SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

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October 1, 2012

Ms. Keeley O'Connell
Restoration Ecologist Manager
People for Puget Sound
911 Western Avenue, Suite 580
Seattle, WA 98104

RE: ALIGNMENT ALTERNATIVES SCREENING ANALYSIS

Dear Ms. O'Connell:

We are pleased to provide this letter presenting three daylight alignment alternatives, a screening analysis, and recommended alignment for the Willow Creek Daylight Early Feasibility Study. This letter was developed by Shannon & Wilson Inc., Confluence Environmental, and Anchor QEA, LLC. Our analysis presents existing and historical conditions of Edmonds Marsh, including the existing outfall pipe and conditions, the upstream Willow Creek channel, and the local and regional context. Alternatives for daylighting the Edmonds Marsh outfall are presented and evaluated through a discussion of pros and cons of anticipated fish habitat and biological response, coastal and tidal marsh hydrodynamics, sediment transport impacts, infrastructure requirements, adjacent landowner implications, and socio-political constraints. The screening analysis is then used to provide justification for a recommended alternative alignment.

HISTORICAL AND EXISTING SITE CONDITIONS

Edmonds Marsh is an estuarine tidal marsh located within the City of Edmonds city limits (Figure 1). Encompassing approximately 23 acres, the marsh is a unique ecological feature along the highly developed shoreline of Central Puget Sound. The marsh is bordered by State Route 104 to the east, Harbor Square to the north, the BNSF Railway (BNSF) railroad tracks to the west, and the Chevron/Unocal property (and 216th Street SW) to the south. The marsh is primarily owned by the City of Edmonds, with other bounding property owners including the Washington State Department of Transportation (WSDOT) (State Route [SR]-104), Chevron/Unocal, BNSF, and Harbor Square properties. Edmonds Marsh receives freshwater runoff from approximately 900 acres, including two creeks and runoff from surrounding properties (Sea-Run Consulting and others, 2007).

400 NORTH 34th STREET – SUITE 100
PO BOX 300303
SEATTLE, WA 98103
206-632-8020 FAX 206-695-6777
TDD: 1-800-833-6388
www.shannonwilson.com

The Shared Strategy for Puget Sound Chinook Recovery (Redman and others, 2005) identifies barrier estuaries and features like it on the shoreline to be invaluable as resting, feeding, and physiological transition zones for the smallest life history types of migrating

Historic Physical Conditions

Edmonds Marsh was historically a sand-spit, barrier (pocket) estuary marsh. The 1870s Government Land Office T-Sheet map shows the sand-spit barrier running north from Point Edmonds. The location and orientation of the spit were due to sediment shoaling, transport, and deposition in a northward direction from Edmonds point (Figure 2). The historical body of the sand spit was likely located near, what is today, the central area of the Edmonds Marina. The historical tidal channel outlet of the channel was likely north of the N-dock, near the Port of Edmonds administration office. Gersib (2008) estimates that the original area of the marsh at approximately 100 acres. The historical 1870s map shows the marsh extending north of current Edmonds Ferry terminal location and north of the SR-104 and Main Street, likely terminating somewhere near Brackett's landing.

Anthropogenic Impacts to Edmonds Marsh

Over time, European settlement, railroad construction, port and marina construction, urbanization, and development have occurred, which has reduced the marsh area to approximately 24 acres, including marsh areas upstream (north) of SR-104. Observed historical conditions and aerial photographs of marsh changes are presented in Biological Condition of the Edmonds Waterfront and Preliminary Feasibility Considerations for Nearshore Ecosystem Restoration (O'Connell and others, 2009. European settlement, port development, rail construction, industrial sawmills, oil and gas production, and commercial and residential development have significantly changed Edmonds Marsh since the original settlements began in the 1870s. Edmonds township was settled in the 1870s after the discovery of the town site by George Brackett, who is considered by many the "founder of Edmonds" (History of Edmonds, 2012), and the namesake of the Edmonds Ferry "Bracketts Landing" location.

In 1891, the Great Northern Railway reached the Edmonds shoreline and was established along the waterfront and western edge of the marsh. The railway brought the opportunity for greater transportation and commerce to the region.

The Edmonds waterfront was dominated by heavy industrial operations in the first part of the 20th century. Early sawmills and shingle mills were established along the Edmonds waterfront from the 1890s until 1951, when the last shingle mill closed.

In 1923, the first automobile ferry was established between Edmonds and Kingston. Private ferry services were operated through 1950, when the ferry was taken over by the State of Washington Ferry System. The ferry dock is located at what was historically the northwestern corner of the marsh. In the 1940s, the marsh area proper was farmed and used for pasture.

In 1962, the Port of Edmonds completed construction of the Edmonds Marina. This included rerouting of the Willow Creek drainage south (in its current alignment) and installation of a top-hinge tidegate, which limited natural tidal saltwater inflow and fish passage to the marsh. Currently, this tidegate is allowed full operation (closing on incoming tides) from late October / early November through early March. The tidegate, located in an enclosed vault, is hoisted open and shut by City of Edmonds stormwater maintenance staff.

Adjacent Chevron / Unocal Property

From 1923 to 1991, Union Oil Company of California (Unocal) operated the Edmonds fuel station. Fuel would arrive by ship at the fuel dock, which was located offshore (southwest) from what is today the Edmonds Marina Beach Park. Fuel would be transferred via pipeline over the railroad tracks to processing facilities and storage tanks located on top of the bluff at Edmonds Point. Fuel was then distributed via fueling trucks to the greater Seattle region. The Unocal site was also used for asphalt production for more than 25 years.

In 1993, Unocal entered into an "agreed order" with the Washington State Department of Ecology (Ecology). In 2001, an interim cleanup plan was approved by Ecology and Unocal initiated cleanup work on the "Upper Yard," which is a processing and storage tank area on top of the bluff. One hundred twenty-five thousand (125,000) tons of contaminated soils were removed from the yard and Ecology issued a letter confirming cleanup in 2003, and since that time condominium units were constructed in the Upper Yard and known as Point Edwards.

A draft cleanup feasibility plan was initiated after 2003, between Chevron Environmental Management Company (who purchased the Unocal site). Cleanup activities have included excavation of the stormwater ponds and removal of up to 140,000 tons of contaminated material from Willow Creek and the marsh in 2007 and 2008. Since 2008, Chevron has monitored the site, submitted a work plan to Ecology, and is currently preparing a feasibility study, due in December 2013, evaluating the effectiveness of the lower yard cleanup.

In 2005, Unocal (Chevron) entered into escrow for transfer of the lower yard property to WSDOT to be used for mitigation in the Edmonds Ferry, multimodal facility. Recent

discussions between the City of Edmonds and WSDOT have indicated that the lower yard areas may no longer be required for mitigation for the relocation of the ferry terminal.

Existing Watershed Conditions

The Edmonds Marsh is located in an urban/suburban watershed. Two streams, Willow and Shellabarger Creeks, are the main stream inputs to the marsh. The marsh then drains through culverts into Puget Sound. The following sections detail the existing conditions in the marsh and the watershed, including the outfall to Puget Sound. The following discussion begins upstream and moves downstream through the marsh and includes conditions in the adjacent portion of Puget Sound.

