Draft Upper Klamath and Lost River Subbasins TMDL and Water Quality Management Plan

Oregon Department of Environmental Quality
U.S. EPA Region 9 & 10
North Coast RWQCB, Oregon DEQ
with support from Tetra Tech, Inc.

March 2010

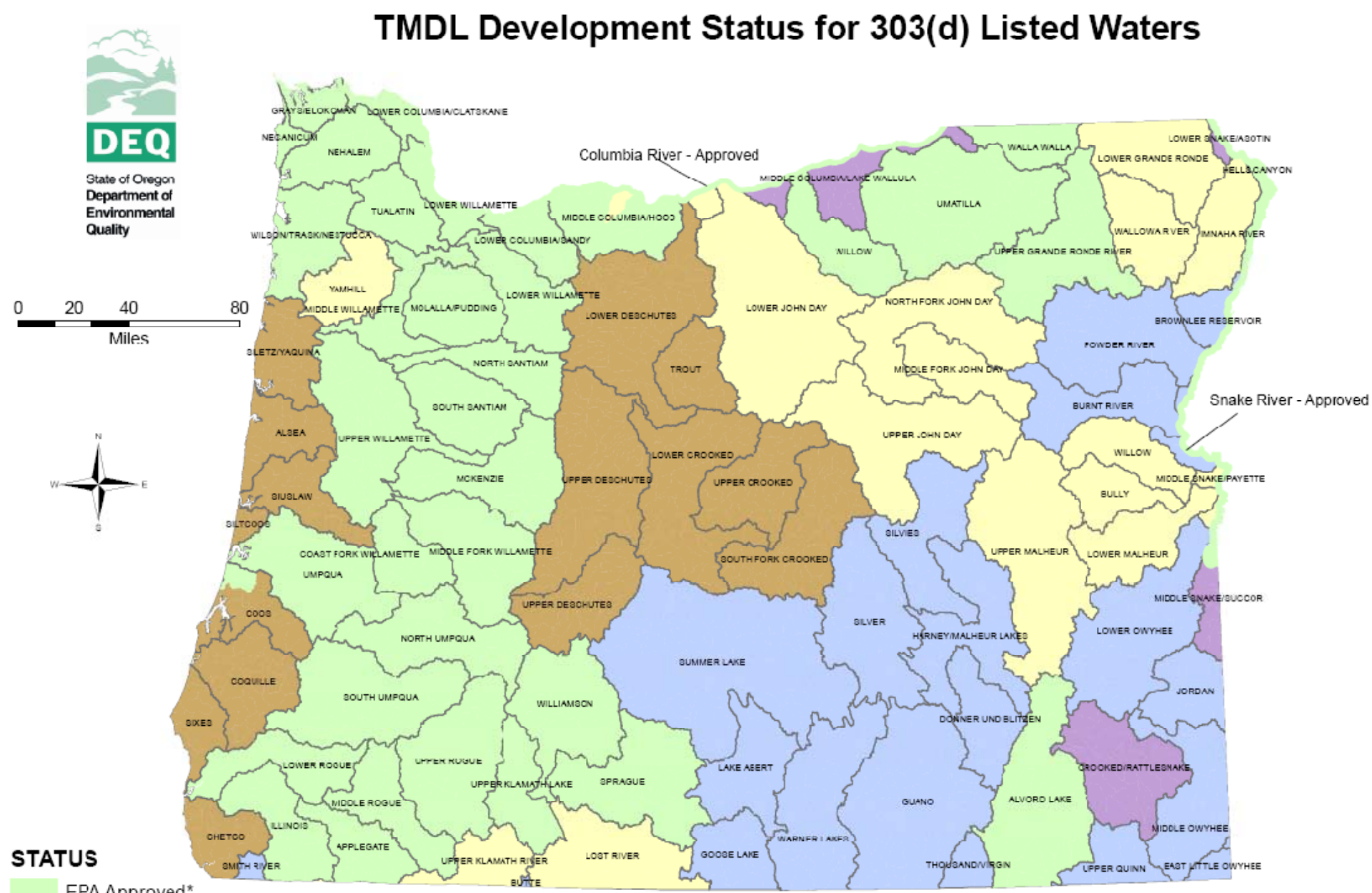
Who does what?

- EPA – Clean water act, delegation and approval
- DEQ
  - Water standards and assessment: 303(d) list
  - TMDL development.
  - Implementation of TMDLs: point sources, 401 certification, review of plans implementation plans
- Designated management agencies
- State of California
- Other Basin Plans and Agreements

Coordination between ODEQ, US EPA 9 & 10, and Cal North Coast RWQCB

- Memorandum of Agreement
- Common analysis
- Shared resources
- Technical assistance by Tetra Tech, Inc.

TMDL Development Status for 303(d) Listed Waters

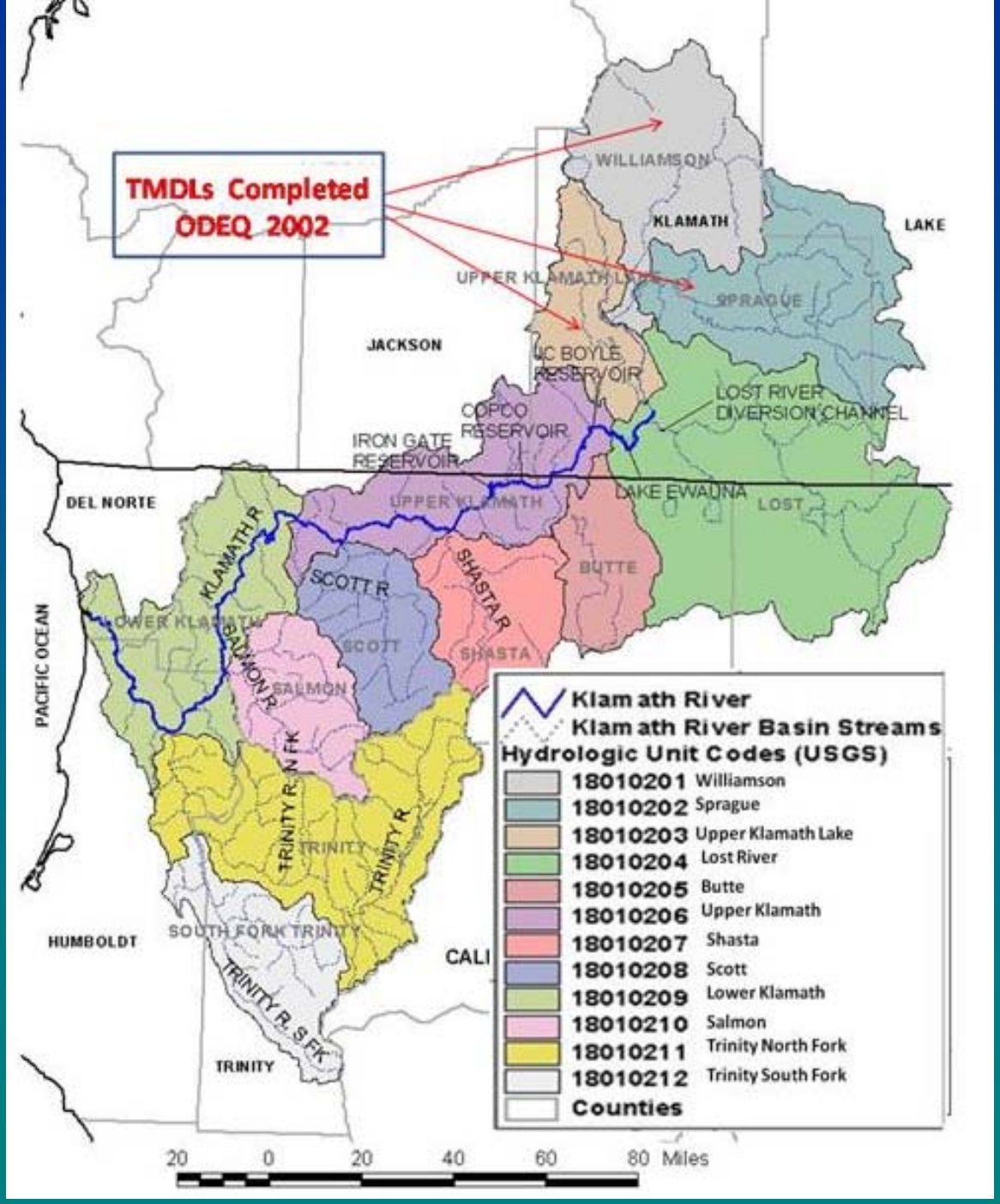


STATUS

- EPA Approved*
- TMDL Report In-Progress (Data analysis & report writing phase)
- TMDL Initiated (Initial scoping & data collection phase)
- TMDL Not Started (Minimal or no activity)
- No TMDL Necessary (No 303(d) listings)

