ITEM No 5.

Klamath River Dissolved Oxygen Site Specific Objectives, Klamath River Action Plan, and Lost River Implementation Plan

Michael Buckman

Water Boards

Items

- **Resolution No. R1-2010-0025:**
  - ✓ **Adopted Basin Plan Amendment to revise Site Specific Dissolved Oxygen Objectives for the Klamath River**
- **Resolution No. R1-2010-0026:**
  - ✓ **Adopted Basin Plan Amendment to include the Action Plan for the Klamath River TMDLs and the Lower Lost River Implementation Plan**

Water Boards

Administrative

- E.O. Corrections
  - ✓ Available on Rear Table and Internet
- Response To Comments
  - ✓ Available on Rear Table and Internet
- Recommend Approval

Water Boards

Structure

- **Modules**
  - ✓ **Board Q&A**
  - ✓ **Staff Response**
    - Further Discussion

Water Boards

Staff Perspective

- TMDL Implementation
  - ✓ Improves Water Quality
  - ✓ Actions Similar to Scott and Shasta
  - ✓ Parties Only Responsible for Meeting CA Allocations/Implementation Measures
  - ✓ Uncertainty in all TMDLs

Water Boards

Presentation Agenda - Modules

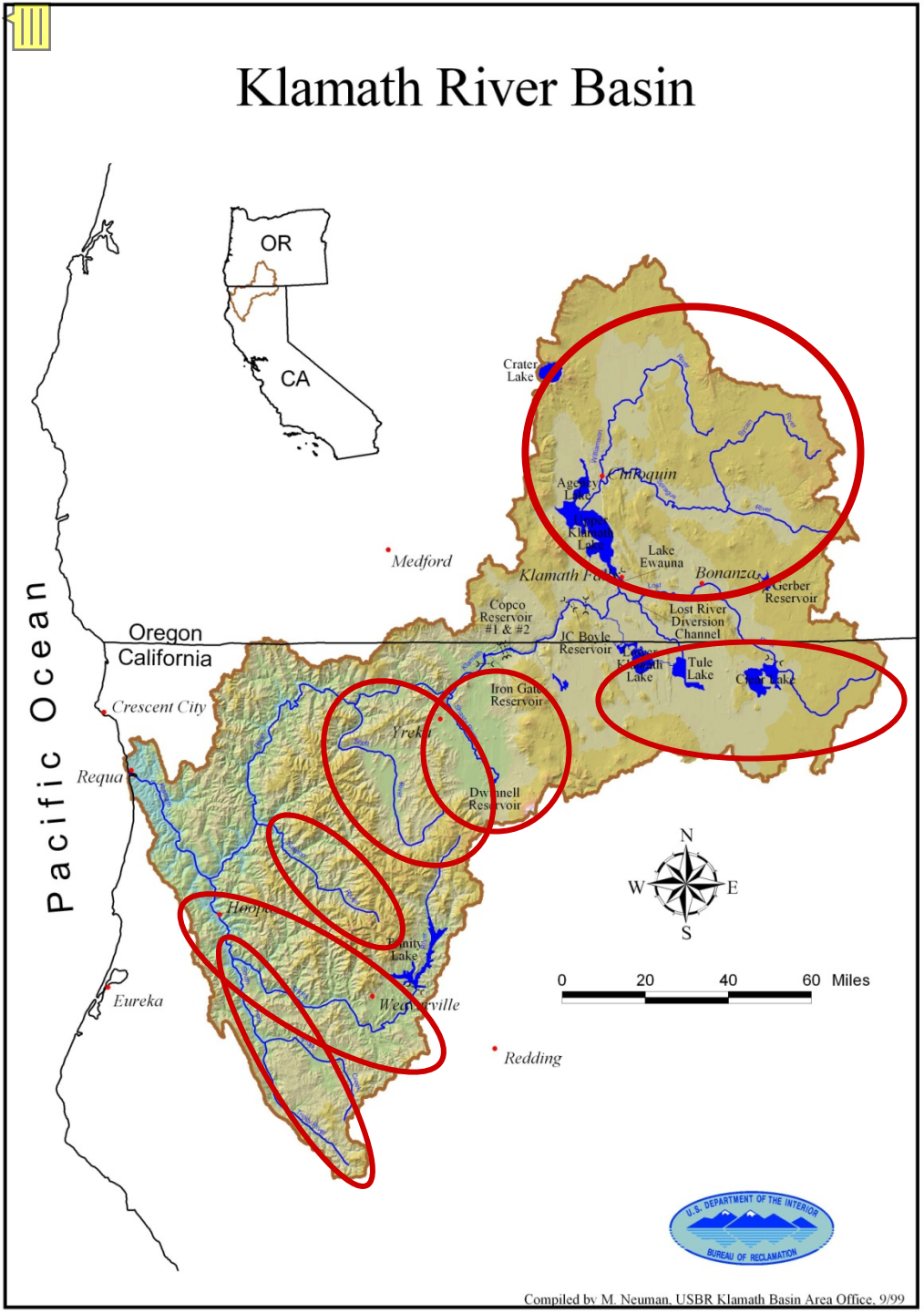
1) Klamath River Overview
2) Dissolved Oxygen Site-Specific Objective
3) Technical Analysis
4) Allocations
5) Action Plan

Water Boards

Module 1

Klamath River Overview

Water Boards



Existing Klamath Basin TMDLs

- Upper Klamath Lake Drainage (UKL)
- Lower Lost River
- Shasta River
- Scott River
- Salmon River
- Trinity River
- South Fork Trinity

Water Boards

Klamath River Impairments

Klamath River in OR:

- Temperature
- Dissolved Oxygen (DO)
- pH
- Ammonia
- Chlorophyll-a

Klamath River in CA:

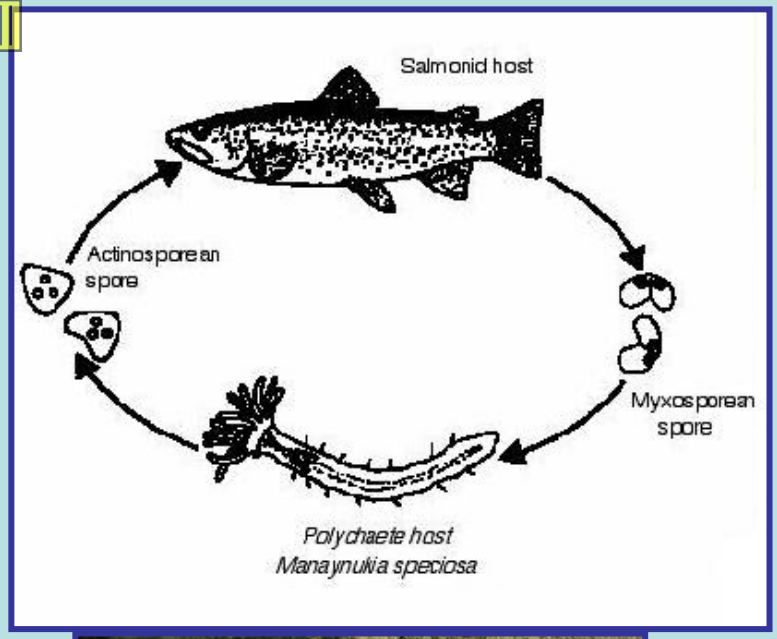
- Temperature
- Organic enrichment / low DO
- Nutrients
- Microcystin

