2015 WEDA Environmental Excellence Awards
Environmental Dredging

DREDGING DIOXINS WITH PRECISION

SUBMITTED BY:

MAUL FOSTER ALONGI

April 22, 2015

PROJECT SUMMARY: GOALS, OBJECTIVES, AND ACCOMPLISHMENTS

Miller's Landing is comprised of 40 acres of waterfront property that is owned by the Port of Ridgefield. It forms the city of Ridgefield's waterfront and, uniquely, is surrounded on three sides by the Ridgefield National Wil¬dlife Refuge. Since the beginning of the 20th Century, forest products industries operated on the property. For 30 years, beginning in 1963, wood was treated by Pacific Wood Treating (PWT), which at its peak, employed nearly 200 people. When PWT declared bankruptcy and abandoned the site, the Port was left to clean up the contamination of creosote, pentachlorophenol, copper, chromium, arsenic and dioxins in soil, groundwater, and sediment in a nearby river and wetland.

Removal of contaminated sediment in the river was the final component of a two decades long effort by the Port to characterize impacts to human health and the environment and implement remedial actions and cleanup uplands and aquatic environments. With the implementation of the in-water remedy, the site cleanup is now complete, ecological restoration has begun, and the Port and surrounding community are able to commence site development and enjoy use of the property for the next century.

Precision dredging.

The design for the in-water remedy that was developed by Maul Foster & Alongi, Inc. (MFA) was tailored to meet client development objectives and expedite permit approval while meeting regulatory requirements to protect human health and the environment. Over one hundred pilings and other structures and debris were removed, 12,000 cubic yards of sediment was dredged, and sand and rock were placed along approximately 2,200 feet of bank line to provide stability and limit transport of any potential contaminated residuals. The innovative design incorporated precision dredging, an approach that limits suspension of contaminated fine-grained sediment during construction; "fish-friendly" gravel to stabilize the bank; and shoreline habitat restoration. These environmentally sensitive components positioned the project for expedited federal and state permitting, resulted in significant cost and logistical advantages, and maximized restorative benefits.

PROJECT TEAM MEMBERS

Project Owners: Port of Ridgefield (Brent Grening, Laurie Olin, Bruce Wiseman, Scott Hughes, Joe Melroy), Washington State Department of Ecology (Ecology)

Stakeholders: Washington Department of Natural Resources, US Army Corps of Engineers, Tribes, National Marine Fisheries Service, Washington Fish and Wildlife

Design Engineer/Construction Oversight: Maul Foster & Alongi, Inc. – WEDA Member (Connor Lamb)

Dredging and Sediment Processing: Dixon Marine Services – WEDA Member (Mark Sutton)

Environmental Monitoring and Quality Control: Maul Foster & Alongi, Inc. – WEDA Member (Connor Lamb)

Nominating Entity: Maul Foster & Alongi, Inc.

ENVIRONMENTAL BENEFITS

The primary objective of the cleanup was to protect human health and the environment in the long term by removing toxic chemicals in the sediment; precision-dredging designed by MFA was selected as the method that would maximize environmental benefits. This remedy was determined by Ecology and stakeholders to provide the highest degree of certainty for immediate reductions in surface sediment contaminant concentrations, long-term protectiveness, and limiting short-term adverse effects to water quality during construction.

Scalloped riverbank edge; no generated residuals were observed.

The project improved long-term sediment and water quality by employing a technique that permanently reduces contaminant concentrations in sediments that could migrate to the water column. Dioxins at the parts-per-trillion level were determined to cause unacceptable risk to human health (through the ingestion of fish that accumulate these chemicals in their tissue) and to benthic invertebrates, fish, and aquatic-dependent wildlife. The dredging method facilitated removal of sediment at these very low concentration levels. Dredging is known to sometimes generate residuals, resulting in concentrations in the surface of the sediment to remain elevated above risk-based concentrations. However, precision dredging, as as designed by MFA for this project, limited disturbance of the finer sediment particles typically associated with dioxins, avoiding substantial generation of residuals. Dredging surfaces were observed during low-tide conditions, and the absence of a thin layer of sediment was confirmed.

