JIMMYCOMELATEY CREEK-LOWER SEQUIM BAY ESTUARY RESTORATION PROJECT:

ESTUARY MONITORING PLAN

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EXECUTIVE SUMMARY

This monitoring plan describes all tasks to monitor the success or failure of the estuary restoration elements of the Jimmycomelately Creek-Lower Sequim Bay Estuary Restoration Project. **This plan is a companion document to the existing Jimmycomelately Creek Realignment Monitoring Plan (Shreffler 2001).** For the sake of clarity, some sections of the JCL Creek Monitoring Plan have been repeated here rather than referring the reader back to that document.

In contrast to the network of structurally and functionally connected habitats that historically occurred in Jimmycomelately Creek (JCL) and the Lower Sequim Bay Estuary (the estuary), the existing habitats are fragmented and not properly functioning. A century of logging, road development, commercial development, railroad construction, dredging, wetland drainage and fill, diking, native vegetation removal, introduction of exotic species, agriculture, residential development, and stream relocation and channelization have resulted in direct loss of wetlands and other historic riverine and estuarine habitats. These human activities have also contributed to reduced floodplain function and the present dysfunctional condition of JCL, Dean Creek, and the Lower Sequim Bay Estuary.

The vision of the Jamestown S'Klallam Tribe, Clallam County, Clallam Conservation District, Washington Department of Fish and Wildlife, Washington State Department of Transportation, Washington Department of Natural Resources, Environmental Protection Agency, U.S. Fish and Wildlife Service, local private landowners, and other partners in the Jimmycomelately Creek-Lower Sequim Bay Estuary Restoration Project (JCL-Estuary Restoration Project) is to: realign Jimmycomelately Creek into one of its historic, sinuous channels; integrate this channel realignment with improvements in, and restoration of, the estuary functions; reestablish the pre-disturbance linkage between the fluvial and tidal energy regimes; reconnect JCL with the historic floodplain; and alleviate pervasive flooding problems in the project area.

To achieve this vision, rigorous monitoring will be essential at all phases of the estuary restoration: pre-project (*baseline monitoring*), during construction (*implementation monitoring*), and post-project (*effectiveness monitoring*). The Estuary Design Group (EDG), which is comprised of technical staff from many of the partner entities listed above, has identified the following monitoring parameters for the proposed estuary restoration:

- Ecological Processes: Hydrology and Sediment Transport & Deposition

- Habitat Conditions & Functions: Habitat Gains, Water & Sediment Quality, and Large Woody Debris

- Biological Responses: Terrestrial Vegetation Establishment, Wetland Vegetation Establishment, Invasive Vegetation Management, Eelgrass Recovery, Shellfish Recovery, Salmonid Use, Invertebrate Use, and Bird Use.

As outlined in this plan, estuary monitoring is intended to proceed for a minimum of 10 years post-construction at an estimated total cost of approximately $492,000 to implement all the essential and recommended monitoring tasks identified in this plan. EDG determined that the tasks listed as essential have higher priority than those listed as recommended. The estimated total cost to implement only the essential tasks is approximately $400,000.

The participating partners in the JCL-Estuary Restoration Project are actively seeking to partner with research organizations and funding agencies to implement the essential and recommended tasks as opportunities become available. Priorities for monitoring will be influenced by funding availability, staff availability, and EDG determinations of which monitoring parameters are most likely to allow us to assess success or failure. This monitoring plan will be subject to future revision, as deemed necessary by EDG or the participating partners.

Sections 1.0, 2.0, and 3.0 of this document provide background information, goals & objectives of the project, and a summary of the proposed estuary restoration actions, respectively. Section 4.0 describes the monitoring tasks & performance criteria.

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ACKNOWLEDGMENTS

I wish to thank Byron Rot and Lyn Muench of the Jamestown S'Kallam Tribe for providing funding and guidance for production of this document. The following members of the estuary design group (EDG) reviewed or provided input to this monitoring plan: Byron Rot, Lyn Muench, Sam Gibboney (Sam Gibboney Engineering and Management Services), Pat Crain (Clallam County), Randy Johnson (WDFW), Carl Ward (WSDOT), Ralph Thomas Rogers (EPA), and Pat McCullough (Engineering Services Associates, Inc.). I also benefited from discussions with Chris May (Battelle Marine Sciences Laboratory) about water and sediment quality monitoring, Ron Thom (Battelle Marine Sciences Laboratory) about eelgrass recovery, Kelly Toy (Jamestown S'Klallam Tribe) about shellfish recovery, and Karen Holtrop (volunteer) about bird use of the estuary.

On behalf of EDG, I praise the invaluable contributions to the JCL-Estuary Restoration Project that have been made by Streamkeepers of Clallam County, led by Ed Chadd and Hannah Merrill, and WDFW volunteers working on the JCL summer chum broodstock recovery program, led by Cheri Scalf and Thom Johnson.

The team approach to restoration continues to be a hallmark of this project. I feel fortunate to have the ongoing opportunity to collaborate with the many, enthusiastic project partners.

ABBREVIATIONS USED IN THIS REPORT

BMP = best management practice

CCD = Clallam Conservation District

DNR = Washington State Department of Natural Resources

EPA = Environmental Protection Agency

ESA =Endangered Species Act

ft = feet

hrs = hours

JCL-Estuary Restoration Project = Jimmycomelately Creek-Lower Sequim Bay Estuary Restoration Project

JCL = Jimmycomelately Creek

JKT = Jamestown S'Klallam Tribe

LWD = large woody debris

m = meter

m^2 = square meter

MLLW = mean lower low water

OBH = Old Blyn Highway

ODT = Olympic Discovery Trail

PTC = Peninsula Trails Coalition

The Tribe = Jamestown S'Klallam Tribe

TPH = total petroleum hydrocarbon

TSS = total suspended solids

USFWS = U. S. Fish and Wildlife Service

WDFW = Washington Department of Fish and Wildlife

WSDOT = Washington State Department of Transportation

yd^3 = cubic yard

yr = year

LOWER SEQUIM BAY ESTUARY MONITORING PLAN

1.0 INTRODUCTION

1.1 Purpose of this Monitoring Plan

The purpose of this monitoring plan is to describe all tasks to monitor the success or failure of the estuary restoration elements of the Jimmycomelately Creek - Lower Sequim Bay Estuary Restoration Project (JCL-Estuary Restoration Project). This plan is intended as a companion document to the Jimmycomelately Creek Realignment Monitoring Plan (Shreffler 2001). Together, these two monitoring plans are intended to encompass the entire freshwater-nearshore gradient. These plans recognize the connectivity of the nearshore with other freshwater (upstream), terrestrial, shoreline, and marine ecosystems.

As with the JCL Creek Realignment Monitoring Plan, the foundation of this estuary monitoring plan is a conceptual model (described in Section 1.4) that links controlling factors, habitat structure, and ecosystem functions. Proceeding from the conceptual model is the following logical sequence of activities designed to evaluate success or failure of the estuary restoration portion of the JCL-Estuary Restoration Project:

1) develop a conceptual model
2) state restoration goals
3) state specific objectives for each goal
4) develop measurable performance criteria for each objective
5) monitor to document whether performance criteria are met
6) use adaptive management and contingency measures if performance criteria are not met
7) disseminate the results of this project (regardless of “success” or “failure”).

Monitoring will be essential at three stages of the restoration process: pre-project (baseline) monitoring, during construction (implementation) monitoring, and post-project (effectiveness) monitoring. Monitoring tasks are divided into three, inter-related categories: ecological processes monitoring, habitat conditions and functions monitoring, and biological responses monitoring.

Shreffler Environmental developed this plan at the request of the Jamestown S'Klallam Tribe (JKT). The technical aspects of this monitoring plan are consistent with "Guidance for Protection and Restoration of the Nearshore Ecosystems of Puget Sound" (NST 2003) prepared by the Nearshore Science Team (NST) for the Puget Sound Nearshore Ecosystem Restoration Program (PSNERP). Where applicable, this monitoring plan has drawn upon draft monitoring protocols newly released by the Washington Salmon Recovery Funding Board (Crawford 2003), as well as other guidance documents (USDA/SCS 1992, Hruby and Brower 1994, Federal Interagency Stream Restoration Working Group 1998, Schneider and Sprecher 2000, Simenstad and Cordell 2000, Thom 2000, Independent Science Panel 2000, and Inter-Fluve 2001).

1.2 Location of the Proposed Restoration Project

The entire restoration project is located in Section 12, Township 29 North, Range 3 West W.M., at the south end of Sequim Bay in Blyn, Washington (Figure 1.1). The estuary restoration portion of the project area will occur on properties owned by the Jamestown S'Klallam Tribe (JKT), Washington Department of Fish and Wildlife (WDFW), and Washington State Department of Transportation (WSDOT) (Figure 1.2).

1.3 Description of the Proposed Restoration Project

Project Phases
The overall project consists of four major phases, as depicted in Figure 1.2:

1. Realignment of the Jimmycomelately Creek channel and revegetation of the new stream corridor and riparian management area.
2. Restoration of the Lower Sequim Bay Estuary (including Dean Creek realignment).
3. Construction of a new Highway 101 bridge for the realigned Jimmycomelately Creek.
4. Diversion of the existing JCL flow into the new stream channel and connection of the new channel to the estuary and its historic floodplain.

Restoration of the estuary will be integrated within the entire stream-estuary ecosystem restoration project, including the realignment of the JCL and Dean Creek channels, removal of roads and other fill (approximately 158,863 yd^3), the design and construction of a new Highway 101 bridge, and land acquisition required to accomplish the stated restoration goals. If successful, this restoration project will provide measurable benefits to native plant diversity, waterfowl, shorebirds, fish, shellfish, and the community.

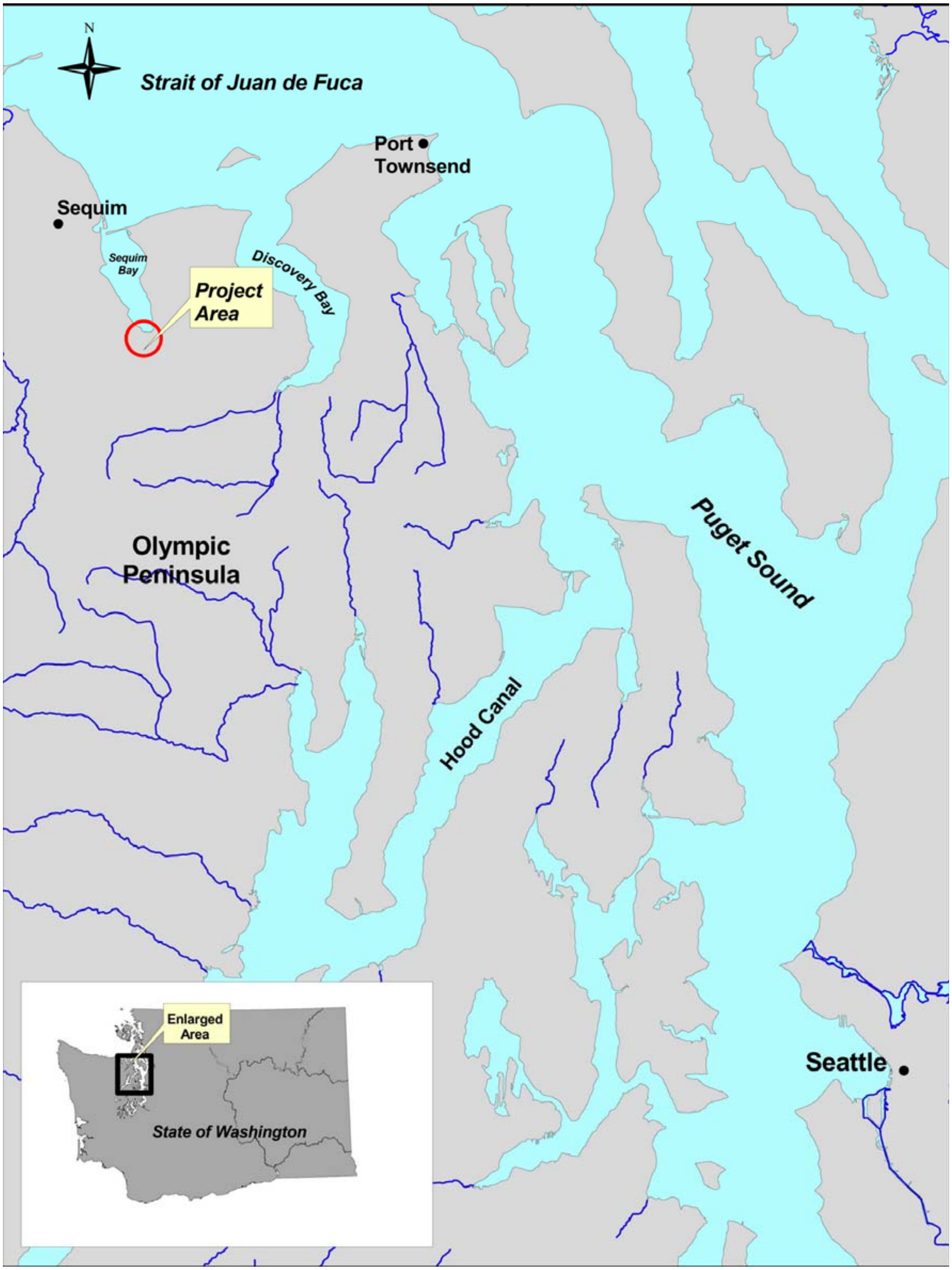


Figure 1.1 Location of the Jimmycomelately Creek-Lower Sequim Bay Estuary Restoration Project (JCL-Estuary Restoration Project). Graphic by Pam Edens.

Figure 1.2. Proposed phases of the Jimmycomelately Creek-Lower Sequim Bay Estuary Restoration Project (JCL-Estuary Restoration Project). Graphic by Pam Edens.

Background: Why Restoration is Needed (excerpted from Shreffler 2000, *A Preliminary Plan for Restoring Jimmycomelately Creek and the Lower Sequim Bay Estuary*)

Jimmycomelately Creek (JCL) is an unfortunate example of human degradation of natural ecosystems. In contrast to the network of structurally and functionally connected habitats that historically occurred in JCL and lower Sequim Bay, the existing habitats in the Bay are isolated and fragmented. A century of logging, road development, commercial development, railroad construction, dredging, wetland and other aquatic area fill, diking, native vegetation removal, agriculture, and residential development have resulted in direct loss of wetlands and other historic riverine and estuarine habitats. These human activities have also contributed to reduced floodplain function and the present dysfunctional condition of Jimmycomelately Creek and the Lower Sequim Bay Estuary.

The former, dendritic JCL channel has been dredged, straightened, and confined. The once extensive tidal marshes at the mouth of JCL have been filled to provide space for roads, railroads, commercial enterprises, and private residences. The historic corridor for fish and wildlife movement from nearshore mudflat, eelgrass, and emergent marsh habitats to the upper JCL watershed with forested terrestrial and fringing riparian habitat has been severely altered. Sediment and water quality in both JCL and the estuary have degraded through time because of human land-use practices. Dramatic sediment aggradation (build up) and resulting increased bed elevations in the lower reaches of the existing JCL channel have contributed to recurring floods in the basin. Flooding along the existing JCL channel poses an unacceptable risk of damage to existing houses, properties, and infrastructure.

Dean Creek is a tributary to Sequim Bay and shares many of the same impairments as Jimmycomelately Creek, but on a smaller scale. Like JCL, Dean Creek was moved into a straightened artificial channel, and culverts and roads (Highway 101, Old Blyn Highway, and Log Deck Road) have constricted both flood flows and tidal action. Non-native vegetation (e.g., Himalayan blackberry, Scot's broom, and Japanese knotweed) have colonized the creek banks and other associated fill, causing further constriction of the narrow, artificial creek channel. These constrictions have contributed to a cycle of sediment build up at the mouth, as well as downstream of culverts. The resultant flooding at road crossings, necessitates dredging of blockages within the Dean Creek channel. Dean Creek is presently the most frequently dredged creek in all of Clallam County (Pat McElroy, Clallam County Roads Department, personal communication 2002).

The cumulative effect of human activities has been fragmentation of the natural landscape into smaller pieces with diminished functions and services for both natural resources and people. This dysfunctional state: (1) limits the ability of JCL and the estuary to provide optimal feeding, rearing, and breeding habitats in support of critical biological resources, including ESA-listed summer chum salmon, other anadromous fish species, shellfish, shorebirds, and waterfowl; (2) places property owners and local, state, and tribal infrastructure at a greater risk of flood damage; and (3) highlights the urgent need to develop and implement integrated restoration actions in JCL, Dean Creek, and the estuary.

In summary, despite the widely recognized ecological importance of the Jimmycomelately Creek-Sequim Bay ecosystem, Jimmycomelatey Creek and Dean Creek are physically and ecologically disconnected from the estuary and their respective historic floodplains, and are presently unable to function as natural river systems with a naturally functioning connection to their estuary.

1.4 Conceptual Model of Controlling Factors, Habitat Structure, and Ecosystem Functions

A conceptual model is a useful tool for developing linkages between restoration goals and performance criteria that can be used to assess overall performance of the restored system relative to the stated goals (Thom and Wellman 1996). Moreover, a conceptual model forces the individuals planning a restoration project to identify: (1) direct and indirect connections among the physical, chemical, and biological components of the ecosystem, and (2) principal components upon which to focus restoration and monitoring efforts.

A conceptual model for restoring the estuary is presented here, which identifies connections among controlling factors, habitat structure, and desired ecosystem functions (Figure 1.3). The major controlling factors for restoring the estuary are light, hydrology, geomorphology, and nutrients. For the purposes of this discussion, hydrology includes surface water and groundwater quality and quantity and tidal prism. Geomorphology includes a suite of parameters such as elevation relative to mean lower low water (MLLW), gradient, tidal channel characteristics (e.g., depth, width, cross-sectional area, sinuosity), and sediment character and quality. The desired ecosystem functions are feeding, refuge, and breeding for salmonids, shellfish, shorebirds, and waterfowl, and reduced flood hazards for people. The link between these desired ecosystem functions and the controlling factors is the habitat structure.

