JIMMYCOMELATEY CREEK-LOWER SEQUIM BAY ESTUARY RESTORATION PROJECT

PHASE 1 MONITORING PLAN: JIMMYCOMELATELY CREEK REALGINMENT

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EXECUTIVE SUMMARY

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 are isolated and fragmented. A century of logging, road development, commercial development, railroad construction, dredging, wetland 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 JCL and lower Sequim Bay estuary.

The vision of the Tribe, Clallam County, WDFW, CCD, WSDOT, EPA, USFWS, DNR, 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; and reestablish the pre-disturbance linkage between the fluvial and tidal energy regimes. To achieve this vision, rigorous monitoring will be essential at all phases of the creek channel realignment: pre-project, during construction, and post project.

This monitoring plan describes all tasks required to monitor the success or failure of the JCL channel realignment elements of the JCL-Estuary Restoration Project. The JCL technical group has identified the following monitoring parameters as essential:

- <u>Ecological Processes:</u> Water Conveyance (Hydrology) and Sediment Transport & Deposition
- <u>Habitat Conditions & Functions:</u> Channel Morphology & Topography, Water Quality, Large Woody Debris, Soils, and Flood Conveyance
- <u>Biological Responses:</u> Riparian Vegetation Establishment, Wetland Vegetation Establishment, Invasive Vegetation Removal, Salmonid Use, and Upland Bird Use.

Monitoring, as outlined in this plan, is intended to proceed for a minimum of 10 years post-construction at an estimated total cost of $225,455. Additional recommended monitoring tasks are provided in an appendix. These tasks would require an additional $268,081 over 10 years. The Executive Committee of the JCL-Estuary Restoration Project is not able, at this time, to commit to performing these additional tasks, but is actively seeking to partner with research organizations and funding agencies to implement these tasks as opportunities become available.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGMENTS

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ABBREVIATIONS USED IN THIS REPORT

BMP = best management practice

CCD = Clallam Conservation District

cfs = cubic feet per second

DNR = Washington State Department of Natural Resources

DO = dissolved oxygen

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

The Tribe = Jamestown S'Klallam Tribe

USFWS = U. S. Fish and Wildlife Service

WDFW = Washington Department of Fish and Wildlife

WSDOT = Washington State Department of Transportation

yr = year

PHASE I MONITORING PLAN: JIMMYCOMELATEY CREEK

1.0 INTRODUCTION

1.1 Purpose of this Monitoring Plan

The purpose of this monitoring plan is to describe all tasks required to monitor the success or failure of the Jimmycomelately Creek channel realignment elements of the Jimmycomelately Creek - Lower Sequim Bay Estuary Restoration Project (JCL-Estuary Restoration Project; see Shreffler 2000). A subsequent monitoring plan will be developed, at a later date, for the estuarine portion of the project.

The foundation of this monitoring plan is a conceptual model (described in Section 1.3) that links controlling factors, habitat structure, and ecosystem functions. Proceeding from the conceptual model is a logical sequence of activities designed to evaluate success or failure of the JCL realignment 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) recommend adaptive management measures when performance criteria are <u>not</u> 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 (performance) 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 draw heavily on restoration plans developed for the Spencer Island Breached-Dike Wetland Site (Shreffler and Thom 1994), Deepwater Slough (Klochak et al. 1999), and the Elliott Bay/Duwamish Restoration Program (Tanner 2000), 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 proposed realigned channel is 3,300 feet (channel centerline distance) and will cross three privately owned properties: McLauglin (797 linear feet of channel), Penn (245 linear feet) and Jamestown S'Klallam Tribe (1,535 linear feet). Assuming an average constructed channel width of 30 feet, the total approximate area of the constructed channel equals 1.8 acres. Associated riparian management zones, which extend 150 feet laterally in each direction from the channel, will constitute an additional 13.6 acres for a total estimated project area of 15.4 acres (Clallam Conservation District 2001).

1.3 Description of the Proposed Restoration Project

<u>Background: Why Restoration is Needed</u> (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 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 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 uplands 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

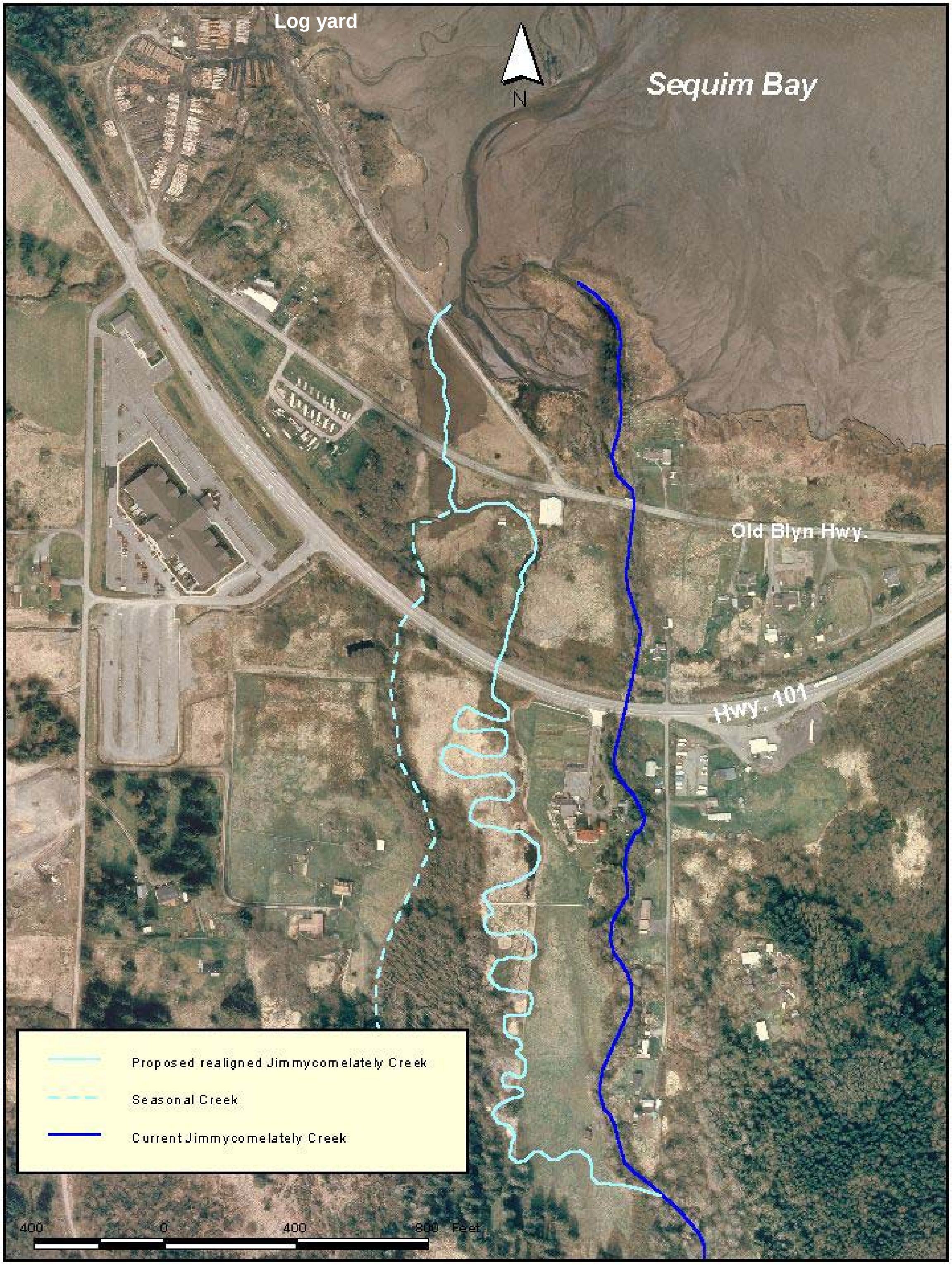


Figure 1.1. The proposed project area for realignment of Jimmycomelately Creek overlayed on a 2000 aerial photograph (graphic by Pam Eden, Jamestown S'Klallam Tribe).

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.

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, shorebirds, shellfish, 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 and the estuary.

In summary, despite the widely recognized ecological importance of the Jimmycomelately Creek-Sequim Bay ecosystem, the creek is physically and ecologically disconnected from its estuary, and is presently unable to function as a natural river system with an intact connection to its estuary.

The Vision for the JCL-Estuary Restoration Project

The vision of the Tribe, Clallam County, WDFW, CCD, WSDOT, EPA, USFWS, DNR, 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; and reestablish the pre-disturbance linkage between the fluvial and tidal energy regimes.

Restoration of the JCL channel will be integrated within the entire stream-estuary ecosystem restoration project, including the removal of roads and fill (up to 13.7 acres), the design and construction of a new Highway 101 bridge, and land acquisition required to accomplish the stated restoration goals (see Figures 9.1 and 9.2, Shreffler 2000). If successful, this restoration project will provide measurable benefits to waterfowl, shorebirds, fish, shellfish, and the community.

The Executive Committee of the JCL-Estuary Restoration Project is proposing to reconnect, reintegrate, and restore degraded and fragmented habitats within the JCL-Lower Sequim Bay ecosystem. The committee acknowledges 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 hope, not a guarantee. No one can predict exactly how the JCL-Sequim Bay ecosystem will change, but the Executive Committee is 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., 1870, 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.

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 the following: (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 realigning JCL is presented here that identifies connections among controlling factors, habitat structure, and desired ecosystem functions (Figure 1.2). The major controlling factors for restoring both JCL and the estuary are light, hydrology, geomorphology, and nutrients. For the purposes of this discussion hydrology includes both surface water and groundwater quality and quantity, and geomorphology includes a suite of parameters such as elevation relative to mean lower low water (MLLW), gradient, 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 and upland birds, and reduced flood hazards for people. The link between these desired ecosystem functions and the controlling factors is the habitat structure.

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 realigning Jimmycomelately Creek, the existing habitat structure must be restored and protected in the following ways:

(1) Restore the natural channel and floodplain configurations of JCL by realigning the creek into one of its historic, sinuous channels;
(2) Restore and revegetate the riparian corridor along the realigned JCL with native plants;
(3) Restore and revegetate freshwater wetlands along the realigned JCL with native plants;
(4) Enhance instream habitat using whole trees with root wads and/or engineered logjams;
(5) Remove and improve bridges, culverts, roads, and fill;
(6) Improve storm water management;
(7) Implement best management practices (BMPs) for upper watershed human activities that can alter natural stream processes; and
(8) Protect restored areas from future undesirable impacts in perpetuity.

Restoring and protecting the habitat structure in the realigned JCL channel should result in increased primary productivity and detritus supply, improved cover and shade, better water and sediment quality, and more prey organisms for fish and birds. These improvements, in turn, should result in better ecosystem functions for salmonids, birds, and people.

