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TECHNICAL MEMORANDUM

to: David Mattern April 25, 2003

from: Don Weitkamp, Parametrix, Inc. 554 1585 025 06 065
Bob Donnely, NOAA Fisheries
Kurt Buchanan, Washington State Dept. Fish and Game

re: **SEATTLE SHORELINE HABITAT RESTORATION OPPORTUNITIES**

Modification of Elliott Bay's Seattle Waterfront has resulted in the total elimination of natural habitat characteristics along the shoreline extending from the mouth of the Duwamish River to the north side of the bay. Filling of intertidal beaches together with construction of the seawall and piers has resulted in steep hard substrate from above high tide elevations to shallow subtidal elevations. This absence of natural slopes and substrates over several miles of shoreline provides a need and an opportunity to restore natural habitat functions to an urban shoreline of considerable value to the anadromous salmonid and other biological resources of WRIA 9 and migrants from other areas. Restoration of natural habitat characteristics to a portion of this area could be provided as part of mitigation for the Alaskan Way Viaduct and Seawall Replacement Project or included as enhancement to improve the existing natural habitat conditions. The described habitat restoration opportunities are conceptual options and are not specific proposals.

There are a number of open areas along the existing waterfront where the shoreline is not committed to commercial uses. These open areas offer limited but substantial opportunities to restore natural habitat functions. The following is a brief summary of habitat restoration opportunities identified as part of the Alaskan Way Viaduct environmental evaluation. The approach is to identify habitat restoration opportunities that can restore some of the shallow water functions needed by young salmon as they migrate along the Seattle waterfront. Because of the substantial length of shoreline involved, it is desirable to develop several habitat restoration actions that would help to restore a connected corridor.

Intertidal habitat along the Seattle waterfront is important because juvenile chinook and chum salmon of the size (50-100 mm) that migrate along the Seattle waterfront from the Green/Duwamish River have specific habitat preferences that are not met by existing waterfront characteristics. These juveniles commonly remain in close proximity to shoreline structures (beach, bulkheads, piers, etc.) and within 1-2 m of the water surface. The fish appear to prefer gently sloping mud-cobble beaches. They commonly prey on epibenthic crustaceans during their rearing migration along this shallow water habitat. Thus, particularly when feeding at the bottom in shallow water they are susceptible to the forces of substantial waves and appear to avoid areas of either substantial wave or current energy. Therefore, we propose mitigation habitat attempt to reproduce both the shallow water characteristics apparently preferred by small juveniles and the sheltered conditions that make this habitat more functional for their needs.

The habitat restoration options described below were developed for publicly owned lands, but generally without knowledge of plans for other potential uses that may have identified for these sites. Available information indicates the sites are owned by the City of Seattle, the Port of Seattle, and/or the Washington State Department of Natural Resources. The habitat restoration options are presented in geographical order from the south end of the seawall to the north end of Elliott Bay and then the two options that are west of the seawall at the southern end of Elliott Bay. These habitat restoration opportunities are presented as options; they are not presented as a specific plan nor prioritized in any manner. General locations of the identified habitat restoration opportunities are shown on Figure 1.

PIER 48

Objective

Develop an intertidal beach complex that is protected by an arch shaped extension roughly following the Pier 48 alignment or possibly other alignment with redevelopment of Colman Dock.

Concept

Remove the existing Pier 48 structure. Construct new beach and extend middle and lower intertidal portions offshore to outer edge of existing Pier 48. Include available portions of area between Pier 46 and Colman Dock. Curve beach to south at outer end to provide protection for Elliott Bay waves. Extend beach from shoreline edge of Pier 46 to south edge of reconstructed/relocated Colman Dock. Use clean excavated soil from tunnel construction or other sources to build beach. The surface layer of the beach would be sandy gravel in protected areas, with cobble to boulder size substrate on the surface of the more exposed areas.