Freshwater Inputs

Willow and Shellabarger Creeks remain the primary freshwater tributaries to the marsh. These tributaries originate to the south and east-northeast areas, respectively. The Willow Creek headwater area originates in the residential City of Edmonds neighborhoods near 220th Street SW and 9th Avenue SW. Willow Creek is predominately a stormwater conveyance system in the upstream urbanized areas of the drainage. The "stream" flows west by northwest, through the township of Woodway, and daylights downstream from a culvert beneath 216th Street SW, past the Willow Creek hatchery, which is operated by Trout Unlimited, into Edmonds Marsh.

Shellabarger Creek is the next drainage system north of the Willow Creek, also originating near 200th Street SW and 9th Avenue SW. The Shellabarger system collects stormwater flows between Pine Park neighborhood near 220th Street SW and Dayton Street. Shellabarger daylights near 4th Avenue S, flows in a confined channel between two apartment complexes, and discharges into a freshwater (stormwater) wetland east of SR-104. Shellabarger Creek flows beneath SR-104 in two 48-inch by 72-inch steel pipe arches just south of Harbor Square (and Dayton Street / SR-104 intersection).

Willow and Shellabarger Creeks flow into Edmonds Marsh in somewhat defined channels; however, recent surveys show that there are no direct stream or tidal channels connecting the streams with the salt-water tidal channel sections of the marsh (Perteet, 2012). The streams disperse stream flow through heavy cattail vegetation in the freshwater (south and eastern) portion of the marsh.

Marsh Vegetation and Hydraulics

Edmonds Marsh supports freshwater and salt-tolerant plant species, with a fairly distinct transition in vegetation type occurring midway along the marsh as observed running from the Harbor Square tennis courts to the eastern edge of the Chevron/Unocal treatment pond. Earlier studies have reported that the emergent salt marsh plants are restricted to lower elevations compared to other salt marshes in Puget Sound and attributed this to the constriction of tidal flow through the pipe and culvert system (Pentec, 1998). This is likely an effect of tidal muting, whereby significant conveyance losses occur in the stormwater pipes, vaults, and confined ditch and allow only a portion of saltwater tidal flow into the marsh. Also, the operation of the tidegate in winter months also limits inflow and tidal exchanges that affect marsh vegetation and habitats.

The downstream (western) portion of the marsh shows evidence of saltwater vegetation, tidal channels, and mudflats. Distinctive tidal channels are observed running adjacent to the Chevron/Unocal treatment pond on the south side of the marsh, and a larger tidal channel originating at the northern edge of the marsh near the Harbor Square tennis courts. More details regarding salt marsh vegetation and tidal channel conditions will be provided by People for Puget Sound (and others) in planned future studies.

At the westernmost location of the marsh and northwestern corner of the Chevron/Unocal stormwater pond, Willow and Shellabarger Creeks (Willow Creek) flow into a 700-foot-long, confined, open channel running along the BNSF railway embankment (Photograph 1). The confined channel flows uniformly with no instream obstructions/structure (e.g., wood) and has little to no overhanging vegetation or cover. The confined channel appears to be wholly located within the Chevron/Unocal property, based on geographic information system information provided by the City of Edmonds (City of Edmonds, 2012). Recent communications with the City of Edmonds indicate that the Chevron/Unocal property remains in escrow with WSDOT, who had originally planned to use the property for roadway alignment and mitigation for the Edmonds Crossing, ferry relocation, and multi-modal project. The Chevron property ownership and escrow issues should be more fully understood as the project progresses.

At the downstream end of the confined channel, two separate stormwater outfalls enter the Willow Creek channel (Figure 1). The first is the Point Edwards stormwater pipe that drains the newly developed residential area at the top of the bluff, which is the historic Chevron/Unocal storage tank area. The second pipe is owned by WSDOT and drains SR-104. The exact amounts

of runoff from these two separate systems to Willow Creek are unknown at the time of this study.

Existing Marsh Discharge to Puget Sound

At the downstream end of the confined channel adjacent to the railroad tracks, the stream enters a pair of pipes: a 22-inch steel pipe and a 36-inch corrugated metal pipe (CMP). The 36-inch pipe has vertical slide gate that was partially closed in the June 2012 survey. Willow Creek then discharges westward through two 42-inch concrete pipes beneath the BNSF railway into a small pond between the railway and then into a vault underneath Admiral Way (Photographs 2 and 3).

Willow Creek then enters the City of Edmonds Storm-vault 2401. The creek discharges into a 48-inch CMP that flows 600 feet southwest along Admiral Way and the BNSF railway south, towards Marina Park. This section of pipe has been reported as aging, in need of replacement, and likely contributes to the significant hydraulic losses and reduction in upstream tidal prism inflow and drainage.

At the northeast corner of the Marina Park, parking lot, the CMP pipe connects with the City of Edmonds storm vault I.D. 2457, through a tidegate into a 48-inch high-density polyethylene (HDPE) pipe. The tidegate is located on the upstream HDPE pipe, and is a top-hinged, steel gate (Photograph 4). The City of Edmonds stormwater department operates the gate for flood protection between late October and early March allowing the tidegate to open and close normally. From early March to late October, the City uses a truck and hoists open the flapgate at a 90 degree angle to the flow line. The City has reported that when in normal operation (fall/winter period) the gate closes, but is not watertight (Moles, 2012).

The tidegate vault then discharges south into another 48-inch HDPE pipe and vault located approximately 50 feet south near the Marina Park grassy area between the parking lots. From this vault, the stormwater pipe extends 1,000 feet to the west and discharges offshore into Puget Sound at an elevation of -9.0 feet (NAVD88), approximately 300 feet west of the shoreline at Marina Beach Park (Photograph 5).

The Edmonds waterfront lies at the northern end of a 5-mile-long drift cell, identified as SN-3 (U.S. Geological Survey [USGS], 2010). This drift cell collects and transports sediment from feeder bluffs and stream deltas along the Puget Sound shoreline. Sediment is transported from as far south as Shoreline, Washington, whereby wind and wave action act in a northerly direction moving sediment along the shoreline to the Edmonds Point area. The tidal range at Edmonds is approximately 12 feet between Mean Lower Low and Mean Higher High tides.

Existing Fish Habitat Conditions

The fish community that has been documented utilizing existing habitats in the Edmonds Marsh and contributing creeks is comprised of coho salmon adults, an occasional chum salmon adult, resident and sea-run cutthroat trout, threespine stickleback, and sculpin (Pentec, 1998; WSDOT, 2004; O'Connell and others, 2009). The Willow Creek Hatchery historically raised coho salmon and Chinook salmon with annual releases of between 2,000 to 8,000 coho fry into Willow Creek (Pentec, 1998). More recently, the hatchery produces only coho fry, but none are intentionally released into the creek (WSDOT, 2004; Thompson, pers. comm. 2012). Low numbers of juvenile coho salmon have been observed in Willow Creek in 2012 (Rice, pers. comm.; Schlenger, pers. obs.). Prior to the early 2000s, it was estimated that approximately 20 to 40 adult coho salmon returned to the creek each year (WSDOT, 2004). However, more recently, no adult coho salmon have been observed in Willow Creek (Thompson, pers. comm. 2012). The following paragraphs describe existing habitat conditions for fish, in particular salmonids, in Edmonds Marsh starting from downstream and moving upstream through the marsh to Willow and Shellabarger Creeks.