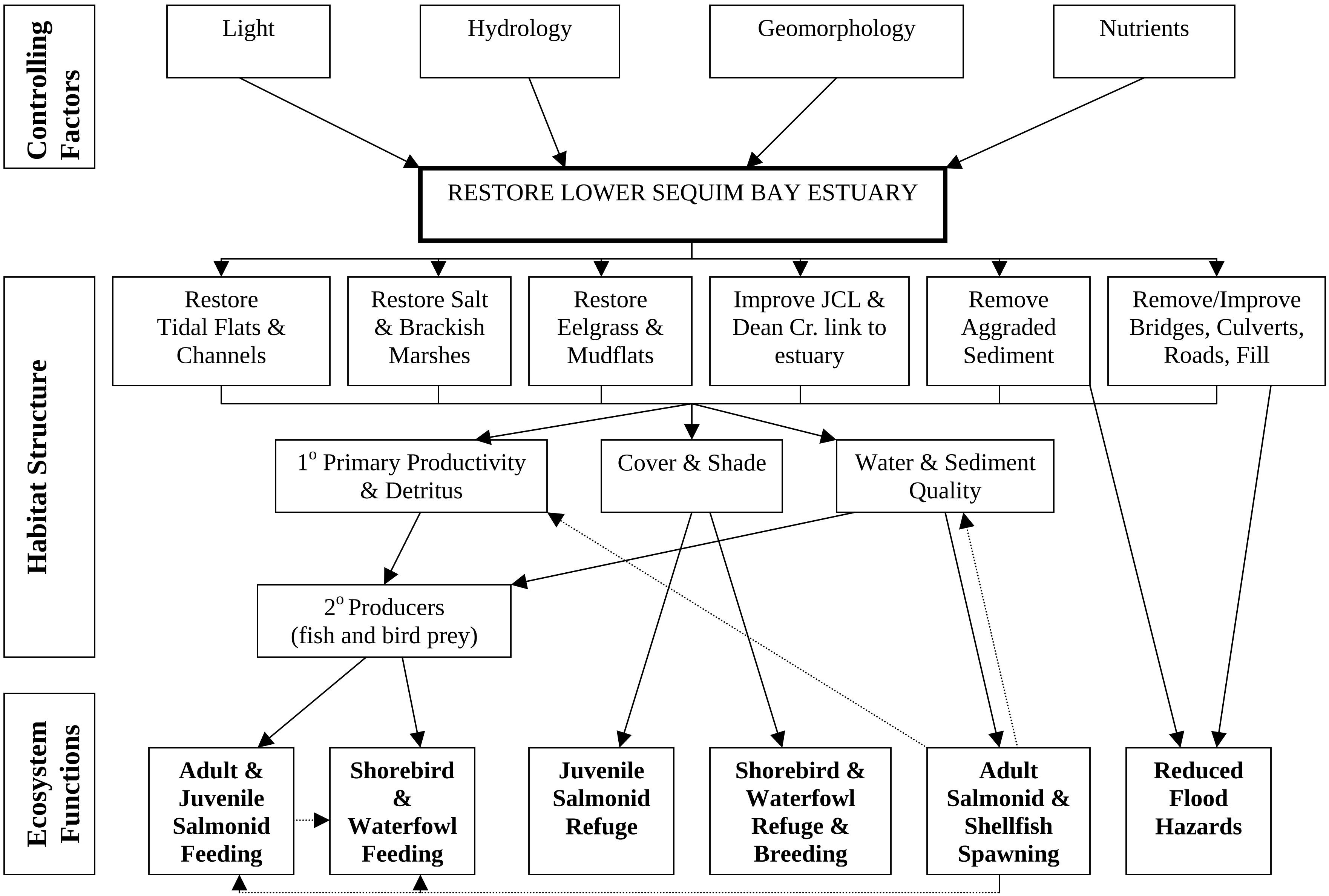


Figure 1.3. Conceptual model for restoring the lower Sequim Bay estuary

Thus, it is the habitat structure that must be changed in order to achieve the desired ecosystem functions. To gain the desired ecosystem functions for restoring the estuary, the existing habitat structure must be restored and protected in the following ways:

(1) Restore the tidal flats and channels within the estuary;
(2) Restore salt marsh and brackish marsh habitats within the estuary;
(3) Restore eelgrass and mudflats within the estuary;
(4) Improve the connections of JCL and Dean Creek to the estuary;
(5) Remove (selectively) aggraded sediment within the estuary;
(6) Remove and/or improve bridges and culverts,
(7) Remove (selectively) roads and other terrestrial fill;
(8) Improve stormwater management;
(9) Protect restored areas in perpetuity from future undesirable impacts.

Restoring and protecting the habitat structure in the estuary as outlined above should result in increased primary and secondary production, improved organic matter flow and nutrient cycling, improved detritus transport to the estuary, better water and sediment quality, and more prey organisms for fish and birds. These improvements should result in better ecosystem functions and services for salmonids, shellfish, birds, and people (for a more detailed explanation of the expected benefits of estuary restoration see the *Conceptual Plan for Restoring the Lower Sequim Bay Estuary*, Shreffler 2003).

2.0 VISION, GOALS, AND OBJECTIVES OF THE RESTORATION PROJECT

The **overall goal** of the Jamestown S'Klallam Tribe for this project is to provide conservation and protection, in perpetuity, of wetlands and creeks in the Jimmycomelately Creek-Sequim Bay watershed, resulting in long-term protection and restoration of fish and shellfish resources to harvestable levels.

The **vision** of Jamestown S'Klallam Tribe (JKT), Clallam County, Clallam Conservation District (CCD), Washington Department of Fish and Wildlife (WDFW), Washington Department of Natural Resources (DNR), Washington State Department of Transportation (WSDOT), Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service (USFWS), local private landowners, and other participating partners is to: 1) realign Jimmycomelately Creek into one of its historic, sinuous channels; 2) integrate this channel realignment with improvements in, and restoration of, the estuary and floodplain functions; 3) reestablish the predisturbance linkage between the fluvial and tidal energy regimes; and 4) alleviate pervasive flooding problems in the project area. Although salmonids, shellfish, shorebirds, and waterfowl have been identified as the target species groups for restoration, the participating partners explicitly intend to restore ecosystem functions and processes of a properly functioning JCL-Lower Sequim Bay ecosystem, thereby benefiting the full range of native species.

The participating partners acknowledge that this project, like any restoration project, must be approached with humility and viewed as an experiment. Restoration of Jimmycomelately Creek and the lower Sequim Bay estuary is a goal, not a guarantee. No one can predict exactly how the JCL-Sequim Bay ecosystem will change, but the participating partners are committed to using the best available science in its efforts to plan, implement, and monitor the proposed restoration project. Over time, natural processes will determine the ultimate path of the restored ecosystem; restoration is just the catalyst that sets these natural processes in motion.

Recognizing the dynamic nature of riverine and estuarine ecosystems, the intent of the Jimmycomelately-Sequim Bay Estuary Restoration Project is to assist the "self-healing" capacity of the ecosystem, rather than to achieve absolutely a desired end-point. Given the current constraints of economics, politics, and the past and present human alteration of the landscape, the goal is not to return the JCL-Sequim Bay ecosystem to a particular historic condition (e.g., 1914), but rather to restore and maintain the landscape processes that formed and sustained the habitats to which biological resources have adapted.

By focusing on the larger landscape, the participating partners are working to ensure that these restored habitats will be linked to existing viable habitats, as well as functionally and structurally integrated into the watershed. This is a holistic, large-scale, long-term restoration effort, involving many partners who are dedicated to ensuring that the project goals and objectives are met, and that both natural resources and people are the beneficiaries. The project has broad local and regional support, and the collective momentum required to move forward toward successful restoration.

The participating partners have identified six **design goals** and interrelated **objectives** for the project (see Shreffler 2000). The goals listed below are specific to the estuary:

Goal 1: Restore the southern end of Sequim Bay (lower Sequim Bay), including the tidal flats and channels, the historic salt marsh, the Dean Creek channel, and the estuary of JCL and Dean Creek for resident and migratory waterfowl and shorebird feeding, refuge, and breeding, as well as habitat for juvenile salmon and shellfish.

- Objective 1.1: Restore tidal flats and channels within the estuary.
- Objective 1.2: Restore salt marsh and brackish marsh habitats within the estuary.
- Objective 1.3: Restore eelgrass and mudflats within the estuary.
- Objective 1.4: Remove (selectively) aggraded sediment from the estuary.
- Objective 1.5: Reconnect JCL and Dean Creek to the estuary and restore the tidal prism.
- Objective 1.6: Remove the log yard access road and the portion of Old Blyn Highway west of the existing JCL channel.
- Objective 1.7: Remove fill, culverts, roads, bridges, or other channel/flow constrictions (wherever and whenever feasible).
- Objective 1.8: Demolish and remove existing structures within the estuary (e.g., dance hall, pump house, Old Blyn Shingle Mill foundation, log yard structures).
- Objective 1.9: Remove creosote-treated pilings.

Goal 4: Restore the ESA-listed summer chum salmon population so that it is naturally self-sustaining after completion of restoration activities in JCL and the estuary.

Objective 4.1: Coordinate with and complement the broodstock program already underway for the JCL stock of summer chum salmon (the broodstock program is currently being undertaken by JKT, WDFW, and volunteers and is in response to the chronically low population size of the summer chum run in JCL). This objective is essential in order to ensure that the JCL broodstock program is consistent with the Summer Chum Initiative and the recovery goals established by Point No Point Treaty Council and Washington Department of Fish and Wildlife.

Objective 4.2: Ensure that the restoration activities in JCL and the estuary occur as quickly as possible to allow natural spawning of the summer chum in JCL, thereby reducing the risks of genetic or behavioral modification of the stock by this broodstock program.

Goal 5: Develop rigorous monitoring requirements (pre-project, during construction, and post project), maintenance actions, contingency actions, and reporting requirements to track and achieve the above goals of this program.

Goal 6: Develop this project as a model for stream and estuary restoration and management, to be used as a guide for larger-scale restoration efforts, especially restoration of estuaries and the fluvial-tidal transition zone.

Objective 6.1: Provide educational opportunities and materials for the general public, agencies, and decision-makers.

Objective 6.2: Document and publish an account of the restoration project planning, implementation, monitoring, contingency actions, costs, and successes or failures.

These stated design goals and objectives will be met while also:

1) Maintaining and/or improving public safety in the project vicinity, through actions such as reduction of flood frequency, bridge design specifications, highway alignment, and proper road approaches;

2) Maintaining vehicular access to parcels under private ownership that remain after project completion;
3) Accommodating the Olympic Discovery Trail to provide, to the extent practicable, controlled public access;
4) Satisfying the goals, intent, and procedural requirements of local, state, and federal laws, including the Endangered Species Act (ESA), the Clean Water Act (CWA), the Shoreline Management Act, the Hydraulic Code, Clallam County's Critical Areas Ordinance; and Clallam County/WSDOT traffic and access requirements;
5) Ensuring that best management practices (BMPs) are implemented for upper watershed human activities to control sediment, pollution, and alterations to instream hydrology; and
6) Performing rigorous monitoring and adaptive management activities at all phases of the project to ensure that all restored or enhanced habitats are resilient to natural and anthropogenic disturbances, and will promote the long-term sustainability of all native species in the landscape.

3.0 SUMMARY OF PROPOSED ESTUARY RESTORATION ACTIONS

The following summary is a condensed version of the proposed estuary restoration actions from the *Conceptual Plan for Restoring the Lower Sequim Bay Estuary* (Shreffler 2003). This section is intended to provide an overview of these actions as depicted in Figure 3.1, for more specific details and figures see the Conceptual Plan.

Log Deck Road

Proposed Restoration Actions and Related Activities

The proposed restoration actions are to:

- Remove the undersized (30 inch) culvert and the entire road bed (~ 900 linear feet) down to mudflat or salt marsh elevations.

Related activities include:

- Restrict excavation to low tides (to avoid the need for sediment and erosion control structures).
- Transport approximately 3,625 cubic yards of fill to an approved offsite disposal location.
- If there are old railroad pilings buried in the log deck road, use any that are not creosote-treated in the estuary restoration.

Old Blyn Highway (OBH)

Proposed Restoration Actions and Related Activities

The proposed restoration actions are to:

- Remove the road bed and two undersized 30-inch culverts down to mudflat or brackish marsh elevations from a point just east of the existing JCL channel west to the entrance to the former RV Park.

Related activities include:

- Transport approximately 3,990 cubic yards of fill to an approved offsite upland location.
- At each edge of the estuary along the former OBH roadbed, construct a quarry spall access road to PUD utility poles—this road will be designed to overtop at tides greater than +8.0 feet MLLW
- Remove the county bridge over the existing JCL channel.
- Construct a turnaround terminus to OBH on the east side of the existing JCL channel.

Figure 3.2. Depiction of the planning units used by EDG in developing a conceptual plan for restoring the Lower Sequim Bay Estuary. Graphic by Randy Johnson.

Log Yard Pier

Proposed Restoration Actions and Related Activities

The proposed restoration actions relative to the log yard pier are to:

- Remove the entire log yard pier down to tideflat elevation.

Related activities include:

- Restrict excavation to low tides.
- Dispose of approximately 20,000 cubic yards of fill at an approved offsite upland location.

Log Yard

Proposed Restoration Actions and Related Activities

The proposed restoration actions at the log yard include:

- Excavate and grade the existing shoreline to the 1870 marsh edge, leaving a barrier spit in front of a tidal marsh/lagoon system.
- Realign and restore Dean Creek.
- Place and bury LWD at the upper marsh edge and in the barrier spit, the tidal channel, and Dean Creek.
- Hydroseed terrestrial areas.
- Plant native trees, shrubs, and groundcover in upland and riparian areas.

Related activities include:

- Decommission and remove structures, infrastructure, and debris.
- Transport logs left behind by Dunlap Towing to the terrestrial edge of the property and stockpile them for use in the Dean Creek channel realignment, the tidal lagoon, and other parts of the estuary.
- Clear and grub.
- Construct sediment and erosion control structures.
- Construct silt fences.
- Remove two utility poles, one with an attached transformer.
- Provide an access easement to the adjacent private property to the west.
- Remove approximately 58,667 cubic yards of fill and dispose at an approved offsite upland location.

Log Yard Pilings and Historical Log Yard Operations

Proposed Restoration Actions and Related Activities

The proposed restoration actions are to:

- Remove and dispose of all the treated pilings (and the surrounding sediment from the base of each piling) at a contaminated waste site that can handle creosote-treated wood and contaminated sediment.
- Leave behind the five untreated pilings and chain a string of three untreated logs to one of the pilings to provide shorebird roosting habitat.
- Place a cone or spikes on the top of each untreated piling to deter perching by raptors.

RV Park

Proposed Restoration Actions and Related Activities

The proposed restoration actions are to:

- Remove blackberries and alder trees within a "triangle" on the eastern boundary of the RV Park property and excavate to match the elevation of the adjacent natural marsh.
- Excavate/grade the eastern portion of the former RV Park to the 16-foot contour and match it with the existing, natural marsh immediately to the north across the Old Blyn Highway to ensure that these presently disconnected areas are hydrologically connected. The remaining area to the west will be hydroseeded and restored to native terrestrial plant communities.
- Construct a network of tidal channels through the brackish marsh.
- Plant native trees, shrubs, and groundcover in terrestrial areas.

Related activities include:

- Decommission and remove infrastructure.
- Clear and grub.
- Restrict excavation to low tides.
- Remove a portion of Old Blyn Highway and construct an alternate access to private properties that remain within the project area.
- Dispose of approximately 14,000 cubic yards of fill in an approved onsite upland area.

Delta Cone

Proposed Restoration Actions and Related Activities

The proposed restoration actions are to:

- Relocate the entire JCL creek out of its artificial channel and into a more sinuous, realigned channel (the new channel must be active and the existing channel bed inactive in advance of any actions at the delta cone).
- Remove and dispose of in an approved upland location approximately 13,500 cubic yards of aggraded sediment to an elevation that will support salt marsh vegetation.

Olympic Discovery Trail (ODT)

Proposed Restoration Actions and Related Activities

- Remove all pilings, decking, beams, and other treated wood in the two trestle structures, and, to the extent possible, contaminated sediment around the pilings; dispose of these at a contaminated waste site that can handle creosote-treated wood. Replace these structures with three new trail bridges (Dean Creek, tidal channel, existing JCL Creek.
- Provide public access, wildlife viewing, and interpretation.

Public Access & Interpretation

Proposed Actions

Because of the ecological sensitivity of the site, interpretive and educational elements will be designed to discourage visitors from physically accessing and exploring the restored areas. The intent is to encourage visitors to stay on the trail, rather than wandering on their own through sensitive restored habitats. Viewing platforms will provide public access to the estuary. Interpretive signage will help to educate trail users.

The following public facilities and interpretive signage have been proposed:

- Two off-trail “viewing platforms” will be constructed at optimal bird watching and estuary viewing locations. Parking will be provided at the existing Sequim Bay Scenic Overlook on Jamestown S’Klallam Tribe property to the east of the project area.

- Two interpretive signs and benches will be installed at each of these viewing platforms. These signs will increase public understanding of: 1) the history of the Blyn area; 2) the process of restoring JCL creek and the estuary; and 3) the functions and values of our natural aquatic lands.
- Washington State Department of Natural Resources Aquatic Land Enhancement Account signs will also be installed at each viewing platform, as well as signs recognizing other contributors to the project.

Eng (WSDOT) Property

Proposed Restoration Actions and Related Activities

The proposed restoration actions are to:

- Remove reed canary grass, blackberries and other invasive vegetation and grade to the elevation of the adjacent brackish marsh.
- Construct a network of tidal channels through the brackish marsh and connect the upstream end of the main tidal channel to the existing JCL channel.
- Hydroseed and plant native trees, shrubs, and groundcover in terrestrial areas.