If the site is used for transfer of construction materials, construct a steel pile supported narrow pier along the north side of the beach for transfer of construction supplies and excavated soil. Extend walkway over beach to floats for Washington St. moorage in small cove at southern edge of revised Colman Dock.

Alternative: design relocated Colman Dock to incorporate new beach along south side between dock and Pier 46.

If groundwater or stormwater source can be provided, add a small stream discharging across shoreward portion of the beach.

Benefit

Add a substantial quantity of protected intertidal and shallow subtidal habitat with fine grain sediment at the mouth of the East Waterway within a short distance of the mouth of the West Waterway. Most young salmon migrating out of the Duwamish River are likely to follow the general surface circulation in Elliott Bay that moves counterclockwise along the Seattle Waterfront.

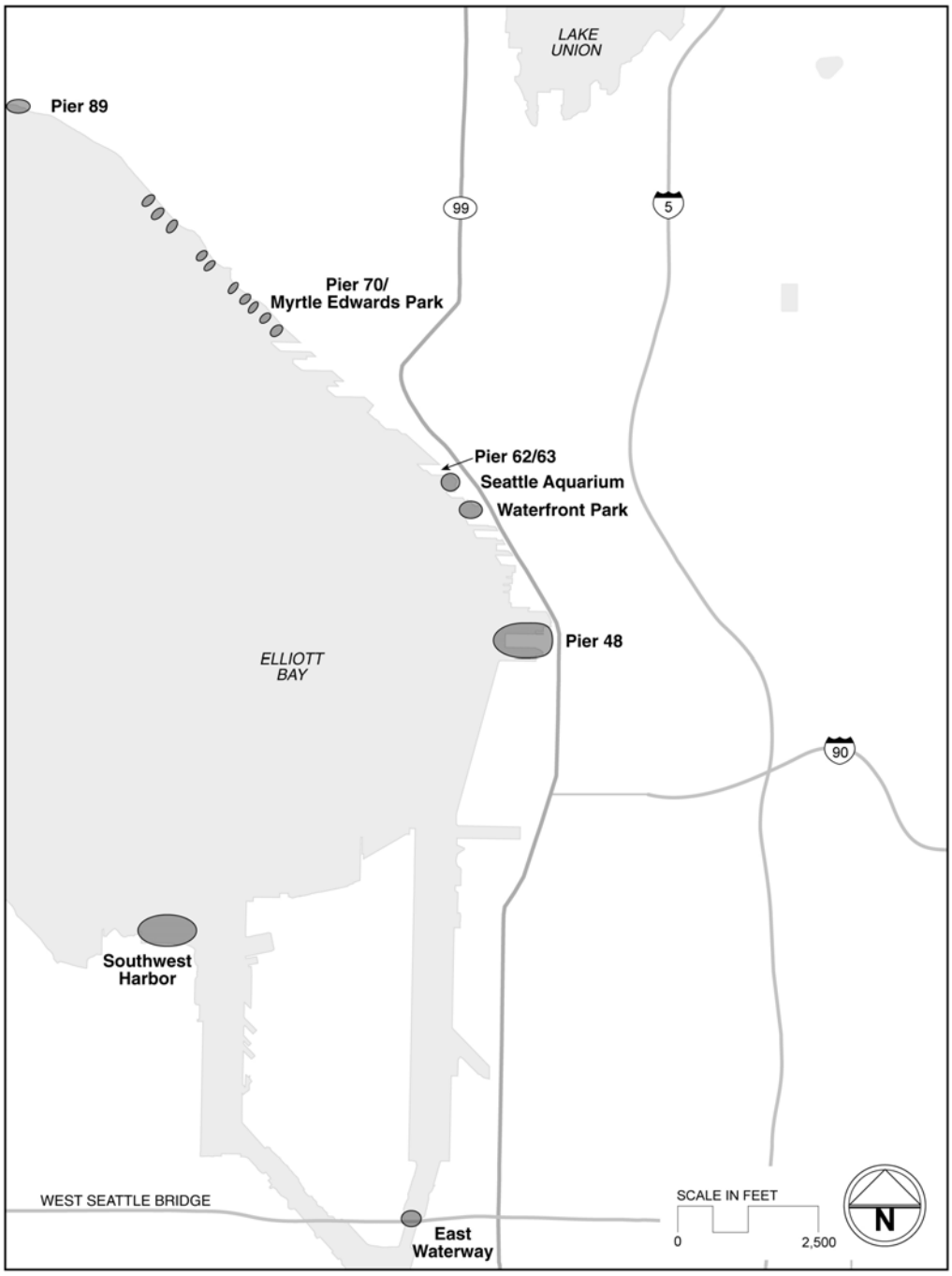

Figure 1. Locations of Identified Potential Habitat Restoration Options.

WATERFRONT PARK

Objective

Develop an intertidal beach along the area immediately adjacent to the Waterfront Park pier.

Concept

The open area at the Waterfront Park site together with the moderate slopes of the shallow subtidal area offer an opportunity to develop a narrow intertidal beach immediately adjacent to and under the outer edge of the park's pier. The survey by divers indicated a rich algal community occurs in shallow water at this location. This production together with the limited protection provided by Pier 57 indicates that site has potential for productive intertidal habitat.

Although the Waterfront Park is constructed on a pier, there is relatively shallow protected water along its face between Pier 57 and the Seattle Aquarium. It is potentially feasible to construct a fill in this area that extends from about -60 ft MLLW up to intertidal elevations. The face of the fill would be at a slope in range of 2:1 to 3:1 (horizontal:vertical) and protected by rock. The beach would be at a slope of about 6:1 to 8:1 within the intertidal elevations of about -2 to +6 MLLW. The beach would have a surface substrate of sand, gravel, and cobble size material.

Benefit

Provide a small amount of moderately sloped intertidal and shallow subtidal habitat with fine grain sediment along the Seattle waterfront migratory corridor for young salmon, at a relatively protected location.

SEATTLE AQUARIUM

