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DEPARTMENT OF ENTERPRISE SERVICES

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The following section is from the "Deschutes Estuary Feasibility Study Final Report," June 27, 2008

Prepared for Washington Department of Fish and Wildlife

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Section 5, Summary of Technical Studies

A full copy of the report is available at:

http://des.wa.gov/SiteCollectionDocuments/Facilities/DEFS_Final_Report.pdf

5. SUMMARY OF TECHNICAL STUDIES

To analyze the environmental and socio-economic consequences of the DEFS alternatives, four technical studies were commissioned by Thurston Regional Planning Commission Washington Department of Fish and Wildlife (WDFW), on behalf of the Capitol Lake Adaptive Management Plan (CLAMP) Steering Committee, detailing:

1) Sediment Transport & Hydraulic Modeling (George and others, 2006)
2) Reference Estuary Study & Biological Conditions (Garano and others, 2006)
3) Engineering Design & Cost Estimate (Moffat and Nichol and others, 2007)
4) Net Social and Economic Benefit Analysis (Cascade Economics and others, 2007)

Subsequently, an Independent Technical Review (PWA, and others 2006) was commissioned to assess whether the technical studies addressed the question: is it feasible to restore estuarine processes to Capitol Lake? The Independent Technical Review Team review provided an assessment of the scientific objectivity and technical merits of each report and provided a consensus review that integrated disciplines across the four reports.

Details of each study and the Independent Technical Review can be found in the technical reports available on the CLAMP website http://www.ga.wa.gov/CLAMP/EstuaryStudy.htm .

5.1 SEDIMENT TRANSPORT AND HYDRAULIC MODELING

A central aspect of the DEFS study is to understand how the lake/estuary environs would change under the proposed restoration scenarios, particularly how the accumulated sediments behind the dam will be redistributed following removal of the dam. To provide a scientific foundation the USGS was commissioned to develop a hydrodynamic and sediment transport model to characterize the flow of tidal waters and the movement of sediment (George and Others, 2006). Key concerns include adjustment of the lake bed morphology, development of scour zones under bridges, deposition of eroded sediment in the Port of Olympia, coarsening or fining of habitat substrate and exposure of biological communities to saline or brackish water.

To address these questions, the USGS used Delft3D, an established hydrodynamic and sediment transport numerical model developed by Delft Hydraulics. The model was driven using tides for Budd Inlet, river discharge from the Deschutes River with sediment input and salinity as constituents. The modeling results provided a quantified assessment of estuarine behavior both prior to dam construction and after each post-dam removal scenarios.

Overall, the modeling study found that after dam removal, tidal and estuarine processes would be immediately restored, with marine water from Budd Inlet being carried into North and Middle Basin on each rising tide and mud flats being exposed with each falling tide. Within the first year after dam removal, tidal processes, along with occasional river floods, would modify the estuary bed by redistributing sediment through erosion and deposition. The morphological response of the bed would occur most rapidly during the first couple of years, and slow over time. By ten years after dam removal, the USGS study concluded, the overall hydrodynamic and morphologic behavior of the estuary is similar to the pre-dam estuary, with the exception of South Basin, which has been extensively modified by human activities.

Predicted bathymetry and tidal elevation outputs from the model were used by the Reference Estuary and Biological Conditions Study, and estimates of flow velocities and mobilized sediment volumes by the Engineering Design and Cost Estimating Study.

5.2 REFERENCE ESTUARY STUDY AND BIOLOGICAL CONDITIONS

The task of the Biological Study was to determine whether an estuarine community, with diverse populations of plants and other organisms, could be reestablished in southern Budd Inlet. The study (Garano and others, 2006) was divided into two separate studies:

1. A Reference Estuary Study consisting of field sampling of selected environmental variable in several estuaries analogous to the potential Deschutes Estuary. Five reference estuaries were examined: Woodard Bay, Ellis Cove, Mud Bay, Kennedy Creek and Little Skookum Bay.

2. A Biological Conditions Study that sought to combine the collected field data with results from the USGS Hydrodynamic and Sediment Transport Study.

