Evaluation of Habitat Benefits and Impacts Associated with the Proposed Daylighting of the Outlet from Edmonds Marsh

Prepared for:

Port of Edmonds

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EXECUTIVE SUMMARY

The Port of Edmonds contracted Pentec Environmental, Inc., to evaluate the potential ecological benefits of daylighting the outlet of the Edmonds Marsh directly to Puget Sound via the Edmonds Marina. At present, the marsh outlet flows to the sound through a closed culvert that is over 1,200 ft long. This culvert comprises a major barrier to the upstream migration of salmon into the marsh and hence into the two main streams that drain into the marsh (Willow and Shellabarger creeks). Despite this barrier, some adult coho salmon do navigate the culvert to return to the privately run, Deer Creek Hatchery on lower Willow Creek. These fish presumably have matured from fry accidentally released from the hatchery, as no successful natural spawning has been reported in the system.

Daylighting the marsh outlet would require construction of a channel through the marina parking lot in the vicinity of F Dock. This channel would displace approximately 15 to 20 parking spaces.

The effects of introducing the marsh outlet into the marina do not appear to be severe. Some increase in sedimentation rates in the southern portion of the marina could be expected that would increase the frequency of required maintenance dredging. Turbid plumes from the marsh would have a minor aesthetic impact on the water clarity in the marina during freshets, but such conditions are infrequent during the summer peak of boating activity.

Daylighting the outlet of the marsh would increase the exchange of water between the marsh and Puget Sound. Increased inflow to the marsh at high tide would allow expansion of the area of mudflat and saltmarsh in the marsh with a concomitant reduction in area of freshwater cattail and purple loosestrife vegetation. This would be considered an ecological benefit, because areas of saltmarsh adjacent to Puget Sound have been greatly reduced over the last century by filling, such as has occurred along the Edmonds waterfront. A more open

channel to the sound would allow the marsh to drain more rapidly during periods of low tide, possibly alleviating waterfront flooding such as that which resulted from the storm in late 1996.

Improving access for adult salmon into the marsh and its tributary streams would allow the hatchery to expand its smolt planting within the system to build a local hatchery run. More significantly, improved access would allow establishment of self-sustaining runs of coho salmon in the two tributary creeks. Only limited access would be gained to spawning habitat in Willow Creek unless passage were also provided above Pine Street; a culvert under that street now blocks upstream movements. Additional habitat enhancement actions could also be applied to improve spawning and rearing habitat in the two creeks.

With the two passage projects completed (daylighting the outlet and passage under Pine Street) spawning area would be accessible for about 60 pairs of adult coho (total for both creeks). The progeny of these fish could provide hundreds of coho for harvest in local fisheries. This would be in addition to the increased harvest provided by any increased local hatchery releases.

Several options are available that would allow at least partial funding of the two passage projects and possibly the other enhancement activities described: (1) The projects could be accomplished as mitigation for impacts of a project like the ferry-terminal relocation or addition of rail lines. (2) Money could be obtained through one of the state grant programs for salmon enhancement programs. (3) Private grant funds may be available through a variety of not-for-profit foundations.

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EVALUATION OF HABITAT BENEFITS AND IMPACTS ASSOCIATED WITH THE PROPOSED DAYLIGHTING OF THE OUTLET FROM EDMONDS MARSH

1.0 INTRODUCTION

The Edmonds Marsh is a unique ecological feature in central Puget Sound because it has a gradual transition from saltwater to freshwater marsh fed by two small tributary streams that, in the past, likely supported anadromous fish runs. The present outlet from the marsh is constrained in a lengthy culvert that limits tidal circulation to the marsh and limits access by anadromous fish. This report evaluates the potential ecological benefits and impacts of daylighting the outlet of the marsh (i.e., Willow Creek) into the Edmonds Marina. The report is based on reconnaissance investigations within the watersheds that compose the Edmonds Marsh (City of Edmonds 1998) and was conducted by Pentec Environmental, Inc. (Pentec), under contract to the Port of Edmonds. It is presumed that the most effective approach to daylighting the marsh outlet would be to abandon the current culvert route and take a much shorter path that would direct the channel into the marina. Alternative approaches to daylight the creek are under consideration as part of the ferry-terminal relocation (Ohlde, A., City of Edmonds, pers. comm.) but were not evaluated in this report.