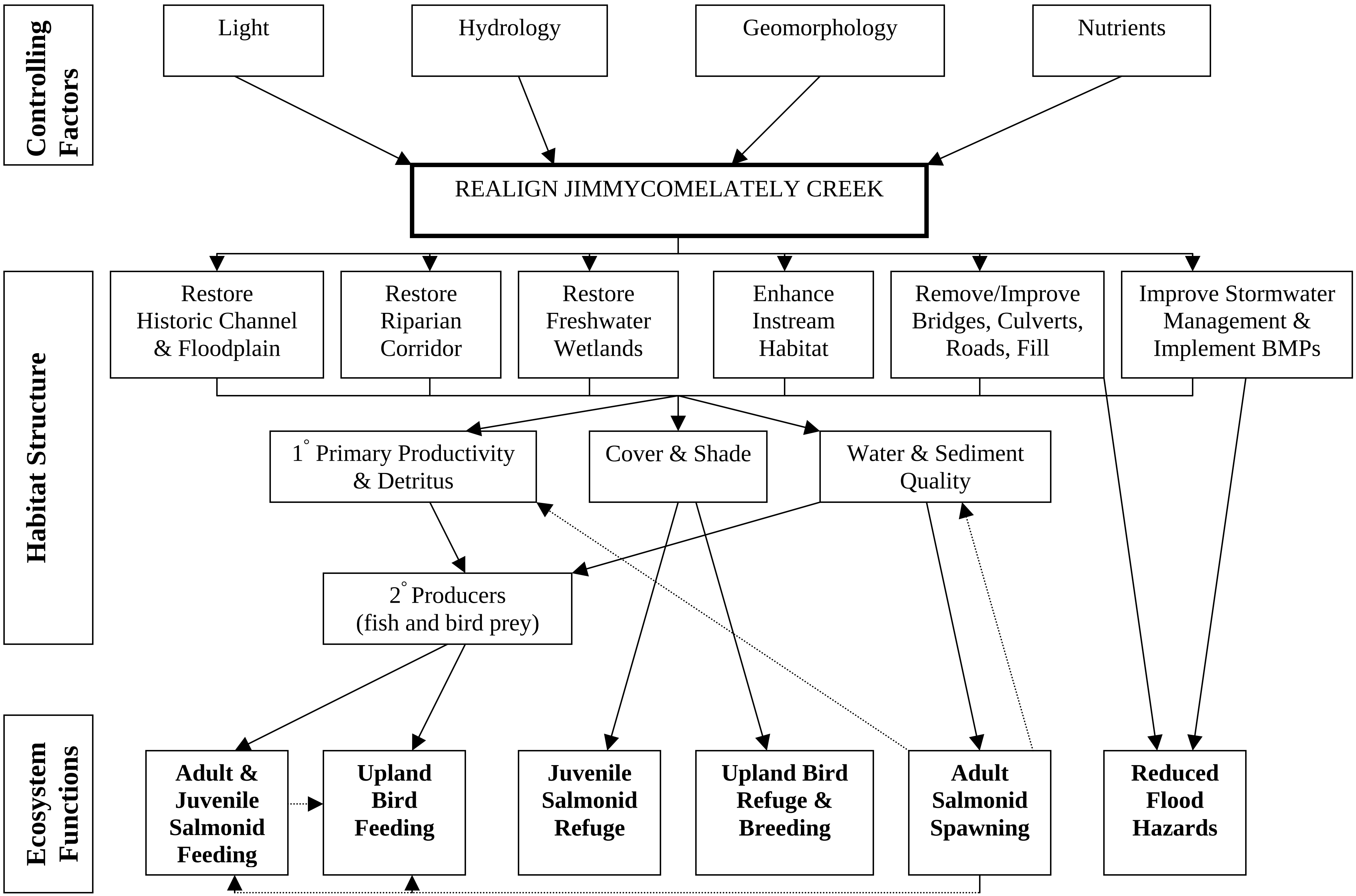


Figure 1.2. Conceptual model for realigning Jimmycomelately Creek into one of its historical channels.

2.0 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 the Tribe, Clallam County, WDFW, DNR, CCD, EPA, local private landowners, and other participating partners 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; and reestablish the predisturbance linkage between the fluvial and tidal energy regimes. The restoration of the channel will be integrated within the entire riverine-riparian-estuarine ecosystem restoration project, including the removal of fill and roads, the design and construction of a new Highway 101 bridge, revegetation, and land acquisition required to accomplish the restoration goals. Also included in the project will be controlled public access and small-scale educational facilities. The intent is true *ecological restoration* of the stream-estuary ecosystem; this means repair of a damaged ecosystem and its attendant functions and processes, not *creation*, *enhancement*, or *rehabilitation* (Clewell et al. 2000). Although salmonids, shellfish, shorebirds, and waterfowl have been identified as the target species groups for restoration, the Executive Committee explicitly intends to restore ecosystem functions and processes of a properly functioning JCL-Lower Sequim Bay ecosystem, thereby benefiting the full range of native species.

The Executive Committee of the JCL/Estuary Restoration Project has identified five **design goals** and interrelated **objectives**:

Goal 1: Restore the southern end of Sequim Bay (lower Sequim Bay), including the tidal flats and channels, the historic salt marsh, and the estuary of JCL for resident and migratory waterfowl and shorebird feeding, refuge, and breeding.

- Objective 1.1: Restore tidal flats and channels within the estuary.
- Objective 1.2: Restore salt marsh habitat within the estuary.
- Objective 1.3: Restore eelgrass within the estuary.
- Objective 1.4: Remove aggraded sediment from the estuary.
- Objective 1.5: Reconnect JCL 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 constrictions (wherever and whenever feasible).

Objective 1.8: Demolish existing structures within the estuary (e.g., dance hall, pump house, Old Blyn Shingle Mill foundation, log yard structures).

Objective 1.9: Determine whether a specified number of the existing pilings should be left for bird perching and resting, and then remove all others.

Goal 2: Restore JCL channel as feeding, refuge, and spawning habitat for ESA-listed summer chum salmon, coho salmon, winter steelhead, and sea-run cutthroat trout, as well as habitat for shellfish and upland birds.

Objective 2.1: Restore the natural channel and floodplain configurations of JCL and the estuary by realigning JCL into one of its historic, sinuous channels.

Objective 2.2: Restore and revegetate the riparian corridor along the realigned JCL with native plants.

Objective 2.3: Restore and revegetate freshwater wetlands along the realigned JCL with native plants.

Objective 2.4: Fill (or partially fill) and revegetate the former JCL channel following realignment of the new channel.

Objective 2.5: Enhance instream habitat in the new JCL channel using whole trees with attached root wads and/or engineered logjams.

Objective 2.6: Same as Objective 1.5.

Objective 2.7: Same as Objective 1.6.

Objective 2.8: Same as Objective 1.7.

Objective 2.9: Same as Objective 1.8.

Goal 3: Reduce the existing flood hazards to the local private landowners, and local, state, and tribal infrastructures.

Objective 3.1: Construct a new Highway 101 bridge over the new JCL channel.

Objective 3.2: Same as Objective 1.6.

Objective 3.3: Same as Objective 1.7.

Objective 3.4: Construct or replace storm water infrastructure to provide adequate storage and conveyance.

Objective 3.5: Implement BMPs to protect water quality from storm water impacts.

Goal 4: Restore the summer chum salmon population so that it is naturally self-sustaining after completion of restoration activities in JCL and the estuary. (Note: Goal 4 is linked to Goal 2, and is stated here as a separate goal for the sake of clarity and emphasis).

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 the Tribe and WDFW, and is in response to the chronically low population size of the summer chum run in JCL).

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 program.

Goal 5: Develop rigorous monitoring requirements (pre-project, during construction, and post project), maintenance actions, contingency actions, and reporting requirements to 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 large-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, costs, and successes or failures.

These stated design goals and objectives will be met while operating under the following constraints:

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 that remain after project completion;
3) Accommodating the Olympic Discovery Trail;

4) Satisfying the goals, intent, and procedural requirements of local, state, and federal laws, such as the Endangered Species Act (ESA), the Clean Water Act (CWA), the Shoreline Management Act, the Hydraulic Code, and Clallam County's Critical Areas Ordinance;
5) Ensuring that best management practices (BMPs) are implemented for upper watershed human activities to control sediment, pollution, and alterations to in-stream 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 MONITORING TASKS & PERFORMANCE CRITERIA

In this section of the plan, monitoring tasks are organized into three categories: ecological processes monitoring, habitat conditions and functions monitoring, and biological responses monitoring. *Process 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 current status of habitat conditions and functions (e.g., did the LWD placed in the realigned JCL channel stay in place and function as designed?). *Biological response tasks* attempt to determine the current status of biological responses to restoration actions (e.g., did anadromous salmonids return to spawn in the realigned JCL channel?).

Monitoring tasks are described for the following phases of the overall restoration project: pre-project (baseline) monitoring, during construction (implementation) monitoring, and post-project (performance) 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. *Performance monitoring* (also sometimes called success 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 4.0) are required. Performance criteria for each monitoring task are summarized in Table 3.1. An example of a performance criterion is: *survival of riparian plantings in each cover class category (herb, shrub, trees) should be at least 75% at the end of 3 years*.

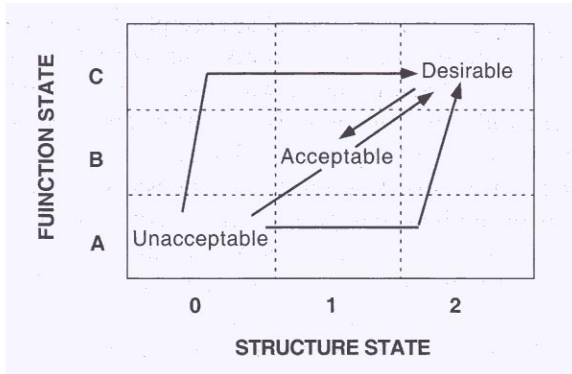
Monitoring, as outlined in this plan, is intended to proceed for a minimum of 10 years post-construction. Although monitoring of restoration sites is typically short-term (i.e., the usual 5-10 year monitoring framework of regulatory agencies), a longer period of monitoring would provide greater understanding of the time lag until ecological processes, habitat conditions and functions, and biological responses are fully restored. 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.*"

Table 3.1. Summary of performance criteria for each JCL channel restoration monitoring task.

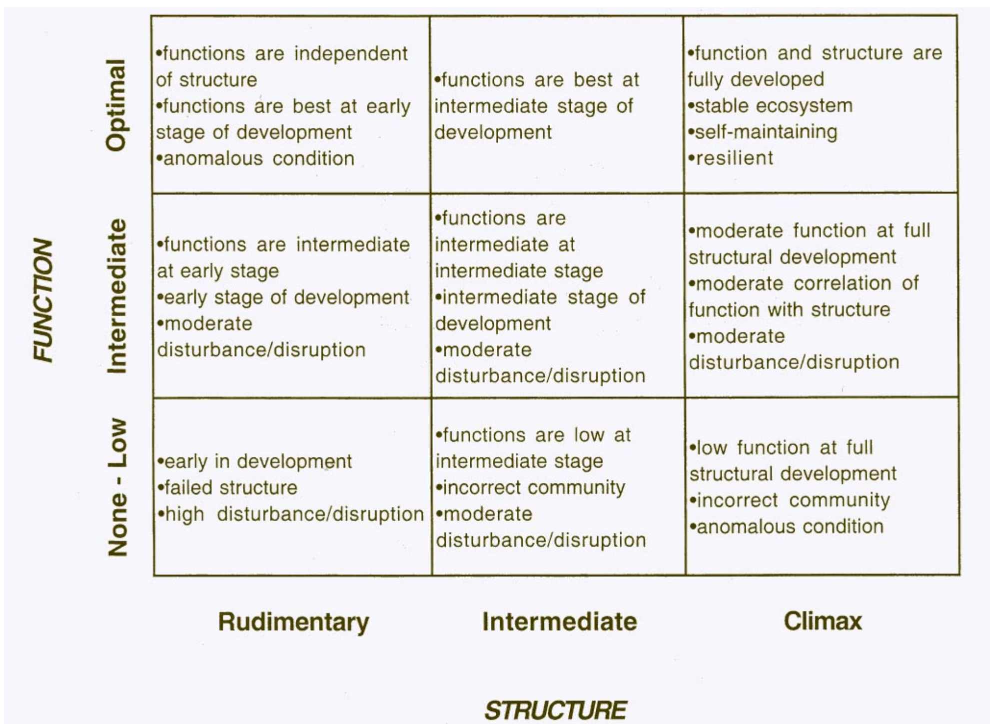
Essential Monitoring Tasks	Performance Criteria
Ecological Processes	
Water Conveyance (Hydrology)	1. Mean discharge from JCL below 2 cfs during Aug-Oct low flow period would trigger the need for potential contingency measures.
	2. Mean annual discharge and tidal elevation for the realigned JCL Creek should be measurably improved relative to mean annual discharge and tidal elevation for the existing JCL Creek after 10 years.
Sediment Transport & Deposition	1. Excessive sediment aggradation could trigger the need for contingency measures.
	2. Scouring will be monitored in each reach of the new JCL channel to ensure that scour depth is less than reported literature values for salmon redd depths of various species.
Habitat Conditions & Functions	
Channel Morphology & Topography	No performance criteria have been established; instead trigger points for further evaluation were identified (see text)
Water Quality	Water quality parameters (water temperature, dissolved oxygen, conductivity, pH, turbidity, nitrate and fecal coliform) within the JCL channel shall: a) not exceed state water quality standards, and b) show improvement over water quality parameters for the existing JCL channel.
Large Woody Debris	LWD placements that move to locations where they pose a threat to infrastructure, properties, or the channel morphology would trigger the need for potential contingency measures.
Soils	not applicable
Flood Conveyance	1. The channel will convey a 2-year bankfull flood of 185 cfs with no avulsions.
	2. No evidence of flooding that threatens property or infrastructure will be observed after a one-year period of initial site stabilization.
Biological Responses	
Riparian Vegetation Establishment	1. Percent cover of riparian vegetation (native trees, shrubs, and groundcovers) should be stable or increasing over time, and cover not less than 90% of the revegetated area at the end of 10 years.
	2. Survival of riparian plantings in each cover class category (herb, shrub, trees) should be at least 75% at the end of 3 years.
Freshwater Wetland Vegetation Establishment	1. Within 10 years, the percent cover of wetland vegetation should be stable or increasing within portions of the project site with elevations suitable to wetland vegetation establishment.
	2. Species composition of native wetland plant species should be comparable (greater than 80%) to that of appropriate reference sites after 10 years.
Invasive Vegetation Removal	The project area should not contain greater than 5% cover by area of invasive plant species after 10 years.
Salmonid Use	1. At the end of 10 years, juvenile salmonid abundance within the restored JCL channel should be higher than the pre-project abundance within the former JCL channel.
	2. With improved habitat access, greater spawning area, and improved spawning gravel available in the new JCL channel, chum and coho spawner abundances should be higher than the pre-project abundances within the former JCL channel.
Upland Bird Use	Diversity and abundances of birds using the restored JCL site and the area within 50 meters of the site should exceed bird diversity and abundances in the vicinity of the existing channel within 10 years post-construction.