Connectivity to Puget Sound

The fish habitat conditions in Edmonds Marsh are strongly influenced by the restrictions to the connectivity of the marsh to Puget Sound, as well as the development that has occurred in the surrounding watersheds. A primary consideration in characterizing fish habitat in the marsh is the blockage of fish movement between the marsh and Puget Sound that the pipe and culvert system poses. Available information indicates that until recent years, a small number of adult coho salmon and an occasional adult chum salmon or sea-run cutthroat trout will locate the outlet pipe in the lower intertidal zone and migrate upstream through the approximately 1,600 feet of the pipe and channel to enter the marsh system (Stay, pers. comm., 1995) as reported in Pentec (1998); Thompson, pers. comm., 2012); however, other salmonid life stages and other fish species are not known to enter the marsh from Puget Sound. For those adult salmonids migrating upstream into the marsh, after exiting the pipe from the low intertidal zone to the railroad tracks, they encounter the 700-foot-long confined channel that leads to the marsh. Since the mid-2000s, no adult salmonids have been documented entering the creek and migrating all the way to the Willow Creek hatchery (Thompson, pers. comm. 2012). It is possible that low numbers of adult salmonids have entered the marsh during this time, but not migrated up to Willow Creek. The straight channel upstream migrating fish encounter after migrating up the outlet pipe is poor habitat for salmonids as it offers no instream structure or overhanging riparian vegetation. WSDOT (2004) described the confined channel bottom as having "exclusively muck

and the water is uniformly shallow, warm, and exposed." Shannon & Wilson field staff observed a sandy substrate with occasional gravels in the confined channel in summer 2012.

Existing Marsh Habitat Conditions

In the main body of Edmonds Marsh, habitat conditions range from freshwater to brackish. The extent of saltwater inundation, the vegetation communities along the salinity gradient, and the overall shape of the marsh are controlled by the tidal exchange through the tide gate and stormwater pipe system, the inputs of freshwater from the surrounding watershed, and the development that has encroached on the marsh's historic footprint of nearly 100 acres. The marsh includes a distinctly estuarine area extending across approximately the western third of the marsh and a freshwater wetland in the remaining areas. Although there is a gradient in the salt tolerance of plants within the estuarine portion, there is a fairly abrupt transition between the estuarine and freshwater portions of the marsh. The estuarine portion of the marsh supports a variety of native plant species in higher salinity areas (e.g., seashore saltgrass and pickleweed) to lower salinity areas (e.g., seacoast bulrush and Lyngby's sedge) (Pentec, 1998). The more salt tolerant plant species occur primarily along the drainage channels in the estuarine portion of the marsh (O'Connell and others, 2009). Pentec (1998) reported that the high tide elevations in the marsh are lower than those documented in nearby shoreline areas with unrestricted tidal exchange due to tidal muting. As a result, the distribution of estuarine emergent plants in the marsh is limited to tidal elevations that are lower than observed in other comparable salt marshes in Puget Sound (Pentec, 1998). The estuarine portion of the marsh includes unvegetated areas and shallow tidal channels, as well as an open channel along the margin of the Chevron property to the south of the marsh. The remaining two-thirds of the marsh area on both sides of SR-104 supports freshwater vegetation. Dense growth of cattail vegetation, along with purple loosestrife and deadly nightshade are reported (Pentec, 1998). Recent surveys of the marsh show that there are no direct channels connecting the streams with the saltwater tidal channel sections of the marsh (Perteet, 2012). As a result, there is no channel route for fish to move between the creeks and the estuarine marsh. Further, it has been hypothesized that the filling of drainage channels in the freshwater wetland due to siltation from the upper watershed has limited saltwater inundation and enabled the freshwater marsh to expand to the west (City of Edmonds, 2008).

Pentec (1998) characterized the fish habitat in the estuarine portion of the marsh as "marginal to fair rearing habitat" citing the lack on instream structure and marginal water quality in summer months (due to high water temperatures). The estuarine portion of the marsh area provides some rearing habitat for juvenile salmonids and other small fish that are able to survive in saltwater. In considering the quality of the habitat, the availability of prey items for fish is an important

consideration and the estuarine portions of Edmonds Marsh can be expected to produce an abundance of prey items because salt marshes are typically highly productive habitats. During high tide, the marsh provides habitat for fish to move throughout the inundation area. During low tide, the marsh drains until only the tidal channels, the channel along the Chevron property, and marsh outlet channel are available. WSDOT (2004) characterized the open channel habitats between the marsh outlet and the upper extent of the Chevron property as "poor" or "very poor" habitat.

Fish access to much of the freshwater portions of the marsh appears limited, except along the approximately 600-foot-long channel along the southern margin of the marsh, which is not fully connected with the confluence of Willow and Shellabarger Creeks. In the area near the confluence of the creeks, the channel is "highly braided and difficult to follow as it filters through thick cattail intertwined with purple loosestrife and deadly nightshade" (Pentec, 1998). Water depths vary substantially in this area, ranging from a few inches to more than 4 feet (Pentec, 1998). As noted previously, there is currently not a channel to allow fish to move between the creeks and the estuarine portion of the marsh. Pentec (1998) characterized the fish habitat in this portion of the marsh as suitable for winter rearing by salmonids, but with potential water quality limitations in the summer due to high water temperatures and low dissolved oxygen.

Upstream Creek Channels

Upstream of the marsh, Willow and Shellabarger Creeks are small creeks that provide some habitats suitable for fish rearing and spawning for at least several hundred feet until obstructions block further upstream fish passage. Pentec (1998) characterizes Shellabarger Creek fish habitat as "fair to good" for rearing and "good spawning potential for salmonids." In Willow Creek, fish habitat was characterized as excellent for rearing (Pentec, 1998), but interpretations of spawning habitat availability differ as Pentec (1998) characterizes the habitat as poor and WSDOT (2004) described the creek as providing "fair to good" spawning habitat.

Contaminant Impacts to Habitat

In addition to the preceding description of primarily physical and biological features comprising existing fish habitat conditions, consideration of potential chemical contamination of water or sediments is necessary. Stormwater and previous industrial operations adjacent to the marsh are two routes of potential contamination. Together, the sources may input metals, polyaromatic hydrocarbons ("PAHs"), total petroleum hydrocarbons ("TPHs"), Light Non-aqueous Phase

Liquids (LNAPL), and nutrients. These inputs can affect the productivity of the marsh habitats and create a prey base for fish that poses potential risks for contamination which could bioaccumulate in fish. Thus, the quality of fish habitat within the should be considered impaired to some degree by chemical contaminants, unless it is demonstrated otherwise that the cleanup remediation actions are comprehensive and complete. The amount of potential effects on fish is unknown at this time, and is not considered in this current early feasibility study.

Overall, the fish habitat conditions in Edmonds Marsh and the contributing tributaries are "fair" with a great deal of improvement possible through restoration actions.

DESCRIPTION OF THE DAYLIGHTING ALTERNATIVES

Three alternative alignments have been identified to discharge Willow Creek from the tidal marsh into the Sound (Figure 1). These alternatives have been identified by People for Puget Sound, previous studies (Pentec, 1998), and by this study as potential locations to realign the Willow Creek Daylight channel. All three alternatives involve daylighting either portions of, or the entire creek channel downstream of the marsh and increasing the tidal connection to Puget Sound. Daylighting in this context is referred to as realigning the creek from a pipe into an open channel. All alternatives will need to cross the BNSF railroad tracks and through property owned by either the Port of Edmonds, the City of Edmonds, or both. The following sections describe the three alternatives in more detail.

