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memorandum

date January 31, 2013

to Renee LeCroix, City of Bellingham

from Steve Winter, PH

subject **Padden Creek Estuary Habitat Enhancements Project No En-38 - Preliminary Basis of Design Document**

This memorandum supports the design phase of the Padden Creek Estuary Restoration project for the City of Bellingham (City) and is intended to:

- Confirm the primary elements to be included in the design;
- Identify and confirm project extents and constraints;
- Provide greater detail and considerations for more complicated design elements; and
- Provide options and considerations for the log jam elements.

We developed this memo to provide an efficient means for the City to provide feedback on the approach and specific design elements and get "buy-in" from the City and other stakeholders before we move forward with the detailed engineering plans, specifications and estimates.

This memo was developed with the support of Jim Johannessen LEG (Coastal Geologic Services), Bob Battalio PE, Phil Luecking PE, and Allisa Carlson ALSA with ESA. A preliminary set of conceptual design drawings accompanies the memo (Attachment A).

Background

Our May 21, 2012 memorandum (Attachment B) provides the results of our initial restoration alternative development and feasibility analysis, as well as a Phase 1 Environmental Site Assessment. The feasibility memorandum also provides the site context and history, as well as the overarching project goals and objectives. Following completion of the feasibility assessment, the project team met with stakeholders and resource agencies received additional input on some project elements from resource agencies and other stakeholders. We also conducted a focused Phase 2 Site Assessment; the results of which indicate that there are no substantial areas of contaminants in areas where we have proposed project work.

Using this information, the City determined that a subset of the proposed project elements should be further developed. The initial list is summarized below in Table 1, including some notes regarding the design.

Table 1. Initial List of Project Elements for the Padden Creek Estuary Restoration Project

Element Name	Description	Design/Access Notes	Requires off-site access?
Creosote Removal (CR)1	Approx. 25 creosote wood piles would be removed in the area immediately north of the Harris Avenue box culvert.	Good access from overlook and upland south of mudflat.	Yes
Creosote Removal 2	The creosoted timber retaining wall and approximately 15 creosoted wood piles located along the southeast bank of the estuary would be removed.	Wall is within 10-20 feet of property line in this location	Yes
Creosote Removal 3	Two and a half lines of approximately 50 creosoted wood piles along the west shore of the estuary would be removed.	Removal may extend into BNSF right of way to the north.	Potentially
Debris Removal (DR) 1	Miscellaneous small pieces of debris (some of which are old office chairs) have entered the southern portion of the intertidal Creek channel, which would be removed.	Many have already been removed by metal scrappers. May not need to be included or implemented as a weekend/volunteer project.	No
Riparian Vegetation (RV) 1	Exotic species would be removed and beneficial native species would be installed in the narrow vegetated buffer along the east shore of the estuary, south of the rock revetment.	Narrow space, but potential to integrate into salt marsh and log jam elements.	Yes
Riparian Vegetation 2	Exotic species would be removed and beneficial native species would be installed in the narrow vegetated buffer along the east shore of the estuary, north of the existing boat launch.	Very narrow space; may need to combine with channel shift west.	Yes
Riparian Vegetation 3	Several clusters of beneficial native riparian vegetation would be installed approximately 160 to 250 feet north of Harris Avenue, immediately east of the existing trees.	Likely can blend RV 3 and RV 4.	No
Riparian Vegetation 4	Several clusters of beneficial native riparian plants would be installed approximately 340 to 410 feet north of Harris Avenue, east of the existing trees.	Likely can blend RV 3 and RV 4.	No
Salt Marsh (SM) 1	Salt marsh vegetation would be installed on select fill associated with concept RV-1 (see above) to increase the salt marsh cover.	Need to determine fill characteristics and initial placement over intertidal. Natural colonization vs. placement.	Yes
Salt Marsh 2	Salt marsh vegetation would be installed on select fill associated with concept RV-2 (see above) to increase the salt marsh cover.	Existing bench is narrow and may not allow stable fill placement	Yes
Log Jam (LJ) 1	A log jam structure would be anchored to divert intertidal creek channel flow and scour away from the southern portion of the east bank of the estuary.	Needs to provide toe protection to replace wall. May include excavation to shift channel west.	Yes
Log Jam 2	A log jam structure would be anchored to divert intertidal creek channel flow and scour away from the rock revetment along a portion of the east bank of the estuary adjacent to the boatyard, where the channel is scouring out a deep area.	Location conflicts with existing boat launch. Potential for focused flows to erode to the east into the riprap area.	Yes

The project elements that were not selected for further design include riparian vegetation and salt marsh placement along the Burlington Northern Santa Fe (BNSF) right-of-way and along the Harris Street right-of-way.