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 5-10 years of monitoring is typically long enough to evaluate replacement of habitat area and occasionally biological responses (e.g., bird use, 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 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 3.1) 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 JCL technical group 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 the JCL technical group promising tools for evaluating how restored sites are <u>progressing</u> toward a more desirable target state or emulating a natural, functioning, self-regulating system.



(A)



(B)

Figure 3.1. 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).

The JCL technical group has identified the following monitoring parameters as essential for the channel realignment portion of the JCL-Estuary Restoration Project:

Ecological Processes

- Water Conveyance (Hydrology)
- Sediment Transport & Deposition

Habitat Conditions & Functions

- Channel Morphology & Topography
- Water Quality
- Large Woody Debris
- Soils
- Flood Conveyance

Biological Responses

- Riparian Vegetation Establishment
- Wetland Vegetation Establishment
- Invasive Vegetation Removal
- Salmonid Use
- Upland Bird Use

Additional monitoring parameters that are highly recommended for the JCL creek realignment are summarized in Appendix A. These recommended parameters include invertebrate prey production and land use changes, as well as additional sub-tasks within some of the monitoring parameters identified above. Paired sampling of some parameters at Salmon Creek, the closest comparable reference system to JCL, is also recommended. The highest priority is for additional monitoring of salmonid use of the restored JCL channel. The second highest priority is for monitoring of invertebrate prey production, as invertebrates are a critical food source for many juvenile salmonids and shorebirds. Implementing these additional monitoring recommendations would be dependent on funding, staff availability, timing, and other potential factors that we cannot foresee at present. Other monitoring parameters (not identified here) will be required for the estuary restoration.

3.1 MONITORING OF ECOLOGICAL PROCESSES

Ecological processes monitoring will focus on hydrology and sediment transport and deposition. These processes are critical to the establishment of physical conditions necessary for development of habitat that will support fish, shellfish, shorebirds, waterfowl, and their invertebrate prey sources. Ecological processes evolve slowly, and thus monitoring of hydrology and sediment processes will be performed for a minimum of 10 years post-construction.

3.1.1 HYDROLOGY

Historic and Current Conditions

Historically, the project area was more open to and more influenced by both river and tidal flows. Prior to human disturbance of the landscape, Jimmycomelately Creek meandered across the floodplain into an extensive estuary estimated to be nearly triple the size of its current, disconnected estuary (Shreffler 2000).

Currently, Jimmycomelately Creek is straight, narrow, diked, and perched above the surrounding land. JCL is hydraulically disconnected from the estuary, and normal hydrological functions (e.g., nutrient and sediment entrapment, 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 and the estuary by realigning JCL into one of its historic, sinuous channels.

Restoration Rationale

By restoring natural channel and floodplain configurations of JCL, there will once again be a free, functional connection between the creek and the estuary, and semi-diurnal tidal fluctuations will also be restored. A free, functional connection will facilitate use of the restored JCL creek by invertebrates, fish, and birds.

BASELINE MONITORING

Methods and Data Analysis

1) Map the historic and current locations of the JCL channel and the estuary. This has already been completed (see Figure 2.2, Shreffler 2000).

2) Install survey control (concrete monuments with brass disks) for Jimmycomelately Creek. Position these fixed control points where they will not likely be lost due to vandalism, erosion, or aggradation processes. Geo-reference all monitoring data relative to these fixed control points. WSDOT has already installed survey control for JCL.

3) Install a continuous recording tide gage near the mouth of the existing JCL channel. Monitor tidal elevation (MLLW), fluctuation, and duration, preferably daily. Plot tidal elevation vs. time monthly.

4) Measure stream flow at a series of locations from the proposed diversion point to the mouth of the existing JCL channel to determine how much the existing creek loses to groundwater.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Year 0 (pre-excavation of new JCL channel)

Personnel:
1) Map JCL locations: Already completed by WDFW
2) JCL control: WSDOT has already installed survey control in the vicinity of JCL
3) JCL tide gage: 3 surveyors for 8 hrs each to install & test
4) JCL stream flow: 2 technicians for 8 hrs each

Cost:
1) Map JCL locations: cost unknown
2) JCL control: cost unknown
3) JCL tide gage: $600 for 3 surveyors + ~$2,000 for continuous recording tide gage
4) JCL stream flow: $400 for 2 technicians

Lead:
1) Map JCL locations: WDFW
2) JCL control: WSDOT
3) JCL tide gage: CCD
4) JCL stream flow: CCD

IMPLEMENTATION MONITORING

Methods & Data Analysis

Document that the constructed JCL channel meets the design specifications for ground and bed elevations, gradients, channel widths and slopes, and meander radii and lengths. Prepare as-built drawings according to standard construction engineering practices.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Year 0; as-built drawings should be completed immediately after construction of the realigned JCL channel.

Personnel: 1 engineer; Clallam Conservation District

Cost: $3,200 (already budgeted under an existing CCD grant; see Section 3.2.3)

Lead: CCD

PERFORMANCE MONITORING

Methods & Data Analysis

1) Permanently install staff gages with pressure transducers at two locations: (1) within the realigned JCL channel above tidal influence, and (2) at the mouth of the JCL estuary. Construct a monument at each site (3-foot rebar set in concrete) and survey cross-sections, photograph view upstream, and measure streamflow at each gage.

2) Monitor discharge and flow stage at the upstream gage, and plot discharge vs. time monthly. Monitor tidal elevation (MLLW), fluctuation, and duration at the mouth gage, and plot tidal elevation vs. time monthly.

3) Measure stream flow at a series of locations from the proposed diversion point to the mouth of the new JCL. Compare to pre-project flows in old JCL channel to determine how much the new JCL channel gains in groundwater.

Performance Criteria

1) If the mean discharge from the JCL channel falls below 2 cubic feet per second (cfs) during the August to October low flow period, this would trigger the need for the JCL technical team to meet and discuss potential contingency measures.

2) Mean annual discharge and tidal elevation for the realigned JCL Creek should be measurably improved relative to mean annual discharge and tidal elevation for the existing JCL Creek after 10 years.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Staff gages: Years 1-10
JCL stream flow: Year 1

Personnel: Staff gages: 3 surveyors 16 hrs each to install gages, survey cross-sections, photograph view upstream, and measure streamflow at each gage, 1 technician 96 hrs/year (8 hrs once/month) for data download + 24 hrs/year for data analysis & plotting.
JCL stream flow: 2 technicians for 8 hours each

Cost: Staff gages: $2,000 for 1 gage (move the other gage from the existing JCL channel to the realigned JCL channel) + $1,200 for 3 surveyors (year 1 only) + $3,000/year for 1 technician
JCL stream flow: $400 for 2 technicians

Lead: Staff gages: CCD
JCL stream flow: CCD

Contingency Measures

Failure to meet the performance criteria should trigger discussions regarding the need to alter the hydrologic regime. Adequate river discharge and tidal connections between the JCL channel and the estuary are essential for the long-term functioning of the ecosystem in support of fish, shellfish, birds, and other aquatic species. Inadequate river flows or tidal connections could reduce fish access and use of the realigned channel and reduce export of organic matter from the site, which, in turn, would deleteriously affect the associated food web support for the estuary. Contingency measures could include: better enforcing regulations to limit any surface water withdrawals from JCL; implementing new regulations, if necessary; and altering the channel morphology to facilitate increased discharge and tidal connections.

Excessive river flows could lead to problems with erosion, redd scouring, and flooding. Contingency measures could include implementing stricter stormwater management BMP’s, implementing and/or better enforcing land use regulations to limit the amount of impervious surfaces in the watershed, or altering the channel morphology to minimize erosion.

3.1.2 SEDIMENT TRANSPORT & DEPOSITION

Historic and Current Conditions

Inspection of historic U.S. Coast and Geodetic maps (1870, 1914, 1926) indicates that the JCL channel naturally migrated across the alluvial fan, 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 channel, loss of instream channel complexity, and a decrease in tidal energy have decreased the existing channel's ability to route sediment through the system. Historic sediment transport rates and volumes are unknown and difficult to assess.

Since the 1950s, the Jimmycomelately Creek bed north of Highway 101 has aggraded (i.e. built up) by more than 4 feet. Based on calculations from aerial photos, the creek mouth has moved 400 feet seaward, 10 feet per year on average in the past 40 years (see Figure 2.5, Shreffler 2000). The JCL channel is now "perched," with the existing creek bed now sitting several feet higher than the surrounding land.

Restoration Objective

The restoration objective relative to sediment transport is to improve the routing of sediment through the fluvial system and into the tidal system, by restoring a functional connection between JCL and its estuary that will enable the estuary to function once again as a sediment "pump."

Restoration Rationale

Sediment mobility is critical to the ecological health of a river 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 is critical in terms of providing habitat for juvenile salmonids, other estuarine fish, shellfish, and shorebirds. Similarly, the deposition of appropriate-sized gravel in the realigned JCL channel is important in providing suitable spawning habitat for adult salmonids.

BASELINE MONITORING

Methods & Data Analysis

1) Determine size fractions of sediment present within given reaches of the existing JCL channel, using the pebble count method (Wolman 1954).

2) Determine size fractions of sediment present within given reaches of the Salmon Creek reference channel. This was completed for Salmon Creek in May 2001.

3) Survey the existing JCL channel bed and install two scour chains per transect along six transects to measure sediment scouring (i.e., bed instability).

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Year 0

Personnel: 1) JCL Creek Pebble counts: 1 CCD technician 8 hrs + 1 tribal biologist 8 hrs
2) Salmon Creek Pebble counts: 1 Clallam County biologist 8 hrs + 1 tribal biologist 8 hrs
3) Sediment scouring: see performance monitoring

Cost: 1) JCL Creek Pebble counts: $600
2) Salmon Creek Pebble counts: $720 (already budgeted)
3) Sediment scouring: see performance monitoring

Lead: 1) JCL Creek Pebble counts: CCD/JKT
2) Salmon Creek Pebble counts: Clallam County/JKT
3) Sediment scouring: JKT

IMPLEMENTATION MONITORING

None

PERFORMANCE MONITORING

Methods & Data Analysis

1) Perform pebble counts at six cross sections within the realigned JCL channel.

2) Survey the new JCL channel bed and install two scour chains per transect along six transects (2 transects in each of the 3 channel reaches) to measure sediment scouring (i.e., bed instability) following each flood event.

3) Sample suspended sediment during high flooding events and sieve to determine grains sizes at three sampling locations: 1 near the diversion point, 1 mid-channel, and 1 near the mouth.

Performance Criteria

1) Pebble counts will provide an indication of whether unexpected sediment aggradation is occurring at undesirable locations within the realigned channel. Indications of excessive sediment aggradation could trigger the need for discussion of contingency measures.