Alignment Alternative 1 - Edmonds Marina Beach Park

Daylighting Willow Creek at the Edmonds Marina Beach Park would involve constructing a new channel across the beach park area from the BNSF railway. Depending on the alignment, the length of the park beach channel would vary from 350 feet if located in the dog park area to the south, or up to 700 feet if located north through the existing parking lot and grassy areas of the park. Appropriate habitat features would be included to make the channel both biologically functional and aesthetically pleasing to park users. For example, instream wood, step pools, and riparian vegetation would improve flow complexity and cover conditions in the channel. Currently, the City of Edmonds is considering the daylight alignment as part of a separate park master planning study.

At the BNSF railway, the daylighted creek would cross under the railroad embankment through a bridged crossing installed by BNSF and Sound Transit during recent railway expansion work in 2010. The bridge crossing was completed in anticipation of the future daylighting work as part of the Edmonds Crossing multi-modal project mitigation (Photograph 6). As-builts for the

crossing installation have been provided by BNSF; however, supporting bridge flow and scour design information for the daylighted flow alignment condition have not been identified at this time. Additional research and coordination with BNSF, Sound Transit, and WSDOT would be required to determine the structural and hydraulic sufficiency of the existing structure. If not adequately designed, retrofit and modification may be necessary.

Upstream from the BNSF crossing, Willow Creek would be daylighted. The exact configuration of the daylighted channel is unknown. In its simplest form, the channel would be 700 feet long flowing straight next to the BNSF railway and on the Chevron/Unocal property. CH2M Hill proposed a meandering alignment, as part of the Edmonds Crossing Final Environmental Impact Statement, that flows east away from the railway onto the Chevron property, and connecting with the downstream and of the existing confined channel near the current stormwater pond. For the purposes of this study, we evaluated a straight channel daylighting on the beach, passing underneath the railroad, and then following a relatively straight alignment to the existing confined channel. The plan form configuration of the channel may be revised in later phases of feasibility and design work, depending upon the availability of the Chevron property for realignment.

Alignment Alternative 2 - Port of Edmonds Dock F

The Port of Edmonds Dock F alternative alignment would divert the stream towards the north into an existing storm drainage pipe alignment, and then cross Admiral Way to the west through the Edmonds Marina parking lot (Figure 1). The estimated length of this realignment from the Marsh to the waterline in the marina is 400 feet. In the 1998 report for the Port of Edmonds, Pentec (1998) describes a possible open channel configuration as:

> *"…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."*

This alignment would include keeping the existing piping under the railroad tracks, modify storm drainage piping along and underneath Admiral Way, and would have a daylighted channel through the existing marina parking lot. The discharge location would be inside the existing marina between Docks F and G (Photograph 7).

Alternative 3 - Sunset Beach Alignment

The Sunset beach alignment would relocate the outlet of Willow Creek to the northwest corner of the marsh and would approximate the mapped historical outlet (Figure 2). The estimated length of this proposed realignment alternative would be approximately 900 feet long. This alignment would require installation of a new crossing underneath the BNSF railway. The alignment would then run northwest through an open gravel parking lot owned by the Port of Edmonds. We have assumed that a property sale or exchange with the Port is not a viable element of the project for a full daylight channel and, therefore, a pipe would need to be installed underneath the gravel parking lot. The pipe would then cross underneath W. Dayton Avenue/Admiral Way and daylight on Sunset Beach between the Edmonds Marina breakwater, fishing pier access, and public beach.

SCREENING ANALYSIS APPROACH

The screening analysis evaluates each of the three proposed alternatives through a qualitative review of habitat modifications and impacts; coastal hydrodynamics; and a compilation of engineering, infrastructure, and property issues. The primary evaluation components of the screening analysis include fish habitat and biological response, using a set of technical criteria developed specifically for the project, and a pros/cons analysis of coastal/tidal hydrodynamics and sediment transport conditions, infrastructure constraints, drainage effects, potential costs, and social-political factors for the alternatives.

A key step in the assessment is the evaluation of the likelihood of juvenile Chinook and other salmonids to use and access into the daylighted alternative alignments. The following biological response criteria and definitions were used in the screening analysis.

- **Likelihood of juvenile Chinook salmon encountering the marsh outlet**
  - *Explanation of Criterion:* This criterion is a qualitative assessment of the likelihood of juvenile Chinook moving in close proximity to the shoreline of each marsh outlet alignment.

- **Likelihood of the marsh outlet connection remaining open and accessible for juvenile Chinook salmon**
  - *Explanation of Criterion:* Qualitatively assess the potential for sediment transport and/or large wood accumulations to block the access channel to the marsh for juvenile Chinook during the spring and early summer outmigration timeframe.

- **Suitability of marsh outlet and channel for juvenile Chinook salmon passage into restored marsh**
  - *Explanation of Criterion:* Consider the marsh outlet features and their affect on juvenile Chinook salmon's ability or willingness to migrate into the marsh. Considerations include access channel length, generally anticipated flow velocity conditions throughout tidal cycle, number/length of overwater structures (or remaining culvert reaches), and potential habitat features within access channel.
- **Potential to integrate with future restoration**
  - *Explanation of Criterion:* Assess whether the marsh outlet would accommodate potential future restoration opportunities along the outlet channel and in the vicinity of the marsh outlet.

A second component of the screening analysis includes a review of coastal and tidal hydrodynamics in the context of maintaining a permanent connection between Edmonds Marsh and Puget Sound. This review includes a qualitative coastal engineering discussion of tidal hydrodynamics, future marsh conditions, local sediment transport, deposition, and shoaling effects on the alternatives.

The third component of the screening analysis focuses on engineering, property, and socio-political issues. These include a qualitative discussion of infrastructure constraints, drainage effects, potential costs, landowner willingness, and social-political factors for the alternatives from a hydraulic/civil engineering perspective.

ALTERNATIVES SCREENING ANALYSIS

Alternative 1 - Edmonds Marina Beach Park

Fisheries

Improving the connection of Edmonds Marsh to Puget Sound by an outlet alignment through the Edmonds Marina Beach Park offers a great deal of potential for fish movement between Puget Sound and the marsh, including juvenile Chinook salmon and adult salmonids such as coho salmon, sea-run cutthroat trout, and possibly chum salmon. The large marsh can provide favorable rearing conditions for migrating juvenile salmon and promote rapid fish growth, which improves likelihood of survival to adulthood.

In this alignment, the marsh outlet would be located in a small beach area which already is a favorable location for fish because it is one of the more natural beach areas along this stretch

of Central Puget Sound which is lined shoreline armoring in front of the BNSF railroad and the Edmonds Marina. Juvenile Chinook salmon tend to remain in close association with the shoreline during their early marine life stage before moving into deeper water and eventually migrating to the ocean (Fresh, 2006). The Edmonds Marsh outlet would be between approximately 8 and 15 miles from the closest Chinook salmon rivers, the Cedar River via Lake Washington Ship Canal, and the Snohomish River, respectively. Given these distances, the marsh may not be as heavily used as it would if it were closer to one of the major rivers; however, some juvenile Chinook salmon do remain in close proximity to the shoreline over long distances in Puget Sound. Several studies of juvenile Chinook salmon distributions in the Puget Sound nearshore have documented the fishes' use of shoreline habitats such as the Marina Beach Park at far distances from their river of origin (e.g., Brennan and others, 2004; Dorn and Best, 2005; Fresh and others, 2006; Beamer and Fresh, 2012). It is likely that juvenile Chinook salmon would locate and utilize the marsh, particularly given this alignment alternative, which would position the marsh outlet along a sandy beach that provides favorable foraging habitat for the fish.