A blind channel concept was also not selected based on guidance from the City and feedback from the Washington State Department of Fish and Wildlife.

Project Constraints

The primary constraints for the Padden Creek project site relate to neighboring properties. The City owns the western and southern shores of the estuary, making access relatively straightforward from these areas. The northern portion of the estuary is within BNSF right-of-way, and the eastern shore is owned by the Port of Bellingham. We have assumed an offset of 10 feet from the eastern property line for most of the proposed earthwork and design elements. The work to remove the failing wall just north of the Harris Street Bridge would likely require earthwork within this 10-foot-wide setback. Therefore, coordination with the Port is anticipated prior to design completion.

We have also assumed that temporary construction access could occur on the neighboring properties to the east and west. This is a crucial assumption, especially on the east side of the site on Port of Bellingham property which would require coordination and movement of several boats in dry-dock. If access is not available from the upland on the east, construction access, circulation, and material staging and placement will be substantially more difficult and expensive.

The project elements being carried forward to design are responsive to overall site constraints including no change to the Harris Street culvert. We also understand that separate efforts are ongoing to address stormwater quality of local inflows to the estuary.

Project Elements

We have developed preliminary sketches for the project elements listed above in Table 1 on the attached conceptual design drawings. The drawing sheets depict the location, size and composition of the major project elements at a conceptual design level. This section describes the more complex elements based on location within the project site:

- Salt Marsh Area 1 and Log Jam 1 (SM1 and LJ1, Sheet 3)
- Salt Marsh Area 2 and Log Jam 2 (SM2 and LJ2, Sheet 4)
- Salt Marsh Area 3 (SM3 North and South, Sheet 5)

Salt Marsh Area 1 and Log Jam 1

The area along the east side of the estuary immediately downstream of the Harris Street culvert includes the most actively migrating portion of channel, captured in site survey from 2012 and discussed in our feasibility study (Attachment B). This area includes an existing low gradient terrace with elevations near +5 ft MLLW.

The southern salt marsh (SM1) creation area is shown on Sheet 2 and 3 along with a typical section of the proposed placement on Sheet 6. Based on reference data from the nearby Post Point marsh, we expect salt marsh to establish in an approximately 2 foot vertical range between +0.5 and -1.5 feet MHHW. The fill placement would include a steeper upper slope above salt marsh range, with a flatter slope within the salt marsh range down to approximately +7.0 feet MLLW. The toe of the placed fill will be exposed to focused flow in the creek along as well as daily tidal fluctuations, making it likely that some of the placed materials will erode. To provide some initial stability for the fill we propose to install a cobble/gravel berm around the perimeter of the salt marsh. The berm will help delineate the fill placement areas and make placement of the fill during construction more efficient and straightforward. This will also serve to contain the select fill material during initial vegetation establishment.

The select fill material can have a broad range of grain sizes to support successful marsh vegetation establishment. We anticipate re-use of excavated material from the log jam and SM3 excavations for most of the salt marsh fill placements shown here. The placement volume is anticipated to be less than the cut proposed on the west side of the estuary, so limited import is anticipated. We will develop specifications for the select fill in future design phases. This will allow for control of materials to be placed in the estuary to avoid materials that would not be favorable to marsh vegetation establishment.

Placement will occur to just above target finish elevations to allow for settlement and some scour, and allow for construction tolerances. The excess depth will be refined during subsequent design and would be related to the grain size of the select fill material. The approach of filling to below target elevation is often used in salt marsh projects to allow natural accretion. We are proposing active placement of sediments at this site because the sediment load into this site is not well known but is expected to be limited, prolonging the time to accrete to salt marsh elevation. The excess fill will also compensate for some loss of fill sediment from the placement sites due to scour by the creek flow. A small portion of the upper slope fill would extend onto adjacent Port property, but would stay on the face of the riprap.

Instead of planting or seeding these created salt marsh habitats, we recommend relying on natural colonization for revegetation. This colonization is likely to occur within 2 to 3 years of fill placement as seed source is available from the west side of the estuary. Salt tolerant seeds and/or starts are typically expensive and not warranted given the lack of weed competition in that portion of the intertidal zone. If there are local projects that are impacting existing salt marsh in the area near the time of construction, we would recommend salvaging existing salt marsh plants that would otherwise be lost. Pickleweed (*Salicornia virginica*) in particular is relatively easy to transplant in shallow mats. These could likely be maintained on site if the impact occurred before Padden Creek project is scheduled.

