Deschutes River Estuary Restoration Feasibility Study Plan

Project Description

One of the fourteen Management Objectives in the *2003-2013 Capitol Lake Adaptive Management Plan* (CLAMP) is to determine the best long-term aquatic environment for Capitol Lake and the Deschutes River estuary. More than 150 years of urban development has created a Puget Sound shoreline which is significantly different than the historical Budd Inlet estuary. The Deschutes River estuary and Budd Inlet have been reduced in size by 124 acres of fill. The dam at Fifth Avenue has caused the accumulation of over 1.8 million cubic yards of sediment in the past 50 years.

Capitol Lake was created by damming the lower Deschutes River. This study seeks to identify the properly functioning conditions of a restored estuary based upon its physical and biological processes. Estuaries are based on tidal processes, particularly in the inter-tidal portion of the shore. All of the area within the current Capitol Lake basin would be an inter-tidal shoreline if restored to an estuary. Tidal inundation is essential to estuarine processes.

Capitol Lake - Historic Shoreline & Filled Land

The construction of the Capitol Lake dam has caused the impoundment of nearly the entire Deschutes River sediment load. Sediment accumulation in the basin will be examined relative to properly functioning estuary processes. The study will determine if a self-sustained routing of sediment is possible within the restored estuary and as it flows into southern Budd Inlet. The ultimate fate of this transported sediment and its effect on activities in Budd Inlet will also be addressed.

Capitol Lake was created in 1951, by action of the state legislature, to fulfill the 1911 Wilder and White Capitol Campus Plan. Acres of park lands, thousands of feet of pedestrian walkways, and two miles of roads now line its shores. These sites are the focal point for community festivals and redevelopment of downtown properties. This study seeks to establish if a restored estuary is feasible, identify how a restored estuary would function, and determine the acceptance of an estuary in this urban setting.

There are many questions that need to be answered before we can determine the best long-term course of action for Capitol Lake. The Estuary Feasibility project is a study to get some of those answers, not a proposal for the conversion of Capitol Lake to an estuary.

Project Objectives and Requirements

The objectives of the estuary feasibility study are to evaluate the possibility of a restored estuary as an alternative to the continued management actions necessary to maintain a lake in this setting; to formulate, evaluate, and screen potential benefits and shortcomings associated with the estuary alternative; and to recommend a series of actions and projects that have a reasonable likelihood of success, can be permitted by the regulatory agencies, and are supported by the local community.

Essential elements of a balanced and objective estuary feasibility study include:

- Rely upon the CLAMP Steering Committee to make the policy decisions about the Feasibility Study.
- Use the CLAMP Technical Advisory Committee to review technical material and provide a recommendation to the CLAMP Steering Committee.
- Hire consultants using an open selection process for Feasibility Study tasks which are beyond the expertise or time line for the CLAMP members to produce.
- Involve CLAMP Steering and Technical committee members in any consultant selection process.
- Incorporate an "Independent Review" process to review completed tasks of the Feasibility Study scope of work.
- Hold timely public meetings and other readily available sources (e.g., WebPages, press releases) to gather public input and to report information.
- Update the State Capitol Committee on the progress of the Feasibility Study.

Project Goals

Produce an objective evaluation of the possibility and potential benefits and risks associated with restoring Capitol Lake to an estuary.

The goals of the **estuary restoration study** are:

- Increase our understanding of the estuary alternative to the level that we currently have about managing the lake environment.
- Determine if it is possible to create a viable, self-sustaining estuary at Capitol Lake, given all the existing physical constraints and the urban setting.
- Identify the potential effects beyond Capitol Lake such as flooding, existing infrastructure, sedimentation, and water quality in Budd Inlet.
- Create a net-benefit matrix which will allow a fair evaluation of overall benefits and costs of various alternative scenarios.
- Provide the completed study to the CLAMP Steering Committee so that a recommendation about a long-term aquatic environment of the basin can be made.