While environmental dredging remedies are readily accepted as appropriate solutions for removing contaminated mass permanently from the environment, there are frequently concerns about short-term impacts during construction activities (e.g. reduced water quality through sediment resuspension). However, the precision dredging method designed by MFA proved to be effective both in mass removal of contaminants and in limiting short-term construction-related impacts. The monitoring developed by MFA and implemented during construction proved that the dredging method did not adversely impact water quality; and there was no significant generation of turbidity downstream of precision dredging operations. During an inspection, Ecology water quality staff said that it was the best-implemented project within their memory.

The project resulted in long-term benefits to aquatic-dependent species and fishers by significantly reducing chemicals in sediment that transfer directly (via physical contact) or indirectly (via trophic transfer) to organisms. Provision of clean substrate is expected to increase benthic invertebrate abundance in the long term, thereby enhancing the prey base for higher trophic level species. Further, accumulation of contaminants in the tissue of benthic invertebrates and fish will decrease, thereby reducing concentrations of contaminants in fish that are consumed by people.

Remedy design incorporated multiple considerations to minimize short-term impacts, as well as enhance habitat value for ecological receptors:

- Eighty-five degraded treated wood pilings and a timber-treated public access dock were removed. Removal of debris in sediments improves habitat conditions; debris removal reduces obstructions and

Native vegetation plantings.

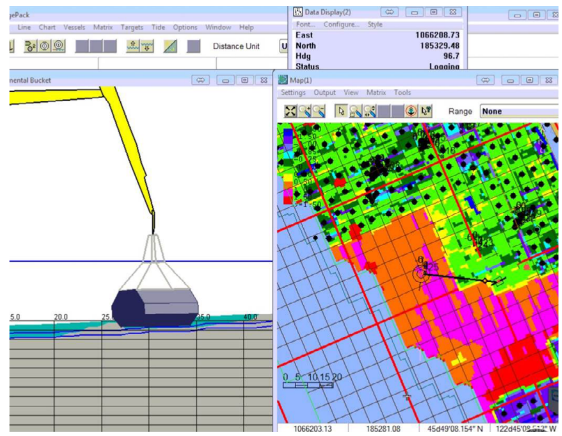
decreases shadowy light conditions, making it more difficult for piscivorous fish to prey on listed species.

- Native vegetation was planted, including approximately 50 trees, increasing the undeveloped riparian habitat by 1.5 acres.

- Fish mix (7-inch median diameter rounded river rock/cobble) was placed primarily in areas that were previously armored or consisted of gravel, cobbles, and debris, and will reduce existing fines and sand by 0.96 acres. Stabilization of the river bank with fish mix gravel and cobblestone will reduce erosion potential and eliminate transport of contaminated soil into the aquatic environment.

Innovation

To accomplish the contaminated sediment removal portion of the remedy, precision dredging—the primary water quality best management practice for the project—was developed as an appropriate method to remove the contamination and limit residuals generation and water quality impacts. The precision dredging approach involved a collection of operational and engineering controls implemented simultaneously to achieve site-wide water quality control and precise removal of contaminated sediment. The precision dredge method was developed because it limits sediment resuspension and associated potential adverse water quality effects without cumbersome and sometimes less effective engineered controls such as isolation of the work area. Further, the method allowed for removal of very low levels of contamination (in the parts per trillion range) such that institutional controls were not necessary.