The log jam just downstream of the Harris Street culvert (LJ1) is primarily intended to stabilize and direct flow away from the fill slope on the eastern side of the estuary. This slope was protected by a creosoted wood pile retaining wall that is nearly vertical. The crib wall is now failing with erosion evident at the toe of the wall. Hydraulics of this area are controlled by the geometry of the existing Harris Street culvert in relation to the historic fill for the adjacent parcel. In the current condition, the culvert focuses fluvial energy toward the steep face of the fill which has undermined the existing creosoted pile wall.

Installing a log jam at this location would:

1. Allow removal of the failing wood wall, and remove creosote from water contact.
2. Inhibit future erosion of the adjacent fill to a greater extent than the failing wall.
3. Provide improved ecological conditions in the form of pool scour and associated wood and riparian cover in this location.
4. Will be consistent with continued migration of the channel toward the west.

Protection for the fill in this case will require a robust, continuous structure given the geometry of the existing culvert. The existing culvert focuses fluvial energy towards the wall, which can be significant at higher flows, and even at moderate and low flows cause a recirculation current (eddy) that sweeps against the toe. Therefore, our concept for the log jam is to use a combination of logs with rootwads placed into a matrix of larger rock. The larger rock will avoid scour between the logs and limit the number of logs that would be required to provide some pool scour and cover. Rock will also provide an adjustable protection that would conform to a new slope if pool scour occurs over time to depths near or below the installation elevation. Logs with rootwads would be incorporated into the rock using it as ballast, avoiding the need for mechanical anchors. Water levels within the estuary will fully inundate the structure, so the rocks will also act as ballast against buoyant forces during high

tides. Logs would be placed to deflect flows in the lateral and vertical dimensions, promoting meander migration to the west and pool scour along the toe of the structure.

The upper slope above the logs will be subject to wave and some fluvial energy. The slope will need to be relatively steep given the proximity to the parcel boundary. We propose vegetated soil lifts in this location where shallow lifts of fill (<12 inches thick) are placed within rolls of coir cloth and densely planted with live stakes. The establishment of these shrubs (typically willow and dogwood) will provide wave attenuation and increased soil strength over time. They will also develop a near shore canopy in this area, providing some shade over the potential pool.

Biotechnical measures, including log structures, require monitoring and potentially maintenance and remedial action following construction. Other solutions for this area may involve more traditional wall methods, composed of rock or sheet pile, but we have not investigated these here as they do not have much potential to enhance ecological function.

The rock and log structure would be built up to approximately MHHW + 1 foot (+9.5 ft MLLW), and the upper slope would be initially stabilized with coir soil wraps and planted with riparian vegetation. This toe treatment can be wrapped around to the upland and culvert headwall structure to the south. During final design, the ratio of logs to rocks will be investigated to determine a cost and ecologically balanced solution. For the log structure, two potential alternatives are shown on Sheet 8. Alternative 1 proposes uses a double layer of overlapping wood to increase pool cover and edge complexity. This configuration provides deflection and revetment as well as complex channel edge habitat. Alternative 2 uses single logs embedded into the rock matrix with root wads extending over the active channel. This configuration provides flow deflection and complex channel edge habitat but has less continuous wood coverage.

Salt Marsh Area 2 and Log Jam 2

The northern portion of the east estuary margin includes a reach where the active channel meanders against the riprap margin with a narrow low tide terrace. The feasibility study identified the potential for the inclusion of salt marsh fill and a log jam in this location in part to deflect flows and eventually the creek channel itself away from the riprap slope.

The northern log jam (LJ2) was originally proposed to deflect creek flows away from the riprap slope at the location of the existing boat launch. Placing log jams as hard points to deflect flows presents a number of design challenges, and is the most complex of the proposed design features at this site. Log jams present an inherent avulsion risk and can often be ‘end-run’ resulting in greater erosion on both sides of the structure. Therefore, they often need to be implemented in combination with other measures, such as wood structures or continuous bank protection, to protect the outer stream bank. A log jam in this location also has the potential to interfere with boaters, given the proximity to the small craft launch.