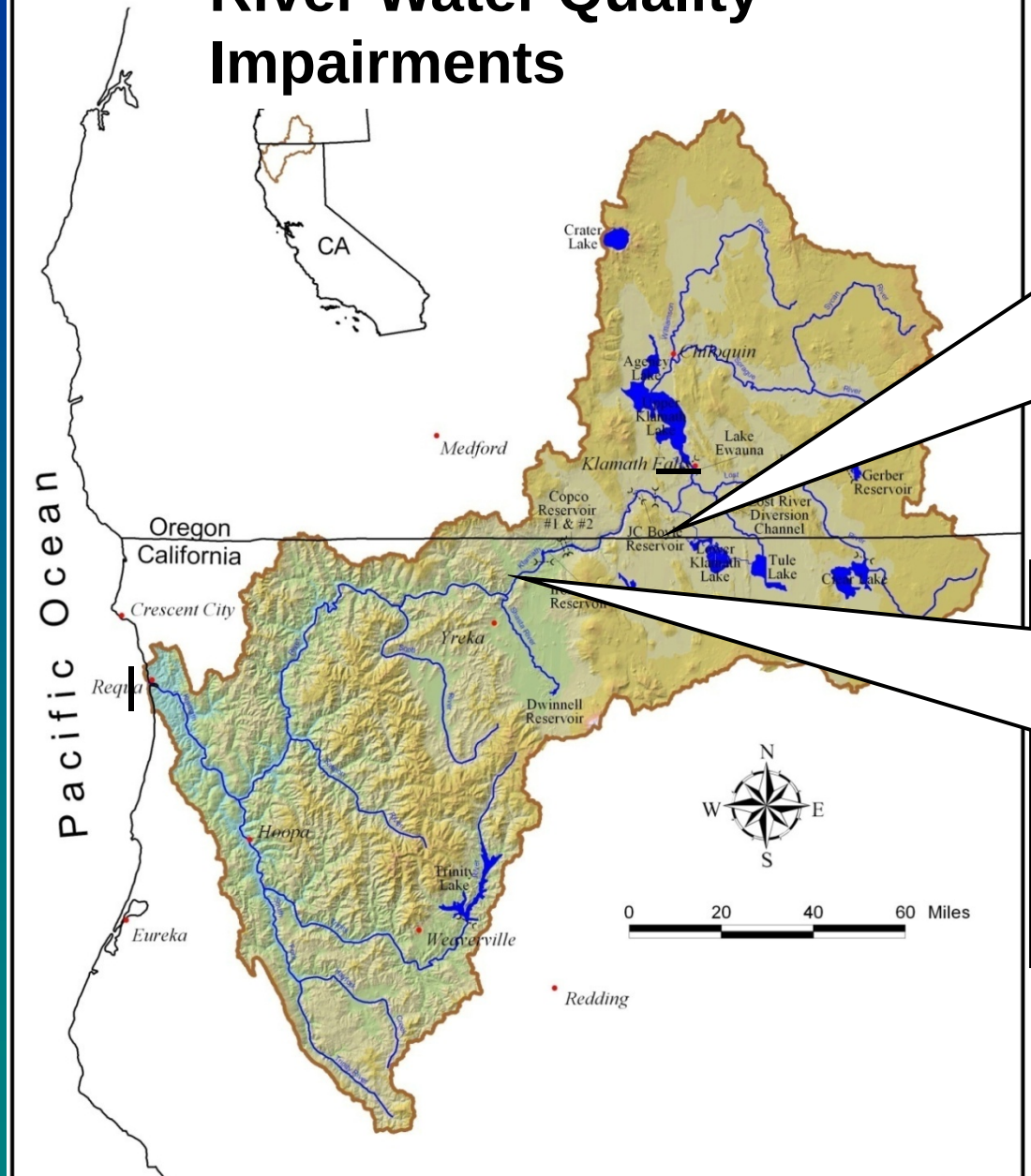
*See TMDL supporting documentation for parameters addressed at: http://www.deq.state.or.us/wq/tmdls/tmdls.htm. Additional 303(d) listings may exist for parameters not addressed in approved TMDLs.

Klamath River Basin



Watersheds Assessed

Klamath River and Lost River Water Quality Impairments



Upper Klamath and Lost Subbasins in Oregon:

- Temperature
- Dissolved oxygen
- pH
- Ammonia toxicity
- Chlorophyll-a

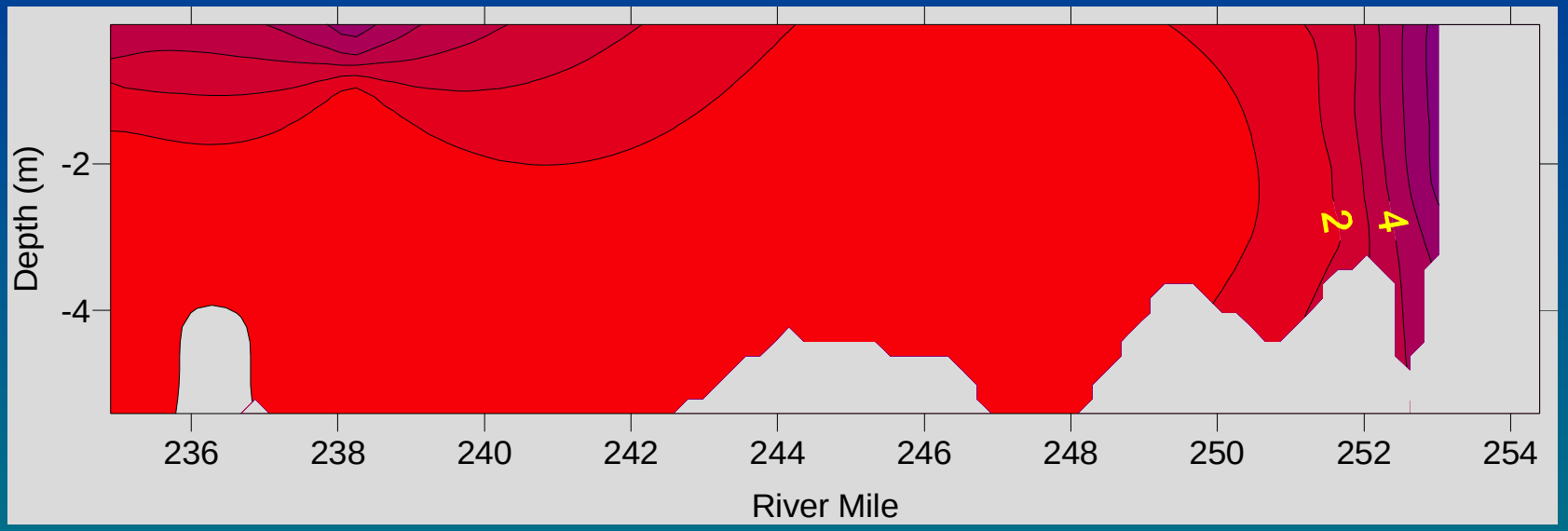
Klamath River in California:

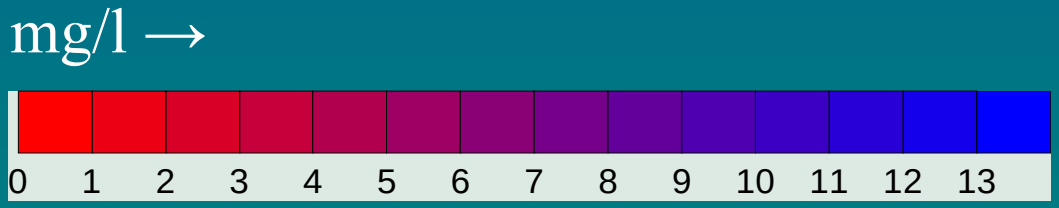
- Temperature
- Organic enrichment / low DO
- Nutrients
- Sediment
- Microcystin