Related actions include:

- Remove the dance hall and related infrastructure.
- Remove the dam in the existing tidal channel.
- Clear and grub.
- Construct sediment and erosion control structures.
- Construct silt fences.

4.0 MONITORING TASKS & PERFORMANCE CRITERIA

In this section, monitoring tasks are organized into three categories: ecological processes monitoring, habitat conditions and functions monitoring, and biological responses monitoring. *Ecological Processes tasks* attempt to determine the success of physical or ecological process restoration (e.g., has the tidal prism been restored?). *Habitat Conditions and Functions tasks* attempt to determine the change and level of success of habitat conditions and functions over time (e.g., did the estuary restoration actions result in a net gain of salt marsh habitat?). *Biological Response tasks* attempt to determine the change and level of success of biological responses to restoration actions over time (e.g., After 10 years, is the species composition of native wetland plants greater than 80% comparable to that of appropriate reference sites?).

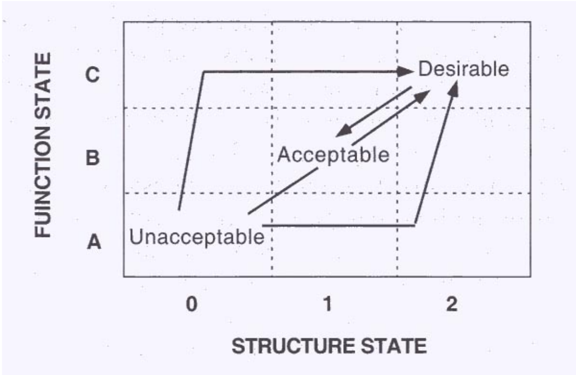
Monitoring tasks are described for the following phases of the overall restoration project: pre-project (baseline) monitoring, during construction (implementation) monitoring, and post-project (effectiveness) monitoring. *Baseline monitoring* documents project site conditions prior to initiation of the restoration actions. *Implementation monitoring* determines whether the project was constructed in accordance with the design specifications and permit conditions. *Effectiveness monitoring* (also referred to as "success monitoring" or "performance monitoring") documents whether performance criteria were met. Performance criteria are the explicit, quantifiable measures that will be used to determine whether the overall restoration project is performing as expected and whether corrective actions (contingency measures) or adaptive management (see Section 5.0) are required. Performance criteria for all the monitoring tasks are summarized in Table 4.1. An example of a performance criterion is: *the project area shall contain not greater than 5% cover by area of invasive plant species after ten years.*

Monitoring, as outlined in this plan, is intended to proceed for a minimum of 10 years post-construction. Although monitoring of restoration sites is typically short-term (i.e., the usual 5-10 year monitoring framework of regulatory agencies), a longer period of monitoring is often necessary to demonstrate whether or not ecological processes, habitat conditions and functions, and biological responses are likely to be restored to the desired level. Thom (2000) suggested that, "*The [restored] system should be monitored long enough to provide reasonable assurances that the system has either met its performance criteria or that it will likely not meet the criteria. The [monitoring] program should extend to a point somewhere after the period of most rapid change and into the period of stabilization of the system.*"

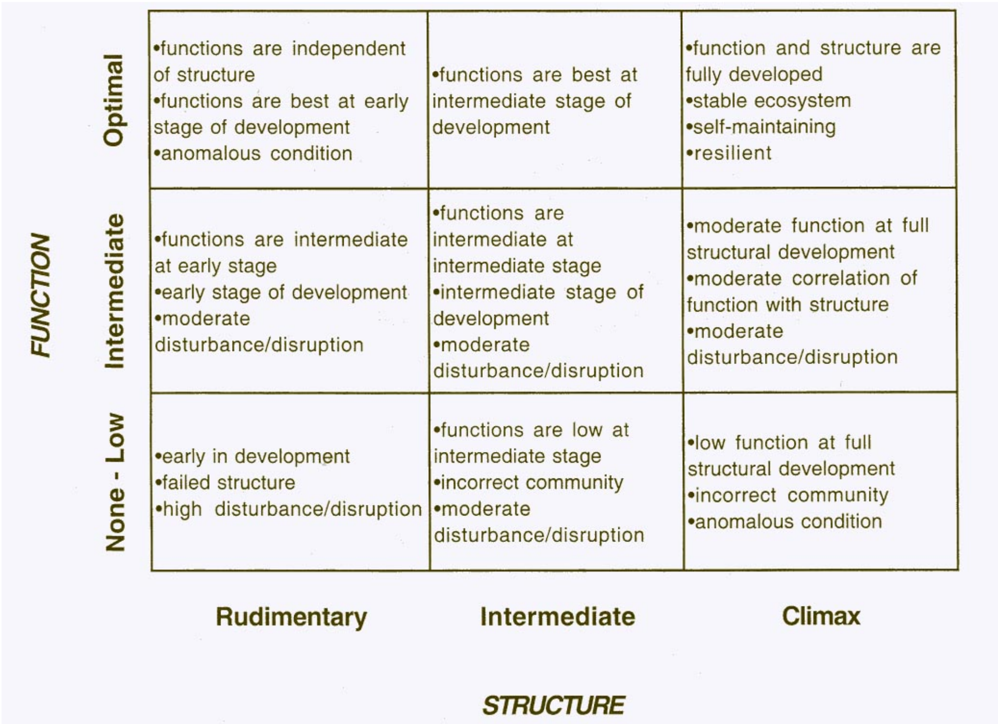
Essential Monitoring Tasks	Performance Criteria
Ecological Processes	
Hydrology	1. A functioning hydrological connection shall be restored and self-maintaining between JCL and the estuary, and Dean Creek and the estuary.
	2. The constructed tidal basins shall result in a net increase of tidal prism (i.e., tidal flushing) relative to pre-project conditions.
Sediment Transport & Deposition	1. Within 10 years following removal of the log yard pier, log yard fill, and delta cone, sediment that was formerly aggraded in these areas will be redistributed by the restored longshore drift cell
	2. Tidal "flushing" capacity of the estuary tidal basins shall be sufficient to transport sediment out into Sequim Bay.
Habitat Conditions & Functions	
Habitat Gains	Targets: intertidal = 20 acres; eelgrass = comparable to densities of existing beds at project edges; creek channels = 1,000 linear feet; tidal channels = 2,730 linear feet; terrestrial plant communities = 9 acres.
Water & Sediment Quality	1. Salinity measurements post-restoration shall demonstrate that the salinity wedge extends further upstream in the new JCL channel and the new Dean Creek channel than in the existing channels. For JCL, the salinity wedge shall reach the McLaughlin property south of HWY 101. For Dean Creek, the salinity wedge shall reach approximately 300 ft upstream of the mouth.
	2. Water quality parameters (water temperature, D.O., and turbidity) at the mouth of the new JCL Creek channel, the mouth of the new Dean Creek channel, and within the footprint of the former pilings shall not exceed state, federal, or tribal water quality standard
	3. Sediment quality parameters (metals, organics, TPH) at the mouth of the new JCL Creek channel, the mouth of the new Dean Creek channel, and within the footprint of the former pilings shall not exceed state, federal, or tribal water quality standard
	4. Post-project fecal coliform concentrations shall not exceed pre-project concentrations, and shall not exceed state, federal, or tribal water quality s
Large Woody Debris	1. 80% or more of the LWD placements should be present in Year 10
	2. LWD placements shall not move to locations where they pose a threat to infrastructure, properties, or the channel morphol
	3. LWD placements shall maintain pool depth and channel form as bu
Biological Responses	
Terrestrial Vegetation Establishmen	1. Percent Cover of riparian native plantings and pioneers (trees and shrubs) should be at least 50% in year 5, 60% in year 8, and 90% at the end of 10 ye
	2. Any planted trees shrubs that die w/in the first year will be replanted. Subsequently, if mortality of the native plantings is >30% in any given year, then repl
Wetland Vegetation Establishmen	1. Areal extent of wetland vegetation should be 60% comparable to that of appropriate reference sites after 5 years and 80% comparable after 10 y
	2. Species composition of native wetland plant species should be 60% comparable to that of appropriate reference sites after 5 years and 80% comparable after 10 y
Invasive Vegetation Removal	The project area shall contain not greater than 5% cover by area of invasive plant species after 10 years.
Eelgrass Recovery	If the site conditions allow for natural recovery, then eelgrass abundance (total area covered) and shoot density should eventually be comparable to the surrounding areas that currently support eelgrass; this will likely take >10 years. No signs of natural eelgrass recovery after 5 years would trigger the need for potential contingency meas
Shellfish Recovery	If the site conditions allow for natural recovery, then shellfish species composition and abundances should be comparable, after 10 years, to the surrounding areas that currently support shellfish. No signs of natural shellfish recovery after 5 years would trigger the need for potential contingency measu
Salmonid Use	1. No stranding of adult chum salmon or other anadromous species returning to spawn in JCL or Dean Creek, and no stranding of juvenile salmonids in the tidal channel networks on the Log Yard, RV Park, and Eng properties
	2. At the end of 10 years, juvenile salmonid abundance within the estuary should be higher than the pre-project abundance within the former estu
Invertebrate Use	The species diversity, density (no. m^{-2}), and standing stock (g wet m^{-2}) of benthic macroinvertebrates and insects within the restored estuary shall: 1) equal or exceed species diversity, density, and standing stock for the existing estuary at the end of 10 years, and 2) be comparable to the Salmon Cr. reference site at the end of 10 ye
Bird Use	1. Within 10 years post-restoration, species richness and abundance of breeding, wintering, and migrating birds using the estuary shall equal or exceed pre-restoration species richness and abundance.
	2. The anchored log booms shall be used consistently by roosting shorebirds and not by seals.

The goal of ecological restoration *is to emulate a natural, functioning, self-regulating system that is integrated with the ecological landscape in which it occurs* (National Research Council 1992). Although 5 to 10 years of monitoring is typically long enough to evaluate replacement of habitat area (i.e. habitat gains) and occasionally some biological responses (e.g., fish use), this short time period is rarely long enough to adequately evaluate restoration of ecological processes and habitat functions. Indeed, recent ecological literature suggests that restoration sites may follow a hypothetical path of development (a trajectory), which will eventually approach natural reference sites (the target) through time, but this may take upwards of 50 years for brackish or salt marsh habitats, and even longer for forested freshwater wetlands (e.g., Simenstad and Thom 1996; Zedler and Callaway 1999, Simenstad and Cordell 2000). The Independent Science Panel (2000) stated that recovery of natural functions in streams and riparian areas that support viable populations of salmon may take 50-100 years. Thom (2000) suggests that using a *system-development matrix* (see Figure 4.1) is a simple way to view the alternative pathways or trajectories of development from an initial undesirable state to the desirable target state for both structural and functional conditions.

Thom and Wellman (1996) found that monitoring programs averaged 13%, and ranged from 3% to 62%, of the total cost of aquatic restoration projects. Until funding agencies are willing to pay for longer-term monitoring, the project partners will be constrained in rigorously evaluating the performance ("success") of restoration projects like the JCL-Estuary Restoration Project. In the interim, functional equivalency trajectories (Simenstad and Thom 1996, Simenstad and Cordell 2000) and system-development matrices (Thom 2000) may provide EDG with promising tools for evaluating how restored habitats are <u>progressing</u> toward a more desirable target state or how the JCL-Estuary ecosystem is emulating a natural, functioning, self-regulating system.



(A)



(B)

Figure 4.1. Generalized system development matrix showing: (A) pathways of development from an initial undesirable state to a desirable (target) state for both structural and functional conditions; and (B) the nine states a restored system can occupy during development (from Thom 2000).

EDG has identified the following monitoring parameters for the estuary restoration portion of the JCL-Estuary Restoration Project:

Ecological Processes

- Hydrology
- Sediment Transport & Deposition

Habitat Conditions & Functions

- Habitat Gains
- Water & Sediment Quality
- Large Woody Debris

Biological Responses

- Terrestrial Vegetation Establishment
- Wetland Vegetation Establishment
- Invasive Vegetation Management
- Eelgrass Recovery
- Shellfish Recovery
- Salmonid Use
- Invertebrate Use
- Bird Use

For each of these parameters, “essential” and “recommended” monitoring tasks have been identified. Essential tasks are of higher priority than recommended tasks.

4.1 MONITORING OF ECOLOGICAL PROCESSES

Ecological processes monitoring will focus on hydrology and sediment transport and deposition. These processes are critical to the development of habitat that will support fish, shellfish, shorebirds, waterfowl, and their invertebrate prey sources. According to the Nearshore Science Team (NST 2003), hydrology, sediment, and food web processes have been the most affected by stressors in the Puget Sound nearshore (the NST definition of nearshore includes estuaries). Ecological processes generally evolve slowly, and thus monitoring of hydrology and sediment processes will be performed for a minimum of 10 years post-restoration of the Lower Sequim Bay Estuary.

4.1.1 HYDROLOGY

Historic and Current Conditions

Historically, the project area was more open to and more influenced by both freshwater and tidal flows. Prior to human disturbance of the landscape, Jimmycomelately Creek (JCL) and Dean Creek meandered across their respective floodplains into an extensive estuary estimated to be nearly triple the size of the current, disconnected estuary. Currently, both JCL and Dean Creek are hydraulically disconnected from the estuary, and normal hydrological functions (e.g., nutrient and sediment exchange, flood and stormwater desynchronization, groundwater exchange, and support of stream baseflow) have been lost or altered (Shreffler 2000).

Restoration Objective

The restoration objective relative to hydrology is to restore the natural channel and floodplain configurations of JCL, Dean Creek, and the estuary by realigning JCL and Dean Creek into sinuous channels with access to the floodplain, and by removing channel constrictions in the estuary (i.e., roads, culverts, and other fill).

Restoration Rationale

By removing roads, culverts, and other fill and restoring natural channel and floodplain configurations of JCL and Dean Creek, there will once again be a functional hydrologic connection between these creeks and the estuary. Semi-diurnal tidal fluctuations will also be restored. A functional connection between each creek, its floodplain, and the estuary will improve habitat of both restored creeks and the estuary for invertebrates, fish, and aquatic birds.

Baseline Monitoring

Methods and Data Analysis

1) **Essential**: Map the historic and current locations of the estuary [Note: Three types of mapping have already been completed: a) Walker and Associates orthophotos with 2-ft contours; b) Randy Johnson's (WDFW) historical shoreline and salt marsh-edge maps based on 1870 shoreline surveys, 1926 and 2000 aerial photos, and 2002 soil test pit data, and c) Randy Johnson's conceptual depiction of the estuary circa 1800].

2) **Essential**: Install survey control points (CP), consisting of concrete monuments with steel disks for the estuary. One CP has already been established near the former location of the old log yard office; another CP has been established at the mouth of Dean Creek. A third CP will be established on the Eng/WSDOT property, and a fourth will likely be established on the RV Park/WDFW property. All monitoring data will be geo-referenced relative to these fixed control points

3) **Essential**: Install a continuous recording tidal gauge at the new mouth of JCL and collect pre-project data on tidal flux and velocities south of Old Blyn Hwy (downstream of the WSDOT tidal basin and RV Park tidal basin).

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Year 0 (prior to excavation of Dean Creek Channel and removal of estuary blockages).

Personnel: 1) <u>Map Creek & Estuary locations</u>: Historic mapping was completed by WDFW in November, 2000. Detailed survey mapping occurred in summer 2003 with additional survey work to occur in summer 2004. Dean Creek has not yet been surveyed or mapped.
2) <u>Survey control</u>: 1engineer 8 hrs
3) <u>Tide gauge</u>: 1 biologist 40 hrs + 1 technician 80 hrs

Cost: 1) <u>Map Creek & Estuary locations</u>: Completed by WDFW in November, 2000.
2) <u>Survey control</u>: $800 labor + $200 equipment
3) <u>Tide gauge</u>: $4,720

Lead: 1) Map Creek & Estuary locations: WDFW, JKT/ESAI
2) Survey control: JKT/ESAI
3) Tide gauge: JKT

IMPLEMENTATION MONITORING

Methods & Data Analysis

1) **Essential**: Document that the design specifications for ground and bed elevations, gradients, channel widths and slopes, meander radii and lengths, and other parameters shown on engineering drawings are met for each element of the estuary restoration. Specifically, prepare as-built drawings according to standard construction engineering practices for the following estuary restoration elements:

a) Log Deck Road removal;
b) Old Blyn Highway removal;
c) Log Yard Pier removal;
d) Log Yard fill removal;
e) RV Park (WDFW) property tidal channel construction;
f) Delta Cone removal; and
g) Eng (WSDOT) property tidal channel construction.

2) **Essential**: Confirm on as-built drawings that all fish blockages or constrictions have been removed from the project area (e.g., roads, culverts, dams, and other fill).

Note: As-built drawings for the JCL Creek realignment will be completed as part of the JCL Creek monitoring plan (Shreffler 2001). As-built drawings for the Dean Creek realignment will be completed as part of the addendum to the JCL Creek monitoring plan.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: 1) As-built drawings: Year 0; as-built drawings should be completed immediately after construction or deconstruction of each of the elements listed above.
2) Fish blockages: Year 0: immediately following construction or deconstruction of each of the elements listed above.

Personnel: 1) As-built drawings: 1 ESAI engineer, 40 hours (except for the Eng property, for which as-built drawings will be completed by WSDOT).
2) Fish blockages: included in #1 above.

Cost: 1) As-built drawings: $4,000
2) Fish blockages: included in #1 above

Lead: 1) As-built drawings: JKT/ESAI
2) Fish blockages: JKT/ESAI

EFFECTIVENESS MONITORING

Methods & Data Analysis

1) **Essential**: Map the post-project configuration of the estuary, JCL, and Dean Creek to document that tidal connections have been restored.

