1. How are you/your family using Capitol Lake and the surrounding parks (from Tumwater Falls to Priest Point Park)?

2. For those of you that used Capitol Lake in the past (before uses were restricted on the lake), how did you/your family use the lake then?

3. If the currently restricted water-based uses were restored under a long-term management option, would this change your use of waterbody?

4. If Capitol Lake was restored to an estuary or hybrid, shorelines would change (incl. vegetation, distance from trails to water, etc.). How would these changes affect your use of the project area?
Measurable Evaluation Process

**Step 1: Alternatives Optimization**
- Evaluate and screen components of alternatives/concept proposals:
  - Feasibility (technical & regulatory)
  - Sustainability (environmental & economic)
- Develop optimized versions of the Managed Lake, Estuary, and Hybrid Alternatives using the objective evaluation criteria

**Outcome:** Optimized versions of the primary alternatives that are feasible and most sustainable advance into the EIS technical analyses

**Step 2: Evaluate and Compare Alternatives**
- Evaluate potential impacts and benefits of each alternative
- Use results of the technical analyses and measure alternatives against discipline-specific significance criteria
- Results presented in the Draft EIS

**Outcome:** Comparative summary of the impacts and benefits of the alternatives

**Step 3: Project Goals Screening and Identification of a Preferred Alternative**
- Evaluate the alternatives against ability to achieve project goals
  - Improving water quality
  - Managing sediment accumulation and future deposition
  - Improving ecological functions
  - Enhancing community use of the resource
- Review and consider public comment on the Draft EIS
- Preferred Alternative identified in Final EIS

**Outcome:** Identification of a Preferred Alternative that best meets the project Purpose and Need Statement

**Legend**
- EIS Public Comment Period
- Milestone

For more information please visit: [CapitolLakeDeschutesEstuary.wa.gov](http://CapitolLakeDeschutesEstuary.wa.gov)
or email: [Info@CapitolLakeDeschutesEstuary.wa.gov](mailto:Info@CapitolLakeDeschutesEstuary.wa.gov)

Abbreivation: EIS = Environmental Impact Statement

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Fieldwork Update

- Ongoing coordination with Ecology
- Water quality sampling in Capitol Lake
- Bathymetric survey anticipated for July
Level of Analysis

- EIS analysis needs to be sufficiently detailed to:
  - Support a *comparative* evaluation of impacts between alternatives
    - Not necessary to understand every detail
  - Support the conclusions about proposed mitigation measures
    - i.e., would mitigation measure feasibly/adequately mitigate potential impacts
- SEPA notes that EISs should be concise, readable documents
  - “…an EIS is not required to include all information conceivably relevant to a proposal…” WAC 197-11-402(6)
- EIS analysis helps support permit review but often additional information will be required and developed during design and permitting phase (e.g., an EIS evaluation of water quality may not be at a level sufficient to meet all of the requirements for obtaining a CWA 401 Certification for the selected project alternative)
Wetlands and Vegetation Methodology – Study Area
Wetlands and Vegetation Methodology

- Analysis of existing conditions
  - Relies on existing data (GIS/mapping, literature, wetland inventories, etc.)
  - Supplement existing data with site reconnaissance
  - Categorize/classify wetlands and vegetation
  - Existing conditions map
Analysis of Impacts – Wetland and Vegetation

Wetlands
• Potential impacts and benefits will be determined by calculating change in area of wetland, mudflat, and deep water habitat and relative change of functions

Vegetation
• The expected change in area of each vegetation type will be compared for each alternative relative to existing conditions.

Analysis will be informed by:
• Topographic and bathymetry data
• Design and modeling of the alternatives
• Tidal range information and assumptions
Fish and Wildlife Methodology — Study Area
Fish and Wildlife Methodology

- Analysis will consider groups/species that occur in the study area
  - Anadromous fish
  - Freshwater fish – pisciverous
  - Freshwater fish – non-pisciverous
  - Marine fish – forage fish
  - Marine fish – bottomfish
  - Shellfish
  - Shorebirds/wading birds
  - Diving/dabbling ducks
  - Insectivorous birds
  - Raptors
  - Passerine birds
  - Bats
  - Freshwater aquatic mammals
  - Marine mammals

