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# Klamath River Basin Revised Natural Flow Study

November 2 – 3, 2022  
Stakeholder Workshop  
Overview Presentation

# Outline

- Goals of the Workshop
- Goal of the Natural Flow Study (NFS)
- Comparison of the 2005 and 2025 NFS
- **Questions**
- Study extent
- Analysis overview
- Comparison of current and pre-development conditions
- Technical review process
- What to expect for this workshop



# Goals of the Workshop

- Receive input from Basin technical experts.
- Ensure that all applicable data sets and references have been included in the Revised Natural Flow Study library for consideration.
- Allow Stake Holders to communicate with and ask questions of the Study Team.
- Allow the Study Team to communicate with and ask questions of the local Klamath Basin technical experts and stakeholders.
- Clarify the goals, definitions and methods planned for the study.



# Why are we revising the NFS?

- Revised study requested by stakeholders and government agencies.
- Contribute to the Klamath Basin Science Initiative
- Provide rigorous scientific information to support habitat studies, drought planning, and water supply/allocation planning
- Address deficiencies from the 2005 study (simplistic, coarse timescale, lack of transparency) identified by National Research Council



# How will the revised NFS be used?

- Add to the scientific understanding of basin conditions
- A tool to address problems and provide solutions within the basin
- Baseline data and tool for a variety of separate studies and purposes, including upcoming biological opinion and consultation



# Foundational Study Definitions

- **Natural Flow or Pre-development Flow:** *"flow of water caused by nature. Water that would exist in a watercourse absent of human intervention/development."*
- **Undepleted Flow:** *"the stream flow in a watershed without the effects of diminishment by water uses for specific beneficial purposes including, but not limited to, irrigation, municipal, domestic, mining, commercial, industrial, stockwatering, recreational, and environmental concerns."*



# 2005 Natural Flow Study

- Purpose was:
  - “provide an estimate of **monthly** natural flows in upper Klamath River at Keno.”
  - “estimate of natural flow represents typical flow without **agricultural** development...”
  - Weather data from water years **1949-2000**
- **Pre-agricultural** flow rather than a “natural” or pre-development flow study.
- National Research Council Recommendations:
  - Daily timestep
  - Quantitative groundwater assessment
  - Improved ET estimate
  - Include land cover changes
  - Include rainfall-runoff model
  - QA/QC and sensitivity analyses
  - Interaction of LKL and Klamath River



# 2025 Natural Flow Revised Study Goals/Assumptions Summarized

- Estimate **daily** flows at chosen locations on the mainstem Klamath River, removing the significant effects of human development (**pre-development**).
- Simulate flows assuming pre-development landscape/hydraulic conditions, and weather data for water years **1981-2020**.





# 2025 Natural Flow Revised Study Goals/Assumptions Summarized

- The study assumes the earliest available basin maps and documents represent basin development up to the time of the map/document's publication.
- Removing human development from the earliest documents/maps will produce a “natural” or **pre-development** landscape condition.
- It is also assumed that Native Inhabitants of the Klamath Basin did not significantly alter the “natural ” condition of the Klamath Basin prior to the publication of the earliest maps/documents.
- The earliest maps of the basin are from the approximate ~1880 time period.



# 2025 Natural Flow Revised Study Goals/Assumptions Summarized

- Human development includes changes in
  - landscape scale vegetation,
  - lake surface water areas,
  - wetland areas,
  - agricultural development,
  - water management and flood control structures,
  - municipal development, channel modifications,
  - levees, roads, railroads, etc.”
- Water years **1981-2020** data were chosen because they better represent current climate conditions, and reasonably accurate hydrologic data is available for this time period.
- Develop the most **scientifically thorough** estimate of **natural flows** possible