To aid in the evaluation of alternatives and the preparation of a management recommendation we need to identify the features for defining a successful estuary

restoration project within the context of the current urban setting of downtown Olympia. The features of successful **estuary restoration** would include:

- Restore critical estuarine processes in the Deschutes River estuary
  - Reconnect the Deschutes River with Budd Inlet
  - Tidal exchange throughout the basin
  - Estuarine sediment transport
  - Estuarine morphology
  - Utilization by expected and desired plant and animal species
  - Minimum utilization by non-native or undesirable species
- Protect civic and recreational values of the basin
  - Maintain and improve recreational opportunities
  - Address the desire for a reflecting pool for the Capitol Building
  - Maintain or improve wildlife watching opportunities
  - Maintain or improve normal park activities and fairs
  - Maintain or improve fishing opportunities
  - Minimize the risk of flooding, both from tide and river discharge
  - Improve water quality in the Deschutes River basin and Budd Inlet
  - Address maintenance needs (e.g., infrastructure, dredging, shoreline stabilization, aquatic weed control, etc.) in the lake, estuary, and marine waters
  - Address concerns over odors from various sources

Work Outline

1. Establish a Technical Advisory Committee (TAC)

2. Create Conceptual Models of Estuarine and Civic Functions
   - Naturally Functioning Estuarine Community
     - Normal estuarine interrelationships, growth and mortality
     - Expected indigenous species
     - Minimal non-indigenous species
     - Non-limiting water quality
     - Ecological succession
   - Naturally Functioning Fluvial Geomorphology
     - Free movement of fluvial, stored, and marine sediments
     - Expected estuarine morphological succession
   - Integrated Urban Estuary
     - Acceptance of an estuary (i.e., the exchange of lake for an estuary)
     - Civic benefits of estuary (flood attenuation, lack of maintenance)
     - Stewardship (local contribution to regional resource)

3. Develop a Public Outreach and Communication Strategy
   - Legislature
   - Media
   - Community

- Meetings and public workshops
- Newsletters

4. Collect and Analyze Existing Information
   - Historical and Existing Hydrologic, Hydraulic, Sedimentation, and Sediment Quality Conditions
     - Pre-dam bathymetry
     - Recent bathymetry
     - Interim (filling) bathymetries
     - Volume change analysis
     - Sediment characteristics (underlying and deposited) settlement, erosion, consolidation, sand and mud fractions.
     - River discharge and sediment load (historical, present, future)
     - Historical and existing hydrologic and hydraulic studies
     - Historical and existing sediment transport and sedimentation studies
     - Historical and existing sediment quality studies
   - Historical and Existing Water Quality Conditions
     - Historical water quality description
     - Existing water quality assessment
   - Historical and Existing Biologic Conditions
     - Historic conditions description
     - Existing habitat assessment
   - Historical and Existing Geologic, Geotechnical, and Seismic Conditions
   - Historical and Existing Social, Cultural, Economic, and Recreational Opportunities
   - Results From Other Dam Removal Actions

5. Identify and Evaluate Reference Estuaries
   - Basin geometry and geomorphology
   - Fine sediment deposition rate
   - River discharge
   - Sediment discharge
   - Human modifications and other impacts
   - Estuary type and associated habitats
   - Plant communities

6. Hydraulic and Sediment Transport Analysis
   - Model Historic Deschutes Estuary
     - Obtain base-line estimates of historical hydrodynamics, sediment transport and morphological changes
     - Correlate estimated physical characteristics with historical habitats
   - Model Infilling of Lake
     - Location and rates of filling approximately
     - Patterns of deposition of different sediment fractions
     - Importance of wave action in deposition