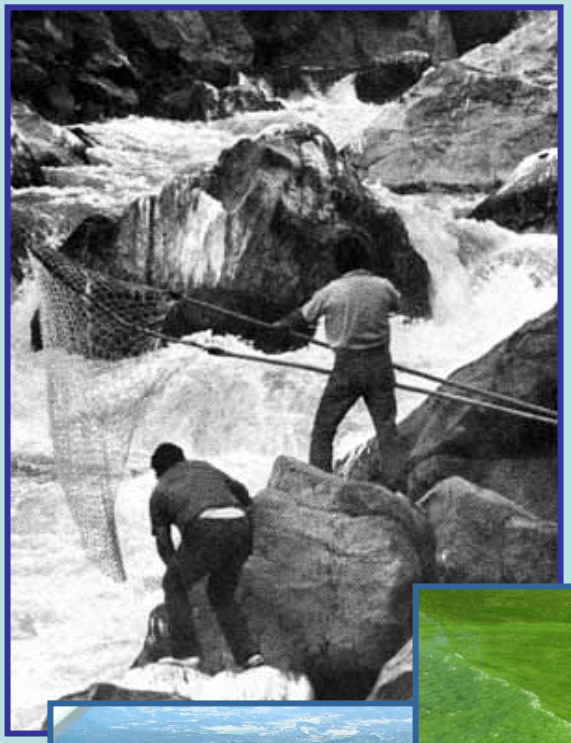
Water Boards

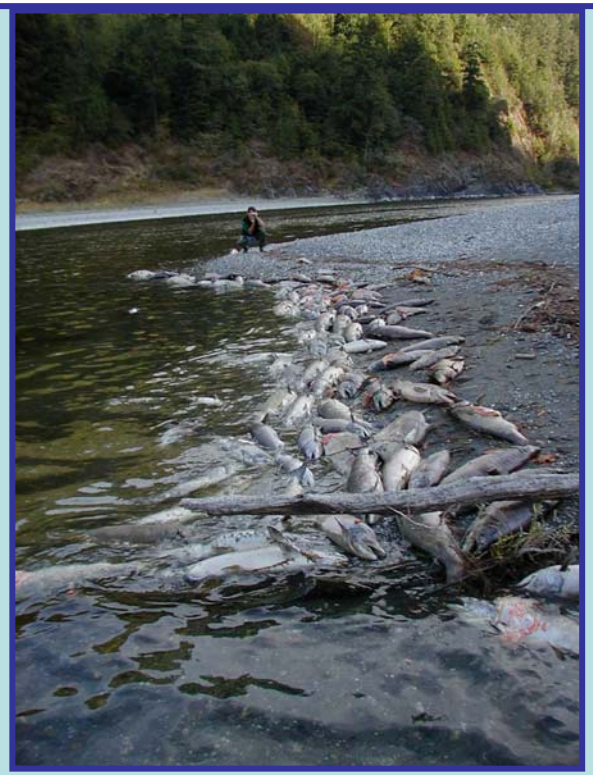
Klamath River Overview

- Historically Klamath River third most productive fishery on Pacific Coast of continental U.S.
- Diverse, healthy aquatic community and productive fisheries throughout basin
- UKL and Klamath River WQ conditions have dramatically declined over time

Water Boards


Salmonid host
Actinosporean spore
Myxosporean spore
Polychaete host
Manayunkia speciosa





17 of 23 California Beneficial Uses Impacted

- Native American Culture
- Subsistence Fishing
- Cold Freshwater Habitat
- Warm Freshwater Habitat
- Rare, Threatened, or Endangered Species
- Migration of Aquatic Organisms
- Spawning, Reproduction, and/or Early Development
- Water Contact Recreation
- Non-Contact Water Recreation
- Municipal & Domestic Supply
- Shellfish Harvesting
- Estuary Habitat
- Marine Habitat
- Aquaculture
- Agricultural Supply
- Commercial and Sport Fishing
- Wildlife Habitat
- Freshwater Replenishment
- Groundwater Recharge
- Industrial Process Supply
- Industrial Service Supply
- Navigation
- Hydropower Generation

Water Boards

Vision for Klamath River Water Quality Restoration

- Restore Klamath River beneficial uses while supporting rural communities
  - ✓ Control nonpoint sources
  - ✓ Reduce nutrient and organic matter loading
  - ✓ Restore site potential shade conditions
  - ✓ Reduce sediment impacts on channel structure
  - ✓ Protect thermal refugia
  - ✓ Support engineered solutions

Water Boards

Key Elements of Action Plan

- Prohibition of unauthorized discharges that violate water quality objectives
- Thermal Refugia Protection Policy
- Conditional Waivers for county roads, USFS, agriculture
- Guidance on control of excess sediment discharges

Water Boards

Key Elements of Action Plan

- Implementation MOA with Oregon DEQ and EPA
- Management Agency Agreement with US Bureau of Reclamation, US Fish and Wildlife Service, and Tulelake Irrigation District
- Klamath Hydroelectric Project Implementation Plan
- Klamath River water quality tracking and accounting program

Water Boards

Module 2
Dissolved Oxygen
Site-Specific Objection (SSO)

Water Boards

Former Klamath DO Objectives

- Table 3-1 of the Basin Plan
  - ✓ Daily minima - 7.0 mg/L above Iron Gate Dam (IGD) and 8.0 mg/L below IGD
  - ✓ Annual median of the monthly means - 10.0 mg/L above and below IGD
- Based on day-time grab samples collected in 1950s and 1960s
- Unachievable under natural conditions during pre-dawn hours of summer months

Water Boards

Revised SSOs for DO

- Revised DO objectives are:
  - ✓ specific to Klamath River mainstem.
  - ✓ based on percent DO saturation at natural receiving water temperatures.
- Reflect seasonal variation:
  - ✓ higher DOs in the winter
  - ✓ lower DOs in the summer

Water Boards

Revised SSOs for DO - Conclusions

- Protective of the beneficial uses;
- Achievable as a result of TMDL implementation
- Consistent with:
  - ✓ National DO criteria
  - ✓ USEPA guidance
  - ✓ Hoopa Valley Indian Reservation DO objectives.