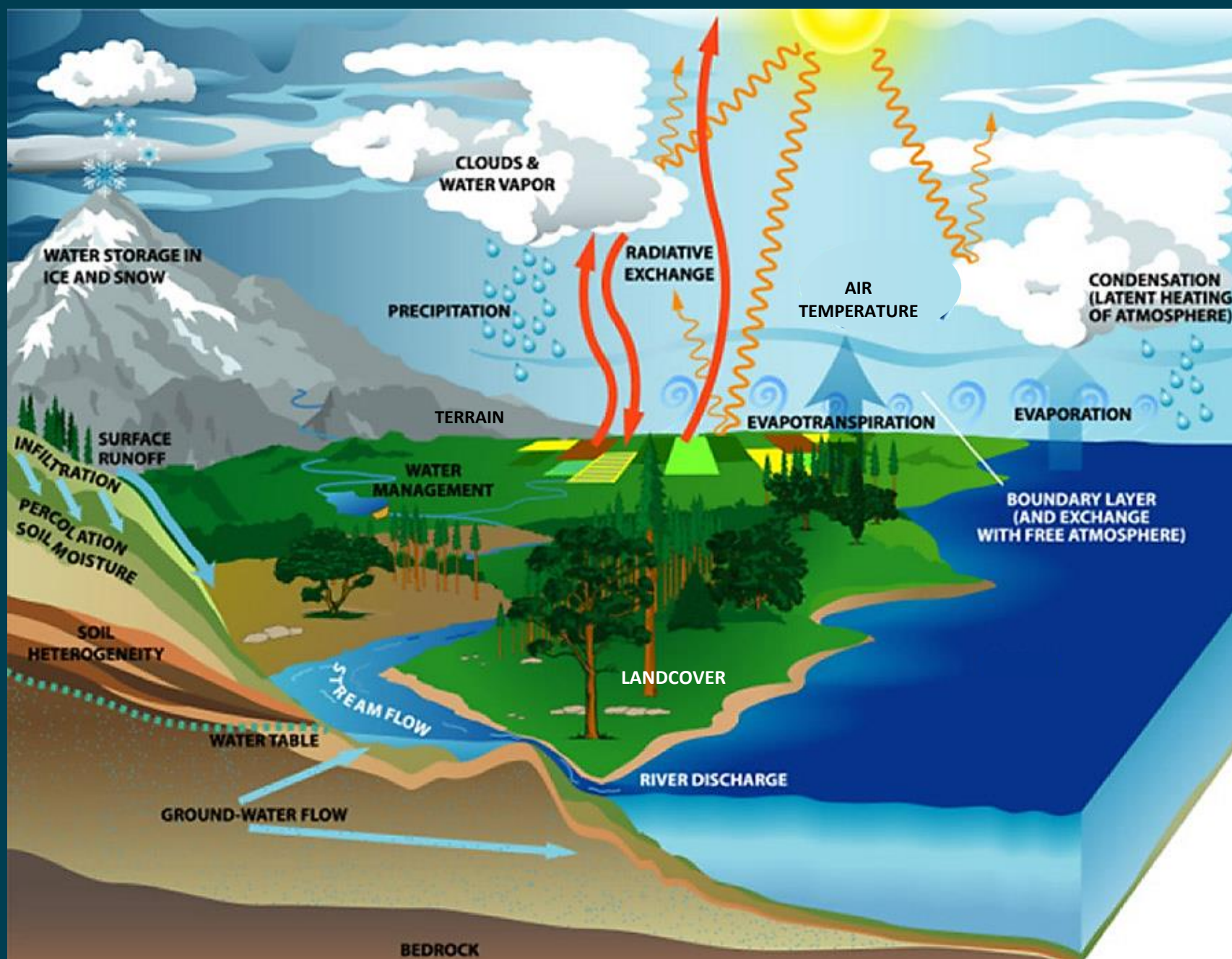




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# Questions

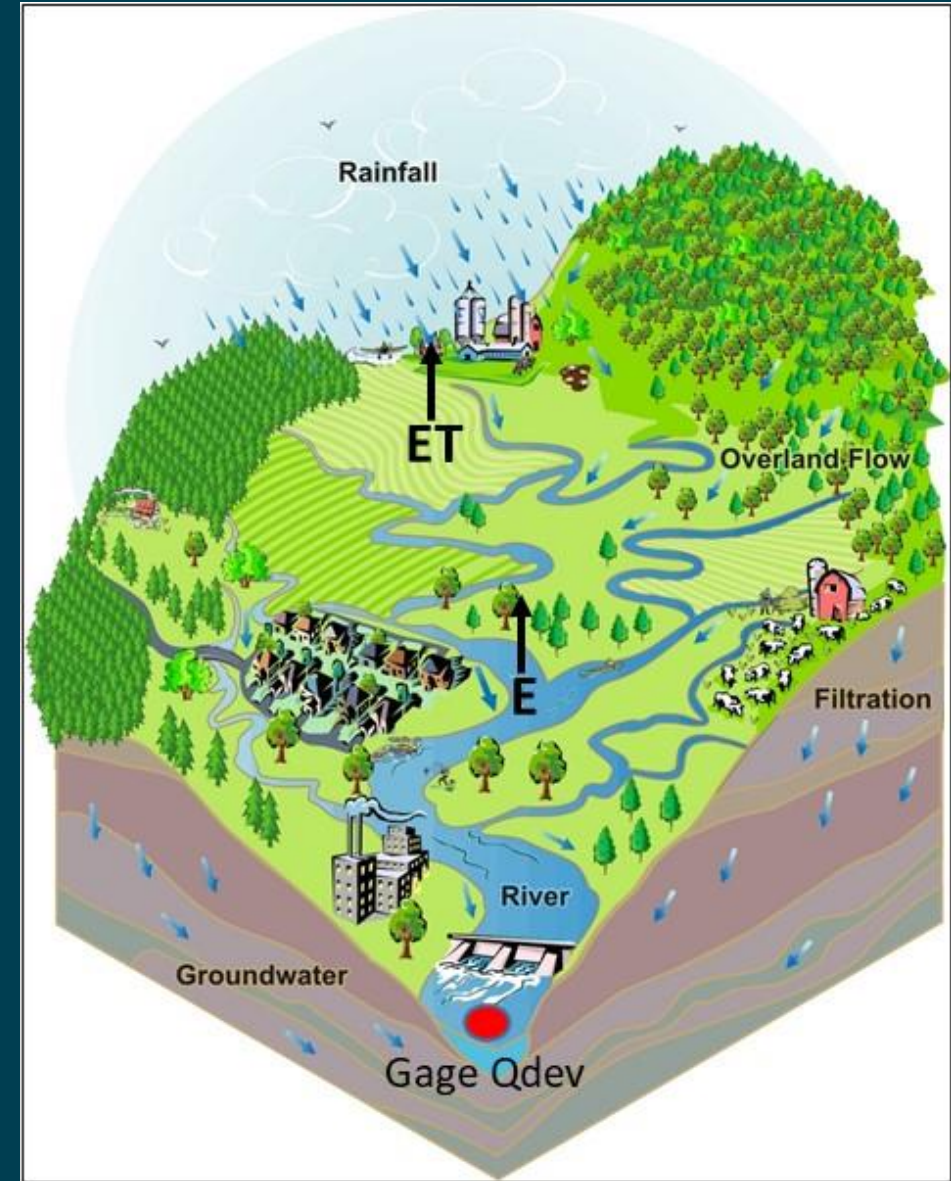
# Hydrologic Cycle



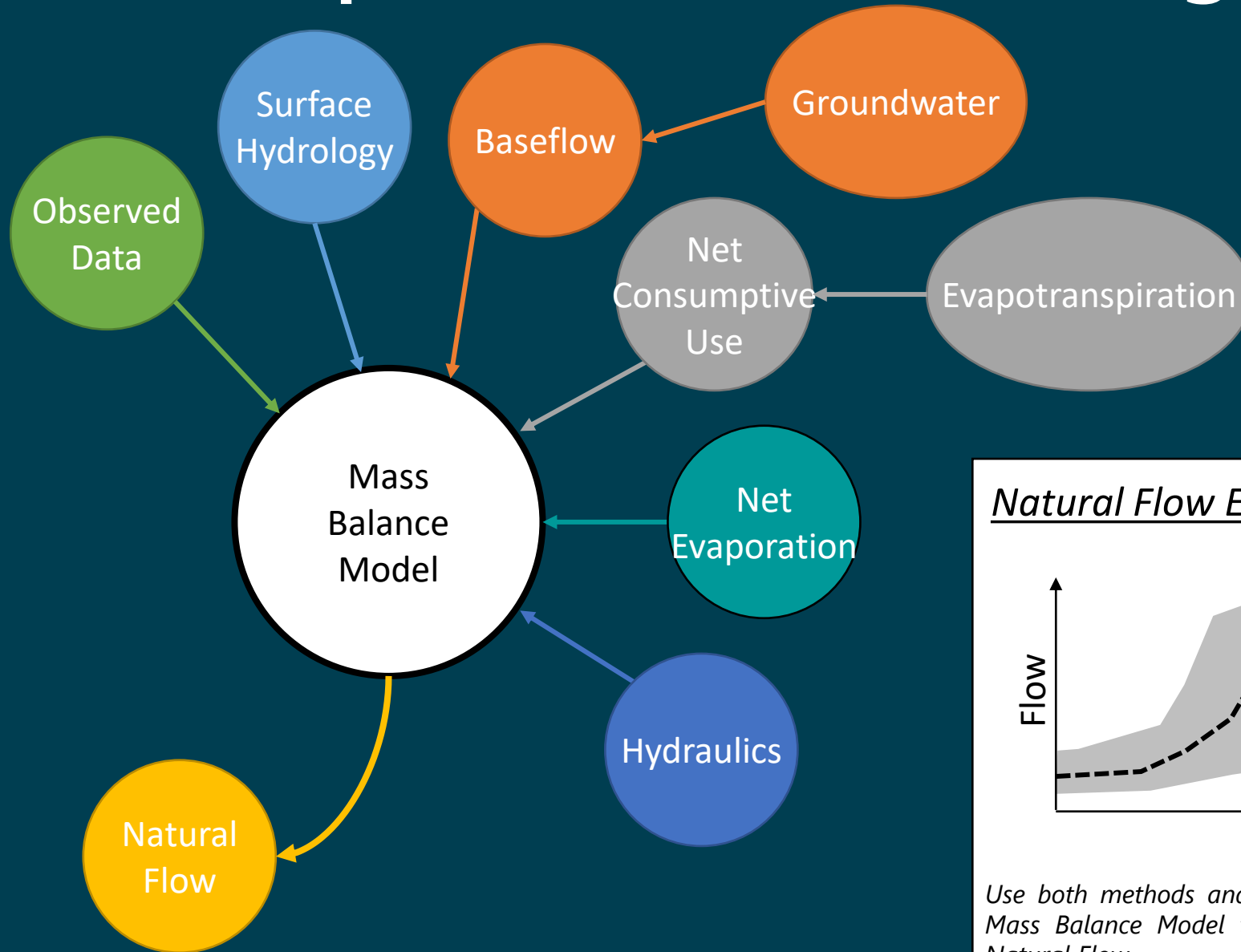