- Model Re-Opening of Lake*
  - Identification of Preliminary Alternatives
    - Various opening widths
    - Possible alternatives at railroad trestle
  - Hydrodynamics
    - Tidal and riverine current velocities
    - Stratification and salinity patterns
    - Residence times v. tidal flushing
    - Inundation durations
    - Wave action on varying water levels
    - Flood flow and base flow conditions
  - Sediment Transport
    - Scour, transport, and deposition from riverine and tidal effects
    - Mud and sand interactions
    - Fluid mud flows
    - Biological and geological controls on erosion
    - Predict timescales of morphological change
  - Morphological Change
    - Initial change patterns expected
    - Long-term change patterns expected
    - Predict possible future morphology, e.g., steady state conditions
    - Predicted changes in hydrodynamics & sediment transport caused by predicted changes in bathymetry
- Reevaluate Alternatives Selected
  - Determine if Additional Alternatives are Needed

7. Net Benefit Analysis
   - Identify Benefits, Problems, Constraints, Opportunities, and Concerns Raised Through Public Outreach Efforts
     - Environmental
     - Political
     - Economic
     - Regulatory
     - Community/Social
   - Summarize Findings From Data Collection
   - Summarize Existing Future Conditions Scenarios without the Estuary
     - Fresh Water Lake with Maintenance Dredging
     - Fresh Water Impoundment without Dredging
   - Comparative Analysis of Lake, River, and Estuary Alternatives

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* When this study task is complete, all the necessary information should be available to evaluate the feasibility of establishing a self-sustaining estuary at Capitol Lake. An interim report should be assembled and an external review panel called upon to evaluate it.

8. Final Report and Recommendation
   - Present CLAMP Steering Committee, GA Director, State Capitol Committee, and other decision makers with a Preferred Management Alternative

Project Elements

Technical Advisory Committee

The CLAMP Steering Committee relies on Technical Advisory Committees (TAC) to develop and review information and to make recommendations. A TAC is generally an *ad hoc* group consisting of staff from CLAMP member agencies and jurisdictions and other experts on a given topic. For this study, a specially selected TAC will be used to guide the study process and address significant issues as they are identified. Independent technical review of all phases of the project is also proposed.

Conceptual Model

Based on the efforts of the Puget Sound Nearshore Ecosystem Restoration Project's (PSNERP) Nearshore Science Team, the conceptual model has become an accepted method to organize restoration studies. The conceptual model outlines the major processes and constraints that are present in the estuary and how they create and support habitat or structure, which in turn leads to specifically addressed goals or desired services. Constraints, or limiting factors, interfere with, or have the potential to interfere with processes and the formation of structure. What are the important elements of lower Puget Sound estuaries; physical, biological, chemical, social? Which of these elements must be included in the study? How do they influence the success of the project? How long do they take to develop? These and similar questions must be addressed in a systematic way.

Three conceptual models have been identified for this study and must be developed in some detail to address specific functions. These three models will guide the informational part of the feasibility analysis:

- **Naturally functioning estuarine community**
- **Naturally functioning fluvial geomorphology**
- **Integrated urban estuary**

Constraints in the Integrated Urban Estuary model are issues that must be addressed affecting social, political, and economic concerns, rather than physical or biological processes as in the other models, such as the likely need for dredging in the Port of Olympia. Certain elements of the Urban Estuary model are dependent on the results of the hydraulic and sediment transport analysis. The integrated urban estuary model must be defined and developed with considerable participation from the community. We recognize that the public are the experts in this field.

Public Outreach

A three-phased public outreach and communication strategy will be developed focusing on the legislature, the media, and the community. Public Information Specialists from CLAMP member agencies and jurisdictions will develop the communication strategy and key messages.

Data Gathering

The primary purpose of the data gathering component of the restoration study is to provide the information needed to determine the possibility of returning Capitol Lake to the Deschutes River estuary. New information will be used, along with what we already know about various dredging scenarios and the consequences of doing nothing, to guide the community and other decision makers to the best long-term course of action for the management of what we know as Capitol Lake. The data should be able to tell us if restoration will work; in other words, can we get a naturally functioning, self-sustaining estuary.