Objective

Develop an intertidal beach along the shoreline between the Seattle Aquarium and Pier 63.

Concept

There is relatively shallow area of protected water immediately north of the Seattle Aquarium Pier that provides an opportunity for intertidal habitat restoration. The diver survey of this area also indicated a rich algal community occurs in shallow water at this location. This production together with the limited protection provided by Aquarium pier indicates that site has potential for productive intertidal habitat.

It appears feasible to construct a fill in this area that extends from about -60 ft MLLW up to intertidal elevations. The face of the fill would be at a slope of 2:1 to 3:1 and protected by rock. The beach would be at a slope of about 8:1 within the intertidal elevations of about -2 to +6 MLLW. The beach would have a surface substrate of sand, gravel, and cobble size material.

Benefit

Provide a small amount of moderately sloped intertidal and shallow subtidal habitat with fine grain sediment along the Seattle waterfront migratory corridor for young salmon, at a relatively protected location.

PIER 62/63

Objective

Develop new intertidal beach habitat along most of the shoreline portion of the piers.

Concept

Remove existing piles and decking along most of seawall to expose the shoreline, leaving only a narrow (<25 ft) access connection to the piers. Develop an intertidal beach between the remaining pier and seawall. The piers appear to have remaining shallow water substrate or fill extending a short distance offshore that could be filled slightly along the shoreline to produce an intertidal beach under the new opening. The surface of the intertidal beach could be a mix of sand and gravel with wave protection provided by the remaining portion of the piers.

Benefit

Increase the shoreline corridor inside a pier while providing a small amount of moderately sloped intertidal and shallow subtidal habitat with fine grain sediment along the Seattle waterfront migratory corridor for young salmon, at a relatively protected location.

PIER 70 / MYRTLE EDWARDS PARK SHORELINE

Objective

Produce new protected intertidal habitat along a substantial length of shoreline north of Pier 70 where it will not conflict with existing shoreline uses. Employ a detached offshore breakwater concept to protect shoreline habitat from wind waves and vessel wakes that commonly reach this shoreline with considerable force.