Water Boards

Module 3

Technical Analysis

Water Boards

Multiple Lines of Evidence

- Expert consultation
- Literature review
- Site specific empirical analyses
- Conceptual models
- Klamath River water quality models
- Spreadsheet model tools

Water Boards

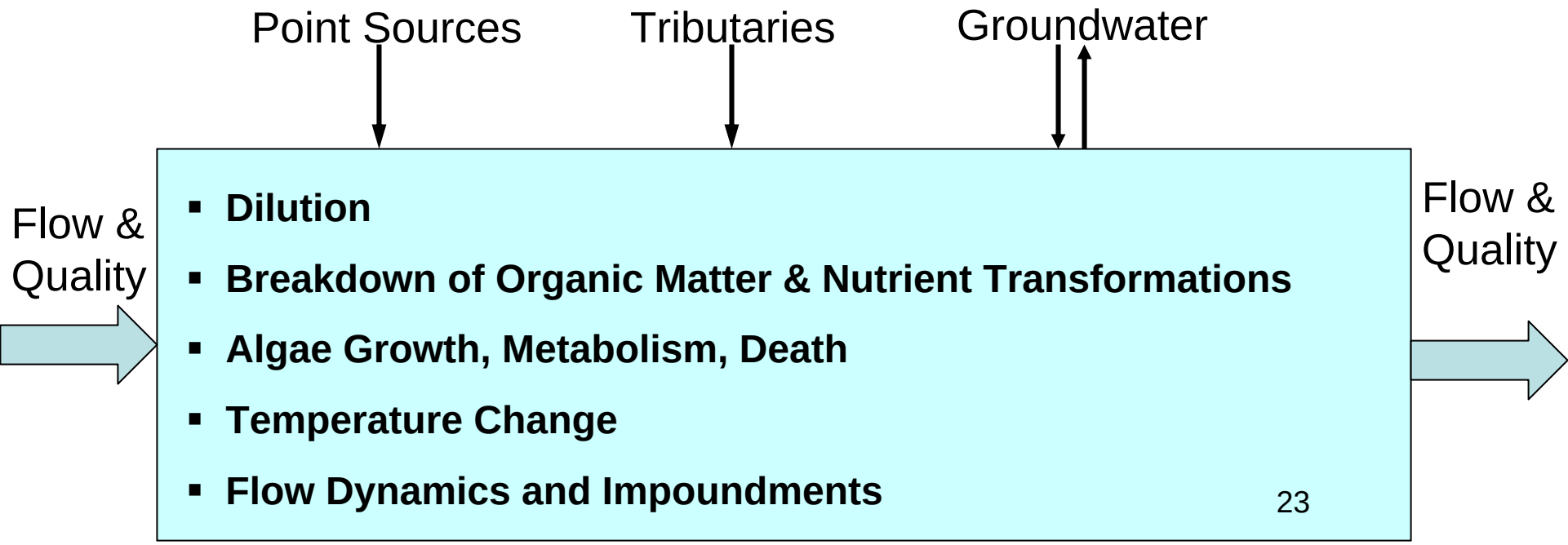
Water Quality Models

- Team effort:
  - ✓ Regional Water Board
  - ✓ ODEQ
  - ✓ EPA Regions 9 & 10
  - ✓ TetraTech
- Built upon PacifiCorp's models
- 3 models: CE-QUAL-W2, RMA, EFDC

Water Boards

Klamath Model Processes

- **Flow and constituents entering the river**
- **Physical, chemical, biological processes within the river**



Modeling Process

Phase I
SCIENCE

Model Development

- Data gathering (historic, field monitoring)
- Model input preparation and configuration

Phase II
SCIENCE

Model Evaluation

- Calibration / Corroboration (predicted vs. measured conditions)
- Peer review

Phase III
SCIENCE & POLICY

Model Application

- Analysis of TMDL Alternatives – Compliance Scenarios

Water Boards

Model Revisions

- All phases of modeling process require many technical judgments by modelers
- Updated models at <u>all</u> phases
- Conducted several rounds of external peer review, plus expert review during comment period
- Responded to all comments

Water Boards

Peer Review

- Pre-2004: Reviews of PacifiCorp model
- 2005:
  - ✓ US Bureau of Reclamation
  - ✓ Portland State University
  - ✓ Brown and Caldwell
- Periodic (Informal):
  - ✓ Watercourse Engineering (for PacifiCorp)
  - ✓ Klamath Tribal Water Quality Work Group

Water Boards

Peer Review

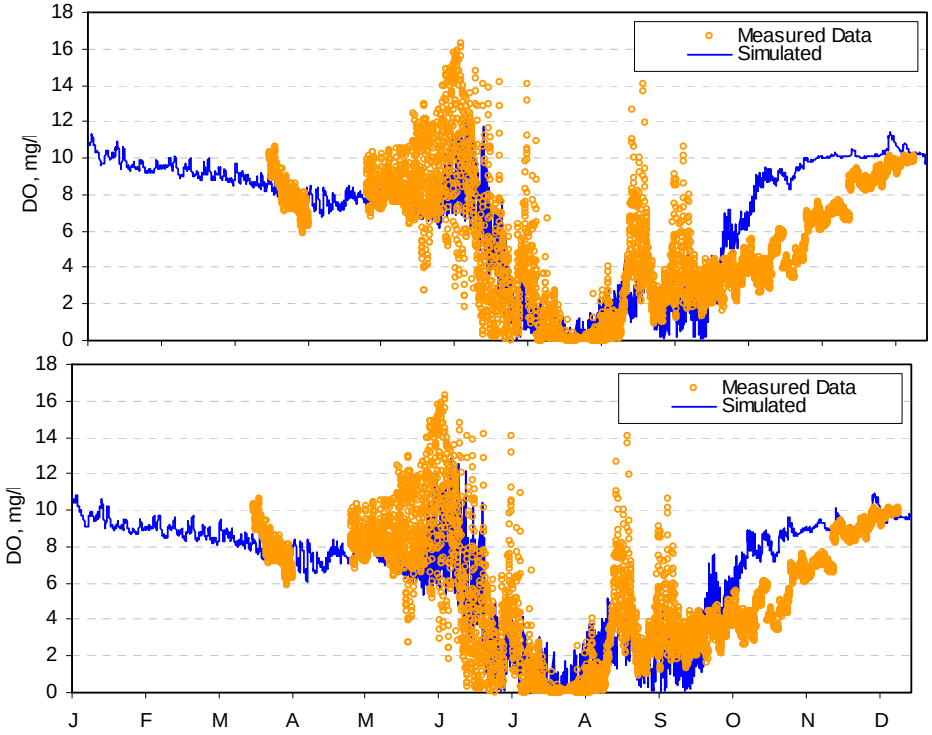
- 2009: Basin Plan Amendment Reviews
  - ✓ Dr. Characklis, University of North Carolina
  - ✓ Dr. Kondolf, University of CA, Berkeley
  - ✓ Dr. Myrick, Colorado State University
  - ✓ Dr. Tullos, Oregon State University
- 2009: Public Comment period
  - ✓ USGS (for US Bureau of Reclamation)
  - ✓ Watercourse Engineering (for PacifiCorp)
  - ✓ Klamath Tribal Water Quality Work Group
  - ✓ Others