2) **Essential**: Compare pre-project and post-project data on tidal flux and velocities in the realigned JCL channel south of Old Blyn Hwy (downstream of the WSDOT tidal basin and RV Park tidal basin).

3) **Essential**: Make flood and ebb discharge measurements (over a range of flood and ebb tides) at the sill of the WSDOT constructed tidal basin, the log yard tidal basin, and the RV Park tidal basin.

Note: The JCL Creek Realignment Monitoring Plan (Shreffler 2001) calls for installing staff gages with pressure transducers at two locations: (1) within the realigned JCL channel above tidal influence; and (2) at the mouth of the realigned JCL creek. These gages and associated cross-section surveys will facilitate tracking changes in hydrology (e.g., mean annual discharge, channel flow capacity, tidal elevation, and tidal prism) post-restoration.

Performance Criteria

1) A functioning hydrological connection shall be restored and self-maintaining between JCL and the estuary, and Dean Creek and the estuary.

2) The constructed tidal basins shall result in a net increase of tidal prism (i.e., tidal flushing) relative to pre-project conditions.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: 1) Mapping: Year 1
2) Tide gauge: Years 1, 2, 3, 5, and 10
3) Tidal basin flows: Years 1, 2, 3, 5, and 10

Personnel: 1) Mapping: 1 biologist 8 hrs
2) Tide gauge: 2 technicians 16 hrs/yr
3) Tidal basin flows: 2 technicians 24 hrs/yr

Cost: 1) Mapping: $480
2) Tide gauge: $1,024/yr
3) Tidal basin flows: $1,536/yr

Lead: 1) Mapping: WDFW
2) Tide gauge: JKT
3) Tidal basin flows: JKT

Contingency Measures

If a functioning hydrological connection is not restored and self-maintaining between the two creeks and the estuary, this aspect of the project would be deemed unsuccessful and serious consideration would have to be given to what corrective actions could possibly result in desired outcomes. If the tidal basins do not result in a net increase of tidal prism and sufficient flow to transport sediment into Sequim Bay, then contingency measures could include: 1) waiting to see whether the desired outcome may be achieved after a longer period of time; or 2) actively manipulating the tidal basins (e.g., deepening and/or widening to increase the overall size).

4.1.2 SEDIMENT TRANSPORT & DEPOSITION

Historic and Current Conditions

Inspection of historic U.S. Coast and Geodetic maps (1870, 1914, 1926) indicates that the JCL and Dean Creek channels naturally migrated across the alluvial fan within the estuary, prior to the time that roads, railroads, Highway 101, and dikes constricted the channel movements (see Figure 2.2, Shreffler 2000). Rerouting of the JCL and Dean Creek channels, loss of instream channel complexity, and a decrease in tidal energy have decreased these channels' ability to route sediment through the system. Historic sediment transport rates and volumes are unknown and difficult to assess accurately.

The construction of a pier off the end of the log yard resulted in disruption of longshore sediment transport (Shreffler 2003). Because longshore drift in Sequim Bay is southerly along the west side of the bay, the pier essentially trapped most suspended sediment, thereby "starving" landscape features to the east of the pier of sediment. For example, EDG attributes the loss of the former sand spit feature to the east of the pier to sediment starvation caused by the pier.

Restoration Objective

The restoration objectives relative to sediment transport are to:

1) Restore the natural pattern of longshore sediment transport by removing the log yard pier, log yard fill, and delta cone, and

2) Allow the routing of sediment through the fluvial system and into the tidal system, by removing estuary blockages (Log Deck Road, Old Blyn Highway, delta cone, culverts, dams, and other fill) and restoring a functional connection between JCL, Dean Creek, and their combined estuary that will enable the estuary to function once again as a sediment "pump" [note: construction of a tidal channel network on the RV Park (WDFW) and Eng (WSDOT) properties should also facilitate the routing of sediment into the estuary].

Restoration Rationale

Sediment mobility is critical to the ecological health of a river-estuary system, and "dynamically stable" channels transport sediment downstream at the same rate that it is delivered to the system from upstream. Dynamically stable channels maintain their general morphology over the time frame of centuries, although their stable pattern does not preclude lateral migration and associated dynamics such as bank erosion and sediment deposition (Inter-Fluve 2001). By restoring natural hydrology and sediment supply (suspended load and bedload) to the project area, sediment transport and deposition will occur within the range of natural systems and proceed along a trajectory toward natural conditions.

The accumulation of fine-grained sediment is indicative of environments that support the build up of organic matter and a detritus-based food web. Organic-rich sediments provide an environment where benthic invertebrate prey resources flourish, and hence provide the capacity for fish and wildlife to forage. Thus, transport of fine sediments to the estuary where they can become redistributed by longshore drift is critical in terms of providing habitat for juvenile salmonids, other estuarine fish, shellfish, and shorebirds and their food base. Similarly, the deposition of appropriate-sized gravel in the realigned JCL and Dean Creek channels is important in providing suitable spawning habitat for adult salmonids.

BASELINE MONITORING

Methods & Data Analysis

1) **Essential**: Map the existing shoreline topography on an aerial photograph with particular attention to sediment deposits at the mouths of both JCL Creek and Dean Creek, as well as the area around the log yard pier and delta cone.

Note: As outlined in the JCL channel realignment monitoring plan (Shreffler 2001) aerial photographs (1 inch = 500 feet) will be taken vertically over the project area and Salmon Creek annually between March and April, as near as possible to solar noon when the tidal height is, at minimum lower than +3 ft MLLW (-2 ft MLLW is ideal).

2) **Essential**: Survey cross sections to map the expected transport of sediment stored updrift from the log yard pier.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: 1) Mapping: Year 0

2) Cross sections: Year 0

Personnel: 1) Mapping: 1 biologist 10 hrs
2) Cross sections: 1 biologist 24 hrs + 1 technician 24 hrs

Cost: 1) Mapping: $540 (note: aerial photo costs are already included in the JCL channel realignment monitoring plan)
2) Cross sections: $2,064

Lead: 1) Mapping: JKT
2) Cross sections: JKT

IMPLEMENTATION MONITORING

1) **Essential**: Prepare as-built drawings of all estuary restoration features (i.e., Log Deck Road removal, log yard fill removal, Old Blyn Highway removal, delta-cone removal, tidal channel construction at RV Park and Eng) that have an effect on sediment transport/exchange or longshore sediment transport (see Section 4.1.1).

EFFECTIVENESS MONITORING

Methods & Data Analysis

1) **Essential:** Map the shoreline topography on an aerial photograph following removal of all the identified estuary blockages (Log Deck Road, Old Blyn Highway, delta cone, culverts, fills, dam).

2) **Essential**: Re-survey cross sections updrift of the log yard pier to map the transport of sediment following removal of the log yard pier.

3) **Essential**: Install permanent cross sections across selected tidal channels in the Eng tidal basin, RV Park tidal basin, and log yard tidal basin to map the evolution of those constructed channels.

Note: suspended sediment sampling during high flooding events will take place at the mouth of JCL Creek and Dean Creek, as part of the JCL Creek monitoring plan. This sampling will document the grain size of material being transported to the estuary during storm events.

Performance Criteria

1) Within 10 years following removal of the log yard pier, log yard fill, and delta cone, sediment that was formerly aggraded in these areas will be redistributed by the restored longshore drift cell. [Note: within 5 years, sediment redistribution should be on a clear trajectory toward the above performance criterion].

2) Tidal "flushing" capacity of the estuary tidal basins shall be sufficient to transport sediment out into Sequim Bay.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: 1) <u>Mapping</u>: Once/year in years 1-10
2) <u>Longshore drift cross sections</u>: Years 1, 4, 7, and 10
3) <u>Tidal basin cross sections</u>: Years 1, 4, 7, and 10

Personnel: 1) <u>Mapping</u>: 1 biologist 16 hrs/year
2) <u>Longshore drift cross sections</u>: 1 biologist 24 hrs/year + 1 technician 24 hrs/year
3) <u>Tidal basin cross sections</u>: 1 biologist 24 hrs/year + 1 technician 24 hrs/year

Cost: 1) <u>Mapping</u>: $864/year
2) <u>Longshore drift cross sections</u>: $2,064
3) <u>Tidal basin cross sections</u>: $2,064

Lead: JKT

Contingency Measures

Adequate sediment transport and deposition is critical for long-term functioning of the ecosystem in support of invertebrates, fish, shellfish, birds, and their prey base. Contingency measures could include attempts to identify whether the problem is caused by excessive sediment, a tidal basin that is too small, inadequate roughness in the tidal channels (lwd), or stormwater runoff. Each cause will have unique solutions.

4.2 MONITORING OF HABITAT CONDITIONS & FUNCTIONS

Habitat conditions and functions monitoring tasks will focus on habitat gains, water and sediment quality, and large woody debris. These tasks are intended to document improvements in habitat conditions and functions that directly result from the restoration activities.

4.2.1 HABITAT GAINS

Historic and Current Conditions

It can be seen from analysis of historic photos and maps that the following habitats were formerly more abundant in the project area (in terms of total acreage) than they are in current times: emergent marsh, tidal channels, mudflat, and native riparian and terrestrial plant communities. It is suspected that eelgrass was also more abundant pre-log yard development, but there is no data to definitively support or refute that supposition.

Restoration Objective

The restoration objective is to increase the total acreage of properly functioning habitats, including emergent marsh (low and high marsh), eelgrass, tidal channels, mudflat, and native riparian and terrestrial plant communities relative to current conditions.

Restoration Rationale

It is predicted that gains in total acreage of properly functioning habitats will result in corresponding gains in the species richness and abundance of flora and fauna that depend on those habitats.

BASELINE MONITORING

Methods and Data Analysis

1) **Essential**: Identify major habitat types on an aerial photograph to define pre-restoration habitat condition/distribution. Field verify habitat type classifications. Calculate acreage of each habitat type.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Baseline in year 0

Personnel: 1 biologist 16 hrs for aerial photo analysis + 1 biologist/botanist and 1 technician 8 hrs each for field verifications + 1 GIS specialist 8 hrs for mapping

Cost: $1,984

Lead: JKT

IMPLEMENTATION MONITORING

1) **Essential**: Prepare as-built drawings according to standard construction engineering practices for all the estuary restoration elements (see Section 4.1.1).

EFFECTIVENESS MONITORING

Methods and Data Analysis

1) **Essential**: Repeat the baseline survey in years 1, 3, 5, and 10 and identify major habitat types on an aerial photograph. Field verify habitat type classifications. Calculate acreage of each habitat type. Compare changes in habitat areas (total acreage) between baseline conditions and post-restoration conditions.

Performance Criteria

EDG has established the following targets for habitat gains (see Shreffler 2003):

- Intertidal: up to 20 acres (includes brackish marsh, salt marsh, unvegetated mudflats, and intertidal areas that formerly supported eelgrass and other benthic and epibenthic plant and animal communities)
- Eelgrass: natural recolonization to densities comparable to existing eelgrass beds at project edges
- Creek channels (JCL and Dean): 1,000 linear feet
- Tidal channels: 2,730 linear feet
- Terrestrial: 9 acres (includes all native terrestrial plant communities; not all of this acreage will be forested).

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Years 1, 3, 5, 10

Personnel: 1 biologist 16 hrs for aerial photo analysis + 1 biologist/botanist and 1 technician 8 hrs each for field verifications + 1 GIS specialist

Cost: $1,984/year

Lead: JKT

Contingency Measures

Contingency measures to increase the total acreage of the target habitats could include: altering the hydrology, estuarine channel network morphology, or habitat elevations relative to MLLW; planting native vegetation; or allowing more time for habitats to naturally recover. If invasive species are a problem, contingency measures could include mechanical treatments (e.g. hand clearing, burning, weed whacking, mowing) and/or, as a last resort, chemical treatments (e.g. herbicides).

4.2.2 WATER & SEDIMENT QUALITY

Historic and Current Conditions

No historic water or sediment quality data are available, pre-1961 for JCL, Dean Creek, or the estuary.

Water and sediment quality in the JCL watershed has been impaired by a minimum of three land-use practices: forestry, residential development, and animal keeping (Brastad et al. 1987). Logging practices in the upper watershed prior to the mid-1980s contributed increased sediment loads to JCL. Currently, sporadic logging is only taking place on state-owned land along the East Fork of JCL, and this logging is not suspected to contribute sediment to JCL. Most of the known failing septic systems that diminished water quality on the lower 0.7 miles of JCL have been repaired or replaced. Animal keeping practices on the lower 0.7 miles of JCL have been changed so that animals no longer have direct access to JCL. The Sequim Bay Watershed Management Plan (1991) noted that, “water samples taken in the JCL drainage exceed state bacteria maximum allowable levels by two-to three-fold.” However, fecal coliform data collected by Washington State Department of Health (DOH) from 1992-1995 in marine waters at the mouth of JCL showed no elevated values that exceed state or federal threshold criteria for fecal coliform concentrations. Similarly, bi-monthly fecal coliform data collected by JKT at the mouth of JCL and Dean Creek (1999 to present) have shown no elevated values.

Stormwater runoff in the vicinity of the proposed project has the potential to create significant capacity and water/sediment quality problems. The creation of impervious surfaces such as parking, rooftops, driveways, and roads results in increases in peak flows during and following storms. Runoff can be high in pollutants such as nutrients, heavy metals, petroleum products, and sediment. BMPs should be used for all new developments in the watershed.

The Sequim Bay Watershed Management Plan (SBWMP 1991) identified the log yard as one of the six most significant sources of pollution into Sequim Bay. There are 86 creosote-treated pilings and 5 untreated pilings between approximately 0 ft MLLW and -3.5 ft MLLW. The creosote-treated pilings are presumed to cause adverse but undocumented effects to water and sediment quality. Each piling also has an associated “footprint” that eliminates subtidal area that may formerly have supported shellfish, eelgrass, or some other natural estuarine habitat.

There are also certified harvestable commercial shellfish beds approximately 50 m west of the log yard, and native shellfish at harvestable levels approximately 50 m to the east of the log yard. At present, there are no harvestable clams within the area of the former log yard operations (Kelly Curtis, former Shellfish Biologist for the Jamestown S'Klallam Tribe, personal communication October 2002). The main water quality impacts affecting these tidelands are: 1) addition of wood waste and chemical leachates from logs rafted in water, which contribute organic substances to the water that can lead to oxygen depletion, and 2) burial or alteration of benthic species.

Restoration Objective

The restoration objective is to improve water and sediment quality relative to current conditions by realigning JCL and Dean Creek and reconnecting these creeks to the estuary, as well as removing roads, culverts, and other fill, removing creosote-treated pilings (and the surrounding sediment from the base of each piling), and improving stormwater management.

Restoration Rationale

Water and sediment quality can be degraded by nearly all human activities that affect the landscape. The quality of water is the most important category of environmental factors affecting the biota of stream ecosystems (Koski 1992).

BASELINE MONITORING

Methods and Data Analysis

The monitoring tasks listed below are either ongoing or planned:

- Ongoing Streamkeepers' quarterly monitoring of air and water temperature, dissolved oxygen (D.O.), conductivity, salinity, pH, turbidity, nitrate, and fecal coliform at four reaches in the existing JCL Creek, as outlined in Section 3.2.2 of the JCL Creek Realignment Monitoring Plan (Shreffler 2001).
- Ongoing Streamkeepers annual monitoring of benthic macroinvertebrates in the existing JCL channel once/year in September or October (see Section 4.3.7).
- Planned water quality monitoring (daily air and water temperature, dissolved oxygen, turbidity, and salinity measurements from June through September using a Hydrolab) along the realigned JCL channel at the McLaughlin Property. This monitoring is outlined in Section 3.2.2 of the JCL Creek Realignment Monitoring Plan (Shreffler 2001).

- Ongoing JKT bi-monthly monitoring of fecal coliform in JCL and Dean Creek.
- Ongoing JKT monthly monitoring of dissolved oxygen, conductivity, pH, and temperature in JCL and Dean Creek.

The following monitoring tasks shall be added:

1) **Essential**: Record weekly salinity measurements at the following JCL Creek stations: the mouth of the existing JCL Creek, just below the JCL culvert under Highway 101, and ~200 feet upstream of Highway 101; as well as the following Dean Creek stations: the mouth of the existing Dean Creek, just below the Dean Creek culvert under Highway 101, and ~200 feet upstream of Highway 101.

2) **Recommended**: Analyze surface sediment samples collected at the mouth of the existing JCL Creek, the mouth of the existing Dean Creek, and 3 stations within the "footprint" of the pilings for metals, organics, and total petroleum hydrocarbons (TPHs).

3) **Recommended**: Continue regular monitoring of fecal coliform concentrations in marine waters of lower Sequim Bay (DOH).

Timeline, Personnel, Cost Estimate, and Lead

Timeline: 1) Salinity Measurements: Weekly, Year 0
2) Sediment Quality: Once, Year 0
3) Fecal Coliform: Monthly, Year 0

Personnel: 1) Salinity Measurements: 1 technician 52 hrs
2) Sediment Quality: 1 technician 16 hrs + 1 biologist 8 hrs for data analysis
3) Fecal Coliform: DOH

Cost: 1) Salinity Measurements: $1,664
2) Sediment Quality: $512 for technician + $432 for biologist + $500 for sample processing (assumes 5 samples at ~$100/sample)
3) Fecal Coliform: no cost to project (DOH expense)

Lead: 1) Salinity Measurements: JKT
2) Sediment Quality: JKT
3) Fecal Coliform: DOH

IMPLEMENTATION MONITORING

Visually inspect sediment and erosion control structures to prevent deleterious water quality impacts.

EFFECTIVENESS MONITORING

Methods and Data Analysis

1) **Essential**: Record weekly salinity measurements at the following JCL Creek stations: the mouth of the new JCL Creek, just below the Highway 101 bridge, and ~200 feet upstream of Highway 101; as well as the following Dean Creek stations: the mouth of the new Dean Creek, just below the Dean Creek culvert under Highway 101, and ~200 feet upstream of Highway 101. Compare pre-project and post-project data.

