# REVITALIZING A PUBLIC TREASURE: SEDIMENT CLEANUP AND RESTORATION OF THE EDDON BOATYARD PROPERTY IN GIG HARBOR, WASHINGTON

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## ABSTRACT

Waterfront restoration projects can be especially challenging when they involve central public spaces with significant historic value, community investment, sediment cleanup regulations, habitat improvements, and restrictive permit requirements. The Eddon Boatyard Property (Property), recognized as a significant portion of the historic waterfront of the City of Gig Harbor (City), Washington, is an example of how such challenges can be successfully met.

In an effort to preserve this portion of the historic waterfront and to develop a waterfront park, the residents of the City approved the $3.5 million Land Acquisition and Development General Obligation Bond (Proposition 1). Working under an Agreed Order (AO) with the Washington State Department of Ecology (Ecology), initial park development activities included necessary environmental cleanup of upland and aquatic portions of the Property, while preserving a historical boathouse and related structures. Subsequent nearshore and offshore environmental cleanup was partially funded by the previous owner and through the U.S. Environmental Protection Agency (USEPA) Brownfield Cleanup Grant Program and Washington Department of Natural Resources (DNR) creosote piling removal program.

The cleanup action required by Ecology generally involved the demolition and removal of existing marine and shoreline structures (i.e., a timber pier, two sets of boat haul-out rails, and a timber bulkhead) and relocation of a floating dock, gangway, and carriageways assembly. Working with limited adjacent upland staging and rehandling areas, shallow water depths, and strict environmental controls, the cleanup action also involved the dredging and disposal of marine sediment at an off-site upland disposal facility. In select areas, sand and select habitat material were placed by mechanical methods to return the intertidal area to the original depths and isolated sediments that exceeded cleanup levels. The timber bulkhead removal was required by Washington Department of Fish and Wildlife (WDFW) as a permit requirement and incorporated the bulkhead removal and creation of new beach habitat. The land behind the bulkhead was reconfigured to a gentle slope down to the beach, and a clean layer of sand and habitat gravel was placed at the Property. The overall post cleanup configuration was consistent with future park construction efforts.

All cleanup activities were completed during early 2009, with subsequent activities, including reconstruction of the pier and marine waterways, to follow. Although the site was relatively small, work was successful due to the selection of an experienced contractor, effective public outreach, a cooperative working relationship between Ecology representatives and the contractor, creative methods to optimize in the dry work during nighttime low tides, and the ability to address critical issues in real time.

**Keywords:** Dredging, habitat integration, park design, intertidal dredging and capping, aquatic permitting, construction management.

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## INTRODUCTION

The Property, shown in aerial view on Figure 1, is located in the City of Gig Harbor (City), Washington, where it is recognized as a significant portion of the City's historic waterfront. In 2004, the residents of the City approved the $3.5 million Proposition No. 1 Land Acquisition and Development General Obligation Bond (Proposition No. 1) to preserve this portion of the historic waterfront. After completing a review of environmental conditions, the City purchased the Property in March of 2005 with the intention of developing it into a waterfront park and housing an interactive shipbuilding museum at the Property's historic boathouse. To meet this objective, initial park development activities included hiring an environmental consultant through a competitive bid process, selective building demolition, land clearing, and necessary environmental cleanup of upland and aquatic portions of the Property where necessary, while preserving a historical boathouse and related structures located on site. Environmental remedial actions were coordinated and partially funded through the U.S. Environmental Protection Agency (USEPA) Brownfield Cleanup Grant Program and the Washington Department of Natural Resources (DNR) creosote piling removal program.

**Figure 1. Aerial view of pre-construction Property, Gig Harbor, Washington.**

To execute the environmental cleanup actions in an efficient and proactive manner, the City submitted an application under the Washington State Department of Ecology (Ecology) Voluntary Cleanup Program (VCP) in late June of 2005 and initiated a number of field investigations and subsequent remedial actions, which, after receiving approval from Ecology, allowed the City and Ecology to enter into Agreed Order (AO) No. DE 5597 on August 8, 2008 (Ecology 2008). A Cleanup Action Plan (CAP) was developed using information developed under the VCP process and was prepared to satisfy the requirements of the Model Toxics Control Cleanup Act (MTCA), Chapter 70.105D Revised Code of Washington (RCW), administered by Ecology under the MTCA Cleanup Regulation, Chapter 173-340 Washington Administrative Code (WAC).