In this report we briefly discuss the current ecological functions of the existing habitats and how they would likely be benefited or impacted by daylighting the marsh outlet. In addition, and perhaps most importantly, this report summarizes and prioritizes other potential habitat and stormwater management improvements that could be taken within the Edmonds Marsh watershed. These improvements could be incorporated into a larger enhancement scheme initiated by daylighting the marsh outlet, and would be necessary to maximize the benefits of daylighting. The primary objective of these proposed habitat enhancement measures is to increase salmonid habitat, in keeping with the goals of the Endangered Species Act, specifically, the potential future listing of Puget Sound coho salmon (*Oncorhynchus kisutch*). This report could be viewed as a preliminary template with which to focus funding efforts and interagency discussion on projects that would benefit the marsh environments and surrounding community of Edmonds.

2.0 SITE HISTORY

Construction of the Great Northern Railroad north of Point Edwards isolated a large (approximately 40-acre) saltmarsh wetland that was formerly connected to Puget Sound by an open channel through coastal sand spits. At least two small streams (Willow and Shellabarger creeks) entered the marsh and likely supported small runs of coho salmon and anadromous coastal cutthroat trout (*O. clarki*). Marsh vegetation no doubt reflected a gradient of species ranging from freshwater types to those tolerant of increasingly saline conditions. In the early part of the century, much of the marsh was ditched and drained for agricultural use, and tide gates were installed to prevent saltwater intrusion. Considerable filling has occurred around the edges of the marsh and for construction of State Route (SR) 104. Current size of the marsh is given as 23 acres. Today the marsh is classified as a rare Category 1 wetland, supporting emergent and forested/shrub wetland communities (City of Edmonds 1998).

Seaward (west) of the Burlington Northern Sante Fe Railroad (BNSFRR) line, progressive filling has resulted in a substantial extent of paved parking lot and boat storage area owned by the Port of Edmonds (port). The outlet from the marsh passes under the tracks through twin 36-inch concrete culverts into a small open tidal area. The flow then reenters a 48-inch culvert that is reported to be approximately 1,275 ft long (City of Edmonds 1998), but may be as long as 1,450 ft on the basis of graphical analysis (Figure 1). This culvert system leads southwest under the road to the City Park at Point Edwards, where the culvert daylights to the sound at about +1.5 ft mean lower low water (MLLW).

In 1962, during the development of the Edmonds Marina, the culvert conveying the waters from Edmonds Marsh to Puget Sound was gated to prevent localized flooding. In May 1989, the tide gates were taken out of the culverts to allow marine waters to enter the marsh once again. Marsh vegetation has responded with the recolonization of salt-tolerant species and reestablishment of a salt- to freshwater gradient of species. A public walkway with viewing platforms and interpretive signs has been constructed along the north side of the marsh. The marsh has also been designated as a wildlife sanctuary.

In 1987, a small, privately funded fish hatchery (The Deer Creek Hatchery) was established on Willow Creek and began rearing coho and chinook (*O. tshawytscha*) salmon from eggs obtained from other sources. The hatchery no longer raises chinook, but continues to produce

Figure 1

coho fry, primarily for transplantation into other watersheds such as Swamp and North creeks. Annually, between 2,000 and 8,000 fry are also released volitionally into Willow Creek, and adult returns to the hatchery from these releases have ranged from an approximate low of 12, to a high of 80 (Thompson, W., Trout Unlimited Laeubugton Chapter President, pers. comm., 1998). This figure conflicts with the 200 to 300 estimated peak adult return as indicated in SR 104 Edmonds Crossing Draft Environmental Impact Statement (hereafter, the DEIS) (City of Edmonds 1998); in fact, no current evidence exists which indicates that returns of this magnitude have occurred. It is likely that substantial avian predation on both adults and juveniles occurs during their migration through the marsh. Natural fish production in Edmonds Marsh is likely limited by habitat degradation within the marsh, sedimentation, and stormwater flows in Willow and Shellabarger creeks, and by culvert barriers at the marsh outlet and in Willow Creek above the hatchery.