2) **Recommended**: Analyze surface sediment samples collected at the mouth of the new JCL Creek, the mouth of the new Dean Creek and 3 stations within the former "footprint" of the pilings for metals, organics, and total petroleum hydrocarbons (TPHs).

3) **Recommended**: Continue monthly monitoring of fecal coliform concentrations in lower Sequim Bay. Compare pre-project and post-project data.

Performance Criteria

1) Salinity measurements post-restoration shall demonstrate that the salinity wedge extends further upstream in the new JCL channel and the new Dean Creek channel than in the existing channels. For JCL, the salinity wedge shall reach the McLaughlin property south of HWY 101. For Dean Creek, the salinity wedge shall reach approximately 300 ft upstream of the mouth.

2) Water quality parameters (water temperature, D.O., and turbidity) at the mouth of the new JCL Creek channel, the mouth of the new Dean Creek channel, and within the footprint of the former pilings shall not exceed state, federal, or tribal water quality standards. [Note: DOE standards for freshwater are: water temperature < 13 degrees centigrade; DO > 7.0 mg/L, and turbidity not

less than 5 NTU or 10% above background levels; At this time DOE has no standards for temperature, D.O., and turbidity in waters that are >10 parts per thousand salinity].

3) Sediment quality parameters (metals, organics, TPH) at the mouth of the new JCL Creek channel, the mouth of the new Dean Creek channel, and within the footprint of the former pilings shall not exceed state, federal, or tribal water quality standards.

4) Post-project fecal coliform concentrations shall not exceed pre-project concentrations, and shall not exceed state, federal, or tribal water quality standards.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: 1) Salinity Measurements: Weekly, Years 1-3
2) Sediment Quality: Once annually, Years 1, 3, 5, 10
3) Fecal Coliform: Monthly, Years 1-10

Personnel: 1) Salinity Measurements: 1 technician 52 hrs/year
2) Sediment Quality: 1 technician 16 hrs/year + 1 biologist 8 hrs/year for data analysis
3) Fecal Coliform: DOH

Cost: 1) Salinity Measurements: $1,664
2) Sediment Quality: $512/year for technician + $432/year for biologist + $500/year for sample processing (assumes 5 samples at ~$100/sample)
3) Fecal Coliform: no cost to project

Lead: 1) Salinity Measurements: JKT
2) Sediment Quality: JKT
3) Fecal Coliform: DOH

Contingency Measures

If performance criteria are not met, the following contingency measures could be considered: source control (of toxics or contaminants); improve stormwater management; improve septic system operation and management; better enforce land-use regulations to limit impervious surfaces; better enforce land-use regulations and/or encourage BMPs to limit the effects of mining, logging, conversion of forest lands to development, and other deleterious clearing of riparian or wetland vegetation in the watershed; better enforce land use regulations to prevent discharge from leaking septic tanks and eliminate domestic animal access to the JCL and Dean Creek stream channels; and implementation of new land-use regulations, if necessary.

4.2.3 LARGE WOODY DEBRIS

Historic and Current Conditions

Prior to human habitation of the Blyn area, the JCL valley was likely a cedar swamp at the head of tidal influence interspersed with higher ground covered by old growth forest. In this undisturbed condition, large woody debris (LWD) would likely have been distributed throughout the estuary at the upper edges of the salt marsh and in tidal channels. At present, there is very little LWD in the estuary, with the exception of a few logs (no branches or rootwads attached) that are remnants from the historical use of the estuary as a log yard.

In 1999, two trained analysts assessed the condition of the riparian corridor along JCL using aerial photos at a scale of 1:12000 (Bernthal et al. 1999). The extent, species composition, and stand density of forested habitats, as well as the land use adjacent to these forested habitats, were analyzed within a 200 ft. zone either side of the JCL channel, from the river mouth to the uppermost extent of summer chum distribution. These data were not verified in the field. Inspection of historical aerial photos indicated that the riparian corridor along the lower 1.5 miles of the JCL has diminished in both width and length over the past century. Within the lower 1.5 miles of JCL where summer chum spawning occurs, land use is approximately 34% in forested habitats, 38% in forestry, 12% in agriculture, 9% in roads and dikes, and 7% in residential land uses. One hundred percent of the forested riparian corridor is in diameter classes less than 20 in. diameter at breast height (dbh). The riparian species composition was 43% conifer dominated, 42% deciduous dominated, and 15% mixed conifer and deciduous. The ability of a riparian corridor to supply large woody debris (LWD) over time is partly dependent on corridor width: a 50 ft no-cut corridor will supply 32% of LWD at age 200, a 135 ft corridor 77%, and a 210 ft corridor 100% of LWD at age 200 (Bernthal et al. 1999). For JCL, sixty-nine percent of the forested riparian corridor is less than 66 feet in width and thirty-one percent between 66 and 132 feet in width; no portion of the existing JCL riparian corridor is within the 210 foot classification that is predicted to supply 100% of LWD at age 200. The loss of riparian habitat along JCL can be attributed to forestry, agriculture, railroads, clearing of land for roads, and private residences. Bank armoring along the lower half mile of JCL has also reduced the full functions of the riverine-riparian habitat.

Restoration Objective

The restoration objective is to install LWD into the estuarine tidal channels as both a hydraulic feature and as a functional habitat, because there is unlikely to be any significant LWD recruitment to the realigned JCL or Dean Creek channels or estuary for at least 20-50 years.

Restoration Rationale

By installing LWD into the estuarine tidal channels, EDG hopes to provide cover for juvenile salmonids, as well as to "jumpstart" physical and biological processes within the channels until a healthy riparian corridor has developed and LWD begins to naturally recruit to the estuary.

BASELINE MONITORING

See Bernthal et al. 1999 as described above in the Current Conditions.

IMPLEMENTATION MONITORING

Methods and Data Analysis

A field biologist will be present on-site during construction to direct placement of wood by the heavy equipment operators.

1) **Essential**: Map the location of each log with a GPS.

2) **Essential**: Photograph each significant LWD placement from a fixed location that is geo-referenced.

3) **Essential**: Record the as-built depths of each pool associated with a LWD placement.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Year 0, during-construction

Personnel: 1) GPS/map: 1 biologist for 40 hours
2) Photo-document: 1 technician for 8 hrs
3) As-built pool depths: included in #1 above

Cost: 1) GPS/map: $2,160
2) Photo-document: $256
3) As-built pool depths: included in #1 above

Lead:	JKT

EFFECTIVENESS MONITORING

Methods and Data Analysis

Logjams will be constructed to resist coming apart in a flood or in winter storms at extreme high tides. However, some movement of LWD is an expected and natural process.

1) **Essential**: Track movement of log jams annually using fixed photo points and GPS positions.

2) **Essential**: Track pool depth and dimensions using cross sections to document that logjams create and maintain pool habitat.

3) **Essential**: Track changes in the number of pieces of wood per logjam.

Performance Criteria

1) 80% or more of the LWD placements should be present in Year 10.

2) LWD placements shall not move to locations where they pose a threat to infrastructure, properties, or the channel morphology.

3) LWD placements shall maintain pool depth and channel form as built.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: 1) Track movements of jams: Years 1, 3, 5, 10
2) Pool depths: Years 1, 5, 10
3) Pieces/jam: Years 1, 5, 10

Personnel: 1) Track movements of jams: 1 technician 8 hrs/year
2) Pool depths: 1 biologist 8 hrs/year
3) Pieces/jam: 1 technician + 1 biologist 8 hrs each/year

Cost: 1) Track movements of jams: $256/year
2) Pool depths: $432/year
3) Pieces/jam: $688/year

Lead: JKT

Contingency Measures

Contingency measures could include adding more LWD and/or relocating or removing problematic wood structures. LWD could be stockpiled on-site (in non-wetland areas) and installed quickly in emergencies.

4.3 MONITORING OF BIOLOGICAL RESPONSES

Biological responses monitoring tasks will focus on terrestrial and wetland vegetation establishment, invasive vegetation management, eelgrass recovery, shellfish recovery, salmonid use, invertebrate use, and bird use. These tasks are designed to evaluate the "success" of the estuary restoration actions in improving the ecosystem for flora and fauna.

4.3.1 TERRESTRIAL VEGETATION ESTABLISHMENT

Restoration Objective

The restoration objective relative to terrestrial vegetation establishment is to re-establish native vegetation (trees, shrubs, and groundcover) on portions of the former log yard property (~2.96 acres), the RV Park property (~3.20 acres), and the Eng property (target acreage presently unknown).

Restoration Rationale

Restoring native vegetation will enhance wildlife habitat at the log yard, former RV Park, and Eng property, and also improve the aesthetics of the project area relative to the bare, compacted ground or invasive vegetation that currently exists in these locations. Vegetation will also help screen wildlife habitat from the transportation corridors (Highway 101 and Olympic Discovery Trail).

BASELINE MONITORING

Methods and Data Analysis

1) **Essential**: Identify transitional and terrestrial vegetation classes on an aerial photograph. Field verify vegetation communities by species composition.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Baseline in year 0

Personnel: same as Habitat Gains section

Cost: already included in Habitat Gains section

Lead: JKT, WSDOT

IMPLEMENTATION MONITORING

Methods and Data Analysis

A planting and watering plan (or irrigation system) will be developed closer to the time of the actual revegetation effort.

1) **Essential**: Photo-document the entire revegetation process from permanently established camera points.

2) **Essential**: Verify plantings by species, number of plants, and locations.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: During construction in year 0

Personnel: Photodocument: 1 biologist 4 hrs to establish photo-points + 1 technician 8 hrs to take photos
Verify plantings: 1 technician 8 hrs

Cost: Photodocument: $472
Verify plantings: $256

Lead: JKT, WSDOT

EFFECTIVENESS MONITORING

Methods and Data Analysis

1) **Essential**: Identify major vegetation types on an aerial photograph for each year of monitoring. Visit the site to groundtruth vegetation communities twice/year in mid-spring and late summer in years 1, 3, 5, 7, and 9, and once/year in late spring or early summer in years 2, 4, 6, 8, and 10. Field verify and categorize vegetation communities by species composition. Establish permanent transects to identify species composition and percent canopy cover (densiometer reading).

2) **Essential**: Establish and mark fixed test plots at the time of planting and monitor these plots annually (once/year in mid-Summer) for densities, spacing, and survival of herb, shrub, and tree

components. Make note of native and non-native pioneer species. [Note: suggested test plot size for trees and shrub species is 1/50 acre, with a 3-ft radius test plot for monitoring herbs nested within the 1/50 acre].

3) **Essential**: Photograph the revegetated areas from fixed camera points.

Performance Criteria

1) Percent Cover of native plantings and pioneers (trees and shrubs) should be at least 50% in year 5, 60% in year 8, and 90% at the end of 10 years.

2) Plant survival: Any planted trees and shrubs that die within the first year will be replanted, and/or other measures (e.g., watering, fencing, weeding) will be implemented as necessary to assure survival. Subsequently, if mortality of the native plantings is greater than 30% in any given year, then replant.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: 1) Percent Cover: Twice/year in Years 1, 3, 5, 7, and 9; Once/year in Years 2, 4, 6, 8, and 10; year 1 monitoring should take place within 4-6 months of planting to determine whether replanting is necessary
2) Plant survival: Mid-summer once/year in years 1, 2, 3, 5, and 10
3) Photo-documentation: Twice/year (in driest and wettest periods of the year) in years 1, 2, 3, 5, and 10

Personnel: 1) Percent Cover: 2 technicians 24 hrs/year each + 1 biologist 8 hrs/year for species verifications
2) Plant survival: 2 technicians 12 hrs/year each + 1 biologist 8 hrs/year for species verifications
3) Photo-documentation: 1 technician 8 hrs/year

Cost: 1) Percent Cover: $1,968/year + $200 supplies in Years 1, 3, 4, 7, and 9; $984/year in Years, 2, 4, 6, 8, and 10.
2) Plant survival: $1,200/year for 2 technicians and 1 biologist
3) Photo-documentation: $256/year

Lead: JKT, WSDOT

Contingency Measures

Potential causes of poor plant survival in year one could include improper installation, poor soil structure and/or organic content, inadequate watering, herbivory, trampling, or competition (especially from grasses). Excessive mortality in subsequent years will be addressed by one or more of the following: additional plantings (same or replacement species as appropriate), soil amendments, more frequent watering, weeding, fencing, management of non-native invasives that may reestablish, and/or improved stewardship. In addition, alders could be thinned around year 10 to allow conifers to thrive.

4.3.2 WETLAND VEGETATION ESTABLISHMENT

Historic and Current Conditions

The historic species composition and areal extent of estuarine wetland vegetation is unknown.

In December 2001, EPA and Shreffler Environmental conducted vegetation mapping in the estuary portion of the project area north of Highway 101. Twenty-three different vegetation communities were mapped, ranging in elevation from low salt marsh (typically dominated by *Salicornia virginica* and *Distichlis spicata*) to high salt marsh (various dominants depending on location).

Restoration Objective

To allow native estuarine wetland vegetation to naturally recolonize and re-establish in the estuary at elevations capable of supporting wetland vegetation.

Restoration Rationale

Wetland vegetation provides habitat structure, facilitates sediment trapping, and serves as a critical source of organic matter to support detritus-based food webs for juvenile salmonids, shorebirds, and waterfowl. A review of the multitude of specific functions performed by estuarine wetlands is provided in Shreffler (2000). EDG believes that the existing seedbed will be sufficient to allow natural recolonization of the estuary, and at this time the only planned planting will be approximately 700 *Carex lyngbyei* plants that were grown from seeds harvested at the site in 1999. Those plants were installed in the restored log yard area in November 2003.

BASELINE MONITORING

Vegetation mapping completed in December 2001.

IMPLEMENTATION MONITORING

None

EFFECTIVENESS MONITORING

Methods and Data Analysis

1) **Essential**: Identify the percent cover of wetland vegetation on aerial photographs, or use GPS or traditional survey techniques to map the perimeter of wetland vegetation patches.

2) **Essential**: Establish permanent transects and survey these transects during mid-summer to determine species composition within a minimum of ten 0.25m x 0.25m quadrats randomly distributed along each transect line. [Note: more than 10 sampling quadrats may be required, depending on the length of the transects and expected variability in species composition]. Record all plant species observed within each quadrat, and visually estimate percent cover of each species within each quadrat.

3) **Essential**: Establish fixed camera points and photograph the areas that have naturally recolonized with wetland vegetation.

Performance Criteria

1) Areal extent (percent cover) of wetland vegetation should be 60% comparable to that of appropriate reference sites after 5 years and 80% comparable after 10 years.

2) Species composition of native wetland plant species should be 60% comparable to that of appropriate reference sites after 5 years and 80% comparable after 10 years.

Timeline, Personnel, Cost Estimate, and Lead

Timeline:
1) Percent Cover: Mid-summer once/year in years 1, 2, 3, 5, and 10
2) Species composition: Mid-summer once/year in years 1, 2, 3, 5, and 10
3) Photo-document: Mid-summer once/year in years 1, 2, 3, 5, and 10

Personnel:
1) Percent Cover: 2 technicians 12 hrs/year each + 1 biologist 8 hrs/year
2) Species composition: same as percent cover
3) Photo-document: 1 technician 8 hrs/year

Cost:
1) Percent Cover: $1,200/year
2) Species composition: no additional cost, if done at same time as percent cover.
3) Photo-document: $256/year (note: no additional cost, if done at same time as terrestrial photo-documentation).

Lead: JKT

Contingency Measures

Excessive failure rates for plant establishment will be addressed with contingency measures. Potential causes could include inadequate natural seed base, inappropriate elevations, poor soil structure and/or organic content, herbivory, or competition. Contingency measures could include plantings, soil amendments, watering, weeding, fencing, excavating to proper elevations, management of non-native invasives that may reestablish, and/or improved stewardship.

4.3.3 INVASIVE VEGETATION MANAGEMENT

Historic and Current Conditions

Historic conditions of invasive plants in the project area are unknown. Invasive plant species of current particular concern at the restoration site are reed canary grass (*Phalaris arundinacea*), Canada thistle (*Cirsium arvense*), Scot's broom (*Cytisus scoparius*), Himalayan blackberry (*Rubus discolor*), reedgrass (*Phragmites communis*), purple loosestrife (*Lythrum salicaria*), and Japanese knotweed (*Polygonum cuspidatum*). Although *Spartina alterniflora* is not currently present at the site, vigilance will be required to ensure that it doesn't colonize given that EDG is depending on natural regeneration.

Restoration Objective

The restoration objective relative to invasive vegetation management is to remove and control the native and non-native, invasive species at the restoration site. The methods to be used in the estuary are the same as those outlined in the Jimmycomelately Creek Revegetation Plan (Clallam Conservation District 2001) for the JCL channel.

Restoration Rationale

Non-native, invasive plant species disrupt native plant community structure that provides higher quality habitat and food for a variety of wildlife species, which, in turn, have evolved in conjunction with native plant communities.

BASELINE MONITORING

Methods and Data Analysis

1) **Essential**: On aerial photographs, map locations of invasive species of concern in the existing estuary.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Year 0
Personnel: 1 biologist 8 hrs
Cost: $480
Lead: JKT, EPA

IMPLEMENTATION MONITORING

1) **Essential**: Excavate all invasive plant species, removing both above-ground and below-ground plant structures when practicable.

EFFECTIVENESS MONITORING

Methods and Data Analysis

1) **Essential**: Following construction, re-map locations of invasive species of concern on aerial photographs. Mechanically remove invasive plants (e.g. hand clearing, burning, weed whacking, mowing), and monitor annually for their reappearance. Use mechanical control until natural conditions (i.e., shading and/or saltwater) cause mortality. Chemical control is not considered an acceptable means of control in salt marsh areas at this time.

Performance Criterion

The project area shall contain ≤5% cover by area of invasive plant species after 10 years.