## DEVELOPMENT OF CLEANUP AND RESTORATION APPROACH FOR SITE

One of the initial steps identified by Ecology was the development of appropriate cleanup actions through a Data Assessment and Conceptual Cleanup Plan (Anchor 2005), which presented an initial evaluation of cleanup action alternatives for the aquatic portion of the Property. Steps needed in developing this plan included:

- Selection of an environmental consultant through the City's competitive bid process
- Definition for appropriate cleanup standards for the upland and offshore portions of the site
- Identification and initial screening of potential remedial approaches for the site
- Evaluation of each potential remedial approach against relevant cleanup criteria
- Identification of a preferred cleanup alternative for the site

The overall goal of the cleanup study was to achieve an acceptable determination by Ecology that the selected cleanup alternative would meet the substantive requirements of MTCA and its implementing regulations (Chapter 70.105D RCW and Chapter 173-340 WAC). In order to weigh the relative merits of different cleanup alternatives, these alternatives were compared against a set of standard cleanup criteria that are listed in Ecology's Sediment Management Standards (SMS; per Washington Administrative Code [WAC] 173-204-560 [4]), as follows:

- Overall Protectiveness of Human Health and the Environment. This criterion addresses the time required to achieve pertinent cleanup standards, and the potential for implementing the cleanup to result in on-site or off-site impacts and risks to human health and the environment.
- Attainment of Cleanup Standards. This criterion addresses the degree to which the cleanup alternative complies with applicable federal, state, and local requirements.
- Short-Term Effectiveness. This criterion addresses the degree to which the cleanup alternative is protective of human health and the environment during its implementation and construction.
- Long-Term Effectiveness. This criterion addresses the degree to which the cleanup alternative is protective of human health and the environment after it has been implemented and into the future, factoring in such considerations as the degree of certainly that the alternative will be successful, and the effectiveness of instituted controls for continuing discharges and remaining waste.
- Ability to be Implemented. This criterion considers the feasibility of successfully implementing the cleanup alternative—specifically, its technical constructability, the availability of required resources and facilities, the likelihood of landowner cooperation, the availability of access for required site activities, and integration with existing site operations and actions.
- Cost. This includes consideration of present and future direct and indirect costs related to construction, operation, and maintenance.
- The Degree to which Community Concerns are Addressed. This criterion addresses the likelihood of the cleanup alternative to meet with community acceptance, including its consistency with future site needs and anticipated public usage.

**DELINEATION OF CHEMICAL CRITERIA AND IMPACTED AREAS AT PROPERTY**

Based on a series of field investigations undertaken by the City, and following discussions with Ecology, contaminants known to have elevated concentrations at the Property included mercury, copper, lead, phthalates, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and tributyltin (TBT). The criteria against which these constituents were compared, representing their potential to cause adverse effects on biological resources, were evaluated against published or commonly accepted numeric criteria. Two sets of criteria were utilized in this process for the Property: SMS sediment quality standards (SQS) and cleanup screening level (CSL) numeric criteria, from WAC 173-204-310(1)(a). For TBT, which did not have standard criteria in the SMS and CSL listings, three "benchmark criteria" for porewater and sediment were used instead to determine the levels at which remedial action was needed, including open-water disposal screening levels from Puget Sound Dredged Disposal Analysis (PSDDA; 2000), a site-specific relationship between bulk chemistry and porewater, and an organic-carbon-normalized criterion of 6 parts per million (ppm) (Meador, et al 2002).

After several rounds of field sampling and analysis, the nature and extent of sediments that exceeded these criteria were well defined for the Property, both in sediment and in porewater. Surface sediments and nearshore soils exceeded one or both of these criteria at one or more locations, which were used to define the area over which site cleanup would be needed. This boundary is depicted on Figure 2 by the line labeled "Extent of Sediment Cleanup Area," and encompasses all exceedances of SMS chemical criteria, as well as all exceedances of the three TBT benchmark criteria discussed above for porewater and sediments.