3.0 APPROACH OF CURRENT INVESTIGATIONS

To address the ecological effects of daylighting the marsh outlet, the nature of existing habitats in the areas that could be affected were evaluated through qualitative field reconnaissance in several outings in October and November 1998. In addition to these field-based efforts, relevant documents such as the DEIS (City of Edmonds 1998) were reviewed to provide further information about the marsh and surface drainages supporting it. Available marsh vegetation maps were reviewed, noting in particular the gradients and transitions between brackish-water species and freshwater species. Pathway(s) and conditions under which marine waters enter the marsh, and the effects that changing the rate and pattern of tidal flushing may have on vegetation, channel stability, and associated ecological functions were also considered. Discussions were also held with staff at the City of Edmonds. Interpretations of the potential impacts and benefits from daylighting the marsh outlet were based primarily upon professional judgement, founded through an understanding of the relevant literature and through experience. More detailed scientific analyses would be necessary to facilitate conceptual design and feasibility analysis of the daylighting option and/or the other habitat improvement suggestions defined at the end of this document, should the port or other entity elect to proceed.

4.0 EXISTING CONDITIONS

4.1 HYDROLOGY

Although tide gates that prevented intertidal exchange have been removed, the long culvert connecting the marsh to Puget Sound restricts free and complete tidal exchange. The City of Edmonds maintains a manual check valve that can be closed during unusually high tides to prevent the marsh from filling above about +13 ft MLLW. Above this level, waters back up through a ditch along SR 104 and culverts along the north border of the marsh and flood low-lying portions of Harbor Square.

Based on observations of water levels in the tidal channel adjacent to the BNSFRR tracks at the southwest end of the marsh, on water levels on the beach at Marina Beach Park in Puget Sound, and on corresponding times for high tides listed in tide tables, tidal flushing and water exchange through the culvert is restricted. Pentec personnel observed a lag between high tide in Puget Sound and maximum water levels in the marsh. Consequently, high tide elevations in the marsh are lower than those measurable in nearby unrestricted areas of the Edmonds shoreline. This hydraulic constriction was evidenced in the restriction of estuarine emergent plants in the marsh to tidal elevations lower than observed in other saltmarsh habitats in Puget Sound.

4.2 EXISTING WETLAND PLANT COMMUNITIES

Fresh water from Willow Creek and Shellabarger Creek flows westward into the Edmonds Marsh through palustrine forested, palustrine scrub-shrub, and palustrine emergent wetland plant communities. These palustrine emergent plant communities are represented in a continuum and they become emergent estuarine wetlands to the west near the marsh outlet. As previously discussed, the marsh receives tidal marine water from Puget Sound through a hydraulically restrictive culvert over 1,200 ft in length.

Freshwater communities extend from the eastern fringe of the marsh, east of SR 104, downstream of the confluence of the two creeks for approximately 600 ft. The northern, eastern, and southeastern perimeter of the freshwater marsh is characterized by seasonally flooded palustrine forested and scrub-shrub wetlands. The dominant plant species in the

overstory include red alder (*Alnus rubra*), black cottonwood (*Populus trichocarpa*), and willow (*Salix* spp.). Trees and snags within the palustrine forested habitat provide breeding, feeding, and rearing habitat for many species of wildlife, including bald eagle (*Haliaeetus leucocephalus*) and great blue heron (*Ardea herodias*). A heron rookery exists on the wooded hillside to the south above the UNOCAL site and in the wooded riparian section of Willow Creek (Thompson, W., Trout Unlimited Laeubugton Chapter President, pers. comm. 1998).

The central portion of Edmonds Marsh consists of palustrine emergent communities characterized by common and non-native cattail (*Typha latifolia*) and purple loosestrife (*Lythrum salicaria*), the latter of which is classified by the state as a Class C noxious weed. This community extends to the limits of tidal influence, where the marsh changes to an estuarine emergent plant community, a tidal elevation that roughly corresponds with the eastern edge of Detention Pond 1 on the adjacent UNOCAL property to the south.

Estuarine emergent marsh species observed in the western portion of Edmonds Marsh are distributed along elevation gradients that correspond to the salinity tolerance of the species (Table 1). Salinities in this portion of the marsh are characteristic of intertidal saltmarshes in the region and likely range from 5 to 15 parts per thousand (ppt). Low to moderately salt-tolerant species are dominant at the slightly higher elevations of the estuarine emergent portion of the marsh, although species exhibiting high tolerance were also observed in this area. The flora adapted to low or moderate salinities in this community include seacoast bulrush, (*Scirpus maritimus*), seashore saltgrass (*Distichlis spicata*), and Pacific silverweed (*Potentilla* spp.) (Hutchinson 1989). More salt-tolerant species, such as fleshy jaumea (*Jaumea carnosa*), pickleweed (*Salicornia virginica*), and fat-hen saltbush (*Atriplex patula*), were found adjacent to the deeper tidal channel running along the toe of the railroad track embankment. These areas are inundated by high tides daily and thus are exposed to higher salinities.

