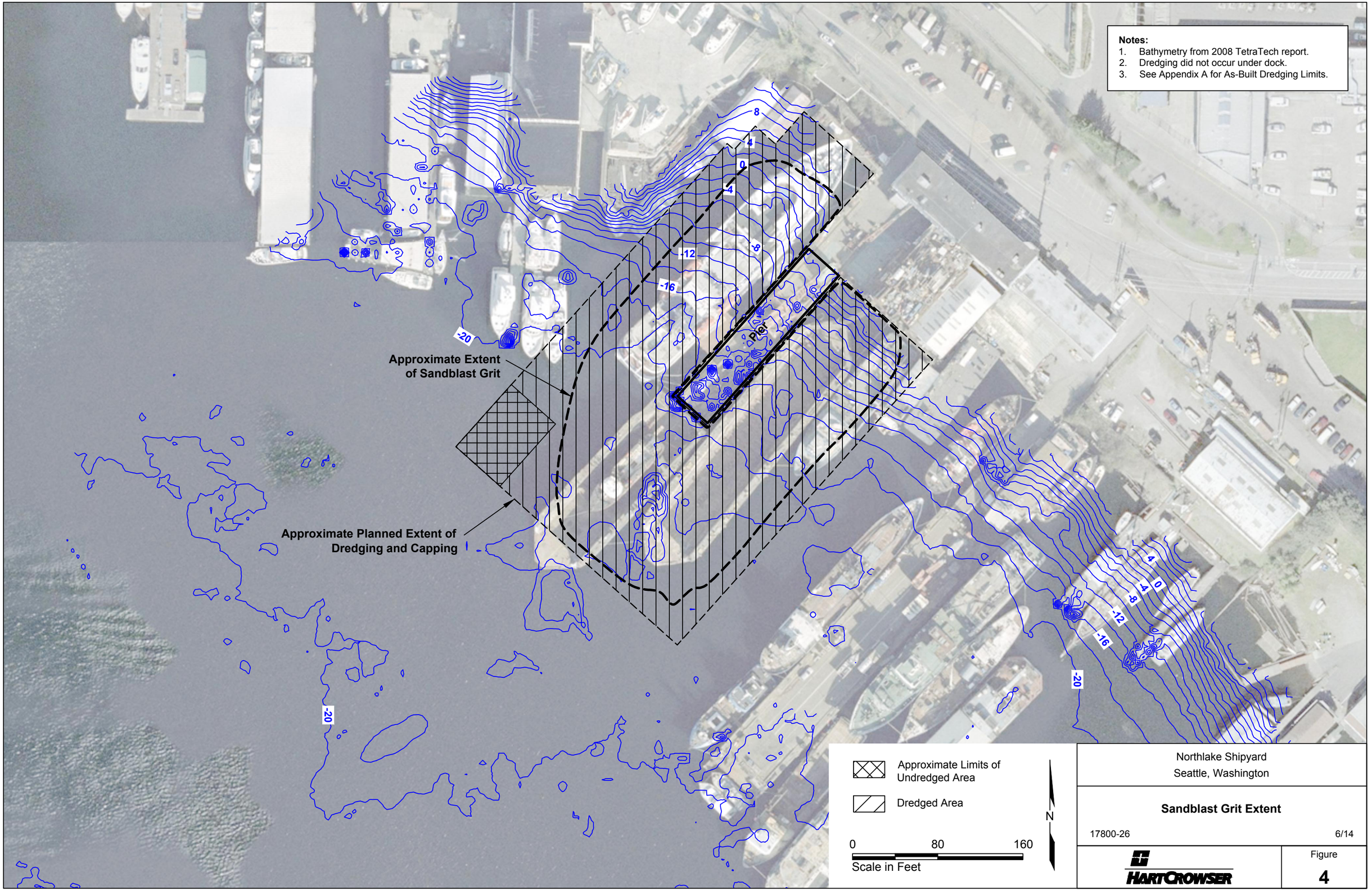
Notes:
1. Bathymetry from 2008 TetraTech report.
2. Dredging did not occur under dock.
3. See Appendix A for As-Built Dredging Limits.
8
4
0
-4
-8
-12
-16
-20
Pier
Approximate Extent of Sandblast Grit
Approximate Planned Extent of Dredging and Capping
Approximate Limits of Undredged Area
Dredged Area
0
80
160
Scale in Feet
N
Northlake Shipyard
Seattle, Washington
Sandblast Grit Extent
17800-26
6/14
HARTCROWSER
Figure
4
MAS 06/17/14 1780026-21.dwg