2) Scouring will be monitored in each reach of the new JCL channel to ensure that scour depth is less than reported literature values for salmon redd depths of various species.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: 1) Pebble counts: Years 1, 5, 10
2) Sediment scouring: Years 1 and 2
3) Suspended sediment loads: Years 1-10 (opportunistically, during flooding events)

Personnel: 1) Pebble counts: 1 CCD technician 8 hrs/year + 1 tribal biologist 8 hrs/year
2) Sediment scouring: 1 technician and 1 biologist 48 hrs each for installation of scour chains and bed survey + 1 technician and 1 biologist 16 hrs/year for monitoring + 1 technician and 1 biologist 32 hrs for removal of scour chains and resurvey
3) Suspended sediment loads: 1 technician 8 hrs/year for "opportunistic" data collection + 1 biologist 8 hrs/year for data analysis

Cost: 1) Pebble counts: $600/year
2) Sediment scouring: $7,872/year for 1 technician and 1 biologist + $250/year for equipment and materials

3) Suspended sediment loads: $656/year for 1 technician and 1 biologist

Lead: 1) Pebble counts: CCD/JKT
2) Sediment scouring: JKT
3) Suspended sediment loads: JKT

Contingency Measures

Adequate sediment transport and deposition is critical for long-term functioning of the ecosystem in support of invertebrates, fish, shellfish, and birds. Contingency measures could include: better enforcement of land use regulations to control sediment inputs from the upper watershed; implementation of new regulations; bank stabilization preferably through “soft” approaches (e.g. vegetation, fiber mats) as opposed to hardening approaches (e.g., rip rap, logs, root wads); alteration of the channel morphology; and installation of grade controls.

3.2 MONITORING OF HABITAT CONDITIONS & FUNCTIONS

Habitat conditions and functions monitoring tasks will focus on channel morphology and topography, soils, water quality, flood conveyance, and large woody debris. These tasks are intended to document improvements in habitat conditions and functions that result from the restoration activities.

3.2.1 CHANNEL MORPHOLOGY & TOPOGRAPHY

Historic and Current Conditions

Jimmycomelately Creek was once characterized by a sinuous fluvial channel connected to extensive tidal marshes (Shreffler 2000). Historic diking, road and railroad construction, riprap placement, culvert installations, channel realignments, and channel dredging have severely altered the morphology of Jimmycomelately Creek. In its current condition, JCL is physically disconnected from its estuary and dysfunctional (Shreffler 2000).

Restoration Objective

The restoration objective relative to channel morphology is to restore channel morphology that is representative of natural systems, as indicated by attributes of habitat connectedness, area, and complexity.

Restoration Rationale

Dynamically stable channel formation will occur as a result of restoration of fluvial and tidal connection and re-establishment of a functional tidal prism.

BASELINE MONITORING

Methods and Data Analysis

1) Baseline aerial photos to document current conditions and elevations: Clallam County used grant funds ($52,000 from GSRO, the Tribe, the WRIA-17 planning unit, and WDOE) for aerial photographs and digital orthophotos of the project area (including Jimmycomelately Creek and the south end of Sequim Bay), as well as Snow Creek and Salmon Creek in the south end of Discovery Bay. These aerial photos and digital orthophotos were completed in 1999. Topography from these orthophotos has been used to design the realigned JCL channel and predict vegetation communities at different elevations.

2) Permanent channel cross-section monuments have been established and surveyed by CCD at eleven locations along the existing JCL channel (up and downstream of the proposed diversion).

3) CCD has performed additional topographic surveys to augment the aerial mapping previously completed by Clallam County.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: 1) Aerial photos & digital orthophotos: 1999
2) Cross sections: 2000
3) Topographic surveys: 2001

Personnel: 1) Aerial photos & digital orthophotos: 1 biologist
2) Cross sections: 3 surveyors
3) Topographic surveys: 1 surveyor + 1 engineer

Cost: 1) Aerial photos & digital orthophotos: $52,000
2) Cross sections: cost unknown
3) Topographic surveys: cost unknown

Lead: 1) Aerial photos & digital orthophotos: Clallam County
2) Cross sections: CCD
3) Topographic surveys: CCD

IMPLEMENTATION MONITORING

Methods and Data Analysis

Same as for Hydrology Process Task above: document that the constructed JCL channel meets the design specifications for channel width, bed elevations, slope, gradient, and meander length. Prepare as-built drawings as per standard construction engineering practices.

Timeline, Personnel, Cost Estimate, and Lead

$3,200 for as-built drawings (already budgeted under an existing CCD grant; see Section 3.2.3)

PERFORMANCE MONITORING

Methods and Data Analysis

1) Establish and survey 6 permanent channel cross-section monuments (2 monuments in each of the 3 reaches) along the new JCL channel above Highway 101. Compare channel depth, width, and overall profile between the former channel and the new channel.

2) Photo-document changes in the new JCL channel morphology and topography, at minimum, four times per year in Winter, Spring, Summer, and Fall.

3) Take high-resolution (1 inch = 500 feet) aerial photographs 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 lower than +3 ft MLLW. Compare channel area and morphology, as determined through photoanalysis, between the realigned JCL channel and the Salmon Creek channel. Produce maps depicting JCL channel morphology immediately post-construction, at 5 years, at 10 years, and predicted conditions at 50 years (based on photo-interpretation and best professional judgment).

Performance Criteria

No performance criteria have been identified. Because of the high degree of uncertainty associated with predicting changes in channel morphology and topography, the technical group has, instead, identified the following triggers that would necessitate further evaluation and potential contingency measures:

- Greater than 3 feet of downcutting at the riffle crests any time in the first 10 years
- Straightening of the channel meander geometry
- Channel avulsions that cause a secondary channel (i.e. side channel) to become primary
- Decreases in channel meander amplitude

Timeline, Personnel, Cost Estimate, and Lead

Timeline: 1) <u>Channel cross sections</u>: Once/year in years 1, 3, 5, 7, and 10
2) <u>Photo-documentation</u>: 4 times/year in years 1-10
3) <u>Aerial photos</u>: Once/year in years 1-10

Personnel: 1) <u>Channel cross sections</u>: 3 surveyors 8 hrs/year each
2) <u>Photo-documentation</u>: 1 technician 8 hrs/year
3) <u>Aerial photos</u>: 1 biologist 12 hrs/year

Cost: 1) <u>Channel cross sections</u>: $600/year for surveyors
2) <u>Photo-documentation</u>: $200/year for technician
3) <u>Aerial photos</u>: $600/year for biologist + $500/year for aerial photos of JCL and Salmon Creek

Lead: 1) Channel cross sections: CCD

2) Photo-documentation: CCD

3) Aerial photos: JKT

Contingency Measures

If any of the four "triggers" are identified at any time during the monitoring period, the technical group will meet to discuss the need to alter channel morphology and/or topography. Contingency measures could include altering the vertical or horizontal profile of the channel, or manipulation of LWD (e.g., adding grade controls for downcutting).

3.2.2 WATER QUALITY

Historic and Current Conditions

No historic water quality data are available, pre-1961.

Water quality in the JCL watershed has been impaired by a minimum of three land-use practices: forestry, residential, and animal keeping (Brastad et al. 1987). Logging practices have contributed increased sediment loads to JCL. Failing septic systems that diminished water quality on the lower 0.7 miles of JCL have been repaired or replaced. 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 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.

Storm water runoff in the vicinity of the proposed project has the potential to create significant capacity and water quality problems. The creation of impervious surfaces such as parking, rooftops, driveways, and roads results in increased in peak flows during and following storms. Runoff can be high in pollutants such as nutrients, heavy metals, petroleum products, and sediment. Preliminary recommendations for storm water management plans have been developed for the East Blyn Basin (Gibboney 2000A) and West Blyn Basin (Gibboney 2000B). The most pertinent recommendation was that JKT should coordinate with other jurisdictions and agencies such as Clallam County and WSDOT to address drainage problem areas and issues.

As part of this monitoring plan (see Section 3.1.1: Hydrology), water quantity will be monitored by staff gages in JCL above tidal influence (south of Highway 101) and at the mouth of the creek. Turbidity will be monitored daily at the McLaughlin property in year 1 following JCL channel realignment (see below). Additional storm water monitoring to address potential water quality issues (e.g., TPH, metals, sediment) may be included in the estuary restoration plan.

Restoration Objective

The restoration objective is to improve water quality relative to current conditions by realigning JCL into one of its historic channels and reconnect the Creek to its estuary.

Restoration Rationale

Water 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

Streamkeepers of Clallam County uses volunteers to monitor water quality at four reaches along the existing JCL creek. This monitoring program includes quarterly measurements of: air and water temperature, dissolved oxygen, conductivity, salinity, pH, turbidity, nitrate (field screening and lab tests), and fecal coliform (Baccus and Chadd 2000). Data collection is performed according to a strict quality assurance plan to ensure the credibility of the results. Temperature, dissolved oxygen, conductivity, and salinity data are collected using a YSI-85 multimeter. PH data are collected using MicroEssential pH Lo Ion strips. Turbidity is measured using a DRT-15C or DRT-15CE meter. Nitrate-nitrogen screening in the field is performed using Hach or Aquachek nitrate test strips. Laboratory analysis of nitrate-nitrogen is performed using an Orion 940 Ion Analyzer.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Streamkeepers: Quarterly water quality monitoring was initiated in September 2000 on JCL

Personnel: Streamkeepers: volunteers & paid staff

Cost: Streamkeepers: estimated ~$10,000/year; Streamkeepers is independently funded for the JCL project through state grants.

Lead: Streamkeepers/Clallam County

IMPLEMENTATION MONITORING

No implementation monitoring will be required at this phase of the project, because a dry channel will be excavated initially with no connection to the existing JCL channel.

PERFORMANCE MONITORING

Methods and Data Analysis

1) Monitor water quality (same parameters as baseline monitoring) along the new JCL channel quarterly for ten years post-construction. During this 10-year period if the funding for the Streamkeepers program is no longer available, the JCL-Estuary restoration team will continue quarterly water quality monitoring using, to the extent possible, the same equipment and monitoring protocols.

2) Supplement the Streamkeepers' quarterly monitoring with the following additional water quality monitoring in the new JCL channel: daily air and water temperature, dissolved oxygen, turbidity, and salinity measurements during the warmest months (~June-September) at the McLaughlin property.

Performance Criteria

Water quality parameters (continuous water temperature, dissolved oxygen, conductivity, pH, turbidity, nitrate, and fecal coliform) within the new JCL channel shall: a) not exceed state water quality standards, and b) show improvement over most water quality parameters for the existing JCL channel.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: 1) Streamkeepers: Quarterly each year, years 1-10.
2) McLaughlin: Daily (June-September) year 1

Personnel: 1) Streamkeepers: Streamkeepers volunteers and paid staff
2) McLaughlin: John McLaughlin (volunteer) + 1 biologist

Cost: 1) Streamkeepers: No anticipated cost to the JCL project
2) McLaughlin: $400/year for 1 biologist + $200 for refractometer & Hydrolab maintenance

Lead: 1) Streamkeepers: Streamkeepers of Clallam County
2) McLaughlin: John McLaughlin with support from JKT

Contingency Measures

If performance criteria are not met, the following contingency measures could be considered: source control (of toxics or contaminants); improve storm water management; better enforce land-use regulations to limit impervious surfaces; better enforce land-use regulations to limit logging and other clearing of riparian or wetland vegetation in the watershed; better enforce land use regulations to prevent discharge from leaking septic tanks and eliminate animal access to the stream channel; and implementation of new land-use regulations, if necessary.

3.2.3 LARGE WOODY DEBRIS

Historic and Current Conditions

Prior to human inhabitation of the Blyn area, Jimmycomelately Creek was likely an old growth forest to the head of tidal influence. In this undisturbed condition, natural recruitment of large woody debris (LWD) would have contributed to a complex and dynamic channel full of wood, in which pools, riffles, and other habitat features were continually reworked and reformed. It is widely believed that anadromous salmonids, as well as numerous other Pacific Northwest aquatic organisms, evolved within, and are adapted to, these dynamic stream ecosystems.

The lower 1.8 miles of Jimmycomelately Creek, where the creek emerges onto the historic floodplain, is only vegetated for a short section with small alders, cottonwood, and various herbaceous species. At present, there are no large conifers along the existing lower channel, and there is very little LWD recruitment.

Restoration Objective

The restoration objective relative to LWD is to install LWD as both a hydraulic feature of the channel and as a functional habitat, because there is unlikely to be any significant LWD recruitment to the realigned JCL channel for at least 20-50 years.

Restoration Rationale

LWD is critical for fish and aquatic invertebrate habitat (e.g., forming pools and riffles, providing cover), sediment trapping, and nutrient cycling, as well as controlling channel morphology and complexity. By installing LWD into the realigned JCL channel, the JCL technical group hopes to “jumpstart” physical and biological processes within the realigned JCL channel, until a healthy riparian corridor has developed and LWD begins to naturally recruit to the system.

BASELINE MONITORING

Methods and Data Analysis

Survey channel cross-sections above and below designated locations for selected LWD structures.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Year 0, pre-LWD installation

Personnel: 1 technician for 40 hours + 1 engineer for 40 hrs

Cost: $3,200 (this cost includes as-built drawings for Hydrology Task [Section 3.1.1], as-built drawings for Channel Morphology & Topography Task [Section 3.2.1], surveying cross-sections for the LWD Task [Section 3.2.3], and CCD's part of as-built locations of the LWD).