Timeline, Personnel, Cost Estimate, and Lead

Timeline:	Years 1, 5, and 10
Personnel:	1 technician 8 hrs/year + 1 biologist 8 hrs/year
Cost:	$688/year
Lead:	JKT, EPA

Contingency Measures

More than 5% cover by area of invasive plant species in any given monitoring year would trigger the need for contingency measures. Contingency measures could include some combination of mechanical treatments (e.g. hand clearing, burning, weed whacking, mowing).

4.3.4 EELGRASS RECOVERY

Historic and Current Conditions

From 1892-2001, a log sorting and transportation operation was in business at the south end of Sequim Bay. During that period (exact dates unknown), former wetlands and mudflats were filled and a "pier" and multiple creosote-treated pilings were installed to facilitate the handling and sorting of logs. The major impairments resulting from the pier, pilings, and log yard operations are creosote contamination, other impacts to water quality, shading, prop wash, wood debris, impacts to eelgrass, disruption of wildlife use of the area, and loss of estuarine mudflat and wetland habitats (Shreffler 2003).

Current conditions immediately off shore of the log yard have been surveyed by Battelle Marine Sciences Laboratory and JKT. In 1999, Battelle (Antrim 1999) conducted a video survey of epibenthic habitat in the lower end of Sequim Bay, excluding the area within the boundaries of the pilings and log rafts at the log transfer facility that were still in use at that time. In July 2001, JKT staff surveyed substrate, wood waste, and algae (primarily *Ulva* spp. and *Enteromorpha* spp.) at minus tides along transects stretching from ~0 ft to -2.0 ft MLLW, which were distributed from the western edge of the log yard property to the mouth of JCL. In July 2002 and July 2003, JKT staff mapped eelgrass beds to the northeast, and outside of, the footprint of the log yard tidelands, using GPS at a -3 ft tide (MLLW). In September 2002, Battelle (Sargeant et al. 2002) conducted a diver survey of eelgrass and wood waste within the area of the former log transfer facility that is bounded by remaining pilings ("the footprint").

Based on the Battelle and JKT surveys, eelgrass beds are present within approximately 90 m from the western edge of the pilings (1999 Battelle video survey and 2002 diver confirmation) and approximately 182 m from the eastern edge of the pilings (2002, 2003 JKT surveys). No eelgrass was found within the log yard footprint by any of the various survey teams from Battelle or JKT. The intertidal survey performed by JKT staff provided little indication of surface wood waste deposits. Similarly, the Battelle divers found minimal bark, chip, or wood waste within the log yard footprint, with the exception of several whole logs on the bottom that had presumably sunk from log rafts. Sargeant et al. (2002) attributed the absence of eelgrass within the footprint to the continuous human disturbance of the site since its establishment in the late 1800s.

Sargeant et al. (2002) predicted that natural recolonization of eelgrass into the footprint would be expected to occur gradually through the spreading of rhizomes from existing eelgrass beds, once the existing pilings are removed, and assuming no further log rafting occurs at the site. The minimal wood debris from the historical log yard operations is not expected to inhibit natural expansion of the existing eelgrass beds. The dominant substrates of sand, mixed fines, and mud present within the footprint are known to support eelgrass beds in comparable ecosystems that have not previously been disturbed by logging operations.

Restoration Objective

To remove anthropogenic impairments (i.e., pier, pilings, fill) and allow existing eelgrass to recover and expand into the footprint of the area formerly impacted by historic log rafting, dredging, and related log yard operations. Note: 5 pilings that are not creosote-treated will remain for shorebird roosting (see Section 3.0).

Restoration Rationale

Removal of anthropogenic impairments should facilitate natural recovery of the eelgrass beds, without the need for a large-scale transplanting effort.

BASELINE MONITORING

Methods and Data Analysis

1) **Essential**: JKT completed a baseline survey of substrate, wood waste, and algae within intertidal portions of the project area in July 2001.

2) **Essential**: Battelle Marine Sciences Laboratory completed a baseline survey of existing eelgrass and wood waste within log yard “footprint” in September 2001 (Sargeant 2001).

3) **Essential**: JKT staff completed a survey of eelgrass to the east of the existing “footprint” of the pilings in July 2002 and July 2003.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: 1) JKT intertidal survey: July 2001
2) Battelle eelgrass survey: September 2002
3) JKT eelgrass surveys: July 2002, July 2003

Personnel: 1) JKT intertidal survey: 1 biologist 8 hrs + 5 technicians, 8 hrs each

2) Battelle eelgrass survey: 3 divers

3) JKT eelgrass surveys: 1 biologist 8 hrs + 2 technicians, 8 hrs each + 1 GIS specialist 8 hrs

Cost: 1) JKT intertidal survey: $1,712

2) Battelle eelgrass survey: $10,000

3) JKT eelgrass surveys: $1,376

Lead: 1) JKT intertidal survey: July 2001

2) Battelle eelgrass survey: Battelle Marine Sciences Laboratory (under contract to JKT)

3) JKT eelgrass surveys: JKT

IMPLEMENTATION MONITORING

None

EFFECTIVENESS MONITORING

Methods and Data Analysis

1) **Essential**: Repeat the JKT low tide monitoring annually in years 1-10, with emphasis on the western edge of the existing eelgrass bed to the east of the log yard footprint and the eastern edge of the existing eelgrass bed to the west of the log yard footprint. [Note: This monitoring must be performed on a low tide series that is at least -2.0 ft MLLW, and may need to be supplemented by snorkeling observations or video in the portions of the project area that cannot be walked at low tide].

2) **Recommended**: In years 5 and 10, repeat the diving survey within the former log yard footprint, using the same transects as in year 0.

Performance Criterion

Monitoring will allow EDG to track the trajectory of eelgrass recovery into the formerly impacted area. Given that no eelgrass currently exists within the impacted area, any natural recovery would be a positive indication of success. The expectation is that if the site conditions allow for natural recovery, then eelgrass abundance (total area covered) and shoot density should eventually be comparable to the surrounding areas that currently support eelgrass. However, based on the best available science, EDG cannot currently predict how many years such recovery will take. No signs of natural eelgrass recovery after 5 years would trigger the need for potential contingency measures as outlined below.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: 1) Low tide survey: Annually, Years 1-10
2) Diving survey: Years 5 and 10

Personnel: 1) Low tide survey: 1 biologist 8 hrs + 2 technicians, 8 hrs each + 1 GIS specialist 8 hrs for mapping
2) Diving survey: 3 divers

Cost: 1) Low tide survey: $1,376/yr
2) Diving survey: $10,000/yr

Lead: 1) Low tide survey: JKT
2) Diving survey: JKT/Battelle

Contingency Measures

If eelgrass fails to show signs of natural recovery at the site within 5 years, potential actions could include: 1) removal of the few logs on the bottom; 2) partial or full removal of wood waste from the bottom; and most likely 3) experimental transplanting of eelgrass.

4.3.5 SHELLFISH RECOVERY

Historic and Current Conditions

Historical shellfish population abundances are unknown. The S'Klallam people, who have lived in the area for thousands of years, used Jimmycomelately Creek, Dean Creek, and Sequim Bay as traditional hunting, fishing, shellfishing, and gathering areas (Gunther 1927).

JKT performed shellfish surveys in 2001, 2002, 2003, which included measures of the total area of the survey, total # of clams (littleneck and manila), total weight (g), density (lb/sq. ft.), total lbs in survey area, and harvestable pounds. The most recent survey (2003) indicated 44,911 harvestable pounds of littlenecks and 27,423 harvestable pounds of manila clams within the surveyed area. Harvestable size was defined as >38 mm. No harvestable clams of either species were found within the footprint of the former log yard area. Privately-owned commercial clam beds to the northwest of the former log yard are actively harvested.

Restoration Objective

To remove anthropogenic impairments (i.e., log yard pier, pilings, and fill) and allow shellfish to recover and expand into the footprint of the area formerly impacted by historic log rafting, dredging, and related log yard operations. The overall goal is to restore the populations of shellfish in the former log yard area to harvestable levels.

Restoration Rationale

Removal of anthropogenic impairments should facilitate natural recovery of the shellfish populations, without the need for a large-scale seeding effort.

BASELINE MONITORING

Methods and Data Analysis

1) **Essential**: JKT performed population surveys (species composition and abundances) in 2001, 2002, 2003, which represent the baseline, pre-project conditions.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: 2001, 2002, 2003

Personnel: 1 shellfish biologist 8 hrs + 5 technicians, 8 hrs each + 1 GIS specialist 8 hrs for mapping

Cost: $2,144 labor + $100 supplies

Lead: JKT

IMPLEMENTATION MONITORING

Methods and Data Analysis

1) **Recommended**: Inventory historic shellfish species composition in the estuary by identifying shells unearthed during the log yard excavation.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Year 0, post-excavation of log yard.

Personnel: 1 technician 8 hrs to collect shell samples + 1 shellfish biologist 8 hrs for identifications

Cost: $688

Lead: JKT

EFFECTIVENESS MONITORING

Methods and Data Analysis

1) **Essential**: Repeat shellfish population surveys using the same methods in years 3, 5, and 10.

Performance Criterion

Monitoring will allow us to track shellfish recolonization of the formerly impacted area. Given that no harvestable shellfish currently exist within the impacted area, any natural recovery would be a positive indication of success. The expectation is that if the site conditions allow for natural recovery, then shellfish species composition and abundances should eventually be comparable to the surrounding areas that currently support shellfish. Substrate type (e.g., sand vs. mud vs. gravel) strongly influences species composition and abundance. No signs of natural shellfish recovery after 5 years would trigger the need for potential contingency measures as outlined below.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Years 3, 5, 10.

Personnel: 1 shellfish biologist 8 hrs + 5 technicians, 8 hrs each + 1 GIS specialist 8 hrs for mapping

Cost: $2,144 labor + $100/year supplies

Lead: JKT

Contingency Measures

If there are no indications that shellfish are naturally recovering at the site within 5 years, potential actions could include: 1) removal of logs on the bottom; 2) partial or full removal of wood waste from the bottom; 3) experimental beach enhancement (e.g. beach graveling) and seeding of shellfish.

4.3.6 SALMONID USE

Historic and Current Conditions

Historic species and numbers of salmonids using the project area are unknown. The S'Klallam people, who have lived in the area for thousands of years, used Jimmycomelately Creek and Sequim Bay as traditional hunting, fishing, shellfishing, and gathering areas. Gunther (1927) reports that the S'Klallam caught chum salmon in traps at the mouth of Jimmycomelately Creek starting in late July, which is much earlier than the run now returns. Salo (1991) suggested that historically chum salmon might have constituted up to 50% of the annual biomass of Pacific Salmon in the North Pacific Ocean.

Anadromous fish species currently in the proposed project area include Hood Canal summer chum salmon, coho salmon, winter steelhead, and sea-run cutthroat trout. Of these species, summer chum salmon are of greatest concern because of their dramatic population declines and federal ESA listing as a threatened species (Shreffler 2000). WDFW has implemented an ongoing broodstock recovery program to try and save the dwindling run of JCL summer chum (for details see Shreffler 2000).

Restoration Objective

The restoration objective relative to salmonid use is to restore unimpeded access to JCL, Dean Creek, and the estuary for juvenile salmonids and returning adult spawners at all tidal elevations, and to provide better rearing and spawning habitat than what is available in the existing Dean Creek and JCL channels and the estuary. The overall goal is to restore the populations of salmonids in these creeks to harvestable levels.

Restoration Rationale

This project will result in an increase in both habitat area and habitat functions. More habitat and better functioning habitat should result in more salmonids using Dean Creek, JCL, and the estuary.

BASELINE MONITORING

Methods and Data Analysis

The monitoring tasks listed below are already ongoing:

- Trap outmigrating smolts in JCL (JKT has pre-project data for 2002-2003)

- Coho and chum spawning surveys (annually, WDFW)
- Returning spawner data and genetic analysis from the summer chum broodstock program (WDFW, 1999-date).

The following monitoring task will be added to supplement the data from the above tasks:

1) **Essential**: Deploy a beach seine and minnow traps at a minimum of three locations (e.g., near mouth of Dean Creek, near mouth of JCL, and somewhere in between the two creeks) to assess species composition, abundance, outmigration timing, and length-frequency distributions of juvenile salmon in the estuary (bi-weekly March to June). All fish will be released alive. The fish use metric = number of juveniles/m^2.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Baseline in year 0

Personnel: 2 technicians 8 hrs each/sampling period + 1 biologist for 8 hrs/sampling period (bi-weekly Mar-Jun=8 sampling periods)

Cost: $7,552 for 3-person sampling team + $1,500 for beach seine & equipment

Lead: JKT

IMPLEMENTATION MONITORING

None identified.

EFFECTIVENESS MONITORING

Methods and Data Analysis

1) **Essential**: Perform visual surveys of returning adult chum salmon and other anadromous species to ensure no stranding.

2) **Essential**: Perform visual surveys (or pole-seine sampling, if necessary) of juvenile salmonids in the tidal channel networks on the Log Yard, RV Park, and Eng properties to ensure no stranding of juvenile salmonids.

3) **Essential**: Deploy beach seines and minnow traps to assess species composition, abundance, outmigration timing, and length-frequency distributions of juvenile salmon in the estuary (bi-

weekly March to June); compare pre-restoration (baseline) data for the estuary to post-restoration data (i.e., after removal of log yard pier, pilings, roads, fill, etc.).
*Note: EDG fully recognizes that an assessment of residence times and growth rates of juvenile salmonids would provide a more definitive measure of the functional performance of the restored system than mere abundance. However, EDG could not justify performing the necessary mark-recapture study to attain data on residence times and growth rates, given the fact that JCL summer chum are near extirpation and the unacceptable potential for additional mortalities associated with any mark-recapture effort. Also, EDG (in conjunction with WDFW) will be closely monitoring summer chum abundance and productivity numbers for JCL to make certain they are on a clear trajectory toward meeting the Point No Point Treaty Tribes and Washington Department of Fish and Wildlife (2003) planning targets of 520 spawners (productivity =1.0) or 330 spawners (productivity =1.6).

Performance Criteria

1) No stranding of adult chum salmon or other anadromous species returning to spawn in JCL or Dean Creek, and no stranding of juvenile salmonids in the tidal channel networks on the Log Yard, RV Park, and Eng properties.

2) At the end of 10 years, juvenile salmonid abundance within the estuary should be higher than the pre-project abundance within the former estuary.

Note: At the time the Jimmycomelately Creek Realignment Monitoring Plan (Shreffler 2001) was completed, summer chum recovery targets for JCL had not been determined. It is now appropriate to use the WDFW/PNPTC (2003) target escapement and productivity numbers as "benchmarks" to evaluate the success of the habitat restoration actions in recovering JCL summer chum. These targets are more appropriate for the JCL channel than for the estuary, and thus are included in Summer Chum Addendum (September 2003) to the Jimmycomelately Creek Realignment Monitoring Plan (Shreffler 2001).

Timeline, Personnel, Cost Estimate, and Lead

Timeline: 1) <u>Stranding</u>: Annually, years 1-10.
2) <u>Juvenile surveys</u>: Years 1, 2, 3, 5 and 10

Personnel: 1) Stranding: WDFW volunteers
2) Juvenile surveys: 2 technicians + 1 biologist for 8 hrs/sampling period (bi-weekly March-June=8 sampling periods)

Cost: 1) Stranding: No cost to project, if done by volunteers
2) Juvenile surveys: $7,552/year

Lead: 1) Stranding: WDFW
2) Juvenile surveys: JKT

Contingency Measures

If fish stranding is a problem, contingency measures could include removing any constrictions/blockages of distributary channels resulting from accretion of sediment and/or reconfiguring the tidal channel network. Failure to meet the performance criteria for juvenile abundance would indicate that fundamental goals of the restoration project are not being met. While specific causes of failure are difficult to predict at this point, an examination of the project design, implementation, and site management would be required.

4.3.7 INVERTEBRATE USE

<u>Historic and Current Conditions</u>

No historic information is available on invertebrate prey production within the existing estuary. Invertebrates were presumably present in natural assemblages and densities prior to human disturbance.

Current conditions are also basically unknown. The only available information on invertebrates in the system is from macroinvertebrate sampling conducted once/year (2000-date) by Streamkeepers at two reaches along the existing JCL channel. Reach 1 is downstream (north) of Highway 101 and just south of the Old Blyn Highway Bridge. Reach 2 is upstream (south) of Highway 101, near the McLaughlin property.

<u>Restoration Objective</u>

The restoration objective relative to invertebrate prey production is to ensure that juvenile salmonids, as well as other fish species, shorebirds, and waterfowl using the estuary will have an adequate food supply.

<u>Restoration Rationale</u>

The availability and quantity of invertebrate prey is a commonly accepted metric of the ability of a habitat to promote juvenile salmonid production (Simenstad and Cordell 2000).

BASELINE MONITORING

Methods and Data Analysis

Streamkeepers is sampling benthic macroinvertebrates in the existing JCL channel once/year in September or October using a Surber sampler and 500-micron mesh sieves. Invertebrate taxa are identified to genus by an invertebrate taxonomist. Three field replicates are taken per sample, and one of 10 replicates is sent to an independent laboratory for quality control checks. The resulting data are used to calculate a genus-level, 10-metric benthic index of biotic integrity (B-IBI) (Karr and Chu 1998).

The following sampling could be added to supplement the Streamkeepers sampling:

1) **Recommended**: Benthic macroinvertebrates--Take 10 sediment core samples haphazardly distributed in the estuary. Take core samples once in March, April, and May to a depth of 10 cm using a PVC plastic core that samples an area of 0.0024 m^2, as recommended by Cordell et al. (1998). Fix all samples in the field using 5% buffered formaldehyde. Approximately 1 week after fixation, wash benthic core samples through two sieve sizes: 0.5mm and 0.106mm. Transfer samples to 50% isopropanol. Identify to species level all invertebrate taxa that are known to be prey for juvenile salmonids, and record abundances of these species.