Concept

The exposed area of Elliott Bay north of Pier 70 extends to Pier 89 with either vertical seawall or steep riprap shoreline, except for a small beach constructed north of the Denny Way CSO outfall. This area commonly receives considerable wave energy from westerly and southwesterly winds and vessel wakes. Providing new protected intertidal habitat in this area would substantially improve the connectivity of the Duwamish River estuary with the north side of Elliott Bay. Pier 70 provides some wave protection to a small portion of the seawall. Additional breakwater type protection with shoreward habitat would provide new habitat supporting rearing functions for young salmon and other fish.

Gently sloping fine grain intertidal habitat would be constructed between the breakwater and the existing shoreline.

The breakwater would approach the shoreline at its southeastern end providing a narrow channel opening for fish with protection from waves. If placed in the lee of Pier 70 the opening can be moderately wide. Most waves approach the shoreline from the south through the west. The detached breakwater would be steeply sloped (2:1) on the offshore side and gently sloped (5-8:1) on the nearshore side.

Benefit

Add a substantial quantity of protected intertidal and shallow subtidal habitat with fine grain sediment along the northeastern end of Elliott Bay where a long reach of steep hardend shoreline currently exists in the highest wave climate portion of the bay.

PIER 89

Objective

Enhance the existing intertidal habitat along the eastern side of the waterway between Pier 90 and 89 (fill rather than a pile supported pier).

Concept

The shoreline of the Pier 89 area has about 2,000 ft of existing, gently-sloping intertidal beach of an apparently natural character. The intertidal area has substantial man-made debris that could be removed. The outer or southern portion of the beach is highly exposed to wave action from the west-southwest. Protection of the southern portion of the intertidal beach from wave action would enhance the rearing function of a large portion of the existing intertidal area for juvenile salmon and other estuarine fishes. Constructing a berm-like beach extension at the southern end with rock protection on its southern face would provide increased wave protection resulting in a cove type habitat that is likely to provide improved rearing habitat for young fish.

Benefit

Provide protection from wave and current energy to a substantial portion of natural beach at the northeast corner of Elliott Bay. Remove man-made debris and creosote treated piles from the gently sloping fine grain beach.

SOUTHWEST HARBOR INTERTIDAL HABITAT

The 1994 design of the Southwest Harbor Cleanup and Redevelopment Project by the Port of Seattle included consideration of a sediment disposal and habitat restoration site in the shallow subtidal portion of the site at the mouth of the Duwamish West Waterway. The project included consideration of a consolidated sediment and habitat restoration over a shallow subtidal area of nearly 20 acres. The site of former Lockheed Shipyard piers could provide new intertidal and shallow subtidal rearing habitat for juvenile salmonids at the mouth of the Duwamish West Waterway where none only steep exposed shorelines and piers currently exist.

The concept is to place contaminated sediment in a facility behind a berm constructed offshore at about 40-60 ft MLLW. Contaminated sediment would be retained at lower intertidal and shallow subtidal elevations. Contaminated sediment would be covered with a clean sediment cap to provide contaminant isolation and shallow water habitat. The offshore berm would rise to upper intertidal elevations to provide protection of the habitat/cap and an offshore beach. A lower intertidal channel would be constructed across the habitat/cap to provide fish access during low tide conditions.

This concept would require cooperation of the Port of Seattle, Washington Department of Natural Resources, USEPA, and other entities involved in sediment cleanup in the Harbor Island-Duwamish River area.

INTERTIDAL PANEL HABITAT

Objective

Reconstruction moderately sloped intertidal habitat where shoreline fill is not feasible.

Concept

Some or all of the City of Seattle seawall replacement may not allow development of a fill providing sloping intertidal habitat. Since sloping intertidal habitat is likely to be a high priority for resource agencies involved in permitting the project, it is desirable to explore opportunities to provide the essential habitat characteristics in the absence of a major fill.