Lead: CCD

IMPLEMENTATION MONITORING

Methods and Data Analysis

1) At least one biologist will be present on-site during construction to ensure the placement and alignment of LWD at pre-determined locations by the heavy equipment operators. Record as-built locations of key members using a hand-held GPS unit, and later map the locations of each LWD structure.

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

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Year 0, during-construction

Personnel: 1) As-built locations/map: 1 biologist for 40 hours
2) Photo-document: 1 technician for 8 hrs

Cost: 1) As-built locations/map: $2,000
2) Photo-document: $200

Lead: 1) As-built locations/map: JKT/CCD
2) Photo-document: CCD

PERFORMANCE MONITORING

Methods and Data Analysis

1) Logjams will be constructed to resist coming apart in a flood. However, some movement of LWD is an expected and natural process, and such movement will be monitored annually using fixed photo points.

2) Document habitat functions of LWD (e.g. pool formation, grade control, bank stabilization, sediment trapping, capturing driftwood so that it doesn't hang up on Highway 101 supports) using fixed photo points in conjunction with aerial photos.

3) Re-survey the channel cross-section above and below the selected LWD structures.

Performance Criteria

LWD placements that move to locations where they pose a threat to infrastructure, properties, or the channel morphology would trigger the need for discussion of potential contingency measures.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: 1) Photo-Documentation: Annually, years 1-10
2) Habitat Functions: Annually, years 1-10
3) Re-survey Cross Sections: Years 1, 5, 10

Personnel: 1) Photo-Documentation: 1 biologist for 8 hrs/year
2) Habitat Functions: 1 biologist 8 hrs/year
3) Re-survey Cross Sections: 2 surveyors and 1 engineer for 8 hrs each

Cost: 1) Photo-Documentation: $400/year
2) Habitat Functions: $400/year
3) Re-survey Cross Sections: $840/year

Lead: CCD/JKT

Contingency Measures

Contingency measures could include adding more LWD or removal of problematic wood structures. LWD could be stockpiled on-site (in non-wetland areas) and installed quickly in emergencies. In non-emergencies, geotextile fabric and gravel could be installed.

3.2.4 SOILS

Historic and Current Conditions

Historic soil conditions in the project area are unknown. The assumption is that native soils likely supported a forested wetland (palustrine emergent wetland vegetation) to the head of tidal influence, where the plant community shifted to salt-tolerant vegetation (estuarine emergent vegetation).

Clallam Conservation District (CCD) soil surveys have delineated two dominant soil types along the JCL channel re-route project area: Mukilteo Muck (0 to 1 percent slopes) primarily from the south side of Highway 101 upstream along the proposed stream course for approximately 750 feet, and Lummi Silt Loam (0 to 3 percent slopes) in the southern half of the proposed project site from Corriea Road north approximately 1000 feet (Clallam Conservation District 2001).

Restoration Objective

The restoration objective relative to soils is to ensure that: 1) soils in the vicinity of the realigned JCL channel that are capable of supporting native vegetation are left intact, 2) no non-native soils are introduced into the project area, and 3) mucks excavated during the channel construction are side-cast to provide a nutrient rich substrate for revegetation efforts and also, presumably, a native seed bank.

Restoration Rationale

Minimizing physical disturbance to existing soils, ensuring that no non-native soils are introduced, and side-casting mucks is expected to enhance the rate at which the riparian corridor becomes re-established.

BASELINE MONITORING

The Clallam Conservation District has already surveyed, characterized, and mapped soils within the proposed corridor for the JCL creek realignment (Allison 2001).

IMPLEMENTATION MONITORING

Methods and Data Analysis

During channel construction, perform inspections to document: 1) that physical disturbance to existing soils is minimized, 2) that no non-native soils are introduced to the project area, and 3) the approximate volumes and locations to which organic soils (i.e. mucks) are side-cast.

In addition, inspection monitoring during construction should document that erosion control measures are adequate to ensure that no unacceptable impacts occur in areas adjacent to, or downstream of, the excavated channel.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Year 0 (during channel construction)

Personnel: 1 engineer for approximately 40 hrs

Cost: $2,200

Lead CCD

Contingency Measures

Vegetation will be selected that is appropriate for the soils found on site. If the intended vegetation fails to survive or grow in the native soils, a new planting plan with different plant species will be needed.

3.2.5 FLOOD CONVEYANCE

Historic and Current Conditions

Historic flooding characteristics within the JCL watershed are unknown. Presumably, pre-human settlement in the Blyn Area, the JCL channel was free to migrate, both vertically and laterally, through the floodplain.

Dramatic sediment aggradation and resulting increased bed elevations in the lower reaches of the existing JCL channel have contributed to recurring floods in the basin (Shreffler 2000). The most notable flood in recent history was the New Year's flood of 1997, which overtopped Highway 101 causing WSDOT to close the highway for twelve hours. Annual flooding near the bridge at Old Blyn Highway, where the channel is perched up to 4 feet above the surrounding land, closes this road for several days each winter. Several houses are routinely flooded, along with septic tanks and wellheads. Flooding along the existing JCL channel poses an unacceptable risk of damage to existing properties and infrastructure.

Restoration Objective

The restoration objective relative to flood conveyance is to realign JCL into one of its historic, meandering channels and construct a new Highway 101 bridge that is engineered to allow maximum flood conveyance.

Restoration Rationale

Restoring floodwater capacity, realigning JCL, removing under-sized culverts, and constructing a new Highway 101 bridge can prevent flooding of properties and infrastructure within the project area.

Channel Design Criteria

The new JCL channel will be designed to contain a 2-year bankfull conveyance of 185 cfs (peak).

BASELINE MONITORING

Methods and Data Analysis

Orsborn and Orsborn (1999) calculated the following flood flows for JCL: average 2-year peak flood at 185 cfs, 50-year peak flood at 645 cfs, and 100-year peak flood at 800 cfs.

Timeline, Personnel, Cost Estimate, and Lead

Orsborn and Orsborn flood report cost: $9,650

IMPLEMENTATION MONITORING

None required

PERFORMANCE MONITORING

Methods and Data Analysis

1) Complete visual inspections of the project area for signs of flood damage, following major rainfalls or rain-on-snow events. Document any observed flood damage with photographs, including channel avulsion into terrace side channels. Mark water surface elevations on Highway 101 bridge during high flow events.

2) Analyze discharge data for the realigned channel to evaluate the potential for flood conveyance problems.

3) Analyze cross section elevation data collected across permanent transects through the realigned channel to evaluate the potential for flood conveyance problems.

Performance criteria

1) The channel will convey a 2-year bankfull flood of 185 cfs with no avulsions.

2) No evidence of flooding that threatens property or infrastructure will be observed after a one-year period of initial site stabilization.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: 1) <u>Visual inspection & photographs</u>: Years 1-10
2) <u>Analyze Discharge data</u>: See Hydrology monitoring task above
3) <u>Analyze Cross-Section data</u>: See Sediment Morphology & Topography task above

Personnel: 1) <u>Visual inspection & photographs</u>: 1 technician for 8 hrs/year
2) <u>Analyze Discharge data</u>: See Hydrology monitoring task above
3) <u>Analyze Cross-Section data</u>: See Sediment Morphology & Topography task above

Cost: 1) Visual inspection & photographs: $256/yr for technician

2) Analyze Discharge data: See Hydrology monitoring task above

3) Analyze Cross-Section data: See Sediment Morphology & Topography task above

Lead: JKT

Contingency Measures

Evidence of threats to property or infrastructure would necessitate discussions regarding both short-term "fixes" and longer-term solutions to flooding problems. One short-term contingency measures would be removal of debris jams or constrictions that are deemed responsible for the flooding, or placement of LWD to disperse flows across the floodplain. Longer-term contingency measures could include: changing the horizontal channel morphology to facilitate flood conveyance; better enforcing land use regulations to limit the amount of impervious surface in the watershed and to limit logging or vegetation removal in the watershed; and property acquisition or conservation easements to ensure an adequate forested riparian corridor along the creek.

3.3 MONITORING OF BIOLOGICAL RESPONSES

Biological responses monitoring tasks will focus on riparian and wetland vegetation establishment, invasive vegetation removal, upland bird use, and salmonid use. Invertebrate prey production has been moved to the appendix, as a recommended rather than essential monitoring task.

3.3.1 RIPARIAN VEGETATION ESTABLISHMENT

Historic and Current Conditions

No data is available on the historic conditions of riparian vegetation along JCL. It is assumed that, pre-human disturbance, the creek was bordered by an old growth forest down to the head of tidal influence. According to the U.S. Forest Service Dungeness Watershed Analysis, much of the Dungeness Watershed burned in 1308, 1508, and 1701. A large fire burned forested lands between Port Angeles and Sequim in 1890, and six other fires occurred in the Sequim area between 1860 and 1925. It is unknown to what extent these fires may have affected the JCL Watershed.

The riparian corridor above river mile 1.5, the uppermost extent of summer chum salmon distribution, is believed to be relatively intact and dominated by conifers. Along the lower 0.5 miles of JCL Creek, the existing riparian vegetation is predominantly willow, alder, and cottonwood. Few remnant conifers remain. The riparian corridor has been reduced to a narrow (less than 100 foot) strip of small, deciduous trees along the lower approximately 0.5 miles of the creek (Shreffler 2000). Between river mile 0.5 and 1.5, most of the existing riparian corridor is in diameter classes less than 20-inch diameter at breast height (dbh).

Restoration Objective

The restoration objective relative to riparian vegetation establishment is to re-establish native riparian vegetation along the entire meandering stream course of the realigned JCL channel, wherever soil types will support this vegetation.

Restoration Rationale

The riparian corridor provides direct and indirect support to a variety of fish and wildlife species. Native trees and shrubs provide a buffer from adjacent residential and commercial land uses. Insects from riparian vegetation are deposited in the water and can provide an important prey resource for fish. Leaf litter enhances detritus-based food webs. Large woody debris (i.e., trees and limbs that fall into the creek) is important for habitat structure. A review of the multitude of specific functions of riverine-riparian habitats is provided in Shreffler (2000).

BASELINE MONITORING

Methods and Data Analysis

Identify major vegetation and habitat types on an aerial photograph. Field verify vegetation communities by species composition.

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

Cost: $1,040

Lead: CCD

IMPLEMENTATION MONITORING

Methods and Data Analysis

Photo-document the entire construction and revegetation process from permanently established camera points.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: During construction in year 0

Personnel: 1 technician 8 hrs

Cost: $200

Lead: CCD

PERFORMANCE MONITORING

Methods and Data Analysis

1) Percent cover: Identify major vegetation and habitat types on an aerial photograph for each year of monitoring. Visit the site to groundtruth vegetation communities once/year. Field verify and categorize vegetation communities by species composition. Establish permanent transects to identify species composition and percent canopy cover.

2) Survival: Establish test plots at the time of planting and monitor these plots annually (once/year) for densities, spacing, and survival of herb, shrub, and tree components.

3) Photo-documentation: photograph the revegetated areas from fixed camera points.

Performance Criteria

1. Percent Cover of riparian vegetation (native trees, shrubs, and groundcovers) should be stable or increasing over time, and cover not less than 90% of the revegetated area at the end of 10 years.

2. Survival of riparian plantings in each cover class category (herb, shrub, trees) should be at least 75% at the end of 3 years.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: 1) Percent Cover: Mid-summer once/year in years 1, 2, 3, 5, and 10; note: 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 12 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: $880/year for 2 technicians and 1 biologist + $200 supplies
2) Plant survival: $880/year for 2 technicians and 1 biologist
3) Photo-documentation: $200/year

Lead: CCD

Contingency Measures

Excessive failure rates for plant survival will be addressed with contingency measures. Potential causes could include improper installation, poor soil structure and/or organic content, inadequate watering, herbivory, trampling, or competition (especially from grasses). Contingency measures could include additional plantings, soil amendments, more frequent watering, weeding, fencing, removal 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.

3.3.2 FRESHWATER WETLAND VEGETATION ESTABLISHMENT

Historic and Current Conditions

The areal extent and species composition of historic freshwater wetland vegetation is unknown. According to a preliminary wetlands survey performed by EPA in April, 2000, hydric soils and wetland vegetation exist along nearly the entire proposed JCL corridor, up to 1400 feet south of Highway 101. Transitional habitat exists on non-hydric soils between wetland boundaries and upland terraces. Most of the proposed new JCL channel will be excavated in wetlands, as evidenced by hydric soils and existing wetland vegetation.