Table 1 Emergent salt-tolerant plants observed in the Edmonds Marsh.

Scientific Name	Common Name	Salt Tolerance*	Comments on Distribution and Abundance
Agrostis gigantica	bentgrass	Moderate	Dominant
Atriplex patula	fat-hen saltbush	Very	Dominant in lower intertidal
Carex lyngbyei	Lyngby's sedge	Moderate	Uncommon in upper intertidal
Cotula coronopifolia	brass buttons	Moderate to high	Usually found in disturbed, tidal depressions
Distichlis spicata	seashore saltgrass	Very	Shallow open water, < 10%
Jaumea carnosa	fleshy jaumea	Very	Shallow open water, < 10%
Potentilla anserina spp. *pacifica*	Pacific silverweed	Moderate	Found near fringe
Salicornia virginica	pickleweed	Very	Dominant in lower intertidal
Scirpus maritimus	seacoast bulrush	Wide range	Important waterfowl food
Triglochin maritima	seaside arrowgrass	Very	Uncommon in lower intertidal
Typha latifolia	common cattail	Sensitive	Dominant; marks boundary between salt and brackish marsh

* Tolerance Ratings range from very sensitive VS, to very tolerant VT; Hutchinson 1989.

4.3 EXISTING FISH HABITAT

With appropriate accessibility, fish habitat in the Edmonds Marsh watershed (i.e., including Willow and Shellabarger creeks) is currently capable of providing fair to good rearing for salmonids, but existing (accessible) spawning habitat within the system is poor. The following discussion considers this existing in-channel (fluvial) habitat, beginning from the western terminus of the Edmonds Marsh drainage, the inlet of the final culvert that directs the drainage under Admiral Way to Puget Sound, and proceeding upstream (Figure 1).

4.3.1 Local Willow Creek (marsh outlet to confluence of Willow and Shellabarger creeks)

From the culvert entrance at Admiral Way, the Edmonds Marsh drainage is channeled through twin culverts under the BNSFRR tracks (Appendix A, Plate 1) and is subsequently directed north in a ditch that flows between the railroad tracks and the northwestern corner of UNOCAL property (Plate 2). This ditched section of the drainage continues to the northwestern

end of UNOCAL property approximately 780 ft, and it is then directed east, paralleling Detention Basin 1 of UNOCAL for another 600 ft (Plate 3). Both banks along the lower 780 ft of this ditched portion lack riparian cover entirely, although the right (south) bank paralleling UNOCAL's Detention Basin 1 has a thick shrub layer. Substrate in these channelized portions is predominantly fine silt and typical intertidal mud (Plate 4). Estimated bankfull widths of the channel in this lower section of the creek vary between 20 and 40 ft, dependent on location. Naturally formed tidal channels entering this section of the creek bring tidal flows to the northwestern portion of the marsh. This portion of the drainage offers no spawning habitat for salmonids, and only marginal to fair rearing habitat due to the absence of in-channel structure (e.g., large wood or cobbles), and to marginal water quality—at least in the summer months.

The channelization of the existing fluvial habitat continues upstream of the UNOCAL Detention Basin 1 approximately another 600 ft, just below the confluence of Shellabarger Creek. The channel at this point becomes highly braided and difficult to follow as it filters through thick cattail intertwined with purple loosestrife and deadly nightshade (*Solanum* spp.). Flows from Shellabarger Creek are intermixed with those of Willow Creek in this braided zone that extends to the eastern terminus of the strictly palustrine emergent marsh habitat, approximately 500 ft. Depths through this section vary substantially, from a few inches to greater than 4 ft (Plate 5). Riparian cover is abundant in this braided section, and shading by deciduous trees is sporadically provided by red alder, black cottonwood, and Scouler's willow (*Salix scouleri*) (Plate 6). The substrate is sandy silt similar to that observed lower in the basin. Although in-channel structure is abundant within this braided reach (aquatic vegetation, no large wood), fish-rearing potential is likely limited by water quality in the summer months, when water temperatures and oxygen concentrations would likely be restrictive, especially during low tide. Velocity gradients attractive to salmonids are not present within this section of the available habitat. Winter rearing conditions could suit a variety of salmonid species.