It is reasonable to conclude that more juvenile Chinook salmon would encounter the marsh outlet at the Marina Beach Park compared to the alternative alignment through the marina (Alternative 2). This expectation stems from the fact that the marina is a partial obstruction to juvenile Chinook salmon that tend to migrate along shallow portions of the shoreline and avoid deep water (until they grow larger). The marina requires the fish to swim around the outside of the marina and either cross the deep water marina entrance or enter the marina. While all juvenile Chinook salmon migrating from south to north would be expected to encounter the marsh outlet if it was located in the Marina Beach Park, a marsh outlet may not be encountered by as many fish because some may not enter the marina as they navigate around the outside of it. For adult salmonids returning to Puget Sound, the marsh outlet in the Marina Beach Park may also be more likely encountered based on likelihood of the adults entering the marina as well as the potential for the fish to detect the odor of the freshwater source from a greater distance if it flows across the beach rather than into a marina.

A marsh outlet in the Marina Beach Park would be exposed to the wind and wave conditions of Central Puget Sound and depending on the outlet configuration, some shifting of the outlet should be expected. As long as the design doesn't detrimentally impact expected adjacent park uses, such movement of the outlet channel across the beach face is a favorable condition such as naturally occurs at other marshes and tributary outlets. Currently, the upper beach accumulates drift logs that come and go with storm events. Beach logs, as well as shifting

beach sediments may partially impede access to the marsh during some time periods, but it is expected that the force of outflows from the marsh will maintain migratory routes for juvenile Chinook salmon and adult salmonids to move between Puget Sound and the marsh.

Fish locating the marsh outlet will need to swim several hundred feet from the beach to the marsh. The alternative includes only a short portion of overwater structure as the channel runs under the BNSF railroad track, otherwise the access channel would be entirely open with the opportunity for habitat features to be included in the design to provide favorable in-channel conditions. Juvenile Chinook salmon and adult salmonids can be expected to migrate this distance to access the marsh habitat. The short distance of overwater structure would not be expected to markedly affect the likelihood of fish entering the marsh entrance channel. The habitat conditions in the entrance channel can be improved by including instream wood, pools, and riparian vegetation.

The Marina Beach Park outlet channel realignment could support future restoration of property along the former Unocal site, east of the BNSF railway. The restored marsh entrance channel could potentially be expanded in size (to the east) if at some point in the future some of the former Unocal site property becomes available and suitable for habitat restoration. This would reduce some of the problems identified with the BNSF railway culvert perpendicular configuration. There are no such plans for such expanded restoration at this time and possible contamination of soils in the former site that may limit potential inclusion of channel restoration and realignment in this area.

Coastal Hydrodynamics

Alternative 1, which includes the alignment through the Marina Beach Park, is the only alternative that does not require the connection between the Sound and the marsh to be placed (at least partially) through pipes or culverts. The use of open channels for nearly the entire alignment (except for the BNSF railway crossing) will allow for larger volumes of natural tidal prism exchange and marsh inundation (both filling and draining) of the marsh compared to the other proposed alternatives. The proposed outlet, as mentioned above, is located along a relatively natural, nearshore reach with minimal shoreline armoring. The connection can, therefore, be designed as a continuous sloping channel from the marsh down to lowest tidal elevations at the Sound. This mimics the type of channel that historically existed connecting the nearshore area with the marsh; although the historic location of the outlet is to the north of the location proposed as part of Alternative 1. The channel could be designed as a relatively unconfined inlet to the marsh or could be designed as an engineered channel to better control in-

channel velocities and minimize movement of the channel location due to nearshore processes depending on park maintenance requirements. Littoral transport along the shoreline in this area is from the south to the north (USGS, 2010). The shoreline to the south is armored; however, there is a limited source of sediment to the system from Deer Creek that discharges one mile south of the proposed outlet. The natural drift process has the potential to deposit sediments in the proposed outlet channel during extended periods of low flow from the upstream marsh to the beach. This may result in some limited access to the channel for fish at lower tides during portions of the year. However, it is anticipated that higher flows from the upstream marsh, as well as coastal storm events, would have the ability to flush a majority of the deposited sediment out of the channel. The orientation and sediment dynamics of the Willow Creek outlet on the beach should be studied further if this alignment is selected and park planning studies are initiated.

This site is subject to direct impact from storm waves from the west and south-west. Depending on the tide level at the time of the storm event, these impacts could include erosion of nearshore sediments at the mouth of the creek, transport, and deposition causing infilling of the mouth of the creek by deposition in the channel, and/or lateral migration and changes in channel location and or depth of the mouth of the creek due to these sediment movements.

The proposed outlet for Alternative 1 has the potential to be the most natural of the proposed alternatives, based on historical understanding of the marsh outlet. In addition, there are opportunities to enhance nearshore restoration activities at Marina Beach Park mouth that would benefit the marsh restoration project and provide additional nearshore fish habitat.

Engineering, Infrastructure, and Property

The Alternative 1 daylight mouth originates in the Marina Park, travels through the BNSF railway, and then northward along the BNSF railway on the Chevron property. As such, there are various infrastructure and property ownership considerations for this alignment.

Within the park, a southern alignment would need to address the existing dog park facilities (Photograph 8). As dogs and a freshwater salmon habitat may not be compatible features, exclusion fencing and vegetation screening may be necessary to protect and shelter fish from external stimulus and allow the fish to migrate through the dog park area. Adjacent to the northern edge of the dog park is a gravel parking lot, which may be impacted if geotechnical bank reinforcement, shoring walls, or earthwork grading encroach into the parking area (Photograph 9).

A northern channel alignment through the park would need to address potential loss of parking spaces and grass landscape areas, and stormwater infrastructure conflicts. The alignment would cross the park access road and parking spaces, and likely flow through the grassy "knoll" and onto the beach at the north (Photographs 10 and 11). This general alignment is near the existing Willow Creek stormwater outfall pipe alignment, as well as other underground utilities. A northern alignment could become a natural setting for the stream restoration, but could potentially involve significant changes in the park landscape and uses, which would translate into additional project costs. Additional evaluation of both a southern and northern channel alignment would need to be conducted as part of a future park planning study, if this alternative is chosen.

At the upstream end of the park, the stream would flow through the BNSF bridge crossing. This crossing is currently perpendicular to the tracks, and may have an abrupt change in flow direction due to the perpendicular nature of the crossing relative to the probable alignment on either side of the crossing. This configuration is not an optimal alignment for Willow Creek daylight restoration, unless space can be provided for the transition associated with the proposed channel approaches. Options for improving this include modifications to the existing crossing alignment, or looking at channel meander patterns and approach directions both upstream and downstream from the crossing that allow room for turning the channel upstream and downstream. It is not known if the current crossing subgrade and foundation were designed and constructed to protect the BNSF railway from the future scour conditions from a daylighted channel. A crossing design report has not been identified at this time. It is noted that this structure may increase in length (to the east) as BNSF expands the second rail line through the Edmonds area.

Known utilities for Alignment 1 include the City of Edmonds stormwater pipeline and vaults, a fire hydrant line that extends south into the dog park, as well as buried communication lines beneath the BNSF railway. A full investigation of utility locations is needed for final design.

Property ownership for Alignment 1 is limited to the City of Edmonds, BNSF, and Chevron/Unocal. The park area is owned by the City of Edmonds, the crossing by BNSF, and the upstream daylight channel would most likely be located on Chevron/Unocal property.