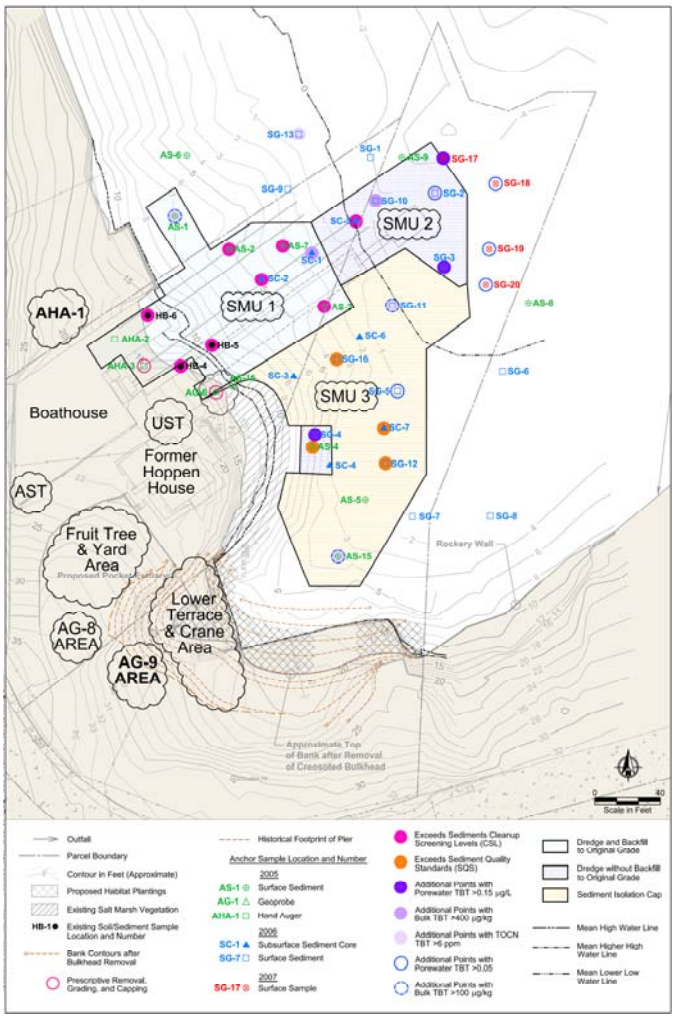


**Figure 2. Layout of Remedial Actions on the Property.**

## SELECTED COMBINED CLEANUP APPROACH: DREDGING AND CAPPING

Having defined the areas over which chemical exceedances existed, the City then evaluated several possible cleanup action alternatives for the Property, including:

- No action
- Monitored natural recovery
- Enhanced natural recovery/thin-layer capping
- Engineered sediment isolation capping
- Dredging and disposal
- Combinations of the above

Design considerations were documented in a Technical Memorandum to Ecology (Anchor QEA 2009a). Based on the known depth of contaminant exceedances at the Property, the dredging depth was selected as 2 feet (0.6 meters [m]), with an additional foot of allowable overdredging. Meanwhile, the design evaluation of engineered capping of impacted soils at the Property was done consistent with the guidelines set forth in USEPA's *Guidance for In-Situ Capping of Contaminated Sediments* (1994), published as part of the agency's Assessment and Remediation of Contaminated Sediments (ARCS) program. Additional guidance is published in Technical Report DOER-1 by the U.S. Army Corps of Engineers (USACE) Waterways Experiment Station, entitled *Guidance for Subaqueous Dredged Material Capping* (USACE 1998). The typical placement section for capping/backfilling materials was a

1-foot- (0.3 m) thick layer of clean sand, overlain by a 6-inch- (15 centimeters [cm]) thick layer of habitat-suitable and erosion-resistant gravel. Final grades need to be achieved within a design tolerance of 12 inches (0.3 m).

Based on a comparison against the various SMS criteria as listed above (environmental benefit, cost, ability to be implemented, etc.), the City proposed to Ecology that a combined cleanup approach—in which prescriptive sediment removal from highest-contamination areas is combined with engineered isolation capping for the rest of the impacted sediments—would be the most implementable, environmentally protective, fully permittable, and cost-effective remedy. The combined approach, depicted in Figure 2, would meet all project goals and SMS requirements by remediating all sediments with exceedances. More intensive construction approaches, such as full dredging of all sediments with chemical exceedances, were shown to provide little to no significant gains in environmental effectiveness, while requiring greater costs and posing more short-term effects from construction.