Water Quality Impairment

Sub-basin	Water Body	River Miles	Parameter
Crosses Multiple	Klamath River	231.5 to 253	Ammonia Toxicity
	Klamath River	231.5 to 253	Chlorophyll a
	Klamath River	207 to 251	Dissolved Oxygen
	Klamath River	231.5 to 253	pH
	Klamath River	207 to 231.1	Temperature
Lost River	Tributaries	36.5 total	Temperature
	Klamath Straits	0 to 0	Ammonia Toxicity
	Klamath Straits	0 to 0	Chlorophyll a
	Klamath Straits	0 to 0	Dissolved Oxygen
Upper Klamath			
	Tributaries	74 total	Temperature

DO Impairment Keno Impoundment





Source: Mike Deas, Watercourse Engineering

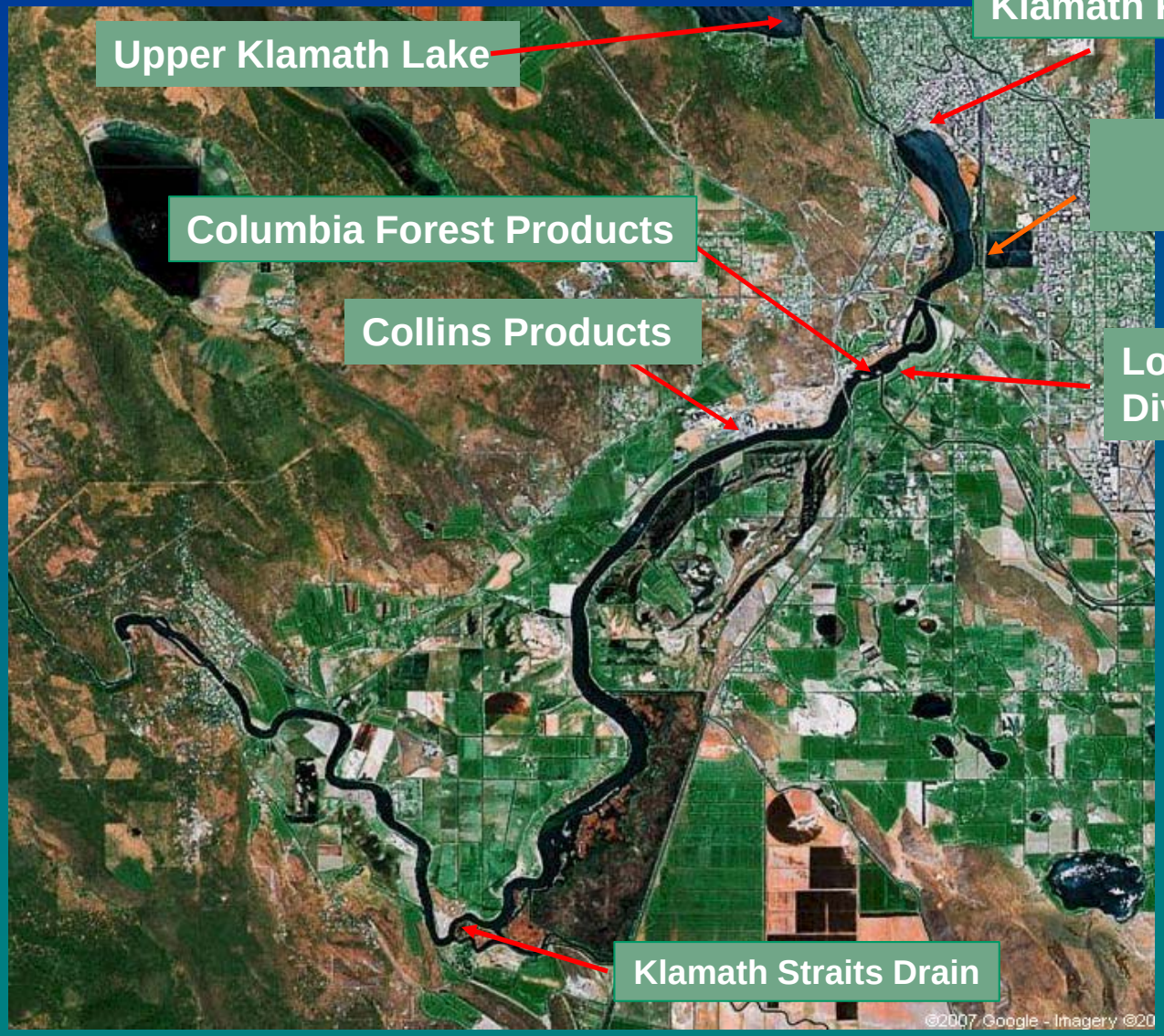
California Klamath River TMDLs Address:

- Altered stream temperatures (all)
- Organic enrichment / low dissolved oxygen (mainstem)
- Nutrient enrichment (all)
- Algae

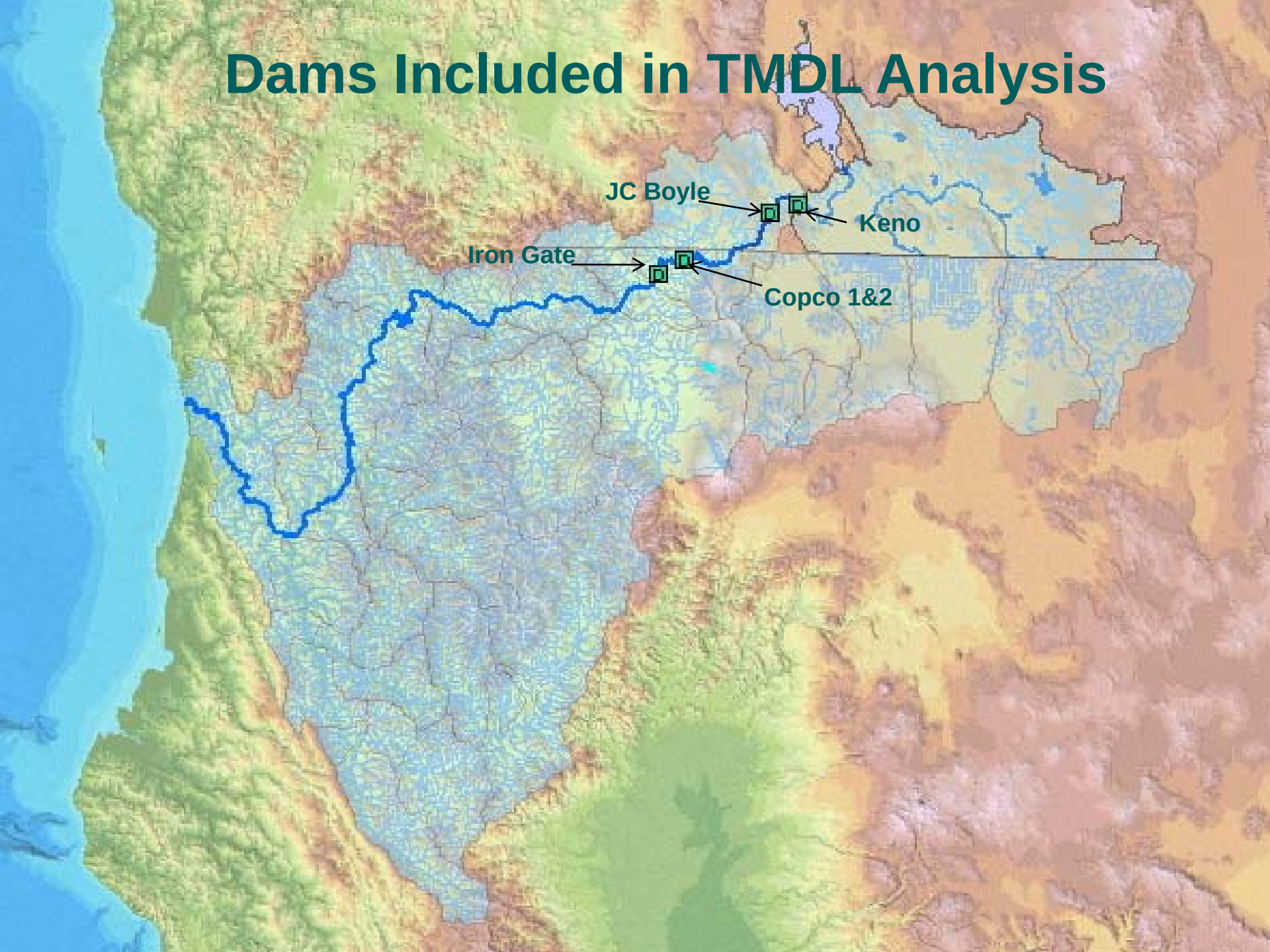
Lost River Subbasin TMDLs Address:

- Within Oregon
  - Dissolved oxygen, pH, algae, ammonia toxicity
  - Temperature for tributaries
- Within California (US EPA 9 lead)
  - Nutrients
  - Tule Lake and Lower Klamath Refuge for pH

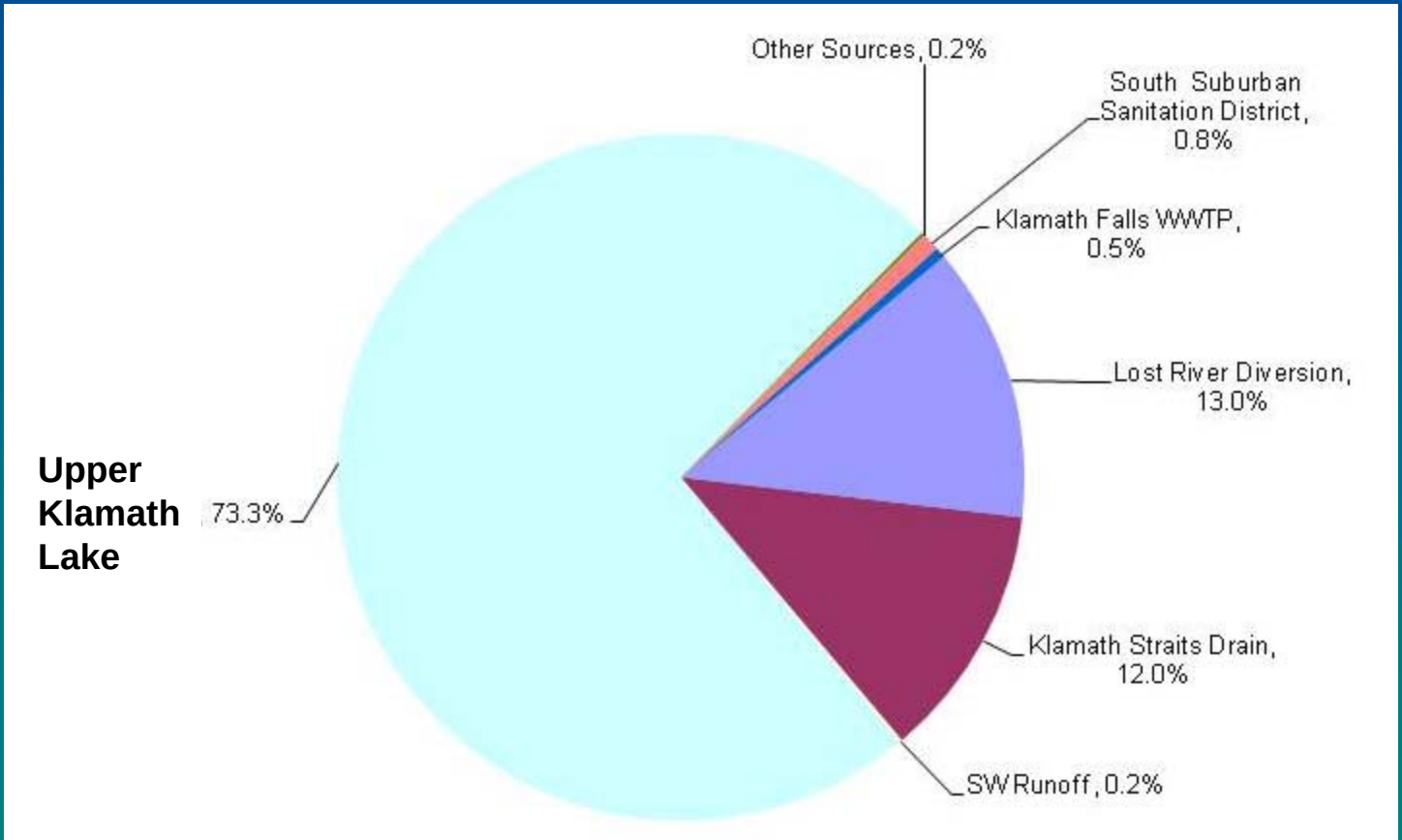
Sources - Keno Impoundment



Dams Included in TMDL Analysis



Biochemical Oxygen Demand Loading 2000

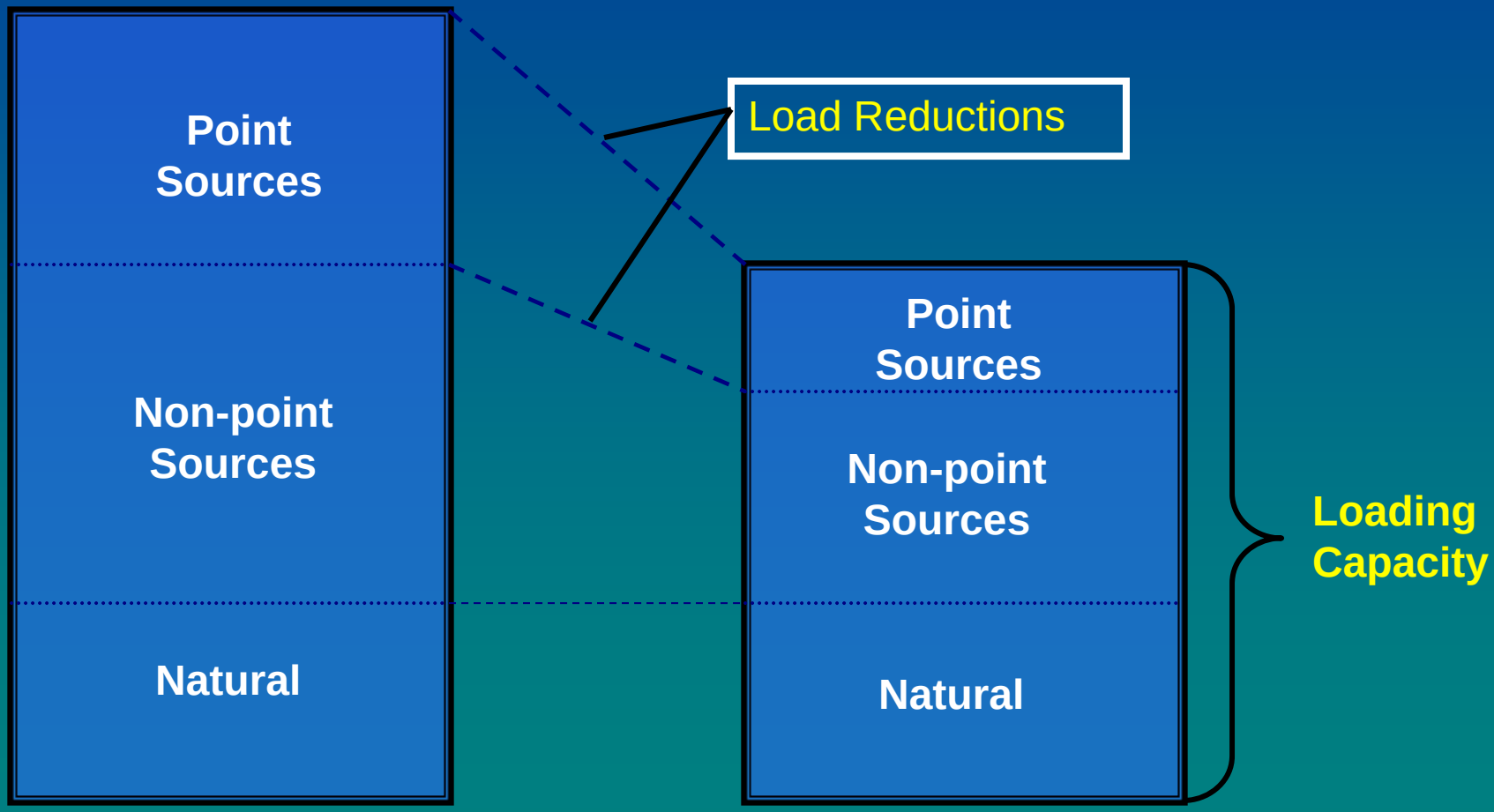


A TMDL is a framework for:

- Evaluating and quantifying the factors that contribute to water quality problems in a waterbody or watershed
- Developing a strategy to meet the loading capacity and attain water quality standards

TMDL Concept

Current Conditions



Klamath TMDL Development Approach

- Data Analysis
- Evaluation of available reports
- Application of water quality models

Reports and Supporting Information

Draft Upper Klamath and Lost Rivers TMDL and WQMP

Tributaries to the Upper Klamath and Lost Rivers Temperature Models

Data Review and Modeling Approach - Klamath and Lost Rivers TMDL Development

Klamath River Model for TMDL Development

Klamath River Model Scenarios Summary

Sediment Oxygen Demand in Selected Sites of the Lost River and Klamath River

Lost River Model for TMDL Development

Klamath River/Lost River TMDL Implementation - December 2009

Klamath River/Lost River TMDL Development - Revised January 2005

http://www.deq.state.or.us/wq/tmdls/klamath.htm

What Is a Water Quality Model?

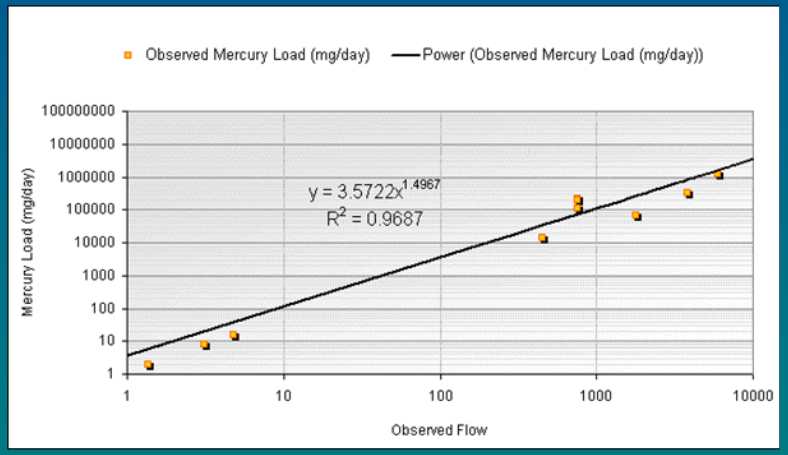
- Mathematical representation of processes
- Incorporates instream data and input data
- Links sources and pollutants to observed impairments

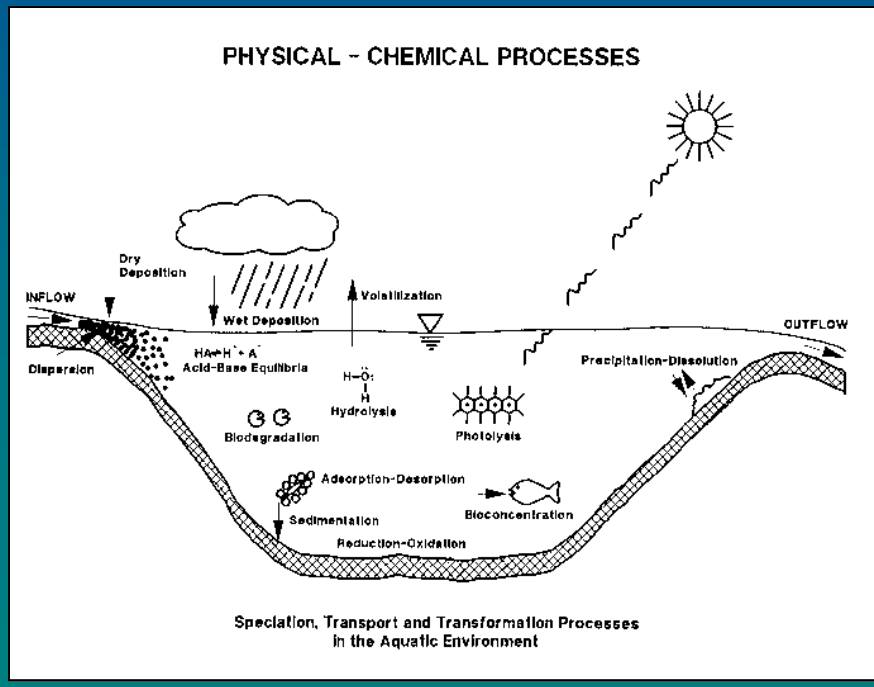
Empirical Formulations

(statistical relationships based on data)

Deterministic Models

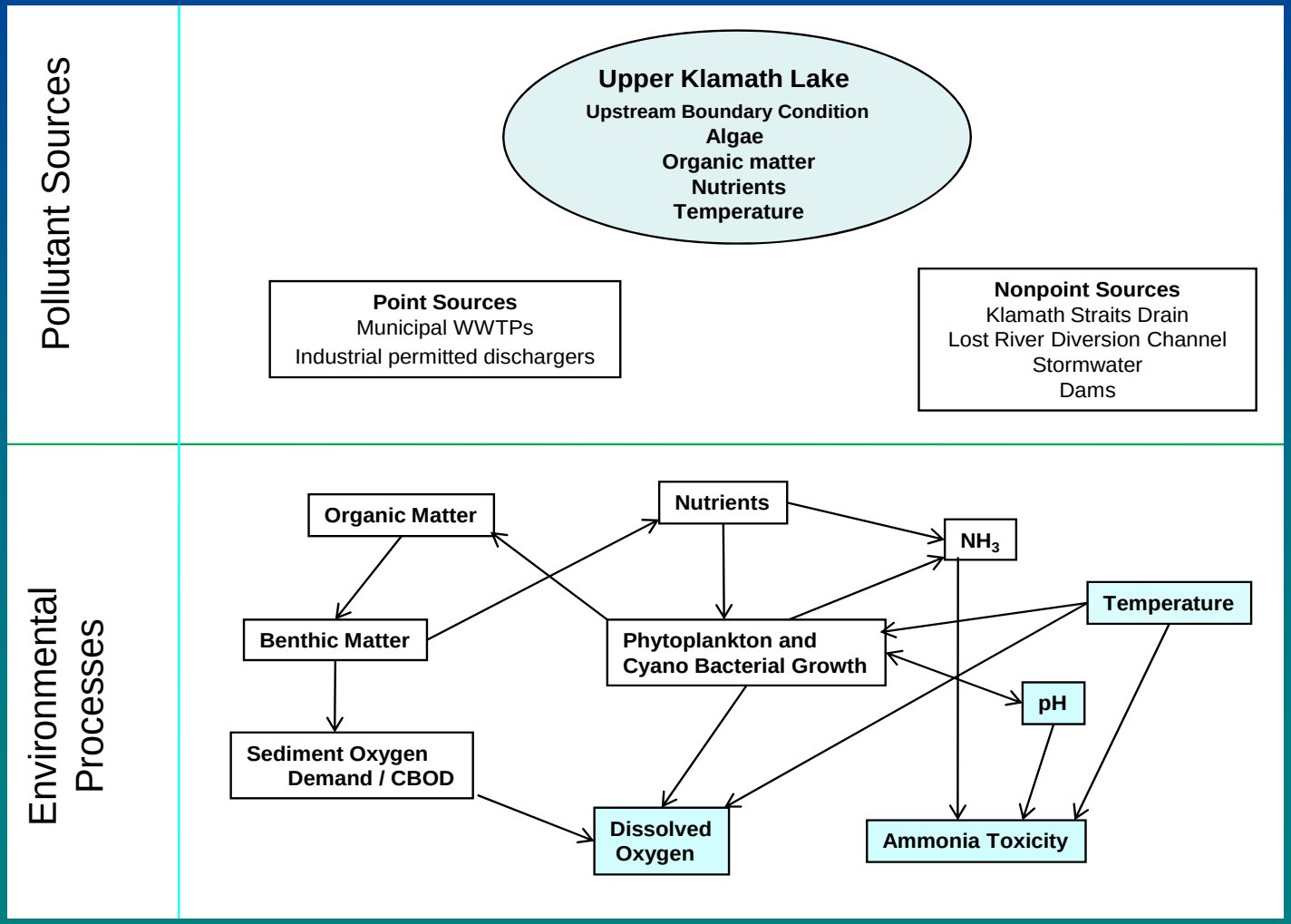
(biological, chemical, physical processes)