# Basic Water Balance Methodology

**Natural flow** = gaged flow  $\pm$  depletion  $\pm$  water management

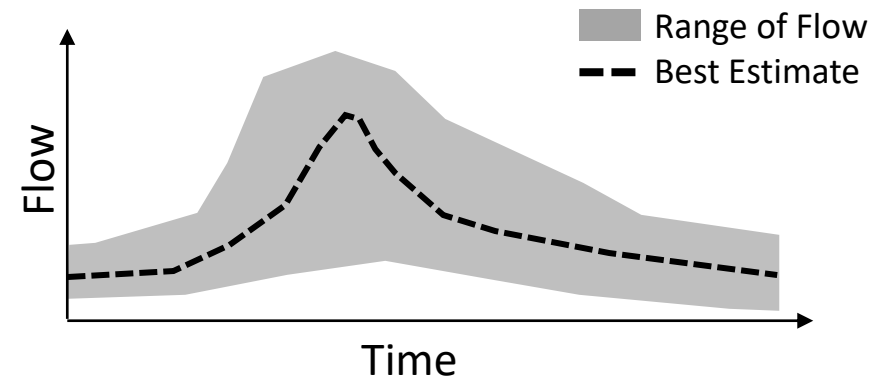
- Calibrate to **current** conditions
- Analyze models for **pre-development** conditions