Install precast concrete panels with a combined pile-seawall support system at a slope in the range of 5:1 to 8:1 along the face of the Seattle seawall and the edge of piers. Use existing technology to provide panels that can be field-tested in the immediate future. Add roughness features to the upper surface in the form of ridges and gravel-cobbles that provide natural characteristics of beaches. Ridges perpendicular to the slope will provide a means to trap fine sediment settling from the water column. The moderately sloped hard substrate would provide a hard surface on which diatoms and algae would grow that form the base of the food web supporting juvenile salmonids and young of other fishes during their shoreline rearing periods.

Benefit

Add moderately sloped intertidal habitat along seawall and/or pier locations where shoreline fill is not practical.

Background

Previously we have explored habitat restoration alternatives along the face of piers as part of the Southwest Harbor Project conducted for the Port of Seattle along the East Waterway of the Duwamish River. One of the concepts we explored was development of sloping intertidal habitat in the form of precast concrete panels that could be incorporated into the face of a pier or vertical bulkhead. Development of a major fill option at the Elliott Bay face of the Southwest Harbor site provided an opportunity to construct intertidal habitat at an alternative location. Thus, the intertidal panel concept became unnecessary and was not fully developed as an intertidal habitat alternative.

Structure

Precast concrete panels will be developed for installation on the face of the seawall and perhaps edges of piers to provide a hard sloping substrate within the intertidal zone at depths most beneficial to young salmon. The precast panels will be supported by steel or concrete piles and possibly the face of the seawall.

EAST WATERWAY HABITAT

Objective

Constructed complex intertidal habitat in a protected portion of the East Waterway where it will not conflict with existing waterway uses.

Concept

The East Waterway of the Duwamish River is the lesser of the two river channels through the estuary. However, it most likely is the migratory route for a portion of the juvenile salmon produced in the Green-Duwamish River system. There is very little intertidal habitat providing natural functions along the East Waterway. Construction of new intertidal habitat would support those young salmon migrating through the waterway or entering from Elliott Bay.

The head of the East Waterway of the Duwamish River underneath the West Seattle Bridge is an area that has no existing shoreline use, making it potentially available for intertidal habitat. Navigational

use of the area is restricted to small boats by the low level Spokane Street Bridge just north of the high-level freeway bridge.

Benefit
Add intertidal habitat to a protected location along the migratory corridor of a portion of the fish passing through the Duwamish estuary at a location unlikely to be used for other purposes.

FRESHWATER SOURCE

A number of the intertidal beach restoration options, such as Pier 48, Seattle Aquarium, Pier 70/Myrtle Edwards Park, etc., would benefit from a clean freshwater source to produce a small stream flowing across the intertidal habitat. The source would provide freshwater for waterfowl and potentially reduce salinity of the beach soils to allow growth of estuarine vegetation. A freshwater stream might also attract more young salmon and other estuarine fishes to the site.

The source of the freshwater would potentially be ground water collected landward of the seawall or AWV structure, or stormwater collected through reconstructed drainage. Treated stormwater would potentially provide a sufficiently clean source of freshwater to provide habitat benefits.

REUSE OF DEMOLITION/DREDGE MATERIALS

The project concepts for the Pier 70/Myrtle Edwards Park area envisions an offshore component to reduce wave energy. This intertidal berm or breakwater structure would need to be structurally sound. Potentially it could be constructed from large concrete remnants from removal of the existing Alaskan Way Seawall, the Alaskan Way Viaduct, rebuild of the SR 520 Lake Washington Bridge, or other sources. The Pontoons from the Lake Washington Bridge could potentially serve either as floating breakwater structures to protect constructed intertidal habitat form extreme wave energy at the Pier 70/Myrtle Edwards Park or Pier 89 sites, or as part of rubble breakwater structures. Clean soil removed from the Alaskan Way Viaduct replacement and/or dredged from the Duwamish turning basin could provide material for construction of the intertidal habitats at any of the locations.