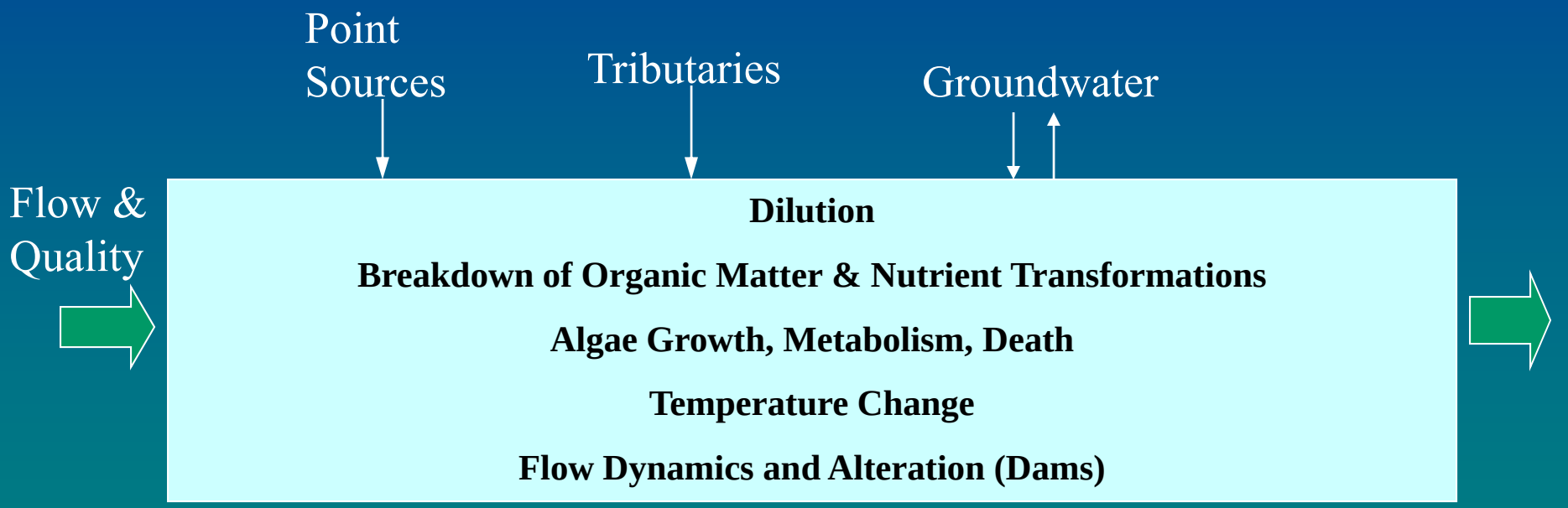


Height = Age × m + b

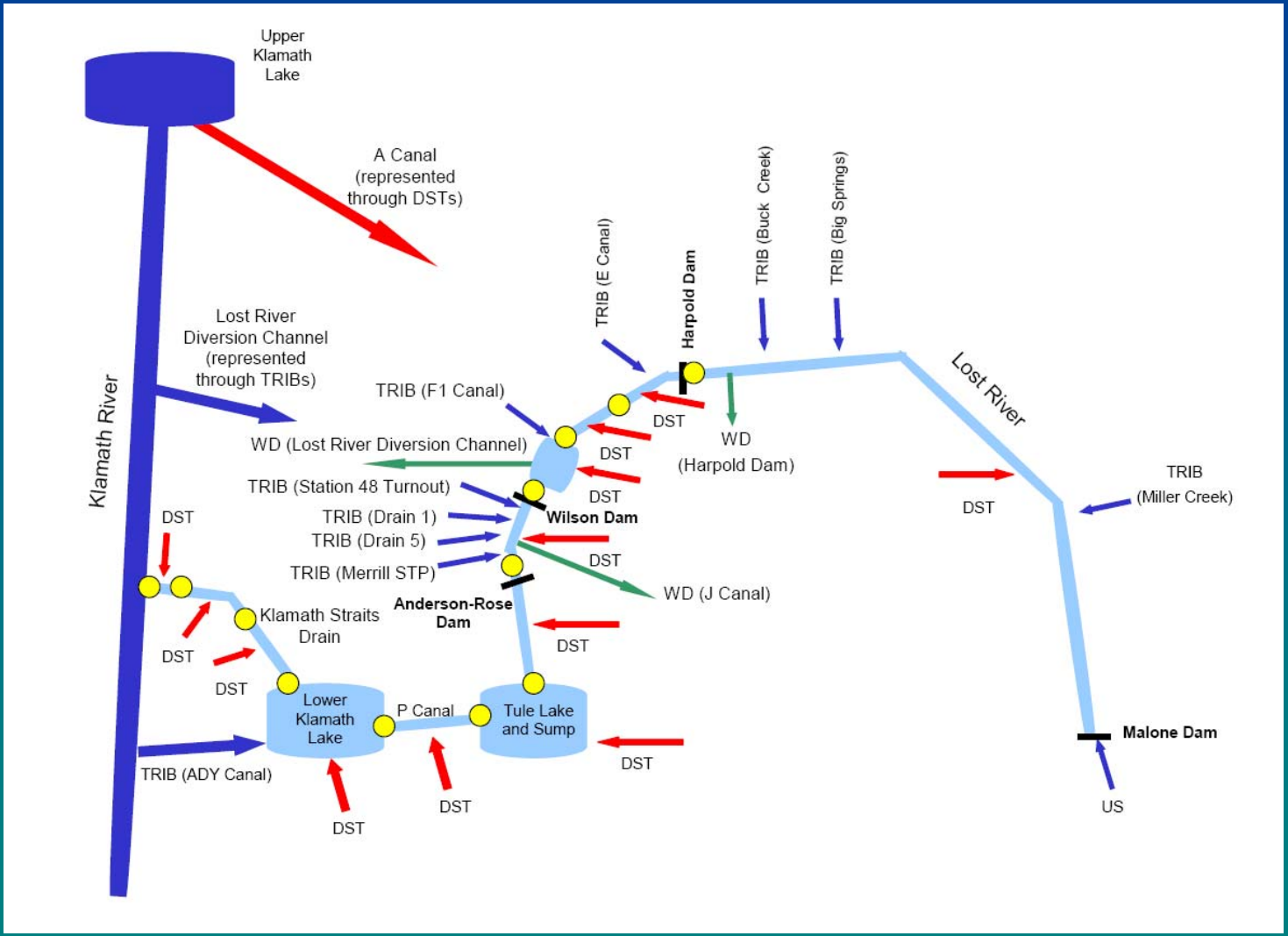
Water Quality Impairment Sources and Processes, Klamath River