The remedial work, however, would need to be done without significantly altering existing elevations, thus requiring that dredged areas be subsequently backfilled to achieve original grades, and the remedial work would need to result in a stable, erosion-resistant substrate that would support future use of the Property. Furthermore, all construction work would need to be protective of historic properties and sensitive saltmarsh vegetation habitat at the site.

The selected cleanup action, therefore, involved dredging and disposal of marine sediments from selected areas (shown with blue and purple shading on Figure 2), with the sediments disposed of at an off-site upland disposal facility. In select areas, sand and select habitat material were placed by mechanical methods to return the dredge area to the original depths and isolated sediments that exceed cleanup levels. Other areas, shown in yellow shading on Figure 2, received a layer of clean sand to confine underlying sediments.

A set of marine railways and a timber pier (Figure 3) were present within the area requiring sediment removal. As part of the process of gaining concurrence from Ecology, the City elected to demolish the marine structures (i.e., a timber pier and two sets of boat haul-out rails), including their timber support piling; while relocating and preserving a floating dock, gangway, and carriageways assembly as that these features could be rebuilt at the site in the future. The demolition actions would greatly facilitate the contractor's ability to accomplish full removal of impacted sediments.

**Figure 3. Timber pier structure to be removed prior to dredging.**

In addition, removal of a timber bulkhead was required by Washington Department of Fish and Wildlife (WDFW) as a requirement of the Hydraulic Project Approval (HPA). The land behind the removed bulkhead was to be reconfigured to a gentle slope down to the beach, and a clean surficial layer of habitat-friendly sand and gravel placed.

In summary, cleanup actions consisted of the following, as depicted on Figure 2:

- Demolition and removal of existing marine and shoreline creosote treated timber structures (i.e., a timber pier, two sets of boat haul-out rails, and a timber bulkhead; 87 creosote-treated timber pilings)

- Deconstruction, salvage, and temporary relocation of a floating dock, gangway, and historic carriageways assembly
- Removal, by dredging, of contaminated marine sediments in intertidal and offshore areas
- Localized excavation and removal of contaminated upland soils
- Placement of clean backfill and/or capping materials in selected marine and upland areas
- Reconfiguration of nearshore land to a gently sloping beach with habitat-suitable gravel surface

The City received Ecology's concurrence that the selected cleanup action alternative for the offshore aquatic portion of the Property was indeed sufficient to meet the specific substantive requirements of the MTCA and its implementing regulations (Chapter 70.105D RCW and Chapter 173-340 WAC) for characterizing and addressing release(s) at the Property. With this concurrence, the City proceeded with the permitting, design, and construction processes.

## PROJECT PERMITTING AND PUBLIC OUTREACH

As required under the AO and applicable federal, state, and local regulations, project permitting was coordinated with Ecology, the WDFW, the USACE, DNR, National Oceanic and Atmospheric Administration (NOAA), and the City. Project permits are listed below:

- Hydraulic Project Approval (HPA)
- Shoreline Management Substantial Development Permit (SMSDP)
- Mitigated Determination of Non-significance (MDNS)
- Water Quality Certification (WQC) from Ecology
- Joint Aquatic Resources Permit Application (JARPA)
- Endangered Species Act (ESA) Concurrence
- Certificate of Appropriateness and Clearing and Grading Permit from the City
- US Corps of Engineers (Corps)
- City State Environment Policy Act (SEPA ) Process

In addition to the permitting process, the project underwent a thorough process of public review and discussion, which was essential since the work was funded by a voter-approved initiative, and residents were highly invested in its successful completion, Public participation occurred through numerous open house and City Council meetings, as well as through articles in local newspapers.

## KEY CONSTRUCTION CHALLENGES

Approximately 3 acres (12,100 square meters) in size, the Property was a relatively small, complex, and unique site, with limited access from the landside. The Property was also subject to a high level of public interest and oversight. These factors posed challenges for the remediation project. Another fundamental challenge was the fact that much of the area requiring remediation—less than 0.5 acre (2,000 cubic meters)—was intertidal, with dredging and clean material placement needing to span upland, intertidal, and offshore areas.