4.3.2 Shellabarger Creek

According to the DEIS (City of Edmonds 1998), Shellabarger Creek flows in a southwesterly direction through the central portion of Edmonds Marsh, joining Willow Creek in the braided area discussed in the previous section (Figure 1). In contrast, our surveys indicate that a substantial portion of the Shellabarger Creek drainage may actually flow due south after crossing SR 104, flowing along the western side of SR 104 approximately 450 ft before turning west to join Willow Creek from an easterly direction as opposed to (or in addition to) a

northeasterly direction. This flow pattern has ramifications for potential enhancement options, as discussed later in this document. Regardless of its flow direction through the marsh, only limited rearing potential and no spawning potential is offered in this section of Shellabarger Creek for the same reasons previously discussed for lower Willow Creek.

Continuing upstream, Shellabarger Creek runs under SR 104 through a 4-ft-diameter culvert, and is directed in a southerly direction along SR 104 in a broad (approximately 30-ft-wide) ditch for 120 ft. The creek subsequently turns due east, running through palustrine forested habitat of blackberry (*Rubus* spp.), red alder, and big-leaf maple (*Acer macrophyllum*) for approximately 170 ft and continuing upward for another 310 ft within a well-defined, gravel-lined channel adjacent to an apartment building. The stream is then directed through a culvert underlying 3rd Avenue, and continues upward to its headwaters in a residential area near 8th Avenue and Elm Street.

The culvert underlying 3rd Avenue is impassable to salmonids due to a velocity barrier caused by the slope and depth of water in the culvert. For this reason, habitat surveys were not conducted above this reach. The roughly 500 ft of stream channel below this impassable barrier, between SR 104 and 3rd Avenue, currently has a coarse sand/gravel bed and offers fair to good rearing potential, and good spawning potential for salmonids. Riparian cover in the lower 170 ft of this section is dense, whereas the 310-ft portion above this section offers little to no riparian cover on the left (north) bank, and cover of only moderate density on the right bank. A thick canopy of big-leaf maple along the lower right bank of this reach would provide shade in the summer months, however. The channel throughout this reach has both step-pool and plane-bed characteristics, with step pools dominating the upper portion. In-channel structure of large quarry rock was artificially placed to provide the step-pool habitat; however, in the lower reaches such in-channel structure is lacking.

4.3.3 Willow Creek Above Shellabarger Creek Confluence

The braided habitat near the confluence of Shellabarger Creek continues upstream for approximately 300 ft, when the channel gradient increases slightly; the main channel becomes more defined, proceeding upstream in a southeasterly direction. Substrate particle size increases from fine silt and mud to a predominantly sand matrix, with subdominant pea-gravel and cobble evident but not abundant or well sorted (Plate 7). Abundant small- and medium-sized wood is present both within and above the wetted width of the channel.

Riparian understory is dominated by salmonberry (*Rubus spectabilis*) and skunk cabbage (*Lysichitum americanum*), while a dense overstory of red alder, western red cedar (*Thuja plicata*), and big-leaf maple provide good shade throughout the reach.

This type of habitat continues to the Deer Creek Hatchery, although immediately adjacent to the hatchery, riparian cover is slightly reduced by visitor trails (Plate 8). This area, from the creeks' confluence to the hatchery, provides good to excellent rearing potential for salmonids. Although historically some salmon have spawned in this reach, it is doubtful that they have done so successfully, given the lack of suitably sized and sorted gravels, frequent public disturbance, vulnerability to poaching and predation, and heavy sand deposition in the area. Although the DEIS (City of Edmonds 1998) classifies this section as providing good spawning habitat, with abundant spawning gravels, those statements do not concur with our findings or interpretations of the existing habitat.

The channel arcs around the hatchery to the southeast, proceeding up through a turbulent cascade reach lacking pools, through a weir, and then through a culvert underlying Pine Street. This reach, approximately 250 ft in length (including the culvert), presents numerous passage problems to adult salmonids, and at present represents a complete block to upstream migration of juvenile salmonids due to velocity, depth, and height barriers of various intensity.

Above Pine Street, Willow Creek primarily exhibits plane-bed channel characteristics, lacking a desirable number of pools for maximum rearing potential, but offering small areas of potentially suitable spawning habitat. Riparian understory of salmonberry and overstory of red alder are dense throughout. Gradient is moderate throughout this reach (2 to 4 percent; Plate 9). Gravels are abundant, although poorly sorted, in most of the reach, with moderate to high amounts of sand embeddedness (> 30 percent; Plate 10). A strictly impassable height barrier to all but adult steelhead was encountered approximately 400 ft above the Pine Street culvert, ending the survey of this reach (Plate 11). This reach would appear to have fair rearing and spawning potential that could be greatly enhanced with appropriate measures.