Restoration Objective

To re-establish native wetland vegetation along the entire meandering stream course of the realigned JCL channel 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 freshwater wetlands is provided in Shreffler (2000).

BASELINE MONITORING

Same as for riparian vegetation establishment.

IMPLEMENTATION MONITORING

None

PERFORMANCE MONITORING

Methods and Data Analysis

1) Percent Cover: 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) Species composition: Establish permanent transects and survey these transects during mid-summer to determine species composition within ten (or more, depending on length of transect) 0.25m x 0.25m quadrats randomly distributed along each transect line. Record all plant species

observed within each quadrat, and visually estimate percent cover of each species within each quadrat.

3) Photo-documentation: Establish fixed camera points, and photograph the revegetated areas.

Performance Criteria

1) Within 10 years, the areal extent (percent cover) of wetland vegetation should be stable or increasing within portions of the project site with elevations suitable to wetland vegetation establishment.

2) Species composition of native wetland plant species should be comparable (greater than 80%) to that of appropriate reference sites 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: 2 technicians 12 hrs/year each + 1 biologist 8 hrs/year
3) Photo-document: 1 technician 8 hrs/year

Cost: 1) Percent Cover: $880/year
2) Species composition: $880/year
3) Photo-document: no additional cost, if done at same time as riparian photo-documentation.

Lead: CCD

Contingency Measures

Same as for riparian vegetation establishment.

3.3.3 INVASIVE VEGETATION REMOVAL

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*), and purple loosestrife (*Lythrum salicaria*).

Restoration Objective

The restoration objective relative to invasive vegetation removal is to completely eliminate non-native, invasive species from the restoration site. The methods to be used are outline in the Jimmycomelately Creek Revegetation Plan (Clallam Conservation District 2001).

Restoration Rationale

Non-native, invasive plant species compete with native plant species that provide 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

Map existing locations of invasive species of concern on aerial photographs.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Year 0

Personnel: 1 technician 8 hrs + 1biologist

Cost: cost is included in mapping of riparian and wetland vegetation

Lead: CCD

Implementation Monitoring

None

Performance Monitoring

Methods and Data Analysis

Following construction, re-map locations of invasive species of concern on aerial photographs.

Performance Criterion

The project area should not contain greater than 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:	$480/year
Lead:	CCD

Contingency Measures

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

3.3.4 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). Only 7 chum salmon returned to spawn in 1999, and 55 returned in 2000.

Restoration Objective

The restoration objective relative to salmonid use is to restore free access to JCL 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 JCL channel.

Restoration Rationale

This project will result in an increase in both habitat area and habitat functions. More habitat and better functioning habitat will result in more salmonids using the realigned JCL channel and estuary.

BASELINE MONITORING

Methods and Data Analysis

Juvenile salmonids in existing JCL channel:

1) Deploy minnow traps, fyke net and/or beach seine, and/or smolt trap to assess species composition, abundance, outmigration timing, and length-frequency distributions in the new JCL channel (monthly March to June).

Adult spawners in existing JCL channel:

1) Deploy a weir (late Aug-early Oct) to catch returning chum spawners to the existing JCL channel; and
2) Conduct weekly spawner surveys for coho (Oct.-Dec.) in the existing JCL channel.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Baseline in year 0

Personnel: Juvenile abundance: 1 technician + 1 biologist 8 hrs/sampling period (monthly Mar-Jun=4 sampling periods)
Chum spawner weir: WDFW biologists + trained volunteers
Coho spawner surveys: WDFW biologists

Cost: Juvenile abundance: $2,624 for sampling team + $200 for nets & field supplies
Chum spawner weir: ~$6,000/year
Coho spawner surveys: ~$2,500/year

Lead: Juvenile abundance: JKT
Chum spawner weir: WDFW
Coho spawner surveys: WDFW

IMPLEMENTATION MONITORING

No implementation monitoring will be required at this phase of the project, because a dry channel will be excavated initially with no connection to the existing JCL channel.

PERFORMANCE MONITORING

Methods and Data Analysis

Juvenile salmonids in new JCL channel:

1) Deploy minnow traps, fyke net and/or beach seine, and/or smolt trap to assess species composition, abundance, outmigration timing, and length-frequency distributions in the new JCL channel (bi-weekly March to June);
2) Compare data collected from the new JCL channel to baseline data collected in the existing JCL channel; and
3) Mark otoliths of salmon fry from the summer chum supplementation program (WDFW).

Adult spawners in new JCL channel:

1) Deploy a weir (late Aug-early Oct) to catch returning chum spawners to the new JCL channel and/or conduct weekly spawner surveys for chum in the new channel;
2) Recover otoliths of returning summer chum spawners to track numbers of natural-origin vs. supplementation-origin summer chum adults, as a measure of population and habitat recovery.
3) Conduct weekly spawner surveys for coho (Oct.-Dec.) in the new JCL channel.
4) Monitor intra-gravel dissolved oxygen (DO) to determine whether spawning gravel has improved; once/month between August and October, collect and titrate samples from 12 sites (4 samples in each of the 3 reaches) along the new channel.

Performance Criteria

1) At the end of 10 years, juvenile salmonid abundance within the restored JCL channel should be higher than the pre-project abundance within the former JCL channel.

2) With improved habitat access, greater spawning area, and improved spawning gravel (i.e. higher intra-gravel dissolve oxygen) available in the new JCL channel, chum and coho spawner abundances should be higher than the pre-project abundances within the former JCL channel.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Juvenile abundance: Years 1, 2, 4, 7, and 10
Mark otoliths: Years 1-10
Chum, and coho spawners: Annually, Years 1-10
Intra-gravel DO: Years 1-3

Personnel: Juvenile abundance: 1 technicians + 1 biologist 8 hrs/sampling period (bi-weekly Mar-Jun=8 sampling periods)
Mark otoliths: WDFW biologists + trained volunteers
Chum spawner weir/surveys: WDFW biologists + trained volunteers
Coho spawner surveys: WDFW biologists
Intra-gravel DO: 2 technicians 8 hours each/month x 3 months

Cost: Juvenile abundance: $5,248/year for sampling team

Mark otoliths: cost is included in chum spawner weir monitoring

Chum spawner weir/surveys: 6,000/year

Coho spawner surveys: $2,500/year

Intra-gravel DO: $1,536/year + $100 materials

Lead: Juvenile abundance: JKT

Mark otoliths: WDFW

Chum spawner weir/surveys: WDFW

Coho spawner surveys: WDFW

Intra-gravel DO: JKT

Contingency Measures

Failure to meet the performance criteria 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.

3.3.5 UPLAND BIRD USE

Historic and Current Conditions

Historic bird use of the JCL channel and corridor is unknown. Seventy bird species were recorded in the vicinity of the proposed project area between 1995 and 1999 (mostly in the estuary). Lower Sequim Bay appears to be a major stopover area for migrating waterfowl and shorebirds and bird use of the adjacent 7 Cedars wetlands is high. The emergent marshes of Sequim Bay support an especially high diversity of bird species. Riparian habitats along JCL offer cover and nesting habitat for waterfowl, songbirds, herons, and raptors (Shreffler 2000).

Restoration Objective

The restoration objective relative to bird use is to increase the amount of habitat available for birds and their prey resources along the new JCL channel. At a later date, a separate monitoring plan will be developed for bird use of the estuary.

Restoration Rationale

By increasing the amount of available habitat supporting native plant communities, the JCL technical group expects to see a corresponding increase in the total number of bird species (i.e., diversity) and the total number of birds of each species (i.e., abundance).

BASELINE MONITORING

Methods and Data Analysis

Gene Kridler, a former USFWS employee and renowned ornithologist, periodically collected birds in mist nests and inventoried both fresh and saltwater use by bird species in the project vicinity between 1995 and 1999. A total of 70 species were recorded between 1995 and 1999, mostly in the estuary. Year-to-year variability in numbers and species in the proposed project area precludes reliable quantification of population trends for individual species or bird groups.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Data exists for 1995-1999

Personnel: 1 volunteer

Cost: unknown

Lead: Gene Kridler

IMPLEMENTATION MONITORING

None

PERFORMANCE MONITORING

Methods and Data Analysis

1) Conduct volunteer bird counts at 2-week intervals from late February through early May during the spring migration and September through October during the fall migration.

2) Conduct a nesting survey once in April and once in May.

3) Conduct a one-time count of over-wintering birds around the time of the annual Audubon Christmas Bird Count.

Make systematic observations from established viewing points of the number, sex, and life stage of each species observed. Note the location of the highest concentrations of each species (e.g., floating in water, perched in tree, in marsh vegetation). Note any indications of mating or nesting behavior. Compare bird species diversity and abundances of individual species between the restored channel and the existing channel. Have all species identifications checked by a recognized expert.

Performance Criteria

Diversity and abundances of birds using the restored JCL site and the area within 50 meters of the site should exceed bird diversity and abundances in the vicinity of the existing channel within 10 years post-construction.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Years 1, 5, and 10 (NOTE: could be done annually, if Audubon volunteers took the lead)

Personnel: trained volunteers + 1 technician for data entry + 1 recognized bird expert for species identifications

Cost: $2,704/year (2 counts/month Feb-May and Sept-Oct=12 technician counts x 4 hrs/count=48 hrs + biologist species verification 8 hrs + technician nesting survey once/month in April & May=2 counts x 4 hrs/count=8 hrs + technician overwintering count once in Dec=8 hrs + technician data entry 8 hrs/year); NOTE: Technician hours for doing the counts could be eliminated, if Audubon volunteers were willing to commit to taking over the monitoring.

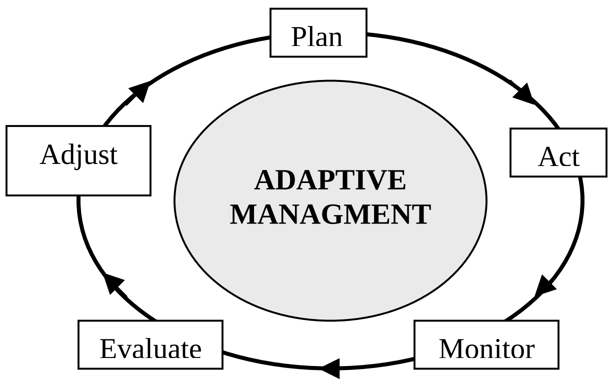
Lead: JKT/Audubon

Contingency Measures

Low bird use of the restored JCL channel may indicate human disturbance. Contingency measures could include limiting public access or planting additional vegetation to serve as a screen from Highway 101 noise.

4.0 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** can be loosely 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 Sections 2.0 and 3.0, the JCL technical group has identified restoration goals and objectives, specific measurable performance criteria to evaluate--through rigorous monitoring--whether those objectives are being met, and potential contingency measures if the objectives are not being met. Adaptive management is the process by which the JCL technical group 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., monitoring) 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 four 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 JCL 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.
3. 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.
4. 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, and hence, monitoring plans must be modified as technical knowledge improves and social preferences change.

5.0 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 5.1. Implementation of the monitoring plan will depend on both volunteers (e.g., Audubon, Streamkeepers, and landowners) and staff from the following entities: CCD, Clallam County, the Jamestown S'Klallam Tribe (JKT), Streamkeepers, and WDFW.

Preliminary cost estimates for each task and subtask over the 10-year monitoring period are summarized in Table 5.2. As discussed in the previous section on adaptive management (Section 4.0), 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 JCL technical team intends to coordinate this monitoring plan for the JCL creek with whatever subsequent monitoring plan is developed for the estuary portion of the project.

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 Costs: 40 hrs/year or ~$2,000/year

Table 5.1. Summary of JCL channel restoration monitoring tasks, subtasks, lead partners, and schedule.