Upland and nearshore areas were reachable by land-based equipment (such as a backhoe or trackhoe with articulating bucket). In intertidal areas, in order to reach locations farther out from shore, equipment would have to travel over the soft sediment surface while avoiding the saltmarsh vegetation. Furthermore, the contractor needed to determine the best way to approach dredging and materials placement in the tidally influenced zone. Land-based equipment would require scheduling work around periods of tidal inundation, while water-based equipment would be similarly constrained to high tides. In either case, the use of long-reach equipment (such as a conveyor or a maneuverable spreader system on floats) was an alternative that could reduce the need to schedule work around high-tide or low-tide events.

Access to landside and intertidal areas was further complicated by the need to work around and preserve, the Property's historic boathouse, an adjacent historic home, selected mature trees, and a prominent shoreline patch of saltmarsh vegetation (protection of this vegetation via an "exclusion zone" was a key permit requirement).

Other key project challenges included the following factors:

- The site was immediately adjacent to a heavily traveled public thoroughfare (Harborview Drive and Stinson Avenue). Harborview Drive is home to shops and restaurants frequently visited by tourists.
- The site is adjacent to an active commercial fishing pier, moorage for recreational boats, and adjacent to private residents.
- Implementation of the cleanup action required preservation of a historical boathouse, related structures, and selected trees located on-site.
- Regulatory agencies required the work to be done with strict environmental controls and best management practices (BMPs) in place, including continuous deployment of floating booms and silt curtains around all in-water work and protections against runoff and erosion on the landside.
- Placement of cap and habitat materials needed to be carefully controlled as to allow for previously existing site grades to be re-established, which required a high level of construction quality control within intertidal and offshore areas.
- The Property needed to be left in a condition that was suitable for the City's plans for future building restoration and park development.
- The project was subject to a high degree of public scrutiny since it was a voter-approved initative and was taking place at a central public location.
- Historic structures on site required special measures for deconstruction and salvage, as well as archaeological observation.

Ultimately, the Project was successful due to the selection of an experienced contractor, effective public outreach (as described earlier), a cooperative working relationship with Ecology representatives, creative methods to optimize in the dry work during nighttime low tides, and the ability to address critical issues real time. The remainder of this paper focuses on the individual elements of construction, and how the selected contractor and construction management team achieved a successful project.

## BID PROCESS AND CONTRACTOR SELECTION

The construction contract was awarded through a formal public works bid process. While the City, as a public entity, had to select the lowest bid, the contract documents clearly established a set of minimum requirements for contractors to be determined as fully responsive and responsible. These requirements were used to ensure that the selected "most responsive" would be an outfit with an appropriate degree of experience working on cleanup projects with similar issues and challenges.

The Notice to Proceed (NTP) was issued on July 29, 2008, and mobilization to the Property started on August 25, 2008.

## MOBILIZATION AND SITE PREPARATION

Site preparation began with setup of temporary facilities, a project office, and other related structures, which were located in the upland areas of the park and remained in their locations for the duration of the project. Site preparation also included laying out a staging area on the construction site to allow for staging and stockpiling of imported materials, demolition debris, and excavated soil and sediment, allowing for ready ingress and egress of trucks and equipment. Upland staging and stockpiling areas were prepared to contain water and solids per established BMPs, as to prevent impacts to surface water. Temporary storm drainage siltation filters were installed in all storm sewer catch basins that outfall in the vicinity of the Property. The Contractor was also required to establish a traffic control system to allow safe truck access to and from adjoining Harborview Drive.

## DEMOLITION

As mentioned previously, existing marine and shoreline structures were demolished or salvaged and relocated to facilitate access to the marine sediments planned for removal. The demolition was accomplished using a combination of land-based excavation equipment and a water-based crane and included complete removal (by pullout) of timber support piling (Figure 4). The removal of these piles had the added environmental benefit of removing creosote from the environment, and as such was accomplished in coordination with the DNR. Creosote piling was removed from the following locations:

- **Marine Railways.** A total of 78 creosoted piles were removed from the railway area. The marine railway piles consisted of relatively short piles ranging in length from 2 to 4 feet (0.7 to 1.2 m). The visible marine railway piles were removed by an excavator and additional buried piles were removed during dredging activities.
- **Boatyard Pier.** A total of 41 creosoted piles were removed from the boatyard pier and pier footprint. The boatyard pier piles consisted of piles ranging in length from 8 to 20 feet (2.5 to 6 m). Nearly a third of the piles were removed by excavator from land and the remaining removed from waterside by floating crane and barge.
- **Wooden Bulkhead.** A total of 39 creosoted piles were removed from the wooden bulkhead structure. The wooden bulkhead was comprised of both piles and horizontal timbers. Both creosoted piles and horizontal timbers were removed by excavator.