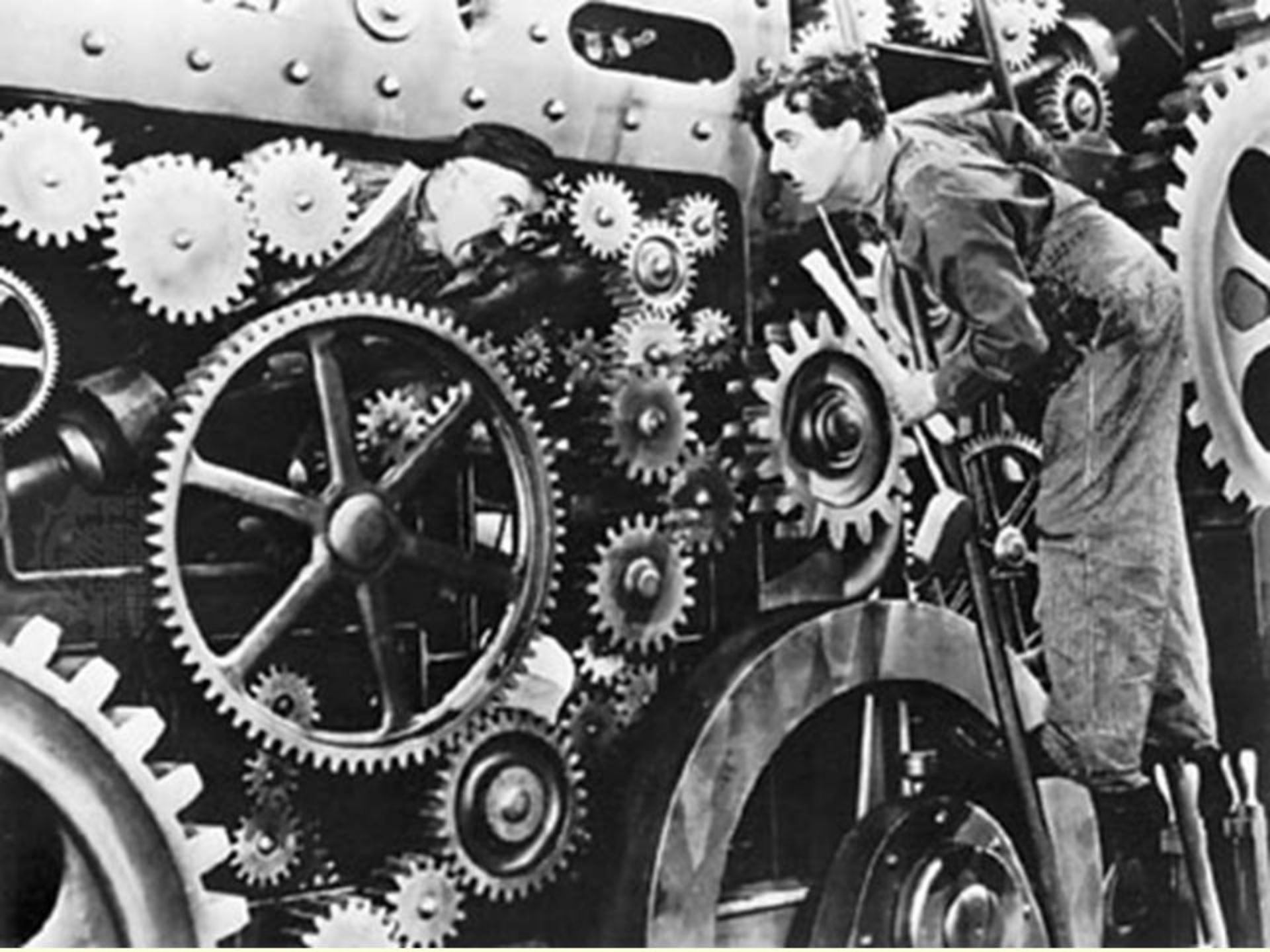


TMDL Model Processes



Lost River model schematic





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

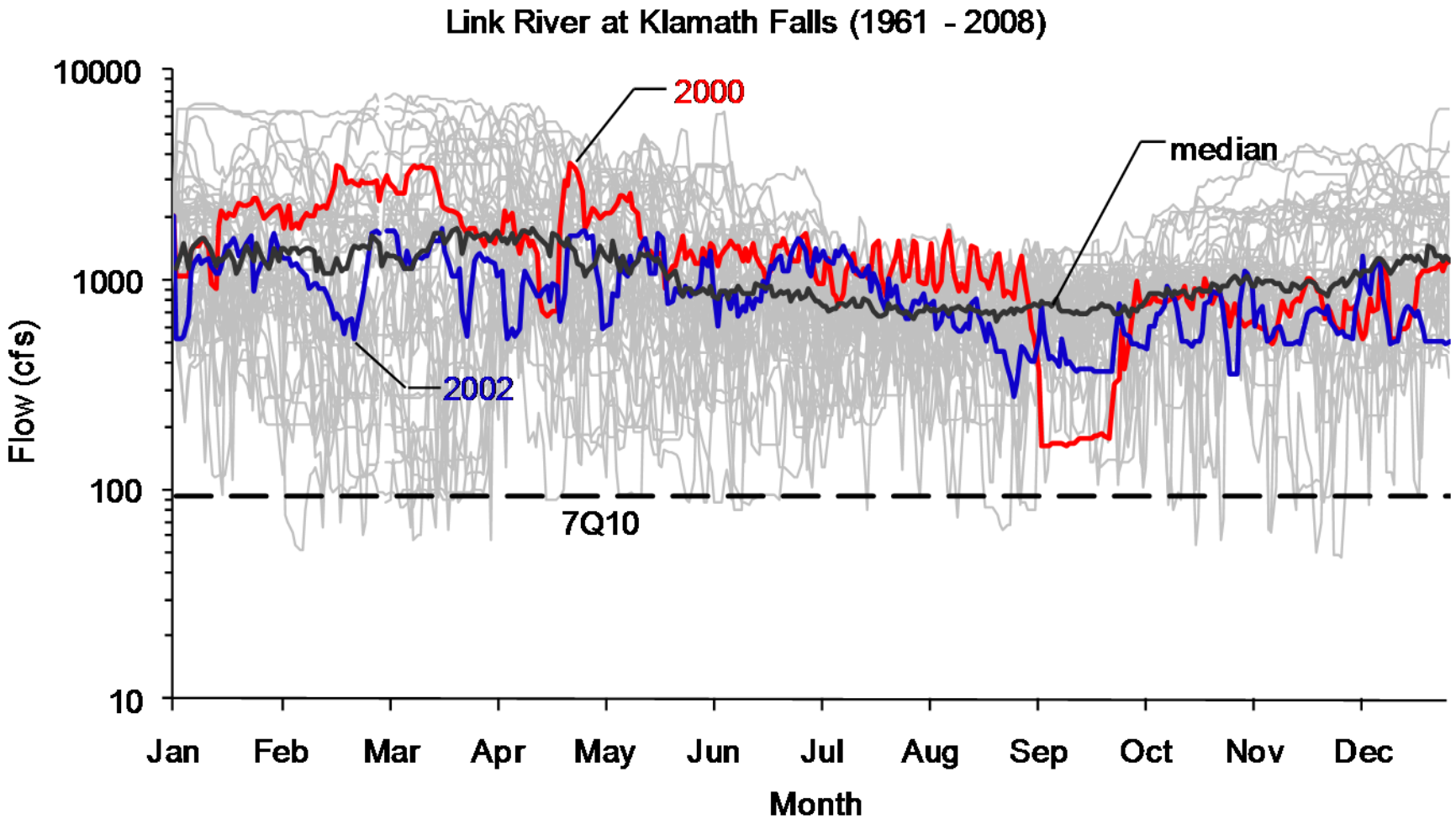
Model Application

- Analysis of TMDL Alternatives – Compliance Scenarios

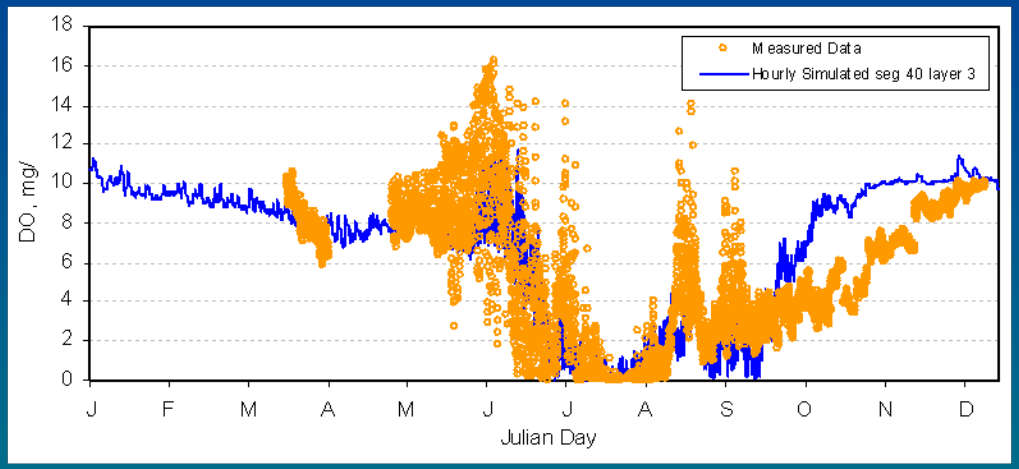
Model Development and Evaluation

Klamath River	Lost River	Tributaries
UKL to Estuary	Malone Dam to KSD	9 streams
CE-QUAL-W2 RMA, EFDC	CE-QUAL-W2	Heat Source
2000 and 2002	1999 and 2004	July 2001
Tetra Tech	Tetra Tech	DEQ
USBR, Dr. Wells, Brown + Caldwell, CA review, USGS	USBR, Dr. Wells	USFS, BLM