In summary, Alternative 1 would include a new channel excavation downstream from the current confined channel between the BNSF and Chevron/Unocal property, for which contaminated soils remain a concern. There are additional restoration opportunities to the east

on the Chevron property, if the owner is amenable, which also have similar contamination potential. The existing crossing beneath the BNSF railway is helpful in that it could reduce the cost of a new crossing; however, the alignment may not be ideal. This needs to be considered in evaluation of the two Marina Beach Park proposed alignments. The Marina Beach Park realignment(s) have infrastructure such as stormwater pipes, fire water supply pipelines, and parking areas that need consideration, for which we recommend a park planning study.

Alternative 2 - Port of Edmonds

Fisheries

Like Alternative 1, an Edmonds Marsh outlet alignment through the Edmonds Marina would offer a great deal of potential for fish movement between Puget Sound and the marsh, including juvenile Chinook salmon. The marsh would be a productive habitat for fish entering the system. With a marsh outlet in the marina, somewhat fewer juvenile Chinook salmon would be expected to encounter the marsh entrance that an outlet to the beaches north or south of the marina (Alternatives 1 and 3, respectively), because not all fish are expected to enter the marina as they navigate past it, and there are few if any forage areas in the marina. Among those fish that enter the marina, the marsh outlet in the marina could be an attractant that increases the amount of time the fish reside in the marina. However, from a fish habitat perspective this would not be favorable due to the habitat conditions in the marina (e.g., extensive overwater coverage, deeper water, modified shoreline within the marina, and potential exposure to chemical contaminants [petroleum), and boat and marina noise) that affects the foraging opportunities and prey base quality, as well as increases predation risks.

A marsh outlet in the marina would need to be a highly engineered channel and culvert that is fixed in place, and maintain and protect existing marina infrastructure. The channel would be designed to provide suitable depth and velocity conditions to enable fish to move between Puget Sound and the marsh. Due to the fixed position of the outlet and the anticipated design to provide suitable flow conditions for access, this marsh outlet is more certain to remain open and accessible to juvenile Chinook salmon and adult salmonids that encounter it. Any step pool feature to provide access to the channel during low tides would be more accessible to adult salmonids than juveniles. A marsh outlet alignment through the marina would also provide the shortest access channel distance to the marsh, which implies improved fish access to the marsh. However, this is in contrast to a hardened channel and pipe system, which offsets potential gains from a shorter system. There are no clear advantages to fish habitat for the marina location.

Coastal Hydrodynamics

Alternative 2, which includes the alignment through what is now a parking lot and into the existing marina basin, would consist of an engineered hardened channel outlet into the marina with an upsteam pipe or culvert connections to the marsh due to site constraints (as discussed above). The use of pipes and culverts within the channel system between the marsh and the sound will result in some attenuation of the tide into the marsh, as well as some delay in draining of the marsh system during periods of low tide. The proposed outlet would be through what is now a parking area and would terminate within the marina directly into relatively deep water. Therefore, the channel would need to be graded in such a way to ensure the mouth of the creek is below mean lower low water or the outlet of the creek may be perched above lower tidal levels due to the lack of an intertidal beach area (low tide bench) at the proposed outlet to support a low tide channel. This would result in higher than desired in-channel velocities during low tides which could be an access problem for fish into the marsh, during the low tide conditions.

Littoral transport along the shoreline in this area is designated as "no appreciable drift" (USGS, 2010), which means that there is either little to no sediment drift at this location or there is no appreciable net drift (however, there could be gross transport north and south during different times of the year). At the location of the proposed outlet for Alternative 2, there is most likely little to no shoreline sediment transport due to the presence of two breakwaters which shelter the marina from waves. However, there would likely be sediment transport and deposition that would occur from upstream marsh sediment supplies. This additional sediment transport into the marina is undesirable and would increase maintenance dredging requirements for the marina. It is not likely that the amount of sedimentation would block the channel, rather the rate of sedimentation in the marina would increase, thereby requiring more frequent marina dredging.

Engineering, Infrastructure, and Property

The Alternative 2 daylight outlet in the marina is located within an array of infrastructure. Infrastructure includes buildings, walls, piles, stormwater pipelines, sewer, water supply, electrical (possibly gas), car parking, and boat docking areas. This amount of infrastructure would likely require a significant amount of engineering design, as well as coordination and protection of infrastructure during construction, which is also during summer months that are the busiest times at the marina. The amount of adjacent infrastructure implies a rather large cost for

installation of a new daylight channel. Also, the daylighted channel (if not in a pipe) would eliminate a number of parking spaces for the port and marina.

Bob McChesney of the Port of Edmonds was contacted during coordination activities for installation of the project data logger in the marina. At that time, he was asked about the viability of daylight channel exiting into the marina between Docks "F" and "G". His response was firmly that the Port did not support a Willow Creek daylight alternative with an outlet into the marina (Cline, 2012).

Further east, the channel would need to cross beneath Admiral Way, where the road tees and heads east near the Port of Edmonds parking lot. This would require traffic control and coordination during construction, which also implies additional costs.

Upstream of the Admiral Way crossing, the channel would follow the road. If a stream channel is designed in this area, it would likely encroach upon the parking area to the east. This may be done without impacting parking, but could potential require the removal of existing trees and vegetation.

Finally, the daylight channel would need to cross the BNSF railroad embankment. This will require installation of a new crossing structure and protection of the railroad embankment, as well as continue to provide rail service during construction. The new crossing would likely be additional cost over the Alternative 1 crossing. Construction in the BNSF railway right-of-way requires special easements and permits from BNSF, as well as special construction contract specifications for safe-zone working along the railroad. This applies for any alternative where construction through, in, and around the embankment and within the right-of-way is required.

Property ownership along Alignment 2 is the City of Edmonds, the Port of Edmonds, and the BNSF. It is doubtful that a viable agreement could be reached with the Port of Edmonds considering their stated position on the Alignment 2 alternative. Alternative 2 alignment is considered a high social-political risk and is not recommended.

Alternative 3 - Sunset Beach Alignment

Fisheries Perspective

Reconnecting Edmonds Marsh through this alignment would offer some potential for fish use of the marsh; however, the extensive channels and lengthy pipe system necessary to connect the beach to the marsh would limit the likelihood that juvenile Chinook salmon and even adult

salmonids would enter the system. The extended pipes would have to be designed to provide suitable depth and velocity conditions to allow fish passage; however, fewer fish would be expected to enter compared to an open channel. This is a significant factor limiting the potential benefits associated with this alignment.

The Sunset Beach alignment of the marsh outlet is in a slightly more protected location than the Marina Beach Park alignment because the marina blocks the strong wind and waves from the south. As a result, the Sunset Beach alignment can be expected to have fewer issues with partial outlet closure than the Marina Beach Park. For fish, this means the Sunset Beach alignment would provide clearer access for fish moving between Puget Sound and the marsh.

The City of Edmonds stormwater staff indicated at the August 9, 2012, kickoff meeting that the Sunset Beach alignment is located near a City of Edmonds combined sewer overflow (CSO) outfall. The proximity of the Sunset Beach outfall with the CSO outfall increases the risks to potentially harm fish due to poor water quality. If fish were attracted to the area during a CSO event, there could potentially be fish fatalities or health risks due to the likely poor water quality from the CSO discharge.

The Sunset Beach location for a marsh outlet would be located in a sand and gravel beach area adjacent to the marina. This is a favorable rearing area for juvenile Chinook salmon and the marsh outflow could transport prey items to fish along the beach. However, based on the adjacent marina and buildings, the marsh outlet would likely have to be engineered to remain in a fixed position which would limit the opportunity to provide a natural marsh outlet. In this way, the Sunset Beach alignment is more like the marina outlet alternative than the Marina Beach Park alignment.