The creek channel has remained in this general configuration for decades (see feasibility memo), with minimal channel migration evident in the northern half of the estuary. The likelihood of a single log structure substantially changing this pattern without active channel excavation is low, in our opinion. Therefore, we recommend that this feature be dropped from further consideration unless additional channel excavation is acceptable.

The northern salt marsh creation area (SM2) also includes fill placement on the existing bench (Sheet 4). The fill placement here will be similar to the overall approach proposed for SM1, however, to conform to the narrow bench we propose a steeper face on the cobble berm, and we would terminate the fill placement at the existing riprap, eliminating the upper slope. This design maximizes potential salt marsh development in a limited space.

This area will be much narrower than SM1, and is also less likely to be stable over time. During final design we would also consider using a coarser cobble berm for greater initial stability of the placed fill.

Creosote Wood Removal

The majority of creosote piles and associated lagging from the mudflats and active channel will be removed. We estimate that this will involve the removal of approximately 90 piles. The only area where pile removal is not proposed is the southwest corner of the estuary, where construction access would damage the existing successful vegetation and likely negate the value of pile removal. Removal will likely be accomplished from adjacent uplands, and will follow current Washington Department of Natural Resources removal procedures (Attachment C).

Riparian Vegetation Establishment

As noted in the feasibility study, there are opportunities to establish a riparian marine vegetation community on the perimeter of the site. There are two general areas where we propose active revegetation efforts totally approximately 12,000 square feet. On the west side of the site, we propose a planting area that would extend from the edge of existing plantings to the excavation areas for SM3 (discussed below). This would likely include an upland forest from +12 MLLW up to the existing plantings and a wetland forest community from +9 to +12 MLLW. On the west side of the site, live stakes would be incorporated into the upper slopes above SM1 and LJ1. Above LJ1 the plantings would be part of vegetated soil lifts placed to stabilize a steeper slope above the log placement. This would establish shade over the active channel and provide longer term stability for these upper fill slopes.

New Salt Marsh Area 3 – West side of estuary

We propose additional salt marsh creation area on the west side of the site (SM3). Pile removal from the west side of the estuary will require construction access from the existing parking lot to near MHHW. Because this area would be disturbed to accommodate a small staging area for stockpile the piles after removal, we recommend excavating two small areas to create additional salt marsh and a more complex shoreline. The north and south removal areas are shown on Sheet 5. The area identified for excavation is a near-level area with existing grades only 1.5 to 3.0 feet above the target elevations for salt marsh establishment. The excavation at SM3 could be field directed to include additional fill removal at the access point, which would lower the ground elevation in this area to the salt marsh establishment range. This would be a low cost addition to the project that would increase salt marsh coverage and edge complexity of the west side of the estuary. This excavation would also provide the material necessary for the fill locations (SM1 and SM2) on the east side of the estuary. We would refine this element in subsequent design.

Next Steps

We anticipate developing quantity take-offs and conceptual cost estimates of the project elements described above after the City indicates if the modified elements we suggest are acceptable. These preliminary cost estimates could then be used to support the City's decision making regarding which elements will be carried through to final design. After the City approves a preferred approach for these project elements, there are a number of items that will require more detailed design. These include, but are not limited to:

1. Force balance evaluation to support log jam design.

2. Rock sizing analysis for the rock toe and cobble/gravel berm

3. Select fill requirements for the salt marsh fill areas.

4. Vertical grading tolerances.

5. Vegetation community species selection, stock type and spacing.

Summary of Decision Points

We have identified some key decision points that will guide the overall development of the restoration plans. These assumptions and/or questions have been captured in the list below:

1. Will construction access be feasible from the Port property to the east? Without this access, a number of costly measures to provide access to the east side of the estuary for fill placement will need to be incorporated into the design and construction cost estimate.

2. We determined that the LJ2 project element would be relatively invasive and has a high degree of uncertainty surrounding the effectiveness of moving the channel away from the riprap in this location. Does the City concur with our recommendation to remove this element from further consideration?

3. Does the City concur with the inclusion of the north and south salt marsh creation areas (SM3) on the west side of the site in the project design?

4. What is the City's level of comfort with natural adjustments of the fill placed for salt marsh development? If natural redistribution of some sediment is acceptable, the large sizes of the material for the cobble berm may be limited or reduced. Even with this step, some sediment redistribution is likely for both SM1 and SM2.

We also recommend that the City consider ongoing projects in the vicinity to determine if they might be sources of fill material and/or existing salt marsh plants.