All creosoted piles and timbers were transported to and disposed at the Pierce County Recycling and Disposal Facility, LRI Landfill, located in Graham, Washington. Creosoted material that was transported to LRI Landfill was documented through truck weigh tickets, documenting the date, time, and weight (tons) of the material entering the facility. A total of 66 tons (60,000 kilograms [kg]) of creosoted material was transported and disposed at the LRI Landfill.


**Figure 4. Extraction of timber piles using land-based excavator (left) and vibratory hammer (right).**

All creosoted piles and timbers were transported to and disposed at the Pierce County Recycling and Disposal Facility, LRI Landfill, located in Graham, Washington. Creosoted material that was transported to LRI Landfill was reported through truck weigh tickets, which documented the date, time, and weight (tons) of the material entering the facility. A total of 66 tons of creosoted material was transported and disposed at the LRI Landfill.

Boathouse appurtenances (marine railways and boat haul-out carriages) were dismantled and salvaged (Figure 5) to be reconstructed later by the City as part of their future park development.

The Site includes properties and structures that were identified by the Washington State Department of Archaeology and Historic Preservation (WADAHP) as having historic value. These the boathouse and its associated structures, and a nearby single family unoccupied residence. On March 14, 2008, final signatures were placed on a Memorandum of Agreement (MOA) between the U.S. Army Corps of Engineers, the State Historic Preservation

Office, and the City of Gig Harbor, regarding preservation, salvage, and documentation of historic structures at the Site, and archaeological observation of ground disturbance activities.

The MOA stipulated requirements for salvage and documentation associated with deconstructing the timber pier, boat cradles, and marine rails at the project site, since portions of these were considered to be artifacts with some historic and cultural value. To support the boat shop carriageway reconstruction efforts, the following information was collected during deconstruction, consistent with the Deconstruction Plan submitted to the Washington State Department of Archeology and Historic Preservation (DAHP), and the Contractor's Work Plan.

- The detailed as-built drawings that document the pre-disassembly configuration of the carriageway (McMillian Design, Inc.)
- American Civil Construction (ACC) clearly marked the joints and disassembly points consistent with the as-built label designation
- ACC hired a photojournalist to document (hard-copy and electronic version in project binder provided to the City in March of 2009) the entire carriageway and the labeled/disassembly points

ACC then removed large sections and were directed to store all salvage items within the boathouse. Together, the photojournalism documentation, as-built drawings, and labeling in photographs function as a plan for future re-assembly of these pieces.

**Figure 5. Dismantling of boat haul-out carriage for salvage.**

## DREDGING

Approximately 2,250 tons (2,000,000 kg) of sediment were dredged from the Property, generally to a depth of 2 feet (0.7 m) below mudline. Access ramps and log mats were placed (Figure 6) to allow access to intertidal and nearshore areas by a combination of a long reach track hoe and short reach track hoe (Figure 7). Dredging in areas farther offshore and not reachable at extreme low tides was performed over water by mechanical dredging equipment (clamshell bucket) during medium to high tide events.

**Figure 6. Use of gravel ramp and log mats to provide access for land-based dredging equipment.**

**Figure 7. Dredging with long-reach trackhoe, with area delineated using survey stakes.**

Confirmatory sediment samples were collected to assess if the prescribed dredging had fully removed the contaminated sediments, which could remain in place as a deeper deposit or could be residual sediment, an inevitable result of temporary resuspension, drop-back, and sloughing of sediment during the dredging process. In some locations, this confirmatory sampling indicated that additional dredging was needed.

At one location, additional dredging was conducted to a depth of a distinct silty/clay layer, and it was determined that the sampling result in this area was an artifact of sediment dredging residuals. An 8- to 12-inch (20 to 30 cm) layer of habitat-friendly gravel was placed to address this residual layer and to enhance natural recovery processes. At another location, where results indicated that chemically impacted sediments remained, additional dredging and excavation was performed until the sample area and adjacent sediments/soil had been removed. In both cases, additional dredging, conformational sampling, and placement of the clean material were all coordinated closely with Ecology.