While the proposed outlet for Alternative 3 has limited spatial extent in the nearshore compared to Alternative 1, there may be some opportunities to conduct beach/nearshore restoration activities at the Sunset Beach outlet location that would benefit the marsh restoration project and provide additional nearshore fish habitat.

Coastal Hydrodynamics

Alternative 3, which includes a northern outlet alignment through Sunset Beach, would consist of an engineered hardened channel with upsteam pipe/culvert connections to the marsh due to site constraints (as discussed above). While the location of the outlet for this alternative coincides with its historical location, as with Alternative 2, the use of pipes/culverts within the

channel system between the marsh and the sound will result in some attenuation of the tide into the marsh, as well as some delay in draining of the marsh system during periods of low tide.

The proposed outlet is located along at Sunset Beach; a small intertidal beach area is backed by shoreline armoring above mean higher high water and adjacent to one of the breakwaters for the marina (located south of the proposed outlet location). The outlet channel can likely be designed as a continuous sloping channel from the marsh down to lowest tidal elevations at the Sound; similar to Alternative 1. However, the nearshore area at this location is significantly smaller than that of Alternative 1 due to the physical constraints of the area (adjacent armoring and upland property).

Littoral transport along the shoreline in this area is designated as "no appreciable drift" (USGS, 2010). At the proposed outlet location, the lack of appreciable drift is likely due to the interaction of the site with the large breakwater to the south; which shelters the area from storm waves from the south, south-west, and west; which are the most significant storm directions for this area. There would likely be minor sediment transport and deposition from the marsh. It is more likely that the outlet of this channel will remain open and free of sediment deposition than Alternative 1.

This site is subject to direct impact from storm waves from the north-west and north, but is sheltered from all other storm wave directions. The presence of the breakwater is anticipated to greatly limit the impact of storm waves on the proposed outlet in terms of sediment transport and infilling. However, it is possible that storm events from the north and north-west could impact the site in similar ways (influencing the channel to migrate in one direction or another) as described for Alternative 1.

Engineering, Infrastructure, and Property

The Alternative 3 daylight outlet at Sunset Beach, to the north would encounter a variety of infrastructure and property owners. This alternative alignment most closely represents the historical marsh mouth to the Puget Sound. Significant development and changes to the landscape have occurred in this area.

Immediately upstream (south) of the beach, the daylight channel would encounter Admiral Way or Dayton Street at the corner. This would require a pipeline crossing, and would need to be built around existing stormwater drainage utilities among other existing underground

utilities. This crossing would need to be a significant structure and would likely have associated significant construction costs.

South of the Admiral Way street corner, the stream channel would flow into a partially used gravel lot which is owned by the Port of Edmonds. The channel could daylight through the parking lot, but would require elimination of overflow parking in this area. This lot was under consideration for the Edmonds Crossing project as an alternative alignment for SR-104, but was not identified as a recommended alternative. The Port of Edmonds was not interviewed regarding this alignment.

At the southeastern corner of the lot, the realigned channel would then flow through a culvert or pipe through the BNSF embankment and directly into the marsh. This would likely require construction of a culvert crossing similar to the existing crossing for Alternative 1. The limitations associated with this crossing are similar to those discussed as part of Alternative 2.

Property ownership along Alignment 3 includes the City of Edmonds, the Port of Edmonds, and the BNSF. A significant amount of the project is located on Port of Edmonds property. The daylight channel would require a lengthy easement or purchase of the current gravel parking lot area on the corner of Admiral Way and Dayton Street. It is unlikely that a viable agreement could be reached with the Port of Edmonds considering their stated position on daylight channel realignment on Port property. We would recommend confirming this position with the Port, if Alternative 3 is identified as having merit warranting further investigation.

RECOMMENDED ALIGNMENT

From a fisheries perspective, all three of the alignments would improve shoreline conditions and expand the saltwater influence in the marsh so it functions more like a natural saltmarsh and can provide fish access. The Marina Beach Park alignment is the most beneficial to fish because it provides an open channel connection that can be designed to provide good habitat for fish moving between Puget Sound and Edmonds Marsh. In addition, the marsh outlet into the Marina Beach Park would add a beneficial feature to an area that provides favorable nearshore rearing conditions for juvenile Chinook salmon, especially compared to the extended section of riprapped shoreline to the north and south. The concerns of the Port of Edmonds Dock F alignment increasing rearing time in the marina among juvenile Chinook salmon that enter the marina and the extended pipe culvert sections associated with the Sunset Beach alignment limit their suitability for the marsh outlet.

From a coastal hydrodynamics perspective, all three of the alignments would provide connectivity between the marsh and Puget Sound, and likely improve tidal inflow and drainage from the marsh. Each alternative has distinctly different littoral drift sediment conditions. Alternative 1 will have design challenges related to littoral drift and sedimentation in the channel that could potentially cause fish access issues at low tides. This, however, is a similar condition observed at other natural stream mouths throughout Puget Sound, and would likely only occur periodically. Alternative 2 would impact maintenance in the Port of Edmonds marina by increasing maintenance dredging. Alternative 3 would require long pipe runs that would be difficult and costly to design for fish passage. Based on these observations, Alternative 1 has the best potential to both improve tidal inflow and drainage from the marsh, while still providing hydraulic conditions conducive to fish passage, relative to Alternatives 2 and 3, which both include lengthy pipes as part of the proposed the alignments.

From an engineering design, infrastructure protection, and property ownership perspective, Alternative 1 requires the least amount of new infrastructure to complete the proposed alternative. Alternative 1 is the only proposed outfall location that has an existing BNSF crossing, although additional approach work may be required. Alternatives 2 and 3 would require significant Port, marina, and City roadway and drainage infrastructure to contend with, which implies increased costs for construction, easements, property purchases, and negotiations. Based on direct discussions with the Port, they would not support Alternative 2 that would outfall in the Port-owned marina. Alternative 3 has a long alignment through Port of Edmonds property that could also be difficult to acquire an easement or purchase, which would significantly increase project costs.

In summary, it is our opinion that Alternative 1, realigning the Willow Creek outfall through the Edmonds Marina Beach Park is the most logical location, given the existing railroad crossing and willing land owners. This alternative will provide the best attractants for juvenile salmonids at a natural beach area, allow for potential additional beach restoration benefits, will improve saltwater tidal inflow and marsh drainage conditions, has the least amount of existing infrastructure to work around, and is located in a position acceptable to adjacent property owners. Alternative 1 is not without challenges: identification and design of a preferred alignment within the park that meets multiple user requirements, the BNSF crossing design configuration, and location of the realigned stream on the Chevron property. The study team recommends the Early Feasibility Study continue forward with the Alternative 1 – Edmonds Marina Beach Park alignment.

CLOSURE

We appreciate the opportunity to be of service to you. Please let me know if you have any questions regarding this report.

Sincerely,

SHANNON & WILSON, INC.

David Cline, P.E.
Associate Hydraulic Engineer

DC/dc

Enc: References (3 pages)
Appendix A – Figures and Site Photographs

c: Jerry Shuster, City of Edmonds
Carrie Hite, City of Edmonds
Phil Williams, City of Edmonds

REFERENCES

Beamer, E., and Fresh, Fresh, 2012, (Draft) Juvenile Salmon and Forage Fish Presence and Abundance in Shoreline Habitats of the San Juan Islands, 2008-2009: Map Applications for Selected Fish Species.