# Simplified NFS Modeling Schematic



## Natural Flow Estimates

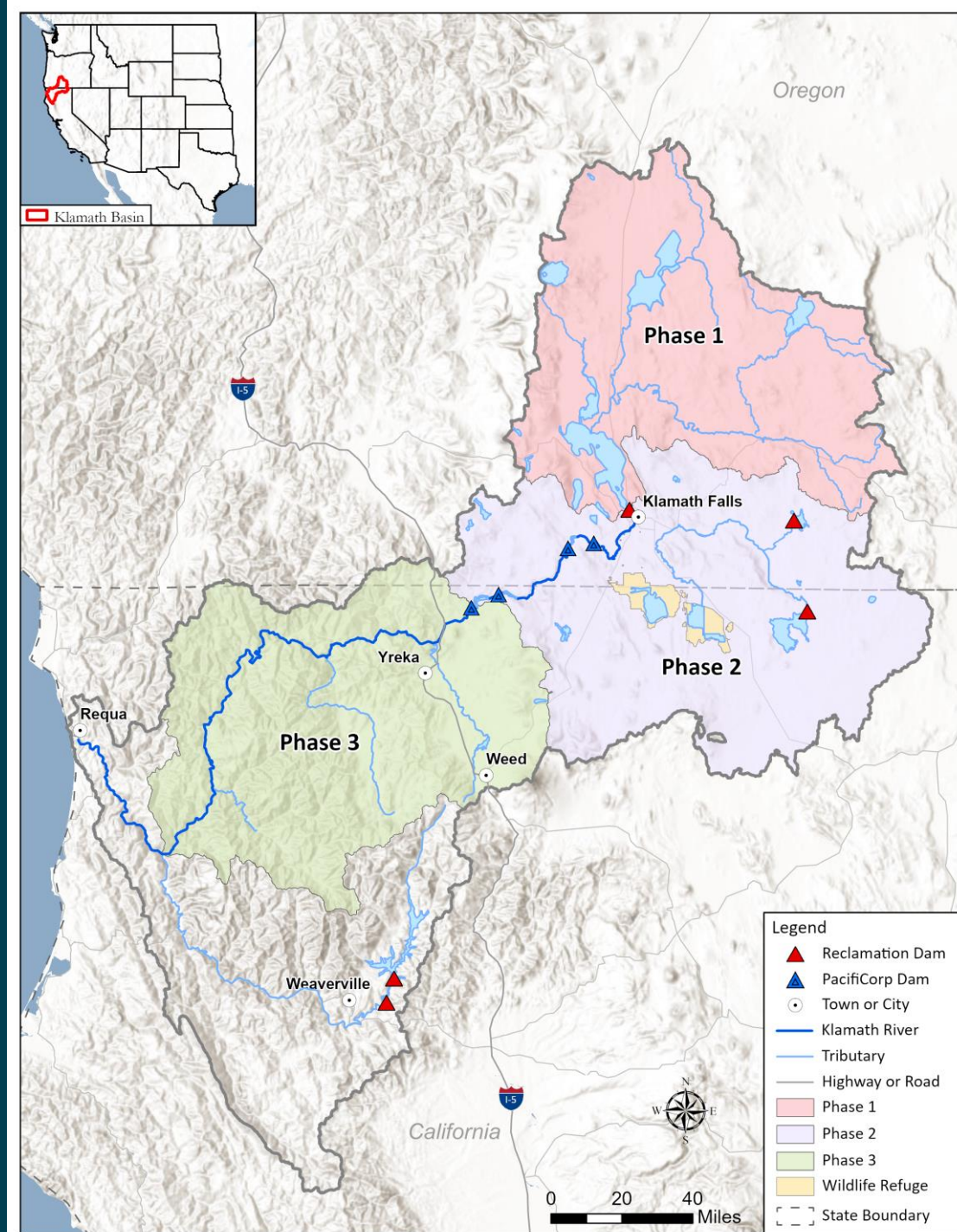


Use both methods and multiple parametrizations of RiverWare Mass Balance Model to generate range and best estimate of Natural Flow.



# Project Extent

- **Phase 1** – Above Link River Dam (UKL inflows)
- **Phase 2** – Link River Dam to Irongate Dam
- **Phase 3** – Irongate Dam to the confluence with the Trinity River



# Modeled Features

## Pre-Development

- Reverse land subsidence
- Represent natural wetlands
- Marsh/Riparian areas
- Vegetation & landcover changes
- Natural mainstem river hydraulics controls (reefs)

## Current Conditions

- Infrastructure
- Agricultural Impacts
  - Dams, reservoirs, canals, drains, ditches, berms, wells, pumping plants
  - Transbasin diversions
- Modified Lakes
  - Fourmile, Clear & Upper Klamath Lake





# Infrastructure Changes

- Dams
- Roads
- Levees & berms
- Railroads
- Pumping plants
- Wells



# Agricultural Impacts + Infrastructure

Canal examples include:

- A Canal
- North Canal
- Ady Canal
- Lost River Diversion Channel

Drains – Klamath Straits Drain

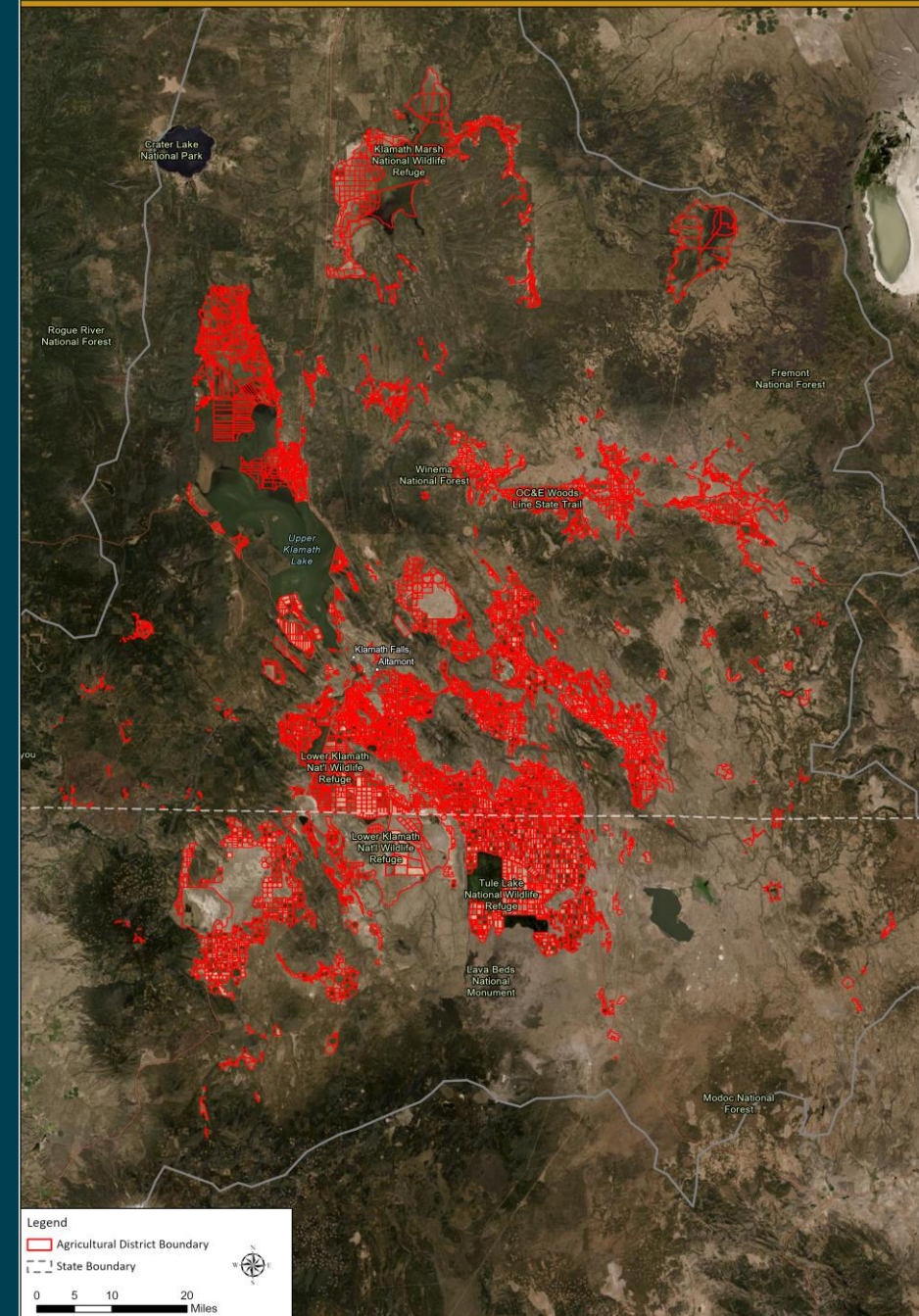