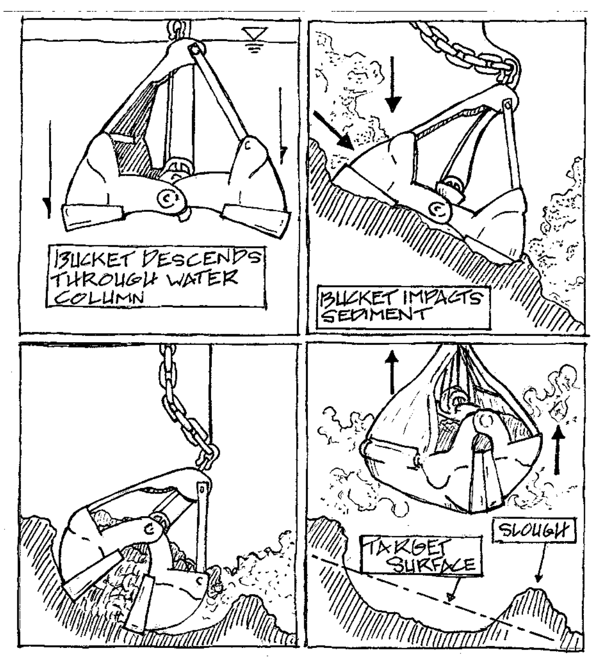


Software used by dredge operator to confirm location of the fixed-arm bucket.

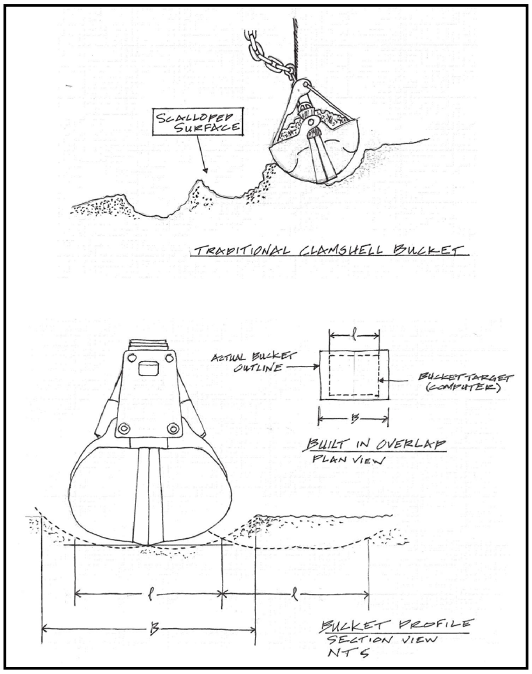
The use of specialty equipment was prescribed in the project design to achieve the control and precision intended. The design included a detailed removal grid developed in AutoCAD Civil 3D that allowed for methodical, phased removal with a high degree of control and tracking offered by RTK-GPS equipment. To reduce generated residuals, the design also included a multiple pass approach requiring bulk removal to be followed by a final cleanup pass.

The use of fixed-arm equipment with RTK-GPS allowed for precise placement of the bucket in three dimensions. Cable-mounted buckets offer significantly less precision than fixed-arm buckets due to cable sway and current deflection. Also, cable-mounted buckets often rely on the momentum of a dropped bucket to penetrate the sediment, which can lead to substantial sediment disturbance .

Fixed-arm buckets were lowered to the appropriate elevation



Slope Slough diagram.
Original artwork by Connor Lamb.



Fixed arm profile
Original artwork by Connor Lamb.

and maintained a static position while closing. The rigid connection of fixed-arm equipment afforded increased control while dredging on slopes, rather than deflecting downslope as cable-suspended buckets have a tendency to do .

BUCKET

The design required the use of a fully enclosed (vented at the top) rehandling clamshell bucket equivalent to that manufactured by the Young Corporation. The double-arc closing bucket left a clean, fairly level cut across the surface of the sediment compared to the "cratered" surface left by traditional clamshell buckets. Level-cut environmental buckets are often used to mitigate an uneven leave surface as they cut a flat profile and are fully enclosed; however, these buckets often result in much greater disturbance of sediment through the plowing motion inherent to their closing mechanism. Additionally, they leave plowed, loose, easily erodible ridges (i.e. windrows) of sediment at the extents of the bucket footprint. The sediment inside the Young rehandling bucket remained relatively undisturbed as the bucket cut through and closed around the sediment. Shallow water observations after dredging revealed a smooth flat cut surface with no noticeable disturbed sediment layer.

Use of the Young bucket limited sediment disturbance at the cut interface and loss of sediment when raised from the river bottom. Observations of the bucket operating in shallow water during implementation confirmed that even localized turbidity was negligible and often nonexistent.