Monitoring Task	Subtasks	Lead Partner	Schedule
Ecological Processes			
Hydrology-baseline	install continuous recording tide gage at mouth of existing JCL channel	CCD	Year 0
	stream flow in existing JCL channel	CCD	Year 0
Hydrology-implementation	as-built drawings for new JCL channel	CCD	Year 0
Hydrology-performance	install continuous recording staff gages at 2 locations in new JCL channel	CCD	Year 1
	download staff gage data, analyze, & plot	CCD	Years 1-10
	stream flow in new JCL channel	CCD	Year 1
Sediment-baseline	pebble counts in existing JCL	CCD/JKT	Year 0
	pebble counts in Salmon Creek	Clallam County/JKT	Year 0
	install scour chains in existing JCL	JKT	Year 0
Sediment-performance	pebble counts in new JCL	CCD	Years 1, 5, 10
	monitor sediment scouring in new JCL	JKT	Years 1, 2
	monitor suspended sediment during flood events	JKT	Years 1-10
Habitat Conditions			
Channel Morphology-implementation	as-built drawings for new JCL channel	CCD	Year 0
Channel Morphology-performance	survey permanent cross-sections	CCD	Years 1,3,5,7,10
	photodocument changes in morphology/topog.	CCD	Years 1-10
	aerial photo analysis	JKT	Years 1-10
Water Quality-performance	quarterly monitoring along new JCL channel	Streamkeepers	Years 1-10
	daily monitoring at McLaughlin property (Jun-Sept)	McLaughlin/JKT	Year 1
LWD-baseline	survey cross-sections above & below LWD	CCD	Year 0
LWD-implementation	document & map as-built locations of LWD	JKT	Year 0
	photograph each LWD placement	CCD	Year 0
LWD-performance	photodocument changes in LWD positions	JKT	Years 1-10
	document habitat forming functions of LWD	JKT	Years 1-10
	re-survey cross-sections	CCD	Years 1, 5, 10
Soils-implementation	document disturbance to existing soils, side-casting of organic mucks, erosion control measures	CCD	Year 0
Flood Conveyance-performance	document/photograph flood damage following storm events	JKT	Years 1-10
Biological Responses			
Riparian Vegetation-baseline	identify & map vegetation and habitat types on aerial photograph	CCD	Year 0
Riparian Vegetation-implementation	Photodocument construction & revegetation activities	CCD	Year 0
Riparian Vegetation-performance	monitor percent cover	CCD	Years 1, 2, 3, 5, 10
	monitor survival	CCD	Years 1, 2, 3, 5, 10
	photodocument revegeted areas	CCD	Years 1, 2, 3, 5, 10

Table 5.1 (continued)

Monitoring Task	Subtasks	Lead Partner	Schedule
Wetland Vegetation-baseline	same as for riparian vegetation	CCD	Year 0
Wetland Vegetation-performance	monitor percent cover	CCD	Years 1, 2, 3, 5, 10
	monitor species composition	CCD	Years 1, 2, 3, 5, 10
	photodocument revegeted areas	CCD	Years 1, 2, 3, 5, 10
Invasive Vegetation-baseline	identify & map existing invasive species on aerial photograph	CCD	Year 0
Invasive Vegetation-performance	re-map invasive species on aerial photograph	CCD	Years 1, 5, 10
Salmonid Use-baseline	monitor juvenile salmonid abundance (March-June)	JKT	Year 0
(existing JCL channel)	monitor returning chum spawners (Aug-Oct)	WDFW	Year 0
	coho spawner surveys (Oct-December)	WDFW	Year 0
Salmonid Use-performance	monitor juvenile salmonid abundance (March-June)	JKT	Years 1, 2, 4, 7, 10
(new JCL channel)	monitor returning chum spawners (Aug-Oct)	WDFW	Years 1-10
	coho spawner surveys (Oct-December)	WDFW	Years 1-10
Bird Use-performance	bird counts biweekly (late Feb-early May; Sept-Oct)	JKT/Audubon	Years 1, 5, 10
	nesting survey (once in April; once in May)	JKT/Audubon	Years 1, 5, 10
	over-wintering count (once in December)	JKT/Audubon	Years 1-10

Table 5.2. Summary of estimated costs for the 10-year JCL channel restoration monitoring program.

Essential Monitoring Tasks & Subtasks	CCD Tech.Hrs $25/hr	CCD Bio.Hrs $35/hr	CCD Eng.Hrs $55/hr	JKT Tech.Hrs $32/hr	JKT Bio.Hrs $50/hr	County Bio.Hrs $40/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:																				
install tide gage old JCL	24	0	0	0	0	0	$600	$2,000	$600	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,600
stream flow in old JCL	16	0	0	0	0	0	$400	$0	$400	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$400
as-built drawings	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
install 2 gages new JCL	48	0	0	0	0	0	$1,200	$2,000	$0	$1,200	$0	$0	$0	$0	$0	$0	$0	$0	$0	$3,200
monitor 2 staff gages	120	0	0	0	0	0	$3,000	$0	$0	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$30,000
stream flow in new JCL	16	0	0	0	0	0	$400	$0	$0	$400	$0	$0	$0	$0	$0	$0	$0	$0	$0	$400
Task Subtotal	$224	$0	$0	$0	$0	$0	$5,600	$4,000	$1,000	$4,600	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	**$36,600**
Sediment Transport & Deposition:																				
pebble counts (old JCL)	8	0	0	0	8	0	$600	$0	$600	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$600
pebble counts(Salm. Cr.)	0	0	0	0	8	8	$720	$0	$720	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$720
pebble counts (newJCL)	8	0	0	0	8	0	$600	$0	$0	$600	$0	$0	$0	$600	$0	$0	$0	$0	$600	$1,800
monitor sed. scouring	0	0	0	96	96	0	$7,872	$500	$0	$7,872	$7,872	$0	$0	$0	$0	$0	$0	$0	$0	$16,244
monitor suspended sed.	0	0	0	8	8	0	$656	$100	$0	$656	$656	$656	$656	$656	$656	$656	$656	$656	$656	$6,660
Task Subtotal	16	0	0	104	128	8	$10,448	$600	$1,320	$9,128	$8,528	$656	$656	$1,256	$656	$656	$656	$656	$1,256	**$26,024**
Habitat Conditions																				
Channel Morphology & Topography:																				
as-built drawings	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
survey cross-sections	24	0	0	0	0	0	$600	$0	$0	$600	$0	$600	$0	$600	$0	$600	$0	$0	$600	$3,000
photodocument	8	0	0	0	0	0	$200	$0	$0	$200	$200	$200	$200	$200	$200	$200	$200	$200	$200	$2,000
aerial photo analysis	0	0	0	0	12	0	$600	$5,000	$0	$600	$600	$600	$600	$600	$600	$600	$600	$600	$600	$11,000
Task Subtotal	32	0	0	0	12	0	$1,400	$5,000	$0	$1,400	$800	$1,400	$800	$1,400	$800	$1,400	$800	$800	$1,400	**$16,000**
Water Quality:																				
Streamkeepers quarterly monitoring	0	0	0	0	0	0	$0	$0	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$110,000
McLaughlin daily monitoring	0	0	0	0	8	0	$400	$200	$0	$400	$0	$0	$0	$0	$0	$0	$0	$0	$0	$600
Task Subtotal	0	0	0	0	8	0	$400	$200	$10,000	$10,400	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	**$110,600**
LWD:																				
survey cross-sections above & below LWD	40	0	40	0	0	0	$0	$0	$3,200	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$3,200
as-built locations	0	0	0	0	40	0	$2,000	$0	$2,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,000
photodocument LWD placements	8	0	0	0	0	0	$200	$0	$200	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$200
photodocument/map changes in LWD positions	0	0	0	0	8	0	$400	$0	$0	$400	$400	$400	$400	$400	$400	$400	$400	$400	$400	$4,000
habitat forming functions of LWD	0	0	0	0	8	0	$400	$0	$0	$400	$400	$400	$400	$400	$400	$400	$400	$400	$400	$4,000
re-survey cross-sections	16	0	8	0	0	0	$840	$0	$0	$840	$0	$0	$0	$840	$0	$0	$0	$0	$840	$2,520
Task Subtotal	64	0	48	0	56	0	$3,840	$0	$5,400	$1,640	$800	$800	$800	$1,640	$800	$800	$800	$800	$1,640	**$15,920**
Soils:																				
document disturbance, erosion, sidecasting during construction	0	0	40	0	0	0	$2,200	$0	$2,200	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,200
Task Subtotal	0	0	40	0	0	0	$2,200	$0	$2,200	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$2,200**
Flood Conveyance:																				
Orsborn flood report	0	0	0	0	0	0	$0	$0	$9,650	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$9,650
document/photograph flood damage	0	0	0	8	0	0	$256	$0	$0	$256	$256	$256	$256	$256	$256	$256	$256	$256	$256	$2,560
Task Subtotal	0	0	0	8	0	0	$256	$0	$9,650	$256	$256	$256	$256	$256	$256	$256	$256	$256	$256	**$12,210**

Table 5.2 (continued).

Essential Monitoring Tasks & Subtasks	CCD Surv. Hrs $25/hr	CCD Bio.Hrs $35/hr	CCD Eng.Hrs $55/hr	JKT Tech. Hrs $32/hr	JKT Bio. Hrs $50/hr	County Bio. Hrs $40/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																				
Riparian Vegetation:																				
I.d. & map vegetation	8	24	0	0	0	0	$1,040	$0	$1,040	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,040
photodocument-constrct.	8	0	0	0	0	0	$200	$0	$200	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$200
monitor percent cover	24	8	0	0	0	0	$880	$200	$0	$880	$880	$880	$0	$880	$0	$0	$0	$0	$880	$4,600
monitor survival	24	8	0	0	0	0	$880	$0	$0	$880	$880	$880	$0	$880	$0	$0	$0	$0	$880	$4,400
photodocument-veg.	8	0	0	0	0	0	$200	$0	$0	$200	$200	$200	$0	$200	$0	$0	$0	$0	$200	$1,000
Task Subtotal	72	40	0	0	0	0	$3,200	$200	$1,240	$1,960	$1,960	$1,960	$0	$1,960	$0	$0	$0	$0	$1,960	**$11,240**
FW Wetland Vegetation:																				
I.d. & map vegetation (see riparian)	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
monitor percent cover	24	8	0	0	0	0	$880	$0	$0	$880	$880	$880	$0	$880	$0	$0	$0	$0	$880	$4,400
monitor species comp.	24	8	0	0	0	0	$880	$0	$0	$880	$880	$880	$0	$880	$0	$0	$0	$0	$880	$4,400
photodocument-veg.	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Task Subtotal	48	16	0	0	0	0	$1,760	$0	$0	$1,760	$1,760	$1,760	$0	$1,760	$0	$0	$0	$0	$1,760	**$8,800**
Invasive Vegetation:																				
I.d./map invasive spp.	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
re-map post-construct.	8	8	0	0	0	0	$480	$0	$0	$480	$0	$0	$0	$480	$0	$0	$0	$0	$480	$1,440
Task Subtotal	8	8	0	0	0	0	$480	$0	$0	$480	$0	$0	$0	$480	$0	$0	$0	$0	$480	**$1,440**
Salmonid Use-baseline:																				
monitor juv. abundance	0	0	0	32	32	0	$2,624	$200	$2,624	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,824
chum spawner weir	0	0	0	0	0	0	$0	$0	$6,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$6,000
coho spawner surveys	0	0	0	0	0	0	$0	$0	$2,500	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,500
Salmonid Use-Performance:																				
monitor juv. abundance	0	0	0	64	64	0	$5,248	$200	$0	$5,248	$5,248	$0	$5,248	$0	$0	$5,248	$0	$0	$5,248	$26,440
chum spawner weir	0	0	0	0	0	0	$0	$0	$0	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$60,000
coho spawner surveys	0	0	0	0	0	0	$0	$0	$0	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$25,000
intra-gravel DO	0	0	0	48	0	0	$1,536	$100	$0	$1,536	$1,536	$1,536	$0	$0	$0	$0	$0	$0	$0	$4,708
Task Subtotal	0	0	0	144	96	0	$9,408	$500	$11,124	$15,284	$15,284	$10,036	$13,748	$8,500	$8,500	$13,748	$8,500	$8,500	$13,748	**$127,472**
Upland Bird Use:																				
bi-weekly counts	0	0	0	56	8	0	$2,192	$0	$0	$2,192	$0	$0	$0	$2,192	$0	$0	$0	$0	$2,192	$6,576
nesting survey	0	0	0	8	0	0	$256	$0	$0	$256	$0	$0	$0	$256	$0	$0	$0	$0	$256	$768
overwintering count	0	0	0	8	0	0	$256	$0	$0	$256	$0	$0	$0	$256	$0	$0	$0	$0	$256	$768
Task Subtotal	0	0	0	72	8	0	$2,704	$0	$0	$2,704	$0	$0	$0	$2,704	$0	$0	$0	$0	$2,704	**$8,112**
Coordination Task:																				
interagency coordination contracting, hiring, etc.	0	0	0	0	40	0	$2,000	$0	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$22,000
Task Subtotal	0	0	0	0	40	0	$2,000	$0	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	**$22,000**
Reporting Task:																				
Data Analysis & Reports	0	60	0	0	110	60	$10,000	$4,000	$0	$10,000	$0	$0	$0	$10,000	$0	$0	$0	$0	$20,000	$44,000
Conferences, Workshops, Public Meetings	0	8	0	0	12	8	$1,200	$0	$0	$1,200	$0	$0	$0	$1,200	$0	$0	$0	$0	$1,200	$3,600
Task Subtotal	0	68	0	0	122	68	$11,200	$4,000	$0	$11,200	$0	$0	$0	$11,200	$0	$0	$0	$0	$21,200	**$47,600**
ESSENTIAL TASKS TOTAL	464	132	88	328	470	76	$54,896	$14,500	$43,934	$62,812	$44,388	$31,868	$31,260	$46,156	$26,012	$31,860	$26,012	$26,012	$61,404	$446,218
SUBTRACT these costs already covered by existing grants	na	na	na	na	na	na	na	$0	$35,710	$23,300	$22,820	$22,820	$18,500	$18,500	$18,500	$18,500	$18,500	$18,500	$18,500	$234,150
ADD 3%/year Cost of Living Increase	na	na	na	na	na	na	na	$435	$1,318	$1,884	$1,332	$956	$938	$1,385	$780	$956	$780	$780	$1,842	$13,387
ADJUSTED TOTAL	424	124	88	280	470	80	$52,240	$14,935	$9,542	$41,396	$22,900	$10,004	$13,698	$29,041	$8,292	$14,316	$8,292	$8,292	$44,746	**$225,455**

6.0 COORDINATION, REPORTING & DISSEMINATION OF MONITORING RESULTS

To date, a number of vital partnerships have been formed and funds in excess of $2.5 million have been spent to accomplish the JCL channel restoration. 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.