Transbasin Diversions

Pumping infrastructure

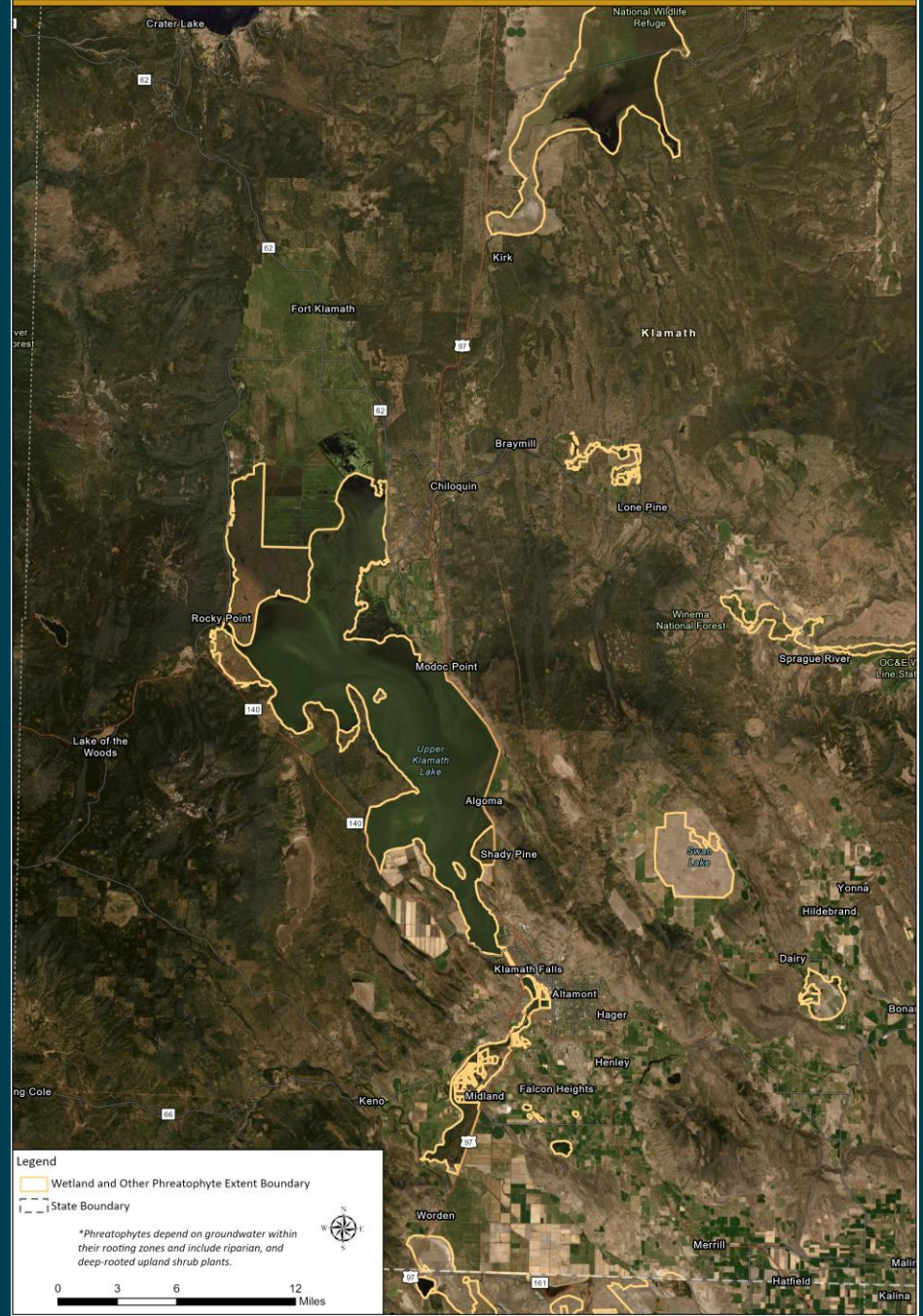
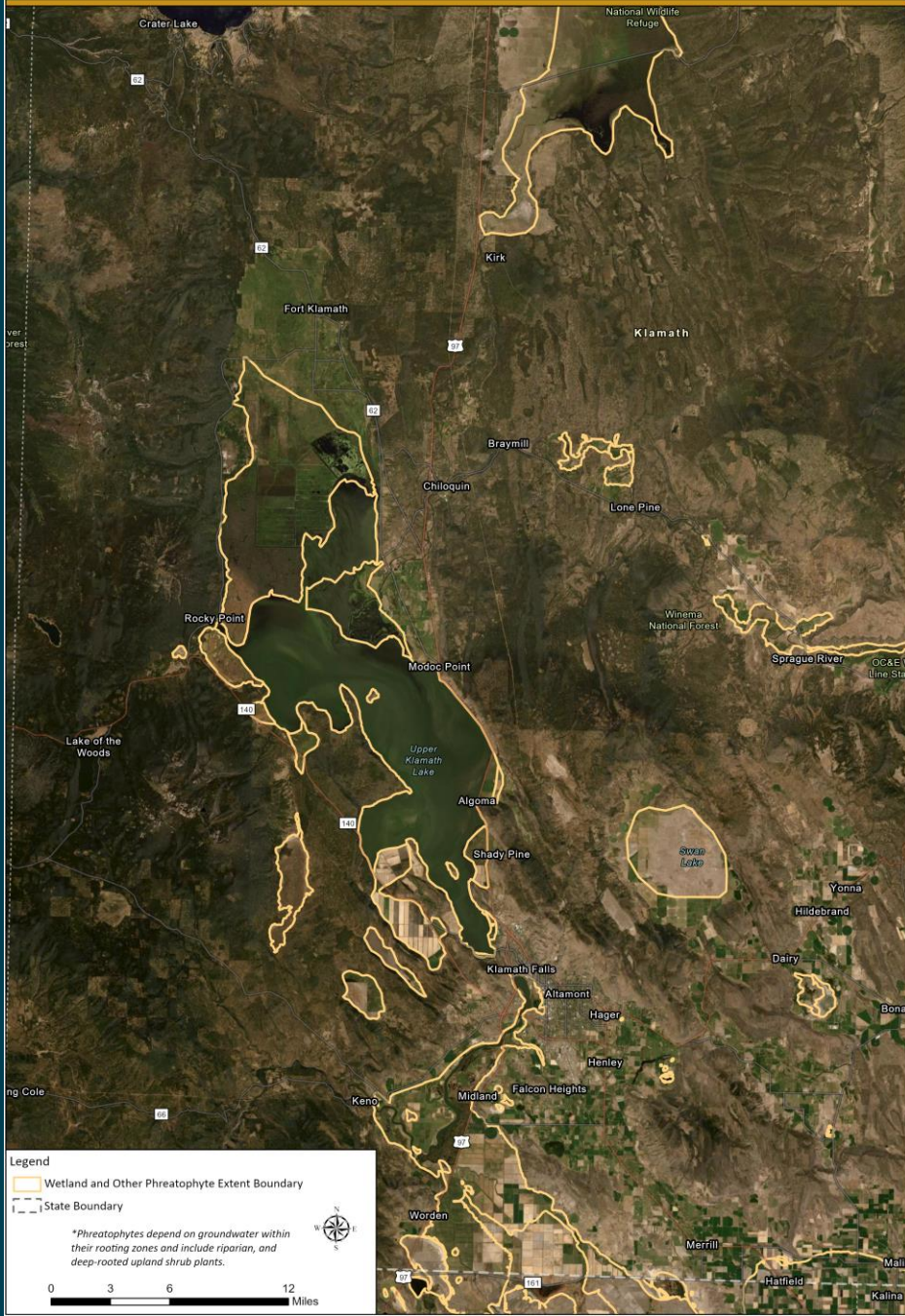
Wells