Given the passage barriers downstream, it is unlikely that this habitat is utilized appreciably by anadromous salmonids, although resident cutthroat trout were captured during our surveys in this reach (Plate 12). Despite surveying the system during the peak of adult coho and chum salmon returns in other local creeks (e.g., Lunds Gulch Creek, Shell Creek), no adults were

observed in this reach, supporting the conclusion that use of this habitat is restricted by the Pine Street culvert and weir.

5.0 ENHANCEMENT OPPORTUNITIES

A number of ideas are suggested in this section that could improve fish habitat and fish use of the Edmonds Marsh watershed. Daylighting of the marsh outlet provides the most appropriate starting point; accomplishing this would allow ready access to the system by anadromous fish. All of the other suggested enhancement actions described in this section would be of minimal value without improving fish access to the existing habitat in the marsh tributaries.

5.1 DAYLIGHTING EDMONDS MARSH OUTLET

The outlet of the Edmonds Marsh could be redirected into the marina by constructing a slightly sinuous open channel into the marina between existing Slips F and G, a lineal distance of approximately 275 ft. Appropriate in-channel structures could be installed to make the channel both biologically functional and aesthetically pleasing to the Edmonds community. For example, a series of step pools with appropriate spacing would facilitate fish access over potentially prohibitive low-tide gradients, while providing nice stream habitat for public enjoyment.

Because upstream passage of fish is required only when tides are above about +8 or +10 ft MLLW, the incision required to create the channel would not need to be tremendously deep. The channel elevation could meet the existing marina bank at about +8 ft MLLW under the existing boardwalk and fall in a steep series of step pools, hardened with larger riprap, down to the extreme low water level. The channel would require a minimum of about 20 ft of width at the top (existing grade) elevation; thus, a single row of parking (about 15 to 20 spaces) would be sacrificed. A new larger culvert crossing of Admiral Way would be required; it is assumed that another, possibly bridged, crossing would be required in the parking lot to maintain existing traffic patterns. These crossings would likely constitute the most expensive features of the daylighting project.

5.1.1 Ecological Benefits

Restoring free tidal exchange would increase the area of estuarine intertidal saltmarsh and associated functions, including providing increased primary and secondary production,

increased nutrient export, and increased rearing habitat for juvenile salmonids. Use by anadromous fish of existing habitats in Shellabarger and Willow creeks would increase. Operations at the Deer Creek Hatchery could be increased to permit a greater release of fish on site—previously a somewhat moot exercise due to the passage problems into and out of the marsh. Following the establishment of a self-sustaining run, the hatchery could reduce its releases and let nature take over.

Use of the estuarine-influenced portions of the marsh by juvenile marine fish and invertebrates would increase as well, thereby increasing the overall functionality of the system. Use by shorebirds would likely increase. These benefits are significant because much of the estuarine intertidal marsh habitat in the Puget Sound region and its associated functions have been lost since European settlement and industrialization began in the 1800s.

In addition, increasing the aerial coverage of saltmarsh flora to the north and east would help control invasive purple loosestrife, which is intolerant of the higher salinities that would be expected from restoring tidal exchange. There would be an overall reduction in the areal extent of palustrine emergent vegetation (although a large area would remain) as this vegetation type is replaced by estuarine emergent plants. This outcome is not expected to be a negative impact, because palustrine emergent vegetation lacks diversity and currently provides limited habitat functions.

Prior to restoring tidal exchange, elevation data should be collected to ensure that palustrine forested and scrub-shrub components of the wetland remain above the extreme high-tide levels. These areas provide valuable fish and wildlife habitat and have a flora that is generally salt-intolerant. It may be possible to expand the area of these habitats by modifying creek channel configurations to control water levels and cattails, and by creating small islands that could be planted with trees and shrubs.

5.1.2 Potential Impacts in the Marina

Redirecting flows from the marsh into the marina would deliver some fine sediment into the marina. Because the marsh acts as a large sediment trap, materials reaching the marina will only be those fine enough to remain in suspension through the marsh—presumably clay-sized and smaller particles only. A portion of the material delivered into the marina would be carried out of the basin with tidal exchange and the remainder would settle out in the marina bed.

Rates of sedimentation that would occur have not been calculated but are conservatively expected (based on rates of sedimentation in marinas and waterways near streams) to be well below an inch a year. Significant sedimentation would affect only a limited portion of the marina.