Annual Reports

At minimum, the participating parties in the restoration monitoring should produce an annual report, which:

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

The technical group should review each year's draft monitoring report, 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. The final version of each annual report should be available on a website in an easily downloadable format, such as PDF.

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 1-9): $10,000/yr + $1,000 printing/yr
Summary Report (year 10): $20,000 + $2,000 printing

Conferences, Workshops, Public Meetings

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

Estimated Costs: $1,200/year

Journal Publications

To the extent warranted, publications documenting the success or failure of the restoration project should be submitted to peer-reviewed, professional journals.

Estimated Costs: $5,000 in year 10

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APPENDIX A: ADDITIONAL RECOMMENDED MONITORING TASKS

The monitoring tasks described below have been cut and pasted from the main text of this monitoring plan. **The Executive Committee of the JCL-Estuary Restoration Project is not able, at this time, to commit to performing these additional tasks, but is actively seeking to partner with research organizations and funding agencies to implement these tasks as opportunities become available.** Estimated costs for these additional tasks are provided in Table A1 at the end of this appendix.

3.1.1 HYDROLOGY

BASELINE MONITORING

Methods and Data Analysis

Install 3 groundwater monitoring wells: 2 within the floodplain of the new JCL channel (one downstream of the diversion point, one near the McLaughlin property) and 1 east of the existing JCL Creek along Sophus Road. Record groundwater elevations (pre-channel construction) at these three locations.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Year 0 (pre-excavation of new JCL channel)
Personnel: JCL groundwater wells: 1 biologist for 10 hrs to install, test, and monitor
Cost: JCL groundwater wells: $400 to install, test, and monitor + $200 for supplies
Lead: JCL groundwater wells: Clallam County

PERFORMANCE MONITORING

Methods & Data Analysis

Monitor quarterly changes in groundwater elevations post-channel construction to evaluate groundwater exchange and support of stream baseflow.

Performance Criteria

Groundwater will measurably contribute to stream baseflow in the new JCL channel.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Groundwater wells: Quarterly in years 1 and 2.
Personnel: Groundwater wells: 1 biologist 32 hrs/year for data collection, analysis & plotting
Cost: Groundwater wells: $1,280/year for 1 biologist + $300/year supplies

Lead: Groundwater wells: Clallam County

3.1.2 SEDIMENT TRANSPORT & DEPOSITION

PERFORMANCE MONITORING

Methods & Data Analysis

Install Montana quartzite rocks with embedded metals (e.g., steel, brass, copper) to measure sediment transport rates in the new JCL channel. Place 100 quartzite rocks in each of 3 to 5 size groups in reaches 1, 2, and 3 above the Highway 101 bridge, and just downstream of the bridge. Track movements of the quartzite rocks using a metal detector.

Repeat JCL sediment monitoring (i.e., pebble counts, sediment scoring, and sediment transport rates) at Salmon Creek, as a paired reference site.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Sediment transport: Years 1, 5, 10
Salmon Creek monitoring: Years 1-10

Personnel: Sediment transport: 1 biologist 16 hrs/year
Salmon Creek monitoring: 40 hrs/year CCD technician + 100 hrs/year JKT technician + 116 hrs/year JKT biologist

Cost: Sediment transport: $640/year for biologist + $150 for metal detector
Salmon Creek monitoring: ~$10,000/year

Lead: Sediment transport: Clallam County
Salmon Creek monitoring: JKT

3.2.1 CHANNEL MORPHOLOGY & TOPOGRAPHY

PERFORMANCE MONITORING

Methods and Data Analysis

Use orthophotos to digitally calculate areas of different habitat types (e.g., channel, riparian corridor, wetlands) within the JCL project area and in the Salmon Creek reference site.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Digital orthophotos: Once in year 10 only.

Personnel: Digital orthophotos: 1 biologist 16 hrs in year 10

Cost: Digital orthophotos: $640 in year 10 for biologist + $10,000 in year 10 for digital orthophotos of JCL and Salmon Creek.

Lead: Digital orthophotos: Clallam County.

3.2.4 SOILS

PERFORMANCE MONITORING

Methods and Data Analysis

1) Monitor channel avulsion (or signs of potential avulsion) around the Spruce tree in Reach 1 and downstream near the pond in Reach 3.

2) Monitor bank competency by soil type.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Years 1-3.

Personnel: none identified

Cost: not estimated

Lead: CCD?

3.3.4 SALMONID USE

BASELINE MONITORING

Methods and Data Analysis

Juvenile salmonids in existing JCL channel:

1) Analyze the gut contents of a subsample of the juvenile chum salmon collected in #1 above to assess foraging success and prey species preferences (take subsamples at minimum once/month from March to June); and
2) Conduct a mark and recapture study to assess residence times and growth: mark different species of juvenile salmonids collected in #1 above with unique fin clips and release alive (March to June).

Adult spawners in existing JCL channel:

1) Conduct weekly spawner surveys for steelhead (Jan.-Mar.) in the existing JCL channel (WDFW)

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Baseline in year 0

Personnel: Chum gut contents: 1 taxonomist for species identifications of consumed prey
Residence times & growth: 2 technicians + 1 biologist 8 hrs/sampling period (bi-weekly Mar-Jun = 8 sampling periods)
Steelhead spawner surveys: 1 biologist for 4 hrs/sampling period (once/week Jan-Mar=12 weeks)

Cost: Chum gut contents: $3,000 for invertebrate taxonomist (15 samples/month x 4 months =60 samples @ $50/sample)
Residence times & growth: $7,296 for sampling team + $100 field supplies
Steelhead spawner surveys: $2,400 for biologist

Lead: Chum gut contents: JKT
Residence times & growth: JKT
Steelhead spawner surveys: JKT

PERFORMANCE MONITORING

Methods and Data Analysis

Juvenile salmonids in new JCL channel:

1) Analyze the gut contents of a subsample of the juvenile chum salmon collected in #1 above to assess foraging success and prey species preferences (take subsamples at minimum once/month from March to June); and
2) Conduct a mark and recapture study to assess residence times and growth: fin clip different species of juvenile salmonids collected in #1 above with unique clips (March to June).
3) Compare data collected from the new JCL channel for 1, 2, and 3 above to baseline data collected in the existing JCL channel.

Adult spawners in new JCL channel:

1) Conduct spawner surveys for steelhead (JKT), or use the weir to monitor other adult salmonids that spawn later in the fall/winter after the chum?

Performance Criteria

1) At the end of 10 years, juvenile chum salmon growth within the restored JCL channel will be higher than the pre-project abundance within the former JCL channel.

2) At the end of 10 years, juvenile chum salmon residence times within the restored JCL channel will be higher than the pre-project abundance within the former JCL channel.

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Chum gut contents: Years 1, 2, 4, 7, and 10
Residence times & growth: Years 1, 2, 4, 7, and 10
Steelhead spawner surveys: Annually, Years 1-10

Personnel: Chum gut contents: 1 taxonomist for species identifications of consumed prey
Residence times & growth: 2 technicians + 1 biologist 4 hrs/sampling period (bi-weekly Mar-Jun = 8 sampling periods)
Steelhead spawner surveys: 1 biologist for 4 hrs/sampling period (once/week Jan-Mar=15 weeks)

Cost: <u>Chum gut contents</u>: $3,000 for invertebrate taxonomist (15 samples/month x 4 months =60 samples @ $50/sample)
<u>Residence times & growth</u>: $7,296/year for sampling team + $100/year field supplies
<u>Steelhead spawner surveys</u>: $3,000/year for biologist

Lead: <u>Chum gut contents</u>: JKT
<u>Residence times & growth</u>: JKT
<u>Steelhead spawner surveys</u>: JKT

3.3.6 INVERTEBRATE PREY PRODUCTION

<u>Historic and Current Conditions</u>
No historic information is available on invertebrate prey production within the existing JCL channel or the 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 September 2000, when Streamkeepers collected and identified benthic macroinvertebrates from two reaches along the existing JCL channel. Reach 1 was downstream (north) of Highway 101 and just south of the Old Blyn Highway Bridge. Reach 2 was 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 and other fish species using the new JCL channel 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 will be added to supplement the Streamkeepers sampling:

Benthic macroinvertebrates: Take 10 sediment core samples haphazardly distributed along the JCL channel and 10 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.

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 along the stream channel and five 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: $1,168
Insect fallout samples: $1,168
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: Streamkeepers/JKT

IMPLEMENTATION MONITORING

None

PERFORMANCE MONITORING

Methods and Data Analysis

Repeat the methods outlined in the baseline monitoring section in the new JCL channel.

Performance Criteria

The species diversity, density (no. m^{-2}), and standing stock (g wet m^{-2}) of benthic macroinvertebrates and insects within the realigned JCL channel should: 1) equal or exceed species diversity, density, and standing stock for the existing JCL channel at the end of 10 years, and 2) be comparable to appropriate reference sites 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: $1,168/year
Insect fallout samples: $1,168/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: Streamkeepers/JKT

Contingency Measures

Lack of a productive benthic 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.

3.4 MONITORING OF CHANGES IN SURROUNDING LAND USE

Historic and Current Conditions

Virtually all of the area surrounding the lower 1.8 miles of JCL was historically wetland. Existing land uses immediately adjacent to the lower 1.8 miles of JCL include farmland, private residences, and a former dance hall on the Eng property.

Restoration Objective

The restoration objective relative to changes in surrounding land use is to ensure that ecological processes, habitat conditions and functions, and the resultant benefits to fish, wildlife, and people are maintained in perpetuity.

BASELINE MONITORING

Methods and Data Analysis

A GIS map of existing and proposed land uses in the vicinity of the project area has been developed by the Tribe (see Figure 4.1, Shreffler 2000).

IMPLEMENTATION MONITORING

Not applicable

PERFORMANCE MONITORING

Methods and Data Analysis

1) Field survey (“windshield survey”) to identify:

- new construction of businesses, residences, roads, trails, or utilities;
- new conservation easements;
- vegetation removal;
- shoreline modifications;
- water diversions out of JCL; and
- any other changes in land use that have the potential to affect the restoration site either positively or negatively.

2) Produce a new GIS map of existing land uses five years and ten years post-construction.

Performance Criterion

Not applicable

Timeline, Personnel, Cost Estimate, and Lead

Timeline: Field Survey: Annually, years 1-10
GIS maps: years 5 & 10 only.

Personnel: Field Survey: 1 technician 8 hrs/year
GIS maps: 1 technician 8 hrs in years 5 and 10

Cost: Field Survey: $256/year for technician
GIS maps: $256/year for technician

Lead: JKT

Contingency Measures

Land use changes that are deemed to deleteriously affect the restoration site should trigger enforcement investigations. Contingency measures could include discussions of the need for better enforcement of existing regulations or new land-use regulations.