Crop consumptive use

Recharge (irrigation & canal seepage)

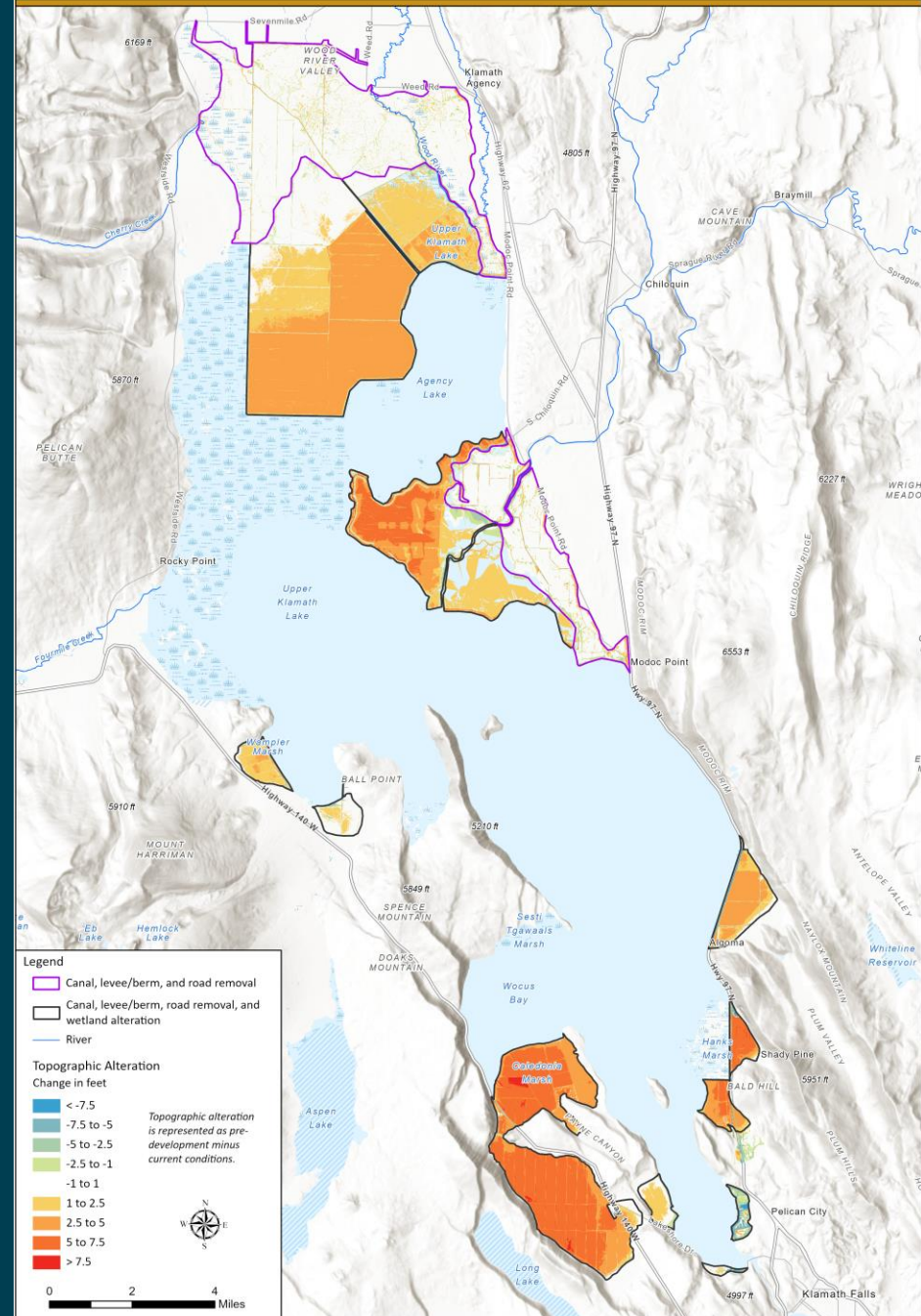


# Wetland Extents



# Topographic Changes

- Reverse subsidence effects
- Wetland alteration
- Removed Infrastructure



# Modified Lakes

- Fourmile Lake
  - Clear Lake
  - Upper Klamath Lake
- 

- Tule Lake
- Lower Klamath Lake



Part of the original dam structure at Clear Lake Reservoir, built in 1910. The rockfill dam was replaced with concrete in 2002.  
Photo credit: Courtney Mathews



# Review Process

## Highly influential Scientific Assessment (**HISA**) Classification

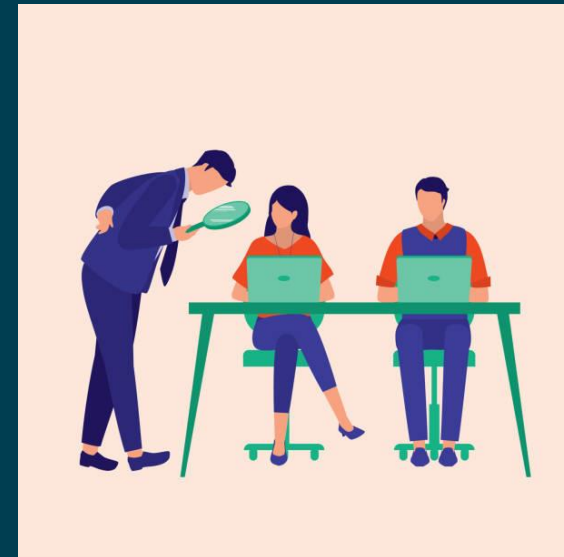
DOI defines **HISA** as:

- Potential impact of more than \$500 million in any one year on either public or private sector
- The dissemination is novel, controversial, or precedent-setting, or has significant interagency interest



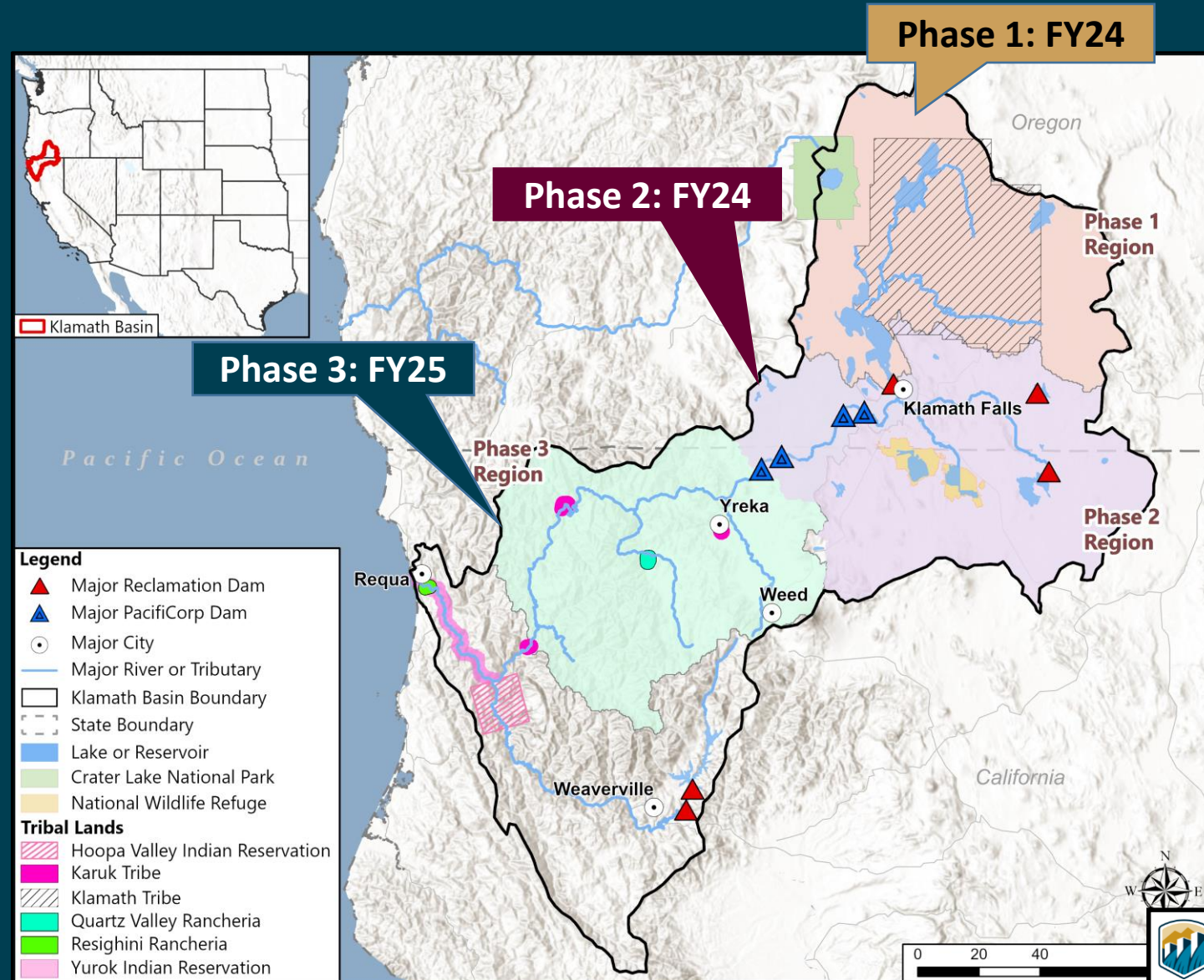
# Study Review Process

- Input from collaborators solicited throughout the study
  - Developing/Finalizing scope of work
  - Focused discussions with local subject matter experts
  - Update meetings
- Internal USBR Peer Review Process
  - Data
  - Model parameters
  - Results
  - Documentation
- External expert review



# Project Schedule

- Phase 1 & 2 Natural Flows in 2024
- Phase 3 Natural Flows in 2025
- Comprehensive Report in 2025





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# Workshop Agenda

- Surface Hydrology Model
- Groundwater Hydrology Modeling
- Evapotranspiration Modeling
- Open Water Surface Evaporation Modeling
- Surface Hydraulics Modeling
- Riverware Mass Balance Model



# Session Agenda

- Model Purpose
- Model Selection
- Input Data
- Methodology
- Comparison to the 2005 Natural Flow Study
- Natural Flow Representation
- Sensitivity & Uncertainty Analysis
- Questions & Discussion





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# Questions and Additional Discussion

# Points of Contact

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