Water Boards

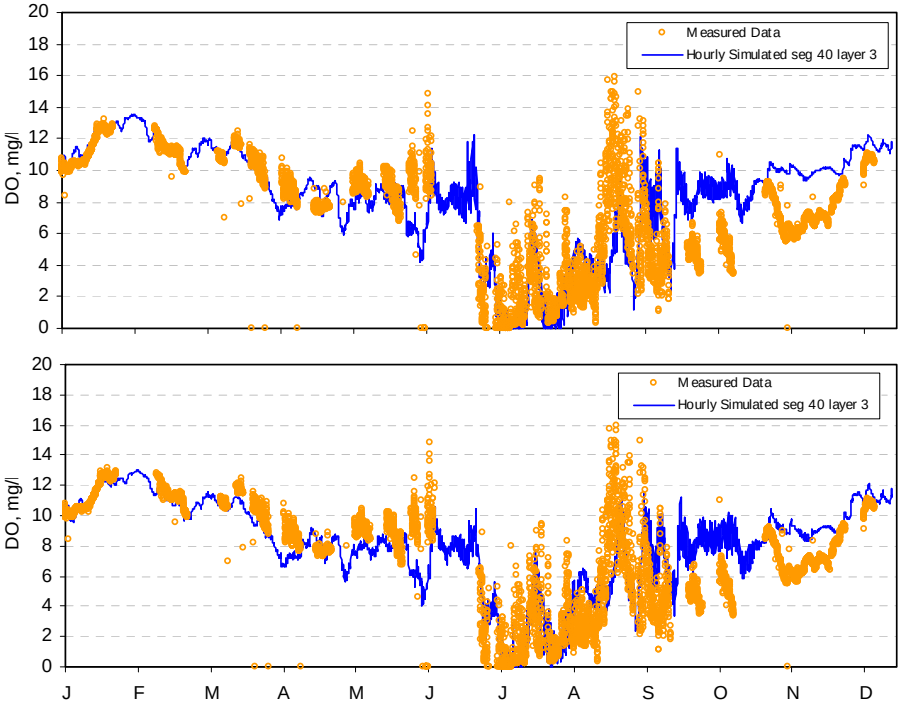
Modeling – Key Points

- A decision support tool
- Models reproduce observed water quality conditions well
- Small variation in magnitudes of some parameters following 2009 model revisions
- Allocations not significantly affected by 2009 model revisions
- Model predictions corroborated by other lines of evidence (e.g. spreadsheet model tools)

Example Calibration/Corroboration Results Dissolved Oxygen



Dissolved Oxygen
Klamath River at Miller Island - 2000

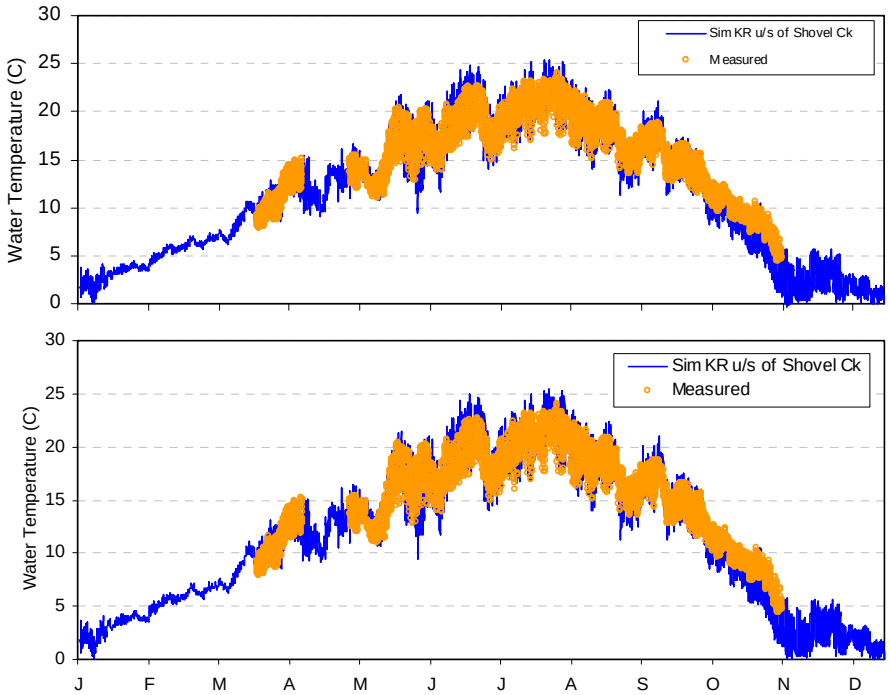


Dissolved Oxygen
Klamath River at Miller Island - 2002

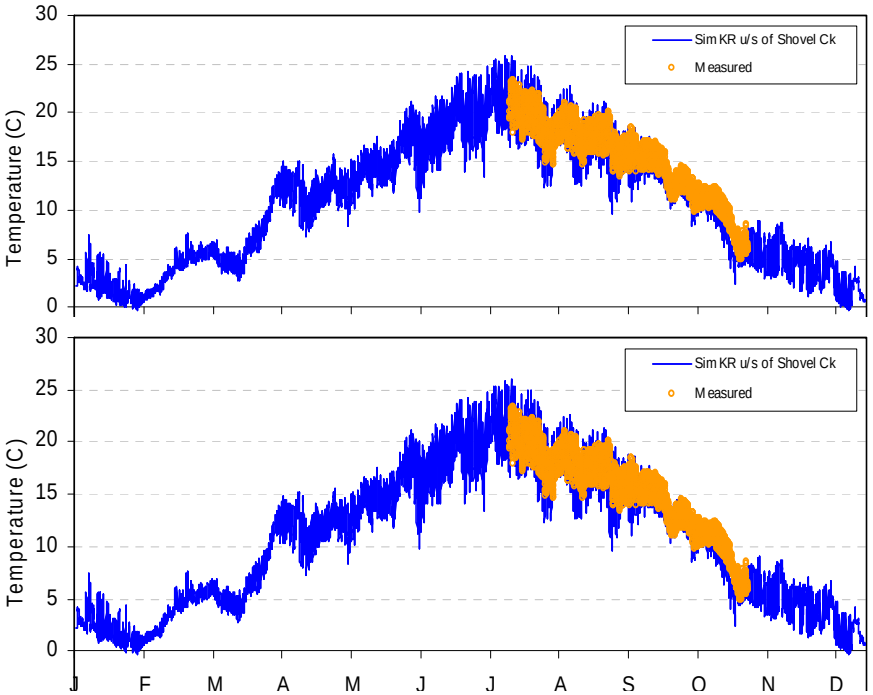
NEW (TOP)
OLD (BOTTOM)

Water Boards

Example Calibration/Corroboration Results Temperature



Temperature
Klamath River U/S of Shovel Creek - 2000



Temperature
Klamath River U/S of Shovel Creek - 2002

NEW (TOP)
OLD (BOTTOM)

Water Boards

Comment: Water quality compliance condition at Upper Klamath Lake (UKL) is unrealistic

Response:

- ✓ **Based on Oregon's UKL TMDL**
  - Best available information
- ✓ **Presented in Oregon's Klamath River TMDL**
- ✓ **Represents prediction of historic water quality conditions**
- ✓ **Used single year that represents median condition of 8 years**

Water Boards

Comment: It is inappropriate to base the TMDL on a single model year

Response:

- ✓ **TMDLs frequently developed using a single "design" year**
- ✓ **The year chosen has significant within-year variability in a highly managed and variable system**
- ✓ **The year chosen included periods of critical low flow and poor water quality**

Water Boards

Technical Analysis - Conclusions

- Project team concludes that the Klamath models are scientifically sound and good tools
- Uncertainty is minimal given magnitude of source load reductions
- Additional analysis will bring diminishing returns for determining implementation actions
- The models can be updated as new information becomes available

Water Boards

Technical Analysis – Optional Additional Slides

Water Boards

Module 4

Allocations

Water Boards

Allocations - Key Points

- Allocations derived to achieve standards
- Temperature:
  - ✓ Riparian shade
  - ✓ Sediment
  - ✓ Impoundments
- Dissolved Oxygen / Nutrients / Microcystin:
  - ✓ Organic matter and nutrients
- Stateline allocations consistent with Oregon allocations
- Compliance with CA TMDL is Not dependent on meeting WQ standards at Stateline

Water Boards

Allocations - Summary

- **Watershed-wide temperature:**
  - ✓ **site potential effective shade**
  - ✓ **control human-caused channel alterations**
- **Tributaries:**
  - ✓ **Organic matter and nutrients**
- **Klamath Hydroelectric Project (KHP) Facilities and Iron Gate Hatchery**

Water Boards

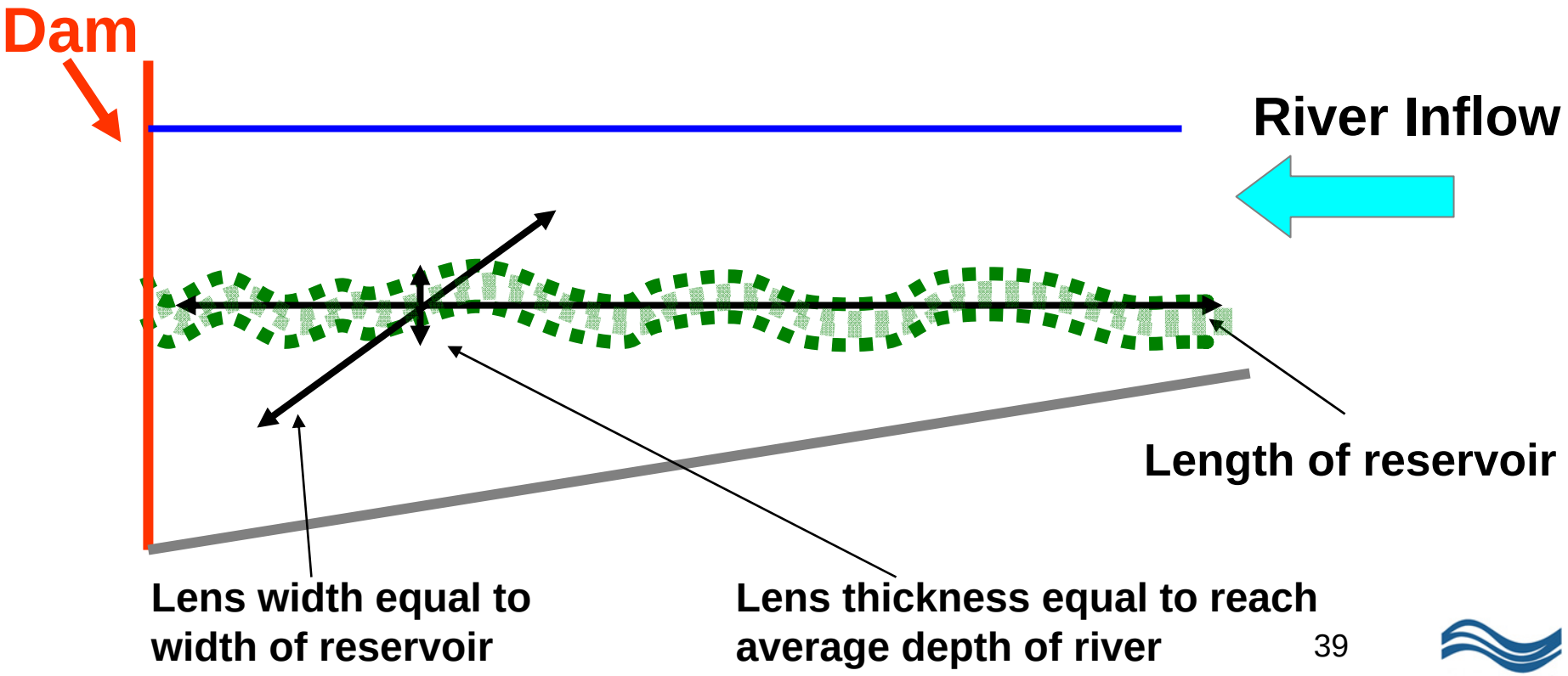
Klamath Hydroelectric Project

- KHP affects water quality and beneficial uses and contributes to impairment
- Impoundments alter assimilative capacity
- Effects of facilities on in-reservoir conditions are pollution sources

Water Boards

KHP Allocations

- No temperature increase above natural at outlet
- Nitrogen and phosphorus reductions



Water Boards

Comment: Stateline and KHP allocations & targets are unachievable

- **Stateline allocations and targets:**
  - ✓ **Consistent with Oregon TMDLs**
- **KHP allocations and targets:**
  - ✓ **Consistent with achieving standards**
  - ✓ **Address altered assimilative capacity**
  - ✓ **Technically feasible to achieve**
  - ✓ **Flexibility in Implementation Plan**
    - Tracking & Accounting Program
    - Engineered solutions
    - PacifiCorp assessing in-reservoir water quality control techniques

Water Boards

Module 5

Action Plan

Water Boards

Bi-State Coordination

- TMDL implementation Memorandum of Agreement
  - ✓ Oregon Department of Water Quality
  - ✓ Regional Board
  - ✓ USEPA Regions 9 and 10
- Maintain separate authorities
- Promote engineered treatment solutions

Water Boards

Klamath River Water Quality Tracking and Accounting Program

- **Creates framework to:**
  - ✓ **Increase effectiveness of actions and investments to restore water quality**
  - ✓ **Create options for regulated entities to meet TMDL requirements through offsets and/or credits**

Water Boards

Basinwide Prohibition

- Prohibits discharges of waste that cause a violation of water quality standards
- Restatement of existing law
- Only applies to discharges that are not otherwise regulated by the Regional Board

Water Boards

Thermal Refugia Protection Policy

- Enhances protection of thermal refugia in the Klamath River in California
- Identifies refugia and establishes protective buffers
- Restrictions and Recommendations:
  - ✓ Restriction on suction dredging discharges within refugia buffers (April 15 - September 15)
  - ✓ Restoration in watersheds that provide refugia
  - ✓ Heightened scrutiny in water quality and water rights permitting