2) **Recommended**: Insects--Collect fallout insects in rectangular traps (55-cm x 38-cm plastic storage bins) in March, April, and May. These floating traps rise and fall with the tide and are kept in place by four vertical PVC pipes. They are designed to catch insects that fall from the air or from riparian vegetation and, as such, measure direct input of insects to the aquatic ecosystem (Cordell et al. 1998). Fill the traps to a depth of about 4 cm with propylene glycol-based antifreeze, which acts as a preservative. Place five traps haphazardly in the estuary and leave in place for 3 days. At the end of the sampling period, drain the preservative in each trap through a 0.106-mm sieve. Remove all insects from the sieve and place in sample jars with 50% isopropyl alcohol. Identify to species level all insect taxa that are known to be prey for juvenile salmonids.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Monthly (March, April, May) in year 0

Personnel: Benthic core samples: 1 technician 24 hrs for sampling + 1 biologist 8 hrs for establishing sampling sites and methods

Insect fallout samples: 1 technician 24 hrs for sampling + 1 biologist 8 hrs for establishing sampling sites and methods

Invert. taxonomy: 1 taxonomist for macroinvertebrate and insect identification

Cost: Benthic core samples: $1,200

Insect fallout samples: $1,200

Invert. taxonomy: $3,000 (10 benthic samples/month x 3 months =30 samples + 10 insect samples/month x 3 months = 30 samples; so 60 samples total @ $50/sample)

Lead: JKT, Streamkeepers

IMPLEMENTATION MONITORING

None

PERFORMANCE MONITORING

Methods and Data Analysis

1) **Recommended**: Repeat the methods outlined in the baseline monitoring section in restored estuary and Salmon Creek reference site.

Performance Criteria

The species diversity, density (no. m^{-2}), and standing stock (g wet m^{-2}) of benthic macroinvertebrates and insects within the restored estuary shall: 1) equal or exceed species diversity, density, and standing stock for the existing estuary at the end of 10 years, and 2) be comparable to the Salmon Creek reference site at the end of 10 years.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Monthly (March, April, May) in years 1, 3, 5, 7, and 10

Personnel: Benthic core samples: 1 technician 24 hrs for sampling + 1 biologist 8 hrs for establishing sampling sites and methods
Insect fallout samples: 1 technician 24 hrs for sampling + 1 biologist 8 hrs for establishing sampling sites and methods
Invert. taxonomy: 1 taxonomist for macroinvertebrate and insect identification

Cost: Benthic core samples: $1,200/year
Insect fallout samples: $1,200/year
Invert. taxonomy: $3,000/year (10 benthic samples/month x 3 months =30 samples + 10 insect samples/month x 3 months = 30 samples; so 60 samples total @ $50/sample)

Lead: JKT, Streamkeepers

Contingency Measures

Lack of a productive benthic invertebrate community could indicate inadequate physical conditions at the site, such as unsuitable sediment grain sizes or excessive scouring. Lack of fallout insects could indicate inadequate riparian or marsh vegetation. Contingency measures could include: altering the channel morphology to facilitate deposition of finer-grained sediments and to reduce excessive scouring, or planting additional riparian and marsh vegetation to enhance the insect community.

4.3.8 BIRD USE

Historic and Current Conditions

Historic bird use of the Lower Sequim Bay Estuary is unknown, but the estuary likely supported large concentrations of shorebirds, waterfowl and other coastal-dependent birds, given prime estuarine habitats within the Pacific flyway. Currently, Sequim Bay is considered a significant stop on the Pacific flyway, and there is a 10-year plan in place to increase the amount of protected wetland acres in the bay by 1,000 acres.

Seventy-three bird species were recorded in the lower Sequim Bay estuary in 121 visits between 1996 and 2002, with a mean of 15 species/visit (Holtrop 2002). During that period, the mean number of individuals/visit was 705. Lower Sequim Bay appears to be a major stopover and wintering area for migrating waterfowl and shorebirds and the emergent marshes and mudflats support an especially high species richness and abundance. A total of 21 shorebird and 25 waterfowl species use the estuary, attracting thousands of birds each year.

The emergent marshes and adjacent terrestrial habitats support a high diversity of landbirds. Surveys in the 2002 and 2003 breeding seasons resulted in 58 landbird species in the vicinity of the estuary (Holtrop, personal communication). Several Washington State Priority Species and Species of Concern, as well as State and Federal Listed bird species, use the estuary.

Restoration Objective

The restoration objective relative to bird use is to increase the amount of habitat available for birds and their prey resources in the estuary. At the time all creosote-treated pilings are removed from the estuary, EDG has agreed to leave behind 5 untreated pilings with single, floating logs attached for shorebird roosting.

Restoration Rationale

By increasing the amount of mudflat, emergent marsh, and eelgrass habitat, EDG expects to see a corresponding increase in the total number of bird species (i.e., species richness) and the total number of individuals of each species (i.e., abundance).

BASELINE MONITORING

Methods and Data Analysis

Gene Kridler, a former USFWS employee and renowned ornithologist, conducted 121 bird counts in lower Sequim Bay estuary from November 1996 to February 2002. During each visit, the birds in the water and along the shore of the Bay between the Jamestown S'Klallam Tribal Center and the log yard west of Dean Creek were counted using a spotting scope and binoculars. All water bird species were counted, including shorebirds, swimmers (such as ducks and loons), waders (such as herons), gulls and terns, and terrestrial-associated waterbirds (such as kingfishers).

Technicians from the Jamestown S'Klallam Tribe entered Kridler's information in a database, including weather and tide data at the time of each survey and the range boundaries of each species. Each species was put in one of four range categories: visitor, winter, breeding season, or year-round resident. Visitors include transients that stop to feed while migrating between southern wintering and northern breeding grounds, or are post-breeding visitors that migrate here in late summer from southern breeding grounds before heading further south for the winter. Winter residents are species that are present in the Northern Olympic Peninsula area during the winter, but that nest elsewhere. Breeding residents are present in this area only during the breeding season of spring and summer, although they don't necessarily nest at Sequim Bay. Year-round residents are present in the area all year.

Karen Holtrop, a wildlife biologist, took over the counts from Gene Kridler in summer 2002, as well as the management and analysis of the database. She determined bird species richness and abundance by range category, year, and month. In addition to continuing the water bird counts, she initiated landbird monitoring in the terrestrial habitats in and adjacent to the estuary.

Timeline, Personnel, Cost Estimate, and Lead

Timeline:	Baseline data exist for 1995-2002
Personnel:	2 volunteers
Cost:	volunteer contribution = $11,200 ($1,400/year x 8 years)
Lead:	Karen Holtrop/JKT

IMPLEMENTATION MONITORING

None

Effectiveness Monitoring

Methods and Data Analysis

1) **Essential**: Conduct annual water bird counts at 2-week intervals from late February through early May, during the spring migration and August through October during the fall migration. Make systematic observations from established viewing points of the number of each species observed. Note the habitat of each species (e.g., water, trees, marsh vegetation, mudflat).

2) **Essential**: Conduct an annual breeding land bird survey (species & abundances) at least three times in May and June. Note any indications of mating or nesting behavior.

3) **Essential**: Conduct at least three counts (species & abundances) annually of over-wintering birds in December and January.

4) **Essential**: Observe species and abundances of shorebirds using the log booms anchored to the untreated pilings offshore of the former log yard, at same time as bi-weekly water bird counts in #1 above.

5) **Essential**: Compare bird species richness and abundance of individual species between the estuary pre- and post-restoration.

Performance Criteria

1) Within 10 years post-restoration, species richness and abundance of breeding, wintering, and migrating birds using the estuary shall equal or exceed pre-restoration species richness and abundance.

2) The anchored log booms shall be used consistently by roosting shorebirds and not by seals.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Years 1-10

Personnel: 1) Water bird counts: 2hrs/survey X 16 surveys/year = 32 hrs/year
2) Landbird surveys: 2 hrs/survey X 6 surveys/year = 12 hrs/year
3) Over-wintering counts: 2 hrs/survey X 6 surveys/year = 6 hrs/year
4) Log boom counts: 1 hr/survey X 16 surveys/year = 16 hrs/year
5) Data entry/analysis: 20 hrs/year

Cost: 1) Water bird counts: $1,120
2) Landbird surveys: $420
3) Over-wintering counts: $210
4) Log boom counts: $560
5) Data entry/analysis: $700

Lead: Karen Holtrop/JKT

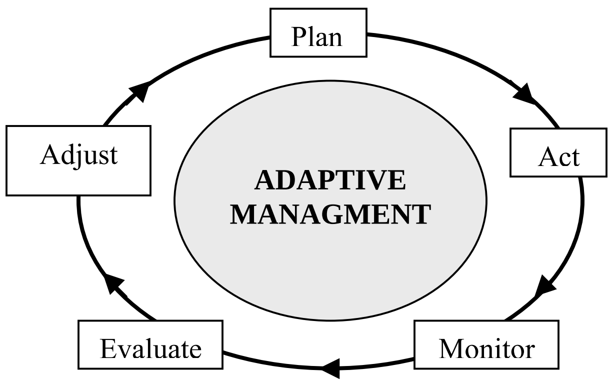
Contingency Measures

Low bird use of the restored estuary would likely indicate too much human disturbance in the area. Contingency measures could include eliminating public access or planting additional vegetation to serve as a screen from Highway 101 noise. Low bird use of the estuary could also indicate a lag time in development of appropriate prey resources or roosting/nesting habitat. There are no good contingency measures to address such a lag other than time and patience.

Note: Use of the floating log booms by seals (in numbers considered to threaten spawning salmon) would require reconfiguration of the log booms or their ultimate removal.

5.0 ADAPTIVE MANAGEMENT

There are, perhaps, as many definitions of "adaptive management" as there are restoration projects currently underway in the United States. In general, adaptive management focuses on reducing uncertainty by treating human intervention into natural systems as experiments (Independent Science Panel 2000). In the context of this document, **adaptive management** is defined as the process of: stating restoration goals (plan), implementing restoration actions (act), collecting credible data (monitor), determining if performance criteria are met (evaluate), and deciding what actions to take (adjust). A flow diagram depicting this process is presented below (modified from Thom and Wellman 1996).



Adaptive management relies on an accumulation of credible evidence to support a decision that demands action (Walters and Holling 1990). As outlined by Thom (2000), an adaptive management program associated with a restoration project requires:

- Measuring the existing condition of the ecosystem using selected indicators;
- Assessing progress toward stated restoration goals using performance criteria (i.e., asking questions of the data); and
- Making decisions on actions to take.

Within an adaptive management framework, the three main actions one can take are: 1) do nothing (i.e., wait for conditions to improve); 2) do something (i.e., implement corrective actions based upon the data); and 3) change the goal (i.e., admit that the project will never likely reach the original stated goal, and that an alternative ecosystem state is acceptable).

As summarized in Section 2.0, EDG has identified restoration goals and objectives, specific measurable performance criteria to evaluate whether those objectives are being met, and potential contingency measures if the objectives are not being met. Adaptive management is the process by which EDG will collectively analyze all the monitoring data and available information, determine the implications for restoration success or failure, and institute actions or policies to make mid-course corrections. In other words, adaptive management is the feedback loop from the assessment step (i.e., monitor) to the decision step (i.e., adjust).

Given the ten-year timeframe of this monitoring plan, it is important to recognize the potential need to modify the plan. At least five types of changes to the monitoring plan can be envisioned at this point (modified from Tanner 2000):

1. Changes in monitoring tasks: The science of ecosystem restoration is rapidly evolving and it is likely that opportunities to improve the estuary monitoring program will be identified (e.g., new or better equipment becomes available, standard monitoring protocols are developed for this region, monitoring protocols can be improved based on each previous year's field experience).
2. Elimination of monitoring tasks: If consensus is reached among the technical group that specific success criteria have been met, then associated monitoring tasks could cease. Alternatively, the group could determine that a particular monitoring task is not returning useful information, and therefore that task is not worth the expense of continuation. It's also conceivable that monitoring funds might no longer be available, and thus monitoring priorities would have to be reconsidered.
3. Addition of new monitoring tasks: Monitoring in the first several years may show that the technical group is not monitoring the appropriate parameters or species.
4. Changes in lead responsibilities for monitoring tasks: Over a ten-year period, staff turnover is inevitable, and this could result in the lead for particular monitoring tasks switching between entities. Changes in funding availability could also result in a different entity taking the lead on a particular monitoring task(s).
5. Modification of project goals: As suggested by Thom (2000), one of the cornerstones of applying adaptive management principles to coastal restoration projects is the ability to modify project goals during the monitoring period.

By using adaptive management, this monitoring plan attempts to balance the need for long-term consistency and comparability in data collection with real-world practicality. As noted by Thom and Wellman (1996), adaptive management recognizes the imperfect knowledge of interdependencies within and among natural and social systems. Hence, monitoring plans must be modified as technical knowledge improves and social preferences change.

6.0 MONITORING TASKS, RESPONSIBILITIES, SCHEDULE, & ESTIMATED COSTS

In the interest of developing a framework that will help ensure that monitoring data is collected consistently and systematically over the ten-year monitoring period, several summary tables have been developed. All monitoring tasks, subtasks, responsible parties (lead partners), and the monitoring schedule pre-construction, during construction (Year 0), and for ten years post-construction (Years 1-10) are summarized in Table 6.1. Implementation of the monitoring plan will depend on both volunteers (e.g., Audubon, Streamkeepers, WDFW broodstock recovery program, and landowners) and staff from entities such as Clallam County, the Jamestown S'Klallam Tribe (JKT), EPA, Streamkeepers, WDFW, Washington State Department of Health, and U.S. Fish and Wildlife Service.

Preliminary cost estimates for each task and subtask over the 10-year monitoring period are summarized in Table 6.2. As discussed in the previous section on adaptive management (Section 5.0), monitoring tasks or subtasks may be added, deleted, or changed when the monitoring data provide credible evidence warranting such decisions. A good monitoring plan is an evolving one: one which is rigorous enough to meet scientific standards and also adaptable enough to allow modifications as technical knowledge improves, social preferences change, or funding sources disappear.

The following are cost estimates for additional management elements of the monitoring plan:

Monitoring Coordination

Given the complexity of the monitoring program, the number of entities involved, and the 10-year time span, one entity (or individual) will need to take the lead on coordination of all the various monitoring. Adequate funds need to be available for hiring, contracting, and directing subcontractors as needed, as well as inter-agency coordination to ensure that the monitoring is being performed as outlined in this plan.

Estimated Cost: $5,000/year

Table 6.1. Summary of estuary restoration monitoring tasks, subtasks, lead partners, and schedule (page 1 of 2).

Monitoring Task	Subtasks	Lead	Schedule
Ecological Processes			
Hydrology-baseline	map historic and current locations of estuary	WDFW	completed (Nov. '00)
	install survey control points for estuary	JKT/ESAI	Year 0
	install continuous recording tide gage in new JCL	JKT	Year 0
Hydrology-implementation	as-built drawings for all estuary restoration elements (i.e. Log Deck Road, OBH, log yard pier, log yard fill, RV Park, Delta Cone, Eng)	JKT/ESAI	Year 0
	Confirm on as-builts that all fish blockages or constrictions have been removed from the estuary (e.g., roads, fills, culverts, dams).	JKT/ESAI	Year 0
Hydrology-effectiveness	Map pre- and post-project estuary; document that tidal connections have been restored.	WDFW	Year 1
	Compare pre- and post-project data on tidal flux	JKT	Years 1, 2, 3, 5, 10
	Make flood and ebb discharge measurements in tidal basins	JKT	Years 1, 2, 3, 5, 10
Sediment transport-baseline	map shoreline topography & sediment deposits	JKT	Year 0
	survey cross sections updrift from log yard pier	JKT	Year 0
Sediment transport-effectiveness	map shoreline topography & sediment deposits	JKT	Years 1-10
	re-survey cross sections updrift of log yard pier	JKT	Years 1, 4, 7, 10
	install cross sections in tidal channels	JKT	Years 1, 4, 7, 10
Habitat Conditions			
Habitat Gains-baseline	Identify major habitat types on an aerial photograph; field verify & calculate acreage of each habitat type	JKT	Year 0
Habitat Gains-effectiveness	repeat baseline survey; compare pre- and post-project acreages for each habitat type	JKT	Years 1, 3, 5, 10
Water & Sediment Quality-baseline	Record weekly salinity measurements at 3 stations each in existing JCL and Dean Creek	JKT	Year 0
	Collect surface sediment samples pre-restoration in JCL, Dean, and log yard footprint	JKT	Year 0
	Monthly fecal coliform monitoring in Sequim Bay	DOH	Year 0
Water & Sediment Quality-effectiveness	Record weekly salinity measurements at 3 stations each in new JCL and Dean Creek	JKT	Years 1-3
	Collect surface sediment samples post-restoration in JCL, Dean, and log yard footprint	JKT	Years 1, 3, 5, 10
	Monthly fecal coliform monitoring in Sequim Bay	DOH	Years 1-10
LWD-implementation	GPS & map as-built locations of LWD	JKT	Year 0
	photograph each LWD placement	JKT	Year 0
	record as-built pool depths	JKT	Year 0
	measure diameter & length of each key member	JKT	Year 0
LWD-effectiveness	track movements of logjams	JKT	Years 1, 3, 5, 10
	track pool depths and dimensions	JKT	Years 1, 5, 10
	track changes in wood pieces/jam	JKT	Years 1, 5, 10

Table 6.1 Summary of estuary restoration monitoring tasks, subtasks, lead partners, and schedule (page 2 of 2).