Due to the enclosed bucket, precision dredging generates a large quantity of water that must be managed and treated. An enhancement in handling the generated water was realized through the vestige of a contractor-proposed slurry transport method. The method, intended to replace mechanical transload, included the use of a hopper on the dredge barge. The relatively undisturbed condition of the sediment keeps the water that gets entrained in the bucket segregated or "free" from mixing. As a result, the bucket could be held above the hopper and opened slightly allowing the free-water to decant and the sediment to remain . The sediment was then placed in the material barge with substantially less water. The decanted water in the hopper was pumped via a floating pipeline to an upland facility where it was treated and eventually discharged back into the river. Removing the water from the sediment before transload resulted in a cleaner and more efficient process.

Young Bucket.

Controls on operations and phasing were specified in the design and implemented during the project to maximize the success of the project as follows:

- Continuous oversight of each component was conducted to verify that the design intent was met while adjusting to field conditions.
- Approval grids were developed as part of the oversight program, allowing for a clear line of communication and helping to define the project's progress to each party.

- A work-area delineation for water quality monitoring was developed, which included early warning and compliance sampling.
- A minimum of two dredge passes were required. The first pass removed the majority of the sediment, and the second targeted the lower prism boundary. A multiple-pass method of dredging contaminated material, with the last pass being the smallest volume removed, reduced generated residuals.
- Side slopes no greater than 3H:1V were designed in the prism and specified during the removal process to reduce over-steep slopes, undercutting during dredging, and sediment sloughing.

Economic Benefits

The regulatory community was quick to recognize that precision dredging methods effectively minimize sediment disturbance and prevent recontamination from spreading or affecting water quality. In addition to Ecology's approval, the method was readily accepted by the both the United States Army Corps of Engineers and National Marine Fisheries Service as a best management practice during the Clean Water Act and Endangered Species Act review. The selection of precision dredging proved to be a substantial benefit to the design approval and permitting process, gaining early agency buy-in and limiting overall transaction time and cost. In the National Marine Fisheries Service documentation of the project, the engineer-specified precision dredging method was called out as an approved approach to limit adverse effects to endangered species. The method, in part, reduced the amount of time needed for a federal ESA process from six months (i.e., a biological opinion) to six weeks (i.e., biological evaluation concurrence).

The implementation of the remedy has led to completion of site cleanup such that development at the Port property may now proceed. Because the dredging remedy was implemented successfully, there are no in-water restrictions for future development and no restrictions for fishing in the river or contacting the sediment. In fact, the Port was left with a "human friendly" beach, with public access for the community's enjoyment. This maximizes the flexibility for future development and is consistent with the owner's goal of preserving human habitat. The reconstructed shoreline is easily accessible from pedestrian trails along the entire length of the waterfront. The cleanup project positions the site for redevelopment with open space, public trails, and shovel-ready development pads all incorporated as part of the final remedy .

Transferability

The precision dredging and initial dewatering techniques applied during this project is transferrable to work involving multiple substrates, varied water depths, and multiple water body types even more so than traditional environmental dredging.

The bucket type is most crucial when work is occurring in an area of finer sediment particles because it limits the resuspension and post-dredging transport of this type of material. However, the bucket was also effective in project areas with cobbles and sand.

The physical system in the project area was amenable to dredging given the generally shallow water (less than 20 feet deep), and generally low water velocities (between 0 and 1.5 feet per second). The techniques employed during the project would be even more practical in deeper water and areas of higher velocities, because these types of challenging conditions would be more likely to result in transport of contamination as a result of sediment disturbance during traditional environmental dredging.

Use of the global positioning system and dredge operator software confirms, in real time, that contamination is being removed; maximizes efficiency; and lessens owner risk associated with not meeting project goals. These technologies have the potential to benefit any dredging project. These technologies also reduce bucket overfilling and associated resuspension, allowing the dredge operator to accurately control the depth of cut in a variety of materials.