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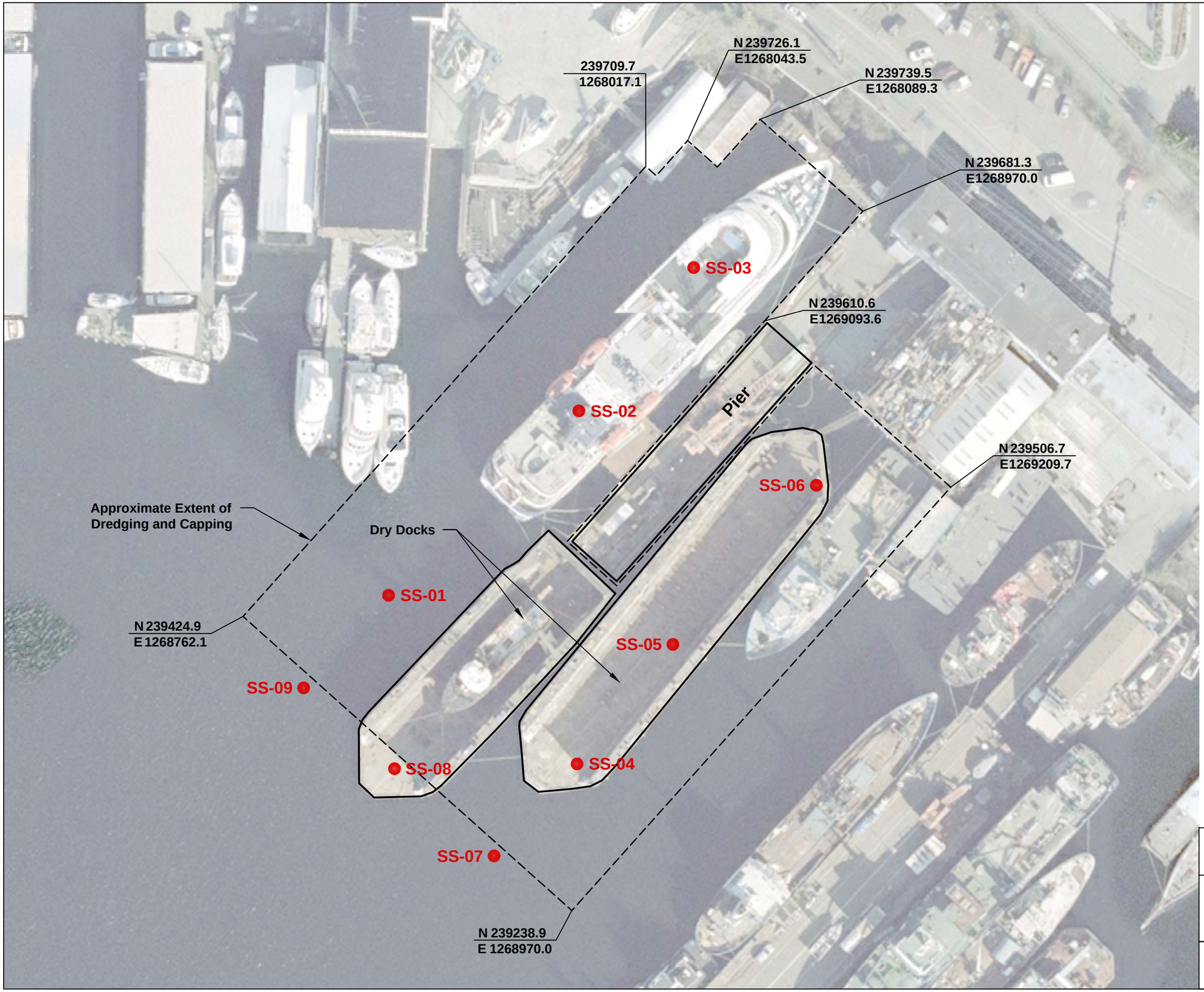

SS-01 Sample Location and Number

Sample Coordinates		
Sample ID	**Northing**	**Easting**
SS-01	239438.3	1268854.2
SS-02	239554.9	1268974.5
SS-03	239645.6	1269047.1
SS-04	239331.7	1268973.4
SS-05	239407.3	1269034.0
SS-06	239508.0	1269124.7
SS-07	239273.5	1268920.9
SS-08	239328.7	1268857.9
SS-09	239379.8	1268800.5

N

0 60 120

Scale in Feet

Northlake Shipyard
Seattle, Washington

Sediment Documentation Sample Locations

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Figure
5

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