## SEDIMENT REHANDLING, TREATMENT, AND DISPOSAL

Dredged sediment was hauled to off-site disposal locations via different methods for the land-based equipment dredging and the water-based equipment dredging. Sediment and soil that was removed using land-based equipment was stockpiled at the established on-site staging area. When the long-reach excavator was being used for dredging from areas farther offshore, it transferred the material to a smaller trackhoe, which moved it to the stockpiling area (Figure 8). From the on-land stockpile area, sediment was loaded into trucks for transport to the upland staging area and ultimately transported to the Pierce County Recycling and Disposal Facility located in Graham, Washington. Truck transport and landfill disposal required that the sediment be sufficiently dewatered to pass the “paint-filter” test, ensuring that free water was minimized during its transportation. Since stockpiling area was limited, the contractor elected to accelerate the dewatering process by adding sawdust and diatomaceous earth to the stockpiled sediment (Figure 9), which allowed it to be sent off-site sooner.

**Figure 8. Transfering dredged sediments from the long reach to the excavator to the staging area.**

**Figure 9. Mixing of sawdust and diatamateous earth into sediment to promote dewatering.**

Dredged material produced by on-water activity was stockpiled on a barge and transported by tugboat (Figure 10) to an offloading area in Tacoma, Washington. Dredged sediment was then loaded into trucks for transport to the LRI Landfill.

**Figure 10. Removal of dredged sediments by barge.**

Material management testing (using the toxicity characteristic leaching procedure [TCLP] analyses) in one location identified approximately 7 cubic yards (5.4 cubic meters) of sediment to be managed and disposed as dangerous waste in coordination with Ecology's Hazardous Waste and Toxics Reduction Program handling and reporting requirements. This material was disposed separately from the rest of the sediment.

## CAPPING AND MATERIALS PLACEMENT

As was described earlier, the cleanup action for the Property involved a combination of dredging and clean material placement and backfilling. The material placement achieved three distinct purposes:

- In areas that were dredged, clean materials were placed to re-establish pre-existing grades
- In areas that were not dredged, it promoted natural recovery and confinement of underlying chemically impacted sediments
- It provided a final gravel surface that was both resistant to erosive forces and promoted healthy habitat

Altogether, approximately 2,300 (2,1000,000 kg) tons of sand and approximately 1,950 tons (1,770,000 kg) of gravel were placed at the site. Figure 11 shows the site as it appeared after dredging and just prior to material placement, and then as it appeared after all materials had been placed.

**Figure 11. Views of site prior to cap placement (left) and following cap placement (right)**

Capping material was placed using a land-based, long-reach, telescoping conveyor belt (Figure 12). A majority of the capping activities were conducted during late-night hours and at low tide in order to precisely place and control the depth of sand and habitat mix and to ensure quick and traffic-free transport of the sand and rock from the off-site staging area. Grades and layer thicknesses were controlled through the use of interim land surveys and grade control survey stakes laid out on a grid and visible during low tides (Figure 13).

**Figure 12. Placement of sand cap using a telescoping conveyor belt.**

**Figure 13. Precision placement of the sand cap with grade control survey stakes showing remaining 6 feet of surface gravel needed.**

## ENVIRONMENTAL COMPLIANCE MEASURES

Project permits required that construction activities be done using environmental BMPS, including continuous and full enclosure of the waterside work area with a floating boom and silt curtain (Figure 14), to contain suspended solids (turbidity) and any material that may have been disturbed into the water. The pre-existing saltmarsh vegetation area needed to be protected throughout the construction work and was surrounded by high-visibility construction fencing (Figure 15).