- Special attention on federally listed species and critical habitats
  - Puget Sound Chinook salmon
  - Puget Sound steelhead
  - Southern resident killer whale
  - Critical habitat
Analysis of Impacts – Fish and Wildlife

Potential impacts and benefits will be described based on:
• Type, extent, and magnitude of habitat change
• Correlating changes to the species groups and species that occupy or are associated with each habitat type

Analysis will be informed by:
• Hydrologic and sediment transport modeling
• Specific design components associated with each alternative
• Habitat zone maps
Land Use, Shoreline Use, and Recreation Methodology — Study Area
Land Use, Shoreline Use, and Recreation Methodology

- Analysis of existing conditions
  - Existing and planned future land uses
    - Assessor’s data, GIS data, local comprehensive plans, local planning documents, local programs
  - Parks and recreation facilities and activities
    - Local park planning documents, local comprehensive plans, master plans, GIS data
  - Coordination with Community Sounding Board at June meeting
  - Recreational user survey – summer and fall 2019
Analysis of Impacts — Land Use, Shoreline Use, and Recreation

Land and Shoreline Use
- Evaluate whether the project is expected to result in major changes to the types or numbers of users and whether such changes are likely to affect existing land use patterns
- Evaluate for consistency with adopted land and shoreline use policies and plans

Recreation
- Impacts will be described in terms of changes to the types of recreation available, and to the quality of the recreational experience
- Potential effects on recreational uses would be categorized uses that would be improved, impeded, or remain unaffected by each alternative
Objective of Numerical Modeling

Objective
• Compare various alternatives quantitatively in terms of:
  o Maximum water surface elevation/extent of inundation
  o Sedimentation and erosion patterns and volumes

Challenges
• Different sizes of sediment
• Uncertainty in long-term morphology prediction
• Modeling two different systems (lake with control structure vs. estuary)
• Prediction for a system that does not exist
Findings & lessons learned from these previous studies will be implemented to improve our modeling effort.
Numerical Modeling of Hydrodynamics

Input
- Definition of Alternatives
- Dredge Plan
- Future Scenario

Hydrodynamic Model

Output
- Maximum Water Elevation
- Maximum Velocity
Numerical Modeling Components

Input:
- Definition of Alternatives
- Dredge Plan
- Future Scenario

Hydrodynamic Model

Output:
- Maximum Water Elevation
- Maximum Velocity

- Modeling System
- Modeling Domain/Grid/Elev
- Analysis Scenarios
- Boundary Conditions
- Calibration/Validation
- Model Uncertainty, Sensitivity Analysis

- Definition of Alternatives
- Dredge Plan
- Future Scenario

- Maximum Water Elevation
- Maximum Velocity

- Calibration/Validation
- Model Uncertainty, Sensitivity Analysis
- Analysis Scenarios
- Modeling Domain/Grid/Elev
- Modeling System
Modeling System, Delft3D

- Delft3D, developed by Deltares Inc.
- State of the art, process-based model, open source
- Suited for tide-driven and river, non-hydrostatic flows
- Version 4.03, two-dimensional hydrodynamic (Delft-FLOW)
- Same model as that used by USGS (2006, 2008)

https://oss.deltares.nl/web/delft3d/home
Model Domain and Computational Grid

Grid
- Two-dimensional structured (Curvilinear) boundary fitted grid

Model Domain
- Deschutes River from Tumwater Falls to outer Budd Inlet, terminating just north of Gull Harbor

Grid Size
- Nearly uniform resolution of approximately 270 ft² or 16 ft x 16 ft (25 m² or 5 m x 5 m)
- 4- to 140-fold x improved resolution compared to previous work
Model Elevation

Available Datasets

- 2019 eTrac bathymetry survey (July)
- 2013 TerraSond bathymetry survey
- 2019 USACE bathymetry survey
- 2004 USGS bathymetry survey
- 2015 Olympia City LiDAR
- 2014 NOAA DEM

Dredge plan will be incorporated

Vertical datum & unit: NAVD 88 & feet
Boundary Conditions – Hydrodynamics

River Inflow
• Deschutes River boundary
  o Direct measurements at USGS Station #12080010 (E Street Bridge in Tumwater)
• Percival Cove boundary
  o Scaled time history based on Station #12080010 measurements
• Ungaged watersheds
  o Computed discharges using scaling factors