Suspended sediment loads and possibly floating organic material (leaves, sticks, saltmarsh vegetation) reaching the marina during high runoff periods would have a minor aesthetic impact in the vicinity of D and F docks, where the turbid plume would contrast to the usually clear waters in the marina. Frequency of such occurrences would be low during the peak boating periods and the visible plume would be dissipated rapidly (e.g., in one tidal cycle).

Ecological impacts in the marina would be largely positive; leaf litter and saltmarsh vegetation that sink to the bottom would decay and be consumed by crabs, shrimp, and smaller bottom organisms. The area of mixing of fresh and saltwater in the marina would provide juvenile salmonids leaving the marsh system an extended estuary in which to acclimate gradually to the higher salinities.

Given that UNOCAL discharges to Willow Creek from its oil/water separator, the potential for polycyclic aromatic hydrocarbon contaminants to be contributed along with the fine sediment is also of concern. Several mechanisms exist through which sediment and contaminant inputs could be minimized and/or avoided. Potential contaminants liberated with the UNOCAL stormwater could be kept out of the marina by retaining the old culvert system exclusively to capture and release UNOCAL's stormwater.

Sediments could be trapped through a series of log check weirs installed in the lower channelized section of Willow Creek. These weirs would serve to slow sediment movement, permitting suspended sediments to settle where they could be periodically (e.g., every 10 to 20 years) dredged out. In addition to sediment trapping, these in-channel check weirs would improve the rearing habitat in the lower marsh. Sediments contributed farther up in the watershed could be trapped in ponds installed adjacent to SR 104, and flows from Willow and Shellabarger creeks could be redirected into these ponds accordingly, before they enter the wetlands.

5.1.3 Potential Benefits for Stormwater Management

Daylighting the marsh outlet to the marina would remove what is currently the main restriction to floodwater movement out of the marsh into the sound. The late 1996 rain-on-snow event caused extensive flooding along the Edmonds waterfront and in the Harbor Square area, in part because of the minimal outlet for water from the marsh (Walker, J., City of Edmonds, pers. comm.). As noted previously, the long culvert under Admiral Way to the sound is the hydraulic control on the marsh. With daylighting of that flow through an open channel to the marina, the hydraulic control would shift to the twin culverts under the rail line (Plate 1). That constriction could also be eased, probably at reasonable cost, by adding parallel culverts under the tracks. In any case, the daylighted outlet should be designed to allow the marsh to fully drain at low tide, preventing progressive increases in level during high runoff periods.

Because daylighting the creek would increase saltwater inflow as well as outflow, some controls may be needed to prevent more frequent flooding of Harbor Square during extremely high tides. Either a seasonally operated tide gate similar to that in the existing creek outlet culvert would need to be placed in the realigned outlet, or a combination of higher dikes and check valves would need to be constructed along the primary flooding routes from the marsh. Alternatively, or in addition to a tide gate, excess stormwater flows could be directed to the existing culvert system that could be maintained to deliver run-off and discharge from the UNOCAL facilities, as suggested above.

5.2 INCREASING BASEFLOWS TO THE EDMONDS MARSH

Surficial and groundwater flows from the upper 945 acres of the Willow Creek basin are currently bypassed to the Edmonds Way drain. This drainage system runs directly under Pine Street. In addition, the northern two-thirds of the Harbor Square development is now directed to the Dayton Street outfall (City of Edmonds 1998). These freshwater contributions are lost from the marsh, with concomitant reductions in the functionality of the fluvial and wetland systems dependent on them. Redirecting flows (all or part) from the Edmonds Way drain into the marsh would increase base flow to Willow Creek, thereby facilitating better fish passage and increasing the carrying capacity of the system.

This action would need to be reviewed in light of the overall stormwater management plan for the basin for its potential to exacerbate flooding in the stream channel and from the marsh into Harbor Square. It may be that diversion into Willow Creek could occur only during low-flow periods to increase summer rearing habitat; however, the City Engineer has expressed doubts that the drain captures sufficient baseflow to provide significant benefit (Walker, J., City of Edmonds, pers. comm.). The quality of water in the drain should be monitored before adding it to creek flow to ensure acceptably low levels of pollutants from street and parking lot runoff.