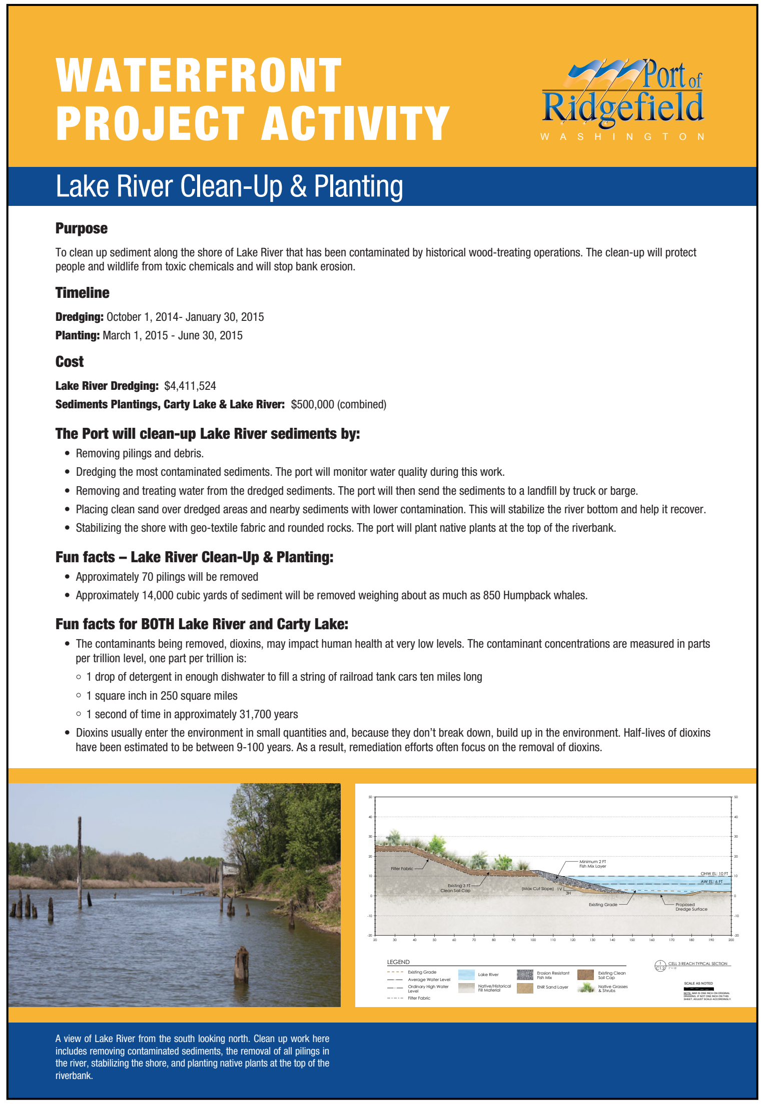
Outreach and Education

Outreach and education were key components to this successful remedy before and during implementation. In the permitting phase of the project, multiple meetings and presentations were conducted to educate the public, tribes, and permitting agencies. As indicated above, this outreach resulted in an efficient permitting process with limited time and costs.

The project site forms the town's waterfront and is located just a few blocks from downtown Ridgefield; the public is accustomed to accessing the area for walks, fishing, and boating. Before and during construction, the neighborhood's residents were given information about construction activities through mailings, signage near the site, and fliers provided at local functions.

During construction multiple tours were provided:

- Managers at nearby ports with similar environmental challenges visited the site and observed the construction activities.
- The project scientists and engineers gave a tour to the town's high school STEM/science students to discuss the environmental benefits of the project and career opportunities .
- Multiple groups from the Oregon regulatory community facing environmental challenges in aquatic environments, including the Portland Harbor, visited the site to observe the precision dredging.



Informational project poster.

High school STEM class site tour.

PORTLAND 971 544 2139 | VANCOUVER 360 694 2691 | SEATTLE 206 858 7620 | BELLINGHAM 360 594 6262 | KELLOGG 208 512 1307 | COEUR D'ALENE 208 664 7880

WWW.MAULFOSTER.COM