Brennan, J.S.; Higgins, K.F.; Cordell, J.R.; and Stamatiou, V.A., 2004, Juvenile Salmon Composition, Timing, Distribution, and Diet in Marine Nearshore Waters of Central Puget Sound in 2001-2002: King County Department of Natural Resources and Parks, Seattle, Washington.

Cline, D.R., 2012, Personal communication with Bob McChesney, Port of Edmonds on August 22,regarding Alternative Alignment 2 exiting into the Edmonds Marina.

City of Edmonds, 2008, Edmonds Marsh Channel Improvements. www.ci.edmonds.wa.us/EngCIP/2008/ProjectDescriptionsPDF/Fund_412-200/2008-412-200.EdmondsMarshChannel.Improv.pdf.

City of Edmonds, 2012, Property and parcel shapefile provided by the City of Edmonds.

Dorn, P., and Best, P., 2005, Integration of Joint City of Bainbridge Island/Suquamish Tribal Beach Seining Results into Shoreline Management and Salmon Recovery Efforts in Kitsap County, Washington.

Fresh, K.L., 2006, Juvenile Pacific Salmon in Puget Sound, Puget Sound Nearshore Partnership Report No. 2006-06: Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Fresh, K.L.; Small, D.J.; Kim, H.; Waldbillig, C., Mizell, M.; Carr, M.I.; and Stamatiou, L., 2006, Juvenile salmon use of Sinclair Inlet, Washington, in 2001 and 2002: Washington Department of Fish and Wildlife Technical Report No. FPT 05-08.

Gersib, 2008, Edmonds Marsh "Aerial" Photograph Interpretation: Internal Memorandum by Washington State Department of Transportation (WSDOT) regarding Edmonds Marsh historical conditions.

History of Edmonds, 2012, Website with information on the history of the township and City of Edmonds establishment. http://www.historicedmonds.org/Edmonds_History.html.

Moles, Todd, 2012, City of Edmonds Stormwater Department staff personal communications regarding Willow Creek tidegate.

O'Connell, K.; Myers, D.; and Owens, B., 2009, Biological Condition of the Edmonds Waterfront and Preliminary Feasibility Considerations for Nearshore Ecosystem Restoration: Prepared for The Maria Norbury Foundation, Edmonds, WA, Prepared by People for Puget Sound, January 31.

Pentec, 1998, Evaluation of Habitat Benefits and Impacts Associated with the Proposed Daylighting of the Outlet from Edmonds Marsh.

Perteet, 2012, Dayton St. and SR-104 Storm Drainage Alternatives Study, City of Edmonds WA.

Redman, S.; Meyers, D.; and Averill, D. 2005, Regional Nearshore and marine Aspects of Salmon Recovery in Puget Sound, Shared Strategy for Puget Sound, June 28, 2005.

Rice, C., Pers. Comm, 2012, Personal communication between Casey Rice, National Marine Fisheries Service, and Paul Schlenger, Confluence Environmental Company, regarding Edmonds Marsh restoration and recent fish observations. Telephone conversation August 31.

Schlenger, P., Pers. Obs., 2012, Personal observation by Paul Schlenger, Confluence Environmental Company, of juvenile salmonids in Willow Creek during site visit on August 31.

Sea-Run Consulting, TetraTech, Inc., Reid Middleton, Inc., and Pentec, 2007, City of Edmonds; Shoreline Master Program Update; Shoreline Inventory & Characterization: SMA Grant Agreement No. 60600108. Prepared for City of Edmonds, November.

Stay, Pers. Comm., 1995, Personal communication as reported in Pentec, 1998.

Thompson, W. Pers. Comm. 2012. Personal communication between Walter Thompson, Willow Creek Hatchery Manager, and Paul Schlenger, Confluence Environmental Company, regarding recent fish observations in Willow Creek and Edmonds Marsh. Telephone conversation August 29, 2012.

U.S. Geological Survey (USGS), 2010, Puget Sound Shorelines and the Impacts of Armoring – Proceedings of a State of the Science Workshop, May 2009, Scientific Investigation Report 2010-5254.

Washington State Department of Transportation (WSDOT), 2004, Edmonds Crossing Final Environmental Impact Statement. Prepared by CH2M Hill, Bellevue, WA.

APPENDIX A

FIGURES AND SITE PHOTOGRAPHS

APPENDIX A

FIGURES AND SITE PHOTOGRAPHS

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FIGURES

Edmonds Marsh
Edmonds, Washington

WILLOW CREEK DAYLIGHT DATA LOGGER PLAN

August 2012 21-1-12393-102

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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 1

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Willow Creek

Edmonds, WA

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FIG. 2

FIG. 2

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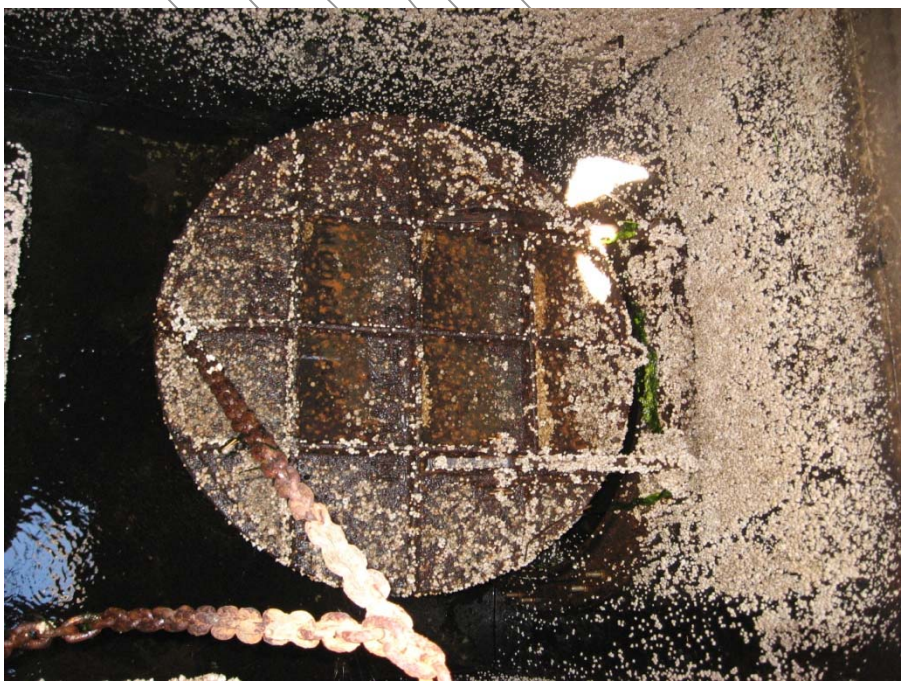
Photograph 1 – Looking downstream Willow Creek confined channel.

Photograph 2 – Looking upstream at Willow Creek crossing underneath BNSF Railway.

Photograph 3 – Looking downstream Willow Creek outlet to vault underneath Admiral with 48-inch concrete pipe.



Photograph 4 – Willow Creek Stormwater Vault and Tide Gate.

Photograph 5 – Looking towards approximate location of stormwater outfall pipe.

Photograph 6 – Looking at pre-constructed BNSF Railway crossing.

Photograph 7 – Marina dock pier and seawall near Docks "F" and "G".

Photograph 8 – Marina Beach dog park area.

Photograph 9 – Marina Beach south parking lot.

Photograph 10 – Marina Beach north parking lot and grassy knoll.

Photograph 11 – Marina Beach park northern beach area.