It was concluded that for all restoration alternatives the hydrology, salinity and topography within the Deschutes estuary, as predicted by the USGS analysis, would fall within the range of those occuring within nearby reference estuaries. The study described that following dam removal the estuary would consist primarily of intertidal mudflats (exposed during low tides and submerged during high tides) with a narrow fringe of vegetated marsh around the periphery of the estuary and with subtidal sandy channel connecting the river through to Budd Inlet.

5.3 ENGINEERING AND DESIGN COST ESTIMATING

Preliminary designs and cost estimate of each of the three proposed restoration alternatives were prepared. This study determined that there are no significant technological constraints to prevent restoration of tidal conditions to the Deschutes River estuary.

To address some concerns about sediment accumulating in dredged channels downstream of the dam the engineers recommended that, for any of the alternatives, the main channel be dredged before the reestablishment of tidal flow, and that dredged material be used to create intertidal habitat along Deschutes Parkway. It was anticipated that dredging the channel would reduce the amount of sediment that would scour from the reconnected estuary and be transported downstream to Port of Olympia and associated marina channels.

The engineers also recommended that the reflecting pool, in Alternative D, be a salt water pool with muted tidal flow. This would allow flushing of the pool to assist in maintaining water quality. If a freshwater pool were to be maintained, an artificial recirculation system and the use of reclaimed water in significant quantities would be necessary.

Construction for all alternatives could be achieved within three to four years, working under the assumption that the chinook salmon and bull trout windows for in-water work are observed.

An engineer's cost estimate is provided, based upon the developed designs. The average engineers' project cost estimates ranged from $76 million, $90 million and $106 million dollars for Alternatives A, B and D, respectively[1]. The low and high range of Alternatives A, B and D total project costs are $66 to $87 million dollars, $80 to $102 million dollars and $94 to $120 million dollars, respectively.

Approximately one-half of the variability in the estimated project costs are associated with the initial dredging of the basin and placement of the dredged material along the Deschutes Parkway to create intertidal habitat. The engineers estimate that a greater quantity of initial dredging, associated with initial costs, would most likely lead to lower costs in later years associated with dredging the marinas along Percival Landing and at the Port of Olympia.

5.4 NET SOCIAL AND ECONOMIC BENEFITS ANALYSIS

Placing an economic value on the environmental change is a challenging task. The socio-economic study was constrained by considerable information gaps that resulted in large uncertainties in the assessment of project benefits. Such a study outcome is a common occurrence when the requirements of an economic assessment are not directly incorporated into the planning of deliverables from scientific and engineering assessment studies. Nevertheless, by undertaking this pilot study at an early stage of the planning processes, a number of information needs have been identified wherein future assessment will improve understanding of project socio-economic costs and benefits. The DEFS Team convened a group of citizens to develop a set of community priorities and concerns. This "visioning" process set the framework for the social analysis. Not surprisingly, the Net Social Benefit and Economic Analysis (NSEBA) revealed a variety of opinions and values among community members.

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[1] Dollar values are given based upon costs in 2006.

5.5 INDEPENDENT TECHNICAL REVIEW

The following conclusions were drawn by the Independent Technical Review (ITR).

Overall, the DEFS technical studies did not identify any significant impediments to restoring estuarine conditions in the lower Deschutes estuary. However, the technical studies did not cover the full range of analysis required to provide for a full feasibility assessment. Some uncertainties exist, which may not be reconcilable with the information at hand; for example: i) further refinement to estimates of the volume of sedimentation in downstream dredged channels post estuarine restoration; and ii) socio-economic implications of potential restoration activities. The ITR identified a number of additional studies to assist in filling data gaps.

5.5.1 Level of Certainty

The technical studies have different levels of certainty in defining the specific outcome of estuarine restoration (Table 1). Higher degrees of certainty are found within the hydraulic and sediment transport assessment, and the engineering cost estimates. Lesser degrees of certainty are associated with quantifying ecological outcome and defining socio-economic consequences of estuarine restoration. While restoration of estuarine conditions appears physically and biologically broadly feasible the socio-economic net benefits remain unclear at this stage.