Collect and analyze existing information

Many studies have been conducted in the Deschutes River, Capitol Lake, and Budd Inlet and those data and results contribute to our understanding of the past and present conditions of Capitol Lake. This information should be collected and summarized so we can learn from what we already know and so we don't inadvertently repeat some analysis that has already been completed. Theses studies include analysis of water quality, land use, fish and wildlife, sedimentation patterns, vegetation communities, etc.

Identify and Evaluate Reference Estuaries

Estuary restoration is not simply a matter of restoring the exchange of tidal flow through a dike or other barrier dam. Estuary processes are complex, subtle and probably sensitive to many design concerns in restoration projects. The fact that tide water moves in and out of the "restored" estuary does not mean that a full range of estuary functions will occur as we expect them to. This portion of the study will examine neighboring natural and urbanized estuaries to determine what processes make them function properly and to determine the important areas to concentrate the rest of this study. An initial list of variables to be measured is proposed here:

Basin geometry and geomorphology: The transformation of the historical estuary type may occur when an estuary is closed off at the mouth and other significant physical modifications.

Fine sediment deposition rate: The movement of sediment is a critical issue for estuary function and the downstream effect in Budd Inlet.

River discharge: The relationship between the flows of the river and tidal volume should be considered.

Sediment discharge: Particle size distribution of transported material (coarse vs. fine) is an important factor affecting many aspects of estuary function.

Human modifications and other impacts: The extent of watershed development, stormwater inputs, adjacent development, etc, can have a significant impact on estuary function.

Estuary type and associated habitats: The biological and physical attributes of estuaries can define important habitat attributes.

Plant communities: Species assemblages associated with the estuary types and physical characteristics and their relation to tidal elevation and other controlling factors.

Hydraulic and Sediment Transport Analysis

The objective of this study is to provide insight into the hydrodynamics (the movement of water) and sediment transport that will occur within Capitol Lake and lower Budd Inlet under several different restoration scenarios in an attempt to improve understanding of the likely consequences of restoration actions.

Certain physical measurements will have to be made to do the hydraulic and sediment transport analysis. The bathymetry will be surveyed as well as other features that will affect river and tidal flow. The configuration of Capitol Lake has been changed dramatically with constrictions separating the lake into four basins – north, middle, south, and Percival Cove. These changes will be factored into the analysis.

The US Geological Survey (USGS) has been contracted to perform this phase of the study. They will use the Delft3D numerical morphological model, in conjunction with the wave model SWAN, to gain an understanding of the mechanisms by which tidal and storm processes influence the transport of sand and mud in and around a proposed restored Deschutes estuary and lower Budd Inlet. As part of this study they will develop and implement a process-based morphological model to simulate tidal and river currents, wave-driven bottom stresses, sediment transport, and morphological change. This will involve developing the model grid, determining boundary conditions, and obtaining existing data on winds, tidal elevations and currents in Budd Inlet. Sufficient data (bathymetry, water levels, bottom sediment type, winds, etc.) should exist to initiate modeling that can provide insights into the general trends and patterns of sediment transport.

The model will be used to first simulate the condition of the Deschutes River estuary prior to dam construction and flow modification. These modeled conditions will be used as a reference for comparing to possible future conditions under various restoration scenarios. The model will also estimate the sediment filling of Capitol Lake after dam construction. If possible, the modeled filling of the lake will be compared to actual measured sediment filling data, through bathymetric change analysis. Finally, the model will include the hydrodynamics and sediment transport in the area of the lake under various dam removal scenarios.

The preliminary results of the study will consist of a series of annotated plots and animations showing the spatial and temporal patterns of water flow, sediment transport, and morphological change that likely existed in the estuary prior to dam construction, as well as simulations of sediment filling after dam construction. Final results will include a

series of annotated plots and animations showing the spatial and temporal patterns of flow, sediment transport, salinity, and morphological change that may occur in the vicinity of the restored Deschutes estuary.

These studies will require some initial assumptions about the project design, which should be selected to accommodate a broad range of possible designs. Because of its influences upon estuarine processes, the primary design issue will be the opening width at the mouth of the River. The 4th Avenue Bridge will likely determine the maximum opening width. The feasibility study will need to determine if the opening under the new 4th Avenue bridge will meet the goals of estuary restoration. Other alternatives that may be considered include modifications to the constriction at Marathon Park.