5.3 IMPROVING IN-CHANNEL CONDITIONS IN WILLOW AND SHELLABARGER CREEKS

Approximately 400 linear feet of stream in Shellabarger Creek (~ 230 m^2 total area, assuming wetted width of 5 ft) and 1,000 linear feet of stream in Willow Creek (~ 465 m^2) are either underutilized or un-utilized for spawning by coho salmon—the salmon species most suitable for the habitat in these systems. Assuming a conservative density of 11.7 m^2 required per spawning pair of coho (Burner 1951 as cited in Bjornn and Reiser 1991), the habitat could potentially support about 60 pair of coho if enhanced appropriately. A sustained run of this number of fish, supplemented by hatchery releases made possible by daylighting of the marsh outlet, could contribute several hundred adults to the local salmon harvest (e.g., at the fishing pier and in the waters from the ferry dock to the UNOCAL oil dock).

Examples of in-channel and riparian enhancement efforts could include the following:

- Restructuring the channels and adding logs or boulders in both streams to increase pool frequencies.
- Improving riparian cover along Shellabarger Creek below 3rd Avenue to facilitate bank stability and provide shade.
- Identifying and stabilizing eroding banks that add sand or silt to downstream areas.
- Importing sorted spawning gravel into sections lacking that substrate (i.e., where it would not be subsequently buried with fines).

The first and foremost opportunity, and one that is essential to realizing the full potential of daylighting of the marsh outlet, is to provide for upstream passage at the Pine Street culvert, just above the hatchery. A series of step pools through the section immediately preceding the culvert would facilitate access through this moderately high-gradient, channelized section that was previously lined with light loose-rip as part of past stormwater control measures.

Although a few adult coho salmon currently negotiate passage through the braided channels in the saltmarsh to the Deer Creek Hatchery, passage could be greatly enhanced by a relatively moderate amount of manual channel refinement through this section. Access to Shellabarger Creek through the marsh could be greatly improved with a similar effort.

Fine sediment delivery to both Shellabarger and Willow creeks could be reduced through a variety of creative methods. One option available that would reduce sediments in Willow Creek from the braided zone up to the hatchery would be to direct the flows from Willow Creek into a central retention basin in a naturally depressed area adjacent to SR 104, just north of the hatchery. This area currently collects water during heavy rains and does not have extensive upland or wetland plant communities. Development of such an aesthetically natural pond would settle fines that would otherwise be transported downstream, thereby improving spawning success within the lower reach of Willow Creek currently used (unsuccessfully) by adult coho salmon.

The potential of the system for rearing of juvenile coho, given the extensive marsh habitat, appears to be more than adequate to support the numbers of fry that would result from successful spawning of 60 pair of adults. Thus, fostering in-channel enhancement for natural spawning should not preclude accelerated hatchery releases in the system (within reason).

6.0 FUNDING RECOMMENDATIONS

The costs of daylighting the outlet of the marsh and providing for fish passage at Pine Street will be substantial. Several options may be available for funding: The project might be accomplished as mitigation for impacts on fish habitat of some other project in the Edmonds area; possibilities include relocation of the ferry dock and addition of rail lines between Seattle and Everett as part of the Sound Transit effort. An alternative daylighting proposal that would direct the outlet of the marsh southward along the rail line to a point south of the present oil dock location is under consideration by the city in its EIS for ferry-terminal relocation (Ohlde, A., City of Edmonds, pers. comm.). Mitigation for impacts of the ferry-terminal relocation may also include improvement of fish passage at Pine Street.

As a second funding option, the projects would appear to be excellent candidates for state funding under ESHB 2496, which established the Washington Department of Fish and Wildlife's Salmon Habitat Recovery Grant Program. This legislation was passed in 1997 to provide funding for projects that will enhance salmon habitat or remove barriers to salmon migration, as these projects clearly would. Additional nonprofit funds are available that could help match public funding efforts. We would welcome the opportunity to work with the port and other teaming partners to initiate some of these ideas.

7.0 REFERENCES

Bjornn, T.C., and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. American Fisheries Society Special Publication 19:83-138.

City of Edmonds. 1998. SR 104 Edmonds Crossing draft environmental impact statement and draft Section 4(f) evaluation. US Department of Transportation Federal Highway Administration, Washington State Department of Transportation, and City of Edmonds, Washington.

Hutchinson, I. 1989. Salinity tolerance of plants of estuarine wetlands and associated uplands. Washington State Shorelands and Coastal Zone Management Program: Wetlands Section. Simon Fraser University, Burnaby, British Columbia, Canada.

Appendix A—
Willow Creek Plates

Appendix A is not available electronically.