Water Boards

Thermal Refugia Protection Policy

- Addresses short-term impacts during critical period
- Does not amount to private property 'taking'
  - ✓ Restrictions provide necessary environmental protection
  - ✓ Restrictions limited in time and space
  - ✓ Majority of claims reviewed by staff do not overlap with thermal refugia

Water Boards

Lost River TMDL Implementation

- Close coordination of Oregon agencies
- Proposed Management Agency Agreement
  - ✓ Regional Water Board, Bureau of Reclamation, US Fish and Wildlife Service, and Tulelake Irrigation District
- Tulelake WWTP NPDES permit revision
- Individual agricultural discharges addressed through future Conditional Waiver

Water Boards

Klamath Hydroelectric Project

- TMDL implementation accommodates two possible regulatory pathways:
  - ✓ Klamath Hydro Settlement Agreement
  - ✓ FERC/401
- PacifiCorp to submit Implementation Plan to meet TMDL
- PacifiCorp expected to implement measures to meet and/or offset TMDL allocations and targets
- Iron Gate Hatchery NPDES permit revision

Water Boards

Future Conditional Waiver for Agriculture

- Address grazing and irrigated agriculture in Klamath Basin in CA
- Develop Conditional Waiver by 2012
  - ✓ Inclusive process headed by Regional Board
  - ✓ Technical Advisory Group(s)
- In interim, staff recommends:
  - ✓ Organizing into watershed groups
  - ✓ Developing group management plans to fit local conditions
  - ✓ Documenting existing practices

Water Boards

US Forest Service Conditional Waiver

- Region-wide nonpoint source program
- Development separate from TMDL process – adopted June 2010
- Addresses nonpoint source activities on National Forest lands
- Incorporates TMDL implementation measures
  - ✓ Watershed restoration
  - ✓ Road sediment sources
  - ✓ Riparian management

Water Boards

Road Discharges – Counties and Caltrans

- County – Five County Salmonid Protection Program
  - ✓ TMDL proposes certification of program by June 2011
  - ✓ Develop individual waivers for counties not participating by December 2012

- NPDES permit for Caltrans

Water Boards

TMDL Reassessment

- Includes timelines to meet allocations and targets
- Annual updates to Regional Board
- Five year reassessment of TMDL

Water Boards

Thank You

Water Boards

Module 3

Optional Additional Slides

Water Boards

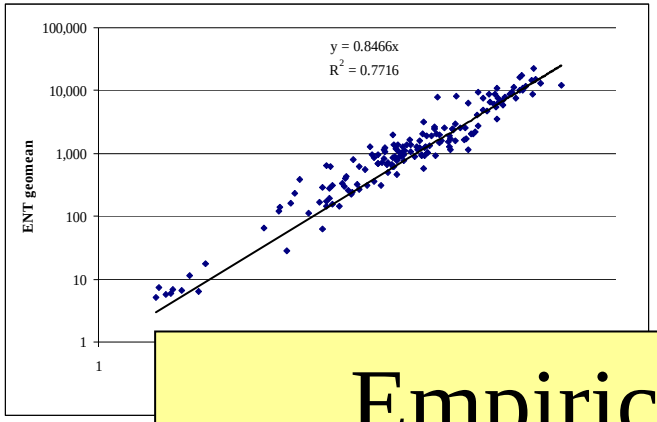
What Is a Model?

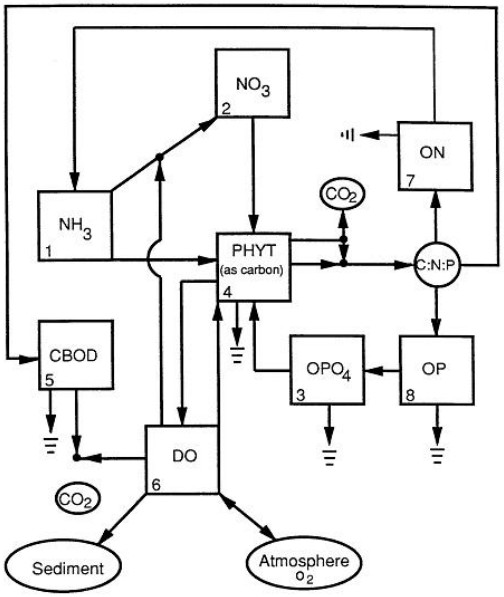
- A theoretical construct,
- together with assignment of numerical values to model parameters,
- incorporating some prior observations drawn from field and laboratory data,
- and relating external inputs or forcing functions to system variable responses.

* Definition from: Thomann and Mueller, 1987

Water Boards

Model Basis



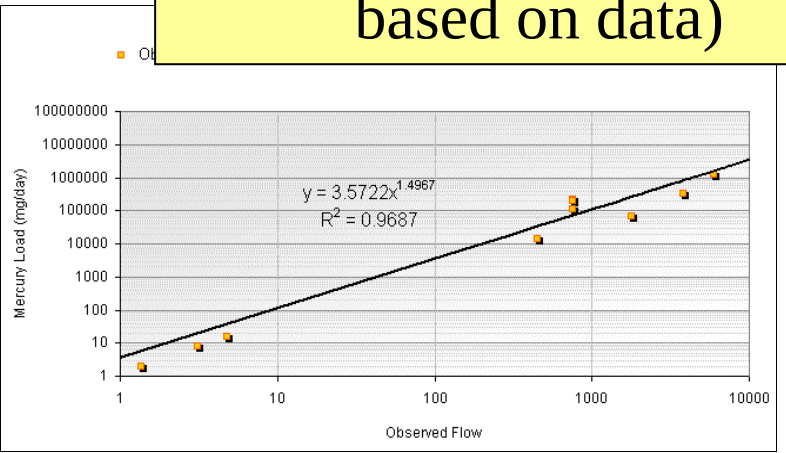


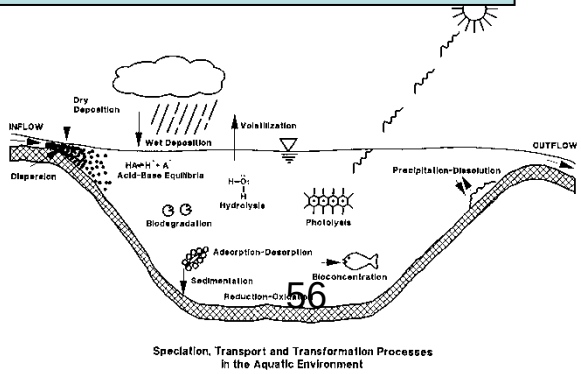
Empirical Formulations

(statistical relationships based on data)

Deterministic Models

(biological, chemical, physical processes)





Speciation, Transport and Transformation Processes in the Aquatic Environment

Regulatory Modeling Practice

- Development and application of Klamath River TMDL models consistent with

  "Guidance on the Development, Evaluation, and Application of Environmental Models" (EPA 2009)