The study results will then be compared to the characteristics of known estuary types. Designs that match site conditions with self-sustaining, productive reference estuaries would move forward to the net benefit analysis. Alternatives that do not lead to self-sustaining, biologically productive estuaries should be clearly identified, as such.

There will be several informal public briefings to discuss initial model development and results as this phase of the project progresses. At this point in the study all the necessary information should be available to evaluate the feasibility of establishing a self-sustaining estuary at Capitol Lake. An interim report should be assembled and an external review panel called upon to evaluate it. A final report with discussion of model development, uncertainties, and key findings will be prepared.

Net Benefit Analysis

The Net Benefit Analysis is simply that – a look at all the needs and all the interests surrounding Capitol Lake and the Deschutes River and deciding what is the best thing to do in light of everything we know. Community values and recreation will be an important part of any plan for the future of Capitol Lake. It will be necessary to assess the impact of a Deschutes estuary on the community and its existing infrastructure in light of new information and changing conditions.

This stage of the project will identify key uncertainties, potential constraints, and limiting factors, in transforming Capitol Lake into an estuary on the basis of current conditions compared to historic and reference estuary conditions. These uncertainties will help guide numerical modeling, public communication, design alternatives, and, ultimately, a final recommendation.

Some of the potential constraints have been identified in the conceptual models for naturally functioning estuaries, self-sustaining sediment transport, and community interests and values. Other constraints and concerns will undoubtedly be identified during the study period. Identifying and addressing these constraints and concerns is a vital component of the study. The communication of this evaluation and the results will be critical to the ultimate success of the study. Public participation will be welcome and encouraged as much as possible.

The results of the hydraulic and sediment studies will define the limits of the potential for development of estuarine conditions. Slight changes in controlling factors such as the size of the opening at the mouth of the river may affect estuary processes and the resulting functions provided. Sediment released from the lake may impact existing nearshore habitat in lower Budd Inlet as well as activities at the Port of Olympia and the Olympia Yacht Club.

The study must also determine the likelihood of success; can the physical, chemical, and biological processes that are necessary to support an estuary be replaced? The feasibility study will identify the expected estuary type for this restoration action based on the findings from the reference estuaries, the estuarine processes that will be restored, and what can be expected given the limitations of current shoreline conditions. In some estuary restorations specific habitat types have not formed as expected. This study should predict the estuary restoration trajectory and identify where complications may arise. The role of noxious weeds, such as milfoil, Spartina, and purple loosestrife, in an estuary restoration project will be investigated. Further, the presence of other nuisance species (such as resident Canada geese) may complicate restoration efforts. The potential for the exposure of contaminated sediments or other hazards will be examined.

The role of the restored estuary in the community will be explored. It is important to look at this role over the past 50 years, when we had a lake in the city, and the previous 50 years when there was an estuary in Olympia. The uses and benefits of estuaries in other urban areas should be used as a comparison, just as we use reference estuaries to guide restoration.

The community, economic, engineering, ecological, and biological benefits and costs for each reasonable alternative will need to be examined in this part of the study. Short and long-term benefits and consequences will be evaluated as part of this analysis. Such things as the transition effects from lake to estuary, the long-term consequences to the lake without dredging, and the practical implications of a long-term dredging scenario will be considered. A common currency should be developed so that comparisons can be made across the full range of alternatives. An important consideration for selecting a preferred alternative will be that the community understands and believes that the benefit-cost analysis was fair and equitable. The public will be involved throughout the process to help develop the criteria to make this final analysis.

Final Actions

The next and final step in this project is what to do with the information generated from the estuary feasibility study. A final report and a management recommendation will be presented to the CLAMP Steering Committee and other decision makers based on the results of this study. The process for making the actual management decision on the future of Capitol Lake and the Deschutes River is beyond the scope of this project.