Table 1. A Qualitative Summary of Confidence in Technical Study Results

DEFS Technical Reports	Confidence in General Outcome	Confidence in Accuracy of Predictions	Potential for Surprises
Tidal Exchange	High	High	Low
Sediment Transport	High	Medium	Medium
Estuarine Ecology	High	Medium	Low
Engineers Estimates	High	Medium	Medium
Socio-economic Net Benefit	Low	Low	High

5.5.2 Recommendations of the Independent Technical Review

The following recommendations were made in the ITR to facilitate the Alternatives Assessment:

1. **Develop a common project understanding.** Integrate level of understanding across project partners regarding key concepts and requirements.

2. **Set planning and study expectations.** "Feasibility study" and "net benefits analysis" are terms of specific reference the use of which set expectations of a particular product or process. Careful use of terminology was recommended, as well as documenting scope of technical study analysis within report documentation.

3. **Place technical information in a planning context.** The following planning steps were recommended to aid any subsequent alternatives assessment:

   a. Set project goals and objectives;

   b. Identify opportunities and constraints;

   c. Define evaluation criteria;

   d. Develop a conceptual model of restored estuarine system evolution and functioning;

   e. Fill data gaps;

   f. Refine alternatives, include business-as-usual (the lake management) alternative;

   g. Forecast future conditions;

   h. Comprehensively document preferred alternative and decision process.

4. **Integrate information transfer through the technical studies.** Information transfer across technical studies is necessary to provide a comprehensive feasibility assessment. It was recommended that information supply and needs be agreed prior to initiation of the feasibility analysis (for example, determine from the economists their information needs from the physical and biological assessments prior to science study initiation). Confirm that the temporal and spatial scale of analysis is comparable across studies. Include provision for information refinement and feedback loops as study progresses.

5. **Define baseline conditions.** At the time of the technical studies were initiated the Lake Management Alternative baseline condition was not defined. This information is required should a more refined full analysis be undertaken.

6. **Refine alternatives.** The alternatives developed so far are appropriate for a scoping level assessment of restoration potential. Should the feasibility assessment move forward these alternatives should be refined further to balance opportunities for restoration against constraints to meet selected restoration objectives.

6. CONCEPTUAL MODEL OF ESTUARINE RESTORATION

This review provides a simple conceptual model of the likely ecological outcomes with restoration of the Deschutes Estuary based information drawn from the four DEFS technical studies and restoration projects elsewhere[2]. Conceptual models (Simenstad and others, 2006), are a basic tool used to help clarify what will be achieved from a restoration project to help define what is known and not known, and the linkages between actions and outcomes. Based upon agreed desired outcomes, the conceptual model provides a basis for setting project evaluation criteria. Where possible, it is beneficial to supplement an ecological conceptual model with a socio-economic conceptual model.

6.1 RESTORATION ACTION AND RESPONSE

Our conceptual model summarizes the expected response of the nearshore ecosystem to a process-based restoration action:

- Baseline scenario: a dam across the former Deschutes Estuary remains in place, creating Capitol Lake, increasing sedimentation in the lake, reducing sediment supply to Budd Inlet, and impairing water quality in the lake and inlet.
- Change/action scenario: removal of a 500-foot length of dam at Fifth Avenue and dredging of a channel through the lake would re-establish hydrodynamic, sediment transport and ecologic processes in a restored nearshore estuary setting.
- Predicted functional response: re-establishment of diverse estuarine ecosystem attributes (e.g. tidally influenced mudflats and channels, supporting native plant and animal communities), with improvements in water quality. The predicted functional responses link to our objectives.

Figure 1 describes conceptual restoration pathways between engineering action and desired ecological functions associated with possible dam removal at Fifth Avenue. Once the dam is removed, physical estuarine processes could be quickly restored (George and others, 2006). Water quality, particularly water temperature and dissolved oxygen concentrations, would potentially improve in the basins because of the increased tidal flushing[3].

Re-establishment of tidal circulation, in concert with high river discharges, would re-suspend some of the surface sediment in Capitol Lake, left behind after any channel pre-dredge operation. This sediment would be transported downstream and re-deposited on intertidal and subtidal areas within the estuary and Budd Inlet (George and others, 2006). Increased sediment accumulations

[2] Certain assumptions are made that are not drawn directly from the existing DEFS studies (for instance water quality).

[3] This assumption is currently under investigation by the Department of Ecology.