- Klamath highlights:
  - ✓ Peer review
  - ✓ Transparency
  - ✓ Project team collaboration

Water Boards

Uncertainty in Modeling Analysis

Data limitations

Science limitations

+ Cost & Time Constraints = Model Uncertainty

Water Boards

Klamath River TMDL Model – Assessment of Accuracy

- There are many measures of model performance
- Two categories for Klamath TMDL model:
  - ✓ Qualitative comparison of time series plots
  - ✓ Calculation of error statistics

Water Boards

Primary Model Revisions

- 20% reduction in surface solar radiation in the Lake Ewauna CE-QUAL-W2 code
- Inconsistencies among kinetic parameters for model runs
- Elevation datum for Lake Ewauna and J.C. Boyle Reservoir
- Upper Klamath Lake natural boundary condition for organic matter and algae

Water Boards

Additional Model Revisions

- Improved resolution of atmospheric pressure representation and updated DO boundary conditions for the Iron Gate to Turwar reach
- Made DO boundaries consistent for scenarios based on saturation %
- Used a consistent EXH2O value for the reservoirs
- Healthy/unhealthy periphyton parameters were made consistent with those for the healthy/unhealthy phytoplankton
- Updated Scott River natural flows and temperatures
- Modified the Jenny Creek boundary condition
- Updated initial conditions
- Deactivated the turbulence-enhanced reaeration for the no-dams scenarios
- Updated the distributed flow temperature for Lake Ewauna
- Computed error statistics

Water Boards

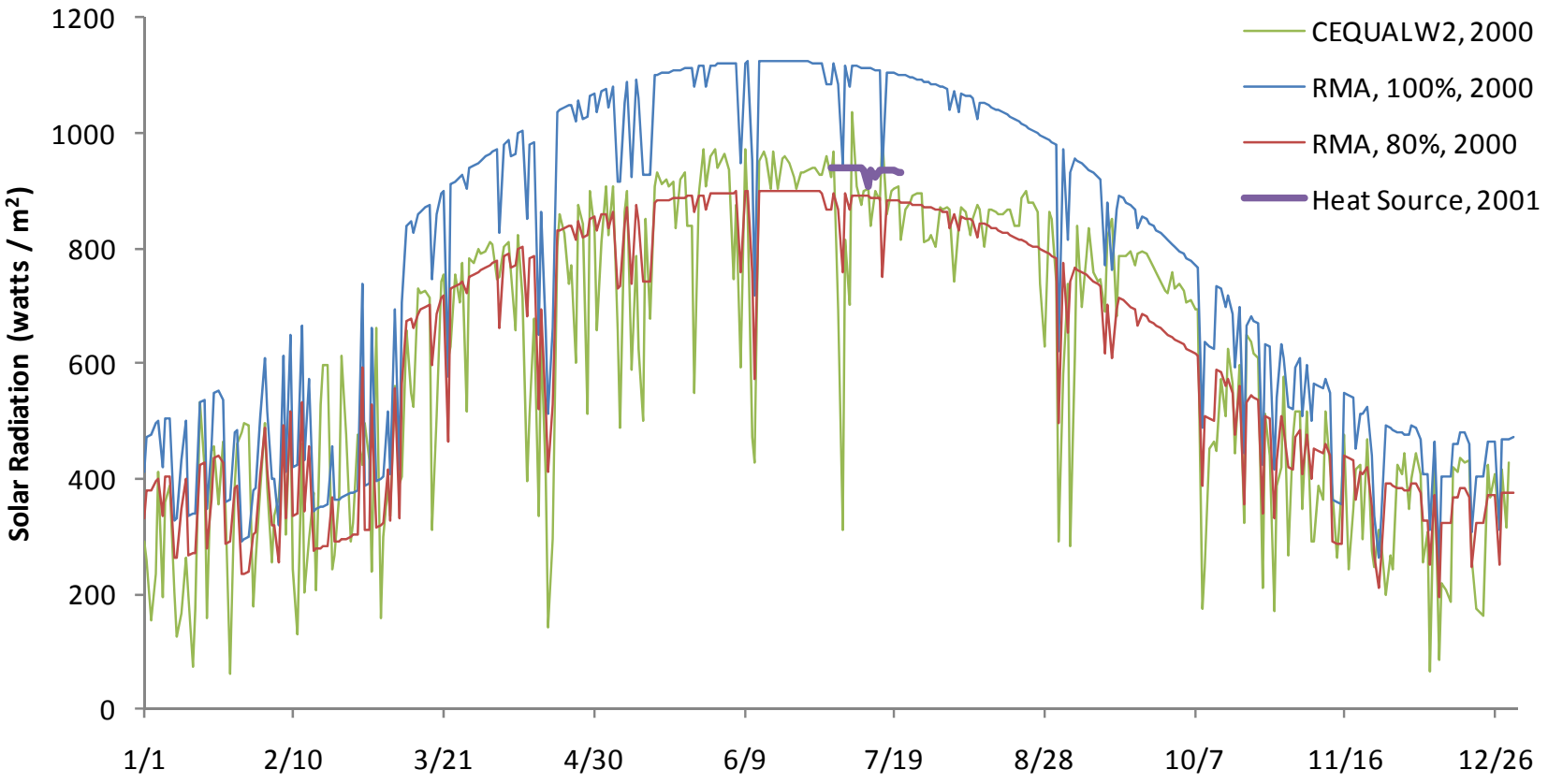
Comment: 20% reduction in solar radiation in riverine model is inappropriate