Tides
• Synthesized time histories based on astronomical tidal constituents + residual due to meteorological effects at NOAA Station #9446807 - Gull Harbor

Water Level at 5th Avenue Dam
• Hourly measurements of water level at the 5th Avenue Dam (2016 – present)
Calibration/Validation — Hydrodynamics

_calibration Data (target)
- Water level at 5th Avenue Dam

Calibration Parameter(s)
- Gate opening with real operation logic and associated discharge from the gate

Calibration Period
- Low flow:
  - 02/04/2017 00:00 – 02/09/2017 00:00
- High Flow:
  - 02/09/2017 14:00 – 02/12/2017 20:00
- Medium Flow:
  - 02/15/2017 20:00 – 02/19/2017 20:00
Production Runs — Hydrodynamics

Four Alternatives
- Estuary, Hybrid, Managed Lake, No Action

River Inflow
- A 100-year return period flooding event

Tides
- The highest tide level ever recorded in Budd Inlet of 10.54 ft NGVD 29 (2.92 m MSL) on 12/15/1977

Future Conditions
- 2-ft RSLR and change in river inflow
Results — Hydrodynamics

- Maximum water level (WL)
- Maximum depth-averaged velocity
- Extracted time series of WL and velocity at observation points

Examples from USGS (2006)
Process-Based Models

- Sediment transport and morphology modules in Delft3D
- Bedload, suspended load, and total sediment load transport of non-cohesive sediment
- Suspended load of cohesive sediment (silt and clay)
- The bed elevation is updated during simulation
Sediment Transport Modeling

Input → Hydrodynamic Model → Sediment Transport Model → Output
Boundary Conditions — Sediment Transport

- Total sediment load
  - Deschutes River and Percival Creek rating curves (Mih & Osborn 1974)
- Cohesive sediment (clay and silt)
  - Sediment class concentrations will be estimated by multiplying the expected flux percentage of each sediment class
- Non-cohesive sediment (sand and gravel)
  - Equilibrium boundary conditions will be applied
Calibration/Validation — Sediment Transport

 Calibration Data (target)
  • Average sedimentation rate in Capitol Lake
  • Sedimentation pattern in Capitol Lake

 Calibration Period
  • 09/01/2004 – 04/01/2013
  • 04/01/2013 – 07/2019 (new survey)

 Calibration Parameters
  • Non-cohesive sediment
    o Sediment size
    o Sediment module parameters
    o Bottom roughness for each constant discharge
  • Cohesive sediment
    o Deposition: Settling velocity and total suspended solid (TSS) load (concentration) for each fraction
    o Erosion: Critical shear stress & erosion rate
Production Runs — Sediment Transport

Four Alternatives
- Estuary, Hybrid, Managed Lake, No Action

River Inflow
- 5-year with actual time histories of river flow

Tides
- Morphological tide (M2 multiplied by 1.1)

Future Conditions
- 2-ft RSLR & change in river inflow
Results – Sediment Transport

- Plots of cumulative erosion and deposition in site-plan
- Sediment flux at selected cross sections
- Sediment volume changes inside the lake and other areas of interest (port, marina)

Example from USGS (2006)
Long Term Morphology Modeling Methodology

- Methodology developed to speed up multi-year morphological simulations
- Utilizes lookup table approach
  - Lookup table consists of sedimentation/erosion rates computed for a set of river discharges (from 10 to 250 m³/s at 10 m³/s increment) for each cell in the model domain
  - During simulation, lookup tables are updated when significant changes in bathymetry occur
- Uses actual historical river discharges
  - Sedimentation rates for each discharge are interpolated from the lookup table and bathymetry is updated accordingly
- Multiple (5 to 10) realizations to address uncertainty in long-term morphological modeling

Example from M&N (2011)
Mississippi River Long Distance Sediment Pipeline Planning
Advantages of Proposed Morphology Methodology

- Modeling is performed for a higher number of river discharges.
- Uses actual measured time series of river discharges and computes morphological changes in real time scale.
- Steady-state simulations for construction of lookup tables are much easier to calibrate.
- Provides similar benefits for speeding up model simulations as using morphological time scale factor (MORFAC).
  - Hydrodynamics is not computed in real time scale, which speeds up morphological computation.
- Several hydrographs can be simulated.
Questions?