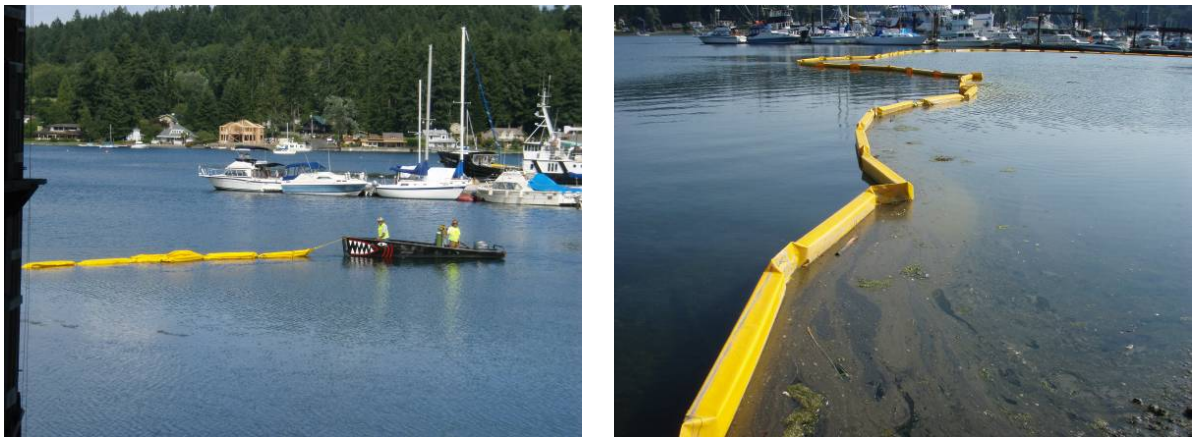

**Figure 14. Deployment and effective use of containment boom and silt curtain.**

**Figure 15. Installation of high-visibility construction fencing around saltmarsh vegetation area.**

The WQC received from Ecology required water quality (turbidity) monitoring and confirmatory sampling for areas of soil and sediment excavation and dredging. Soil testing was also required in the upland area where the bulkhead was removed and the area regarded to form a beach.

## DEMONSTRATION OF ENVIRONMENTAL EFFECTIVENESS

Post-cleanup confirmatory chemical and physical testing results are being documented in a final post-construction completion report for the site (Anchor QEA 2009b, in development) and demonstrate that existing surface soil and sediment quality meets SQS sediment quality criteria throughout the Property. This completion report will be submitted to Ecology, and upon their review and approval of this report along with their approval of an Institutional Control Plan (Anchor QEA 2009c) and Long-Term Monitoring Plan (Anchor QEA 2009d) for the Property, will meet the City's final obligations under the AO.

When Ecology provides written approval that the work has met its obligations under the AO, the City's subsequent park development phase will begin, which will consist of rebuilding the marine railway, pier, and floating dock, followed by park construction. The existing structures will be preserved or restored through an ongoing effort as locations for community, cultural, and educational activities.

## SUMMARY AND CONCLUSIONS

The Property underwent a complex cleanup action process during late 2008 and early 2009, completing an intensive effort by the City to clear an early step in its ultimate goal of turning this site into a public park that celebrates the City's historic waterfront heritage. The City face and met many hurdles during this process, all of which involved close coordination with Ecology through Ecology's VCP. Steps included:

- Performing an intensive series of field investigations to determine chemicals of concern, and their distribution at the site
- Defining appropriate cleanup criteria through detailed discussions with Ecology to gain their concurrence
- Evaluating various cleanup options against SMS remediation criteria, and concluding that a combination of dredging and clean material placement would be the most appropriate options
- Permitting and designing the project
- Construction
- Post-construction documentation

Throughout this process, the following strategies have been integral in the project's success and are recommended for similar projects by others, where appropriate:

- Coordinating closely and continuously with regulatory agencies (in this case, Ecology) and their technical staff
- Ensuring that the winning "low bid" contractor is experienced with remediation projects under similar circumstances
- Allowing the selected contractor the flexibility to determine their own approach and equipment for accomplishing the construction tasks in upland, intertidal, and offshore areas
- Granting as much flexibility as possible in terms of timeframes (no work hour restrictions, as that late night low-tide cycles could be taken advantage of)
- Developing a definitive monitoring and management program on the part of the Contractor, the City, and the City's consultant to ensure that each successive construction task was completed as planned, including surveys and staking
- Performing post-dredging and post-excavation sampling and having ability to make quick "real-time" decisions if additional remedial action, dredging, or capping was needed, including keeping Ecology fully aware on all such decisions
- City/Contractor partnering efforts and procedures resulted in the contract being completed ahead of schedule and under budget
- Awarded Contract = $1,040,098.00; Final Amount = $1,012,569.82; Saved =$27,528.19
- Documenting full post-construction characterization of conditions in a completion report

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