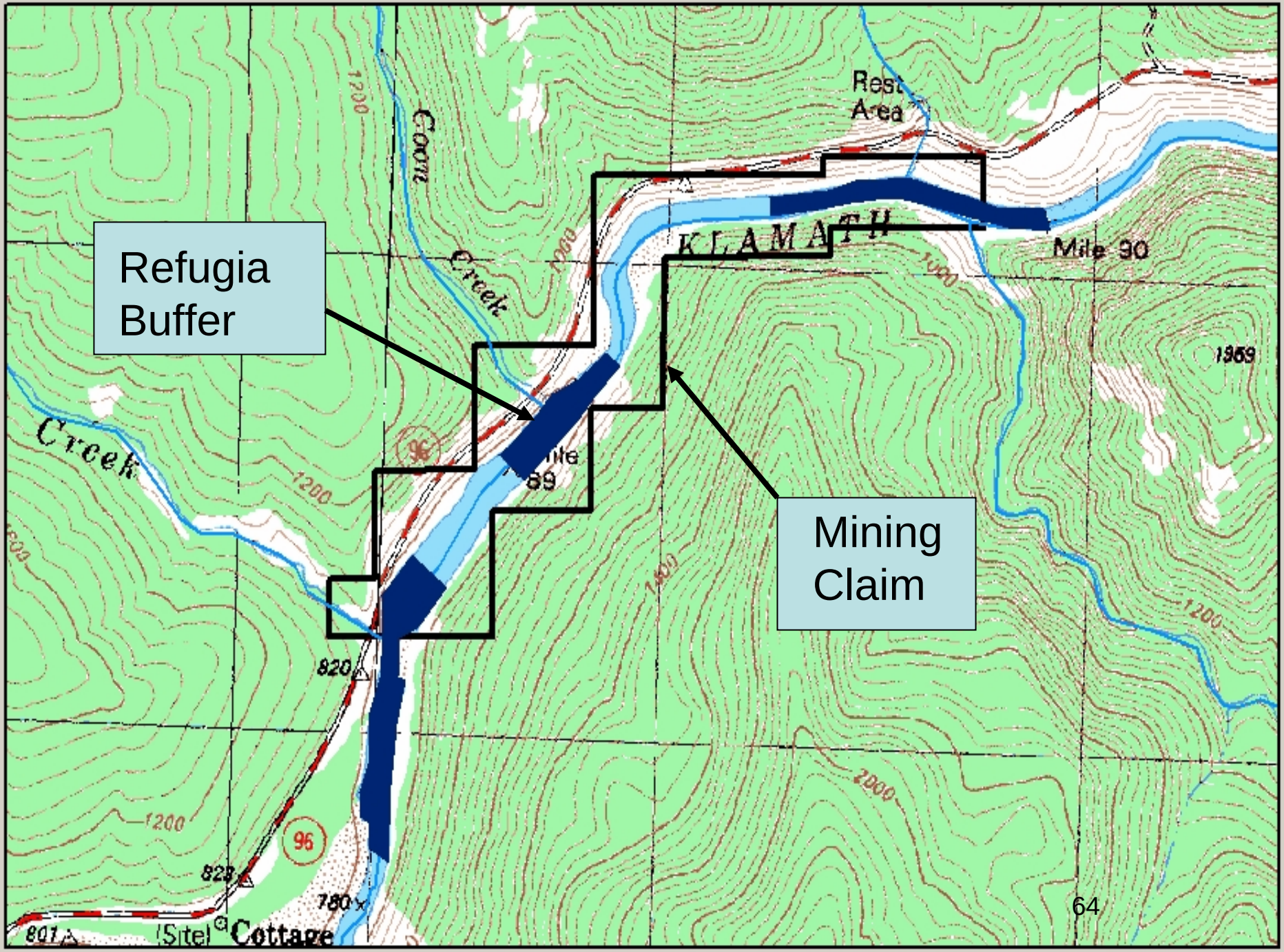
Response:

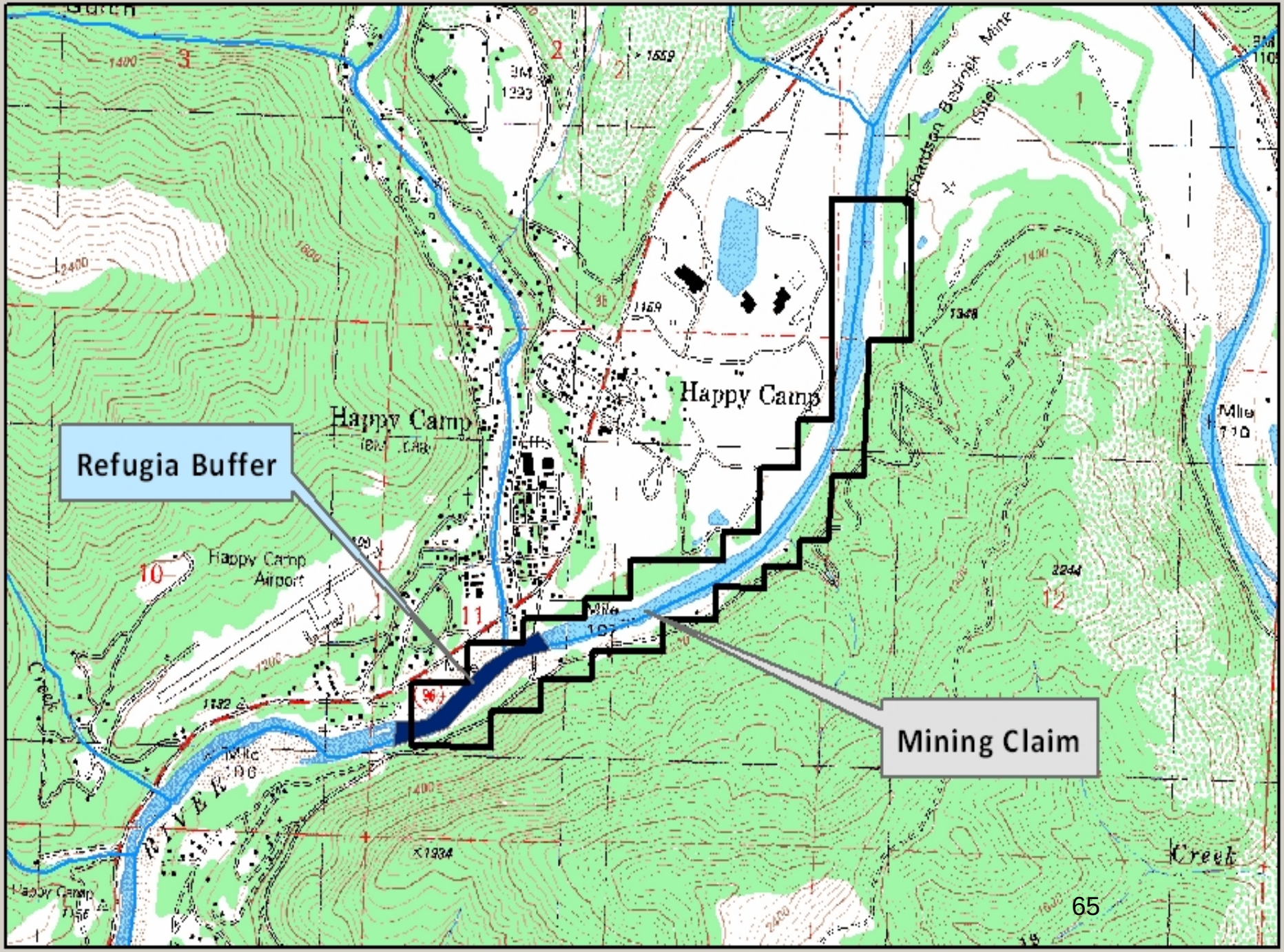
- ✓ **The reduction was done as part of a calibration process for better model performance**
- ✓ **Solar radiation values used in the riverine model are consistent with those used in the reservoir model**
- ✓ **Used consistent solar radiation values for all scenarios**

Water Boards

Modeled Solar Radiation Conditions




Refugia Buffer
Mining Claim
Rest Area
KLAMATH
Mile 90
Mile 89
Coon Creek
Creek
1200
1000
1400
2000
1969
820
823
780
801
96
(Site) Cottage


Refugia Buffer
Mining Claim
Happy Camp
Happy Camp
Happy Camp Airport
Creek
Creek