Monitoring Task	Subtasks	Lead	Schedule
Biological Responses			
Terrestrial Vegetation-baseline	identify tansitional and terrestrial vegetation classes on aerial photograph	JKT/WSDOT	Year 0
Terrestrial Vegetation-implementation	Photodocument revegetation activities	JKT/WSDOT	Year 0
	verify plantings by species, numbers of plants, and locations	JKT/WSDOT	Year 0
Terrestrial Vegetation-effectiveness	monitor percent cover	JKT	Years 1, 2, 3, 5, 10
	monitor survival	JKT	Years 1, 2, 3, 5, 10
	photodocument revegeted areas	JKT	Years 1, 2, 3, 5, 10
Wetland Vegetation-effectiveness	monitor percent cover	JKT	Years 1, 2, 3, 5, 10
	monitor species composition	JKT	Years 1, 2, 3, 5, 10
	photodocument revegeted areas	JKT	Years 1, 2, 3, 5, 10
Invasive Vegetation-baseline	identify invasive species on aerial photograph	JKT/EPA	Year 0
Invasive Vegetation-implementation	excavate invasive plant species; remove all above- and below-ground	JKT	Year 0
Invasive Vegetation-effectiveness	repeat baseline survey; compare pre- and post restoration over time	JKT/EPA	Years 1, 5, 10
Eelgrass Recovery-baseline	intertidal survey of substrate, wood waste, algae	JKT	Year 0
	diving survey of eelgrass/wood waste in footprint	Battelle	Year 0
	walking survey of eelgrass/wood waste outside footprint	JKT	Year 0
Eelgrass Recovery-effectiveness	repeat baseline intertidal survey; compare pre- and post restoration over time	JKT	Years 3, 5, 10
	repeat diving survey; compare pre- and post restoration over time	JKT/Battelle	Years 5, 10
Shellfish Recovery-baseline	survey & map population densities	JKT	Year 0
Shellfish Recovery-implementation	id excavated shells at log yard and determine historical species composition	JKT	Year 0
Shellfish Recovery-effectiveness	repeat baseline survey; compare pre- and post restoration over time	JKT	Years 3, 5, 10
Salmonid Use-baseline	monitor juvenile salmonid species comp., abundance, outmigration timing, and length-frequency distrib. in estuary (beach seines & minnow traps)	JKT	Year 0
Salmonid Use-effectiveness	perform visual surveys of returning spawners to ensure no stranding	WDFW	Years 1-10
	perform visual surveys of juveniles to ensure no stranding	WDFW	Years 1-10
	repeat baseline survey; compare pre- and post restoration over time	JKT	Years 1, 2, 3, 5, 10
Invertebrate Use-baseline	take core samples for benthic macroinvertebrates	JKT	Year 0
	collect insects in "fallout" traps	JKT	Year 0
Invertebrate Use-effectiveness	repeat baseline sampling and compare pre- and post restoration over time	JKT	Years 1, 3, 5, 7, 10
Bird Use-baseline	baseline surveys	Kreidler, Holtrop	completed 1995-2002
Bird Use-effectiveness	bird counts biweekly (late Feb-early May; Sept-Oct)	Holtrop/JKT	Years 1-10
	nesting survey (once in April; once in May)	Holtrop/JKT	Years 1-10
	over-wintering count (3 counts in December and January)	Holtrop/JKT	Years 1-10
	survey shorebird use of log booms	Holtrop/JKT	Years 1-10

Monitoring Tasks & Subtasks*	JKT Tech. $32/hr	JKT Bio. $54/hr	JKT GIS $54/hr	ESAI Eng. $100/hr	Est. Total staff $	Est. Equipt/ supplies $	Est. Total $ Yr 0	Est. Total $ Yr 1	Est. Total $ Yr 2	Est. Total $ Yr 3	Est. Total $ Yr 4	Est. Total $ Yr 5	Est. Total $ Yr 6	Est. Total $ Yr 7	Est. Total $ Yr 8	Est. Total $ Yr 9	Est. Total $ Yr 10	Est. Subtask Total $
Ecological Processes																		
Hydrology:																		
(E) install survey control	0	0	0	8	$800	$200	$800	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,000
(E) install tide gauge	80	40	0	0	$4,720	$6,000	$4,720	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$10,720
(E) as-built drawings & confirm fish blockage removal	0	0	0	40	$4,000	$0	$4,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$4,000
(E) document tidal connections	0	8	0	0	$480	$0	$480	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$480
(E) tidal flux & velocities	32	0	0	0	$1,024	$0	$0	$1,024	$1,024	$1,024	$0	$1,024	$0	$0	$0	$0	$1,024	$5,120
(E) flood & ebb measurements	48	0	0	0	$1,536	$0	$0	$1,536	$1,536	$1,536	$0	$1,536	$0	$0	$0	$0	$1,536	$7,680
Task Subtotal	160	48	0	48	$12,560	$6,200	$10,000	$2,560	$2,560	$2,560	$0	$2,560	$0	$0	$0	$0	$2,560	**$29,000**
Sediment Transport & Deposition:																		
(E) map shoreline & sediments	0	16	0	0	$864	$0	$864	$864	$864	$864	$864	$864	$864	$864	$864	$864	$864	$9,504
(E) cross sections updrift of pier	24	24	0	0	$2,064	$0	$2,064	$2,064	$0	$0	$2,064	$0	$0	$2,064	$0	$0	$2,064	$10,320
(E) cross sections in tidal basins	24	24	0	0	$2,064	$0	$2,064	$2,064	$0	$0	$2,064	$0	$0	$2,064	$0	$0	$2,064	$10,320
Task Subtotal	48	64	0	0	$4,992	$0	$4,992	$4,992	$864	$864	$4,992	$864	$864	$4,992	$864	$864	$4,992	**$30,144**
Habitat Conditions																		
Habitat Gains:																		
(E) id. habitats on aerial photo	8	24	8	0	$1,984	$0	$1,984	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,984
(E) calculate acreage changes	8	24	8	0	$1,984	$0	$0	$1,984	$0	$1,984	$0	$1,984	$0	$0	$0	$0	$1,984	$7,936
Task Subtotal	16	48	16	0	$3,968	$0	$1,984	$1,984	$0	$1,984	$0	$1,984	$0	$0	$0	$0	$1,984	**$9,920**
Water & Sediment Quality:																		
(E) salinity monitoring	52	0	0	0	$1,664	$0	$1,664	$1,664	$1,664	$1,664	$0	$0	$0	$0	$0	$0	$0	$6,656
(R) sediment samples	16	8	0	0	$944	$2,500	$944	$944	$0	$944	$0	$944	$0	$0	$0	$0	$944	$7,220
(R) fecal coliform (DOH)	0	0	0	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Task Subtotal	68	8	0	0	$2,608	$2,500	$2,608	$2,608	$1,664	$2,608	$0	$944	$0	$0	$0	$0	$944	**$13,876**
LWD:																		
(E) GPS & map as-built locations + pool depths	0	40	0	0	$2,160	$0	$2,160	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,160
(E) photodocument LWD placements	8	0	0	0	$256	$0	$256	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$256
(E) track movements of logjams	8	0	0	0	$256	$0	$0	$256	$0	$256	$0	$256	$0	$0	$0	$0	$256	$1,024
(E) track pool depths and dimensions	0	8	0	0	$432	$0	$0	$432	$0	$0	$0	$432	$0	$0	$0	$0	$432	$1,296
(E) track changes in # of logs/jam	8	8	0	0	$688	$0	$0	$688	$0	$0	$0	$688	$0	$0	$0	$0	$688	$2,064
Task Subtotal	24	56	0	0	$3,792	$0	$2,416	$1,376	$0	$256	$0	$1,376	$0	$0	$0	$0	$1,376	**$6,800**
Biological Responses																		
Terrestrial Vegetation:																		
(E) photodocument-revegetation	8	4	0	0	$472	$0	$472	$256	$256	$256	$0	$256	$0	$0	$0	$0	$256	$1,752
(E) verify species plantings	8	0	0	0	$256	$0	$256	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$256
(E) monitor percent cover	48	8	0	0	$1,968	$200	$0	$1,968	$984	$1,968	$984	$1,968	$984	$1,968	$984	$1,968	$984	$14,960
(E) monitor survival	24	8	0	0	$1,200	$0	$0	$1,200	$1,200	$1,200	$0	$1,200	$0	$0	$0	$0	$1,200	$6,000
Task Subtotal	88	20	0	0	$3,896	$200	$728	$3,424	$2,440	$3,424	$984	$3,424	$984	$1,968	$984	$1,968	$2,440	**$22,968**

Monitoring Tasks & Subtasks*	JKT Tech. $32/hr	JKT Bio. $54/hr	JKT GIS $54/hr	ESA Eng. $100/hr	Est. Total staff $	Est. Equipt/ supplies $	Est. Total $ Yr 0	Est. Total $ Yr 1	Est. Total $ Yr 2	Est. Total $ Yr 3	Est. Total $ Yr 4	Est. Total $ Yr 5	Est. Total $ Yr 6	Est. Total $ Yr 7	Est. Total $ Yr 8	Est. Total $ Yr 9	Est. Total $ Yr 10	Est. Subtask Total $
Biological Responses																		
Wetland Vegetation:																		
(E) monitor percent cover & spp composition	24	8	0	0	$1,200	$200	$0	$1,200	$1,200	$1,200	$0	$1,200	$0	$0	$0	$0	$1,200	$6,200
(E) photodocument-revegetation	8	0	0	0	$256	$0	$256	$256	$256	$256	$0	$256	$0	$0	$0	$0	$256	$1,536
Task Subtotal	32	8	0	0	$1,456	$200	$256	$1,456	$1,456	$0	$0	$1,456	$0	$0	$0	$0	$1,456	**$7,736**
Invasive Vegetation:																		
(E) identify & map invasive spp.	0	8	0	0	$480	$0	$480	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$480
(E) re-map invasives post-construct.	8	8	0	0	$688	$0	$0	$688	$0	$0	$0	$688	$0	$0	$0	$0	$688	$2,064
Task Subtotal	8	16	0	0	$1,168	$0	$480	$688	$0	$0	$0	$688	$0	$0	$0	$0	$688	**$2,544**
Eelgrass Recovery:																		
(E) intertidal survey	40	8	0	0	$1,712	$0	$1,712	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,712
(E) diving survey	0	0	0	0	$0	$0	$10,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$10,000
(E) low tide eelgrass survey	16	8	8	0	$1,376	$0	$1,376	$1,376	$1,376	$1,376	$1,376	$1,376	$1,376	$1,376	$1,376	$1,376	$1,376	$15,136
(R) repeat diving survey	0	0	0	0	0	$0	$0	$0	$0	$0	$0	$10,000	$0	$0	$0	$0	$10,000	$20,000
Task Subtotal	56	16	8	0	3,088	$0	$13,088	$1,376	$1,376	$1,376	$1,376	$11,376	$1,376	$1,376	$1,376	$1,376	$11,376	**$46,848**
Shellfish Recovery:																		
(E) survey shellfish pre-restoration	40	8	8	0	$2,144	$100	$2,144	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,244
(R) identify excavated shells	8	8	0	0	$688	$0	$688	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$688
(E) re-survey post-restoration	40	8	8	0	$2,144	$300	$0	$0	$0	$2,144	$0	$2,144	$0	$0	$0	$0	$2,144	$6,732
Task Subtotal	88	24	16	0	$4,976	$400	$2,832	$0	$0	$2,144	$0	$2,144	$0	$0	$0	$0	$2,144	**$9,664**
Salmonid Use:																		
(E) monitor juv. abundance in estuary	128	64	0	0	$7,552	$1,500	$7,552	$7,552	$7,552	$7,552	$0	$7,552	$0	$0	$0	$0	$7,552	$46,812
(E) visual surveys of adult & juvenile stranding	0	0	0	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Task Subtotal	128	64	0	0	$7,552	$1,500	$7,552	$7,552	$7,552	$7,552	$0	$7,552	$0	$0	$0	$0	$7,552	**$46,812**
Invertebrate Use:																		
(R) sample benthic macroinverts.	24	8	0	0	$1,200	$0	$0	$1,200	$0	$1,200	$0	$1,200	$0	$1,200	$0	$0	$1,200	$6,000
(R) sample insects in traps	24	8	0	0	$1,200	$0	$0	$1,200	$0	$1,200	$0	$1,200	$0	$1,200	$0	$0	$1,200	$6,000
(R) invertebrate taxonomy	0	0	0	0	$18,000	$0	$3,000	$3,000	$0	$3,000	$0	$3,000	$0	$3,000	$0	$0	$3,000	$18,000
Task Subtotal	48	16	0	0	$20,400	$0	$3,000	$5,400	$0	$5,400	$0	$5,400	$0	$5,400	$0	$0	$5,400	**$30,000**
Bird Use:																		
(E) bi-weekly counts	0	0	0	0	$1,120	$0	$1,120	$1,120	$1,120	$1,120	$1,120	$1,120	$1,120	$1,120	$1,120	$1,120	$1,120	$12,320
(E) nesting survey	0	0	0	0	$420	$0	$420	$420	$420	$420	$420	$420	$420	$420	$420	$420	$420	$4,620
(E) overwintering count	0	0	0	0	$210	$0	$210	$210	$210	$210	$210	$210	$210	$210	$210	$210	$210	$2,310
(E) shorebird use of log booms	0	0	0	0	$560	$0	$560	$560	$560	$560	$560	$560	$560	$560	$560	$560	$560	$6,160
(E) data analysis & reporting	0	0	0	0	$700	$0	$700	$700	$700	$700	$700	$700	$700	$700	$700	$700	$700	$7,700
Task Subtotal	0	0	0	0	$3,010	$0	$3,010	$3,010	$3,010	$3,010	$3,010	$3,010	$3,010	$3,010	$3,010	$3,010	$3,010	**$33,110**
(E) Monitoring Coordination	0	0	0	0	$5,000	$0	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	**$55,000**
(E) Data Management System	0	0	0	0	$25,000	$0	$0	$25,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	**$70,000**
(E) Data Analysis & Reporting	0	0	0	0	$11,000	$0	$0	$11,000	$0	$11,000	$0	$11,000	$0	$0	$0	$0	$22,000	**$55,000**
(R) Conferences & Workshops	0	0	0	0	$2,400	$0	$0	$2,400	$2,400	$2,400	$2,400	$2,400	$2,400	$2,400	$2,400	$2,400	$2,400	**$24,000**
(R) Journal Publications	0	0	0	0	$10,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$10,000	**$10,000**

Monitoring Tasks & Subtasks*	JKT Tech. $32/hr	JKT Bio. $54/hr	JKT GIS $54/hr	ESAI Eng. $100/hr	Est. Total staff $	Est. Equipt/ supplies $	Est. Total $ Yr 0	Est. Total $ Yr 1	Est. Total $ Yr 2	Est. Total $ Yr 3	Est. Total $ Yr 4	Est. Total $ Yr 5	Est. Total $ Yr 6	Est. Total $ Yr 7	Est. Total $ Yr 8	Est. Total $ Yr 9	Est. Total $ Yr 10	Est. Subtask Total $
MONITORING TASKS TOTAL	764	388	40	48	$126,866	$11,000	$57,946	$79,826	$33,322	$54,578	$22,762	######	$18,634	$29,146	$18,634	$19,618	######	$503,422
SUBTRACT monitoring tasks already completed	na	na	na	na	na	$6,300	$19,376	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$25,676
ADD 3%/year Cost of Living Increase	na	na	na	na	na	$141	$1,157	$2,395	$1,000	$1,637	$683	$1,985	$559	$874	$559	$589	$2,710	$14,332
ADJUSTED TOTAL	na	na	na	na	na	$4,841	$39,727	$82,221	$34,322	$56,215	$23,445	######	$19,193	$30,020	$19,193	$20,207	######	**$492,078**
ESSENTIAL TASKS ONLY																		**$400,170**
RECOMMENDED TASKS ONLY																		**$91,908**
*(**E**) = essential task																		
(**R**) = recommended task																		

<u>Data Management System</u>

For meaningful analysis, all monitoring data needs to be stored in a single system. JKT has received a grant from EPA to design such a system in FY2004. Adequate funds need to be available for staffing the system, as well as for future software and hardware upgrades.

Estimated Cost: $25,000 in FY2004; $5,000/yr in subsequent years through year 10.

7.0 COORDINATION, REPORTING & DISSEMINATION OF MONITORING RESULTS

Given the clear local and regional interest, and potential national interest, in the results of this restoration project, timely and accurate reporting and dissemination of monitoring results will be critical.

<u>Status Reports</u>

At minimum, the participating parties in the restoration monitoring should produce a summary report in years 1, 3, and 5, which:

- reviews all monitoring tasks that were completed,
- itemizes costs of the monitoring,
- summarizes all relevant data and information,
- evaluates whether performance criteria are being met,
- draws inferences about the status and trends in the ecological development of the restored JCL channel, Dean Creek channel, and estuary,
- details any adaptive management or contingency measures that were implemented, and
- provides recommendations for subsequent monitoring.

The technical group should review draft monitoring reports, discuss the implications of the results, and identify any contingency measures that need to be implemented immediately or in future years of the monitoring program. Hard copies (or CDs) of the monitoring reports will be provided to funding agencies and other interested parties. The final version of each report should also be available on a website in an easily downloadable format, such as PDF.

<u>Final Report</u>

A final report should be produced at year 10, which draws conclusions about the overall success or failure of the restoration project and provides recommendations or "lessons learned" about planning, implementing, and monitoring that will benefit and guide future restoration projects.

Estimated Costs:

Data Analysis & Annual Reports (yrs 1, 3, 5):	$10,000/yr + $1,000 printing/yr
Summary Report (year 10):	$20,000 + $2,000 printing

<u>Conferences, Workshops, Public Meetings</u>

Periodically, as opportunities arise, individuals from the participating partners should give presentations at local, regional, and national conferences and workshops. In addition, public meetings should be held locally in years three, five, and ten to present findings to landowners, stakeholders, tribal members, agencies, researchers, and all interested citizens.

Estimated Costs: $2,400/year

<u>Journal Publications</u>

To the extent warranted, publications documenting the restoration plan (design and implementation) and the success or failure of the restoration project should be submitted to peer-reviewed, professional journals.

Estimated Costs: $10,000 in year 10

8.0 LITERATURE CITED

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