Klamath River flow

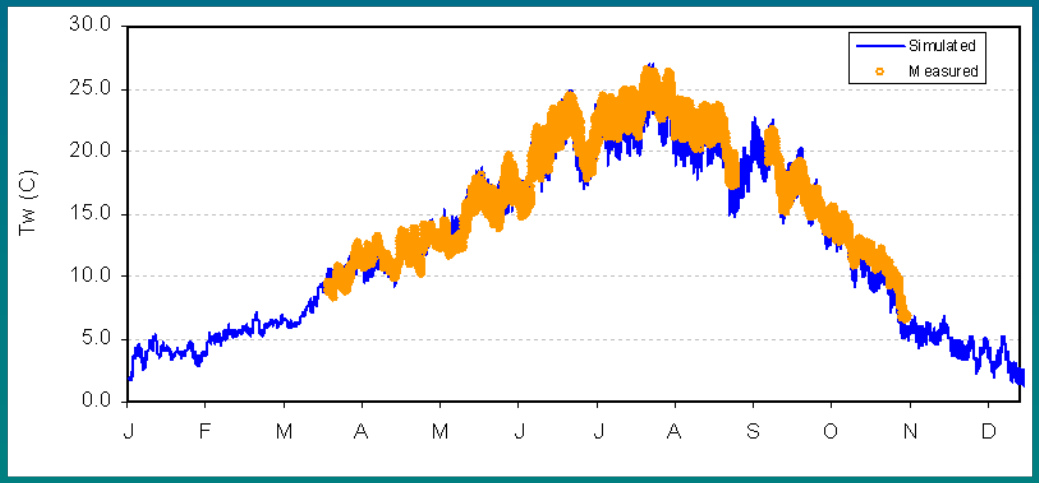


Model Evaluation: Klamath River example



Miller Island (2000)
Dissolved Oxygen

Model successfully captures trends, magnitudes, and unusual variability



Seiad Valley (2000)
Temperature

Model Application

- Estimate internal sources
- Estimate unmeasured sources
- Determination of the limiting pollutant
- How much can each source discharge so the river does not exceed standard?
  - Numeric criteria v. natural criteria
  - Even under the best conditions, Klamath River would not achieve the numeric water quality standards.

Natural Condition Baseline Scenario

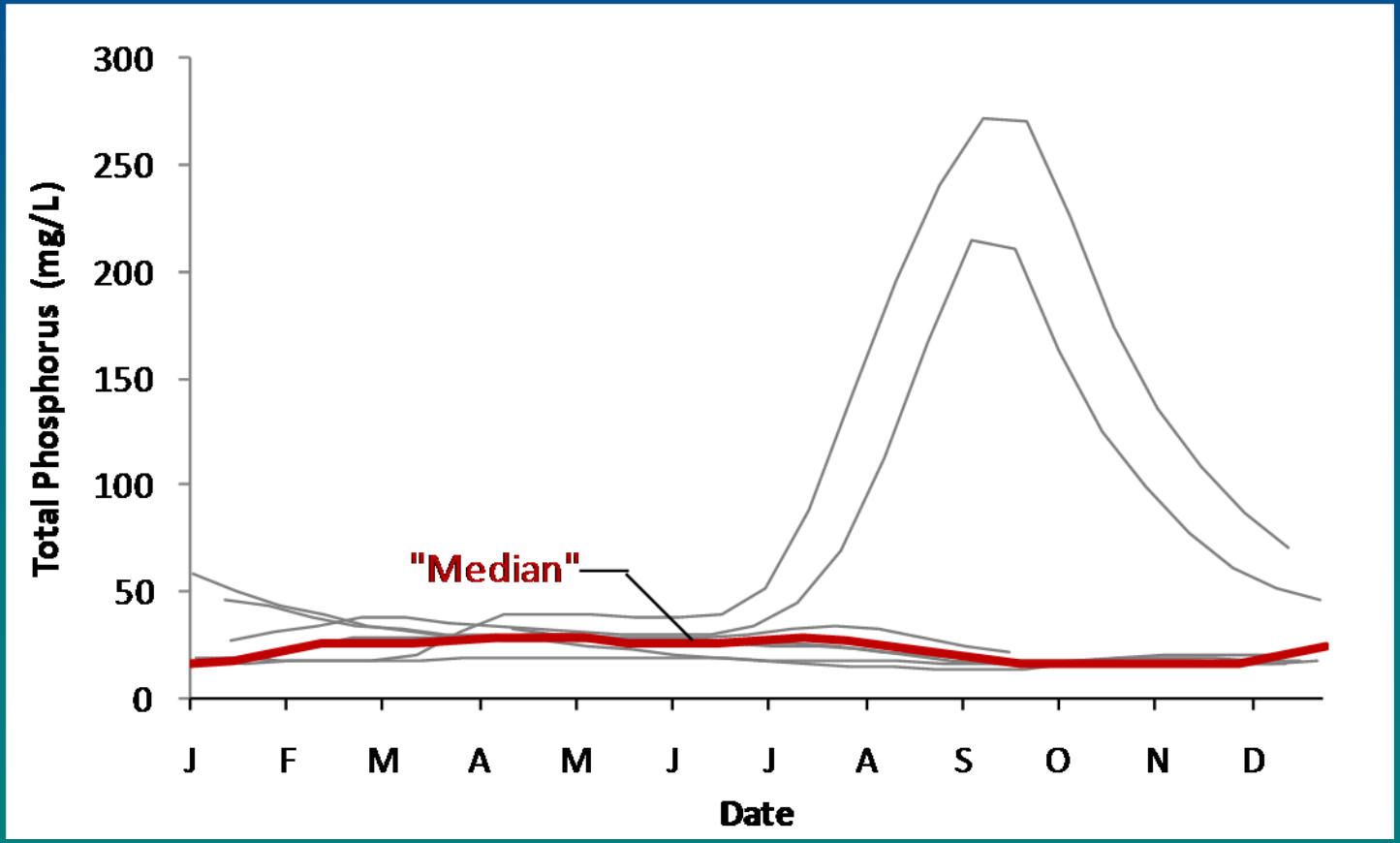
- What: Representation of "natural" Klamath River water quality conditions
- Why: To characterize loading capacity. Some water quality standards (and TMDL targets) are based on natural conditions
- How: By changing portions of the model framework to represent our best understanding of natural conditions

Natural Condition Baseline

- Represent Klamath River with no dams
- Upstream boundary based on Upper Klamath Lake TMDL
- Remove: Point Sources; Lost River DC & KSD inputs (water quality)
- Assign natural or TMDL conditions for tributaries
- Run for 2000 flow and climate

Klamath River – Natural Condition Baseline Scenario

- Upper Klamath Lake, TMDL model concentrations 1991 – 1998.



Pollutants

Klamath River	Lost River	Tributaries
Total Phosphorus Total Nitrogen Biochemical Oxygen Demand (BOD) Heat Impoundments impact temperature and DO	Dissolved Inorganic Nitrogen Carbonaceous biochemical oxygen demand (C-BOD) Impoundments impact temperature and DO	Human caused temperature increases from warm water discharges, increased solar radiation and flow modification.

Klamath River Allocation Approach

Reduction of anthropogenic loading will not always achieve biologically based numeric criteria for temperature, DO and pH.

Therefore, natural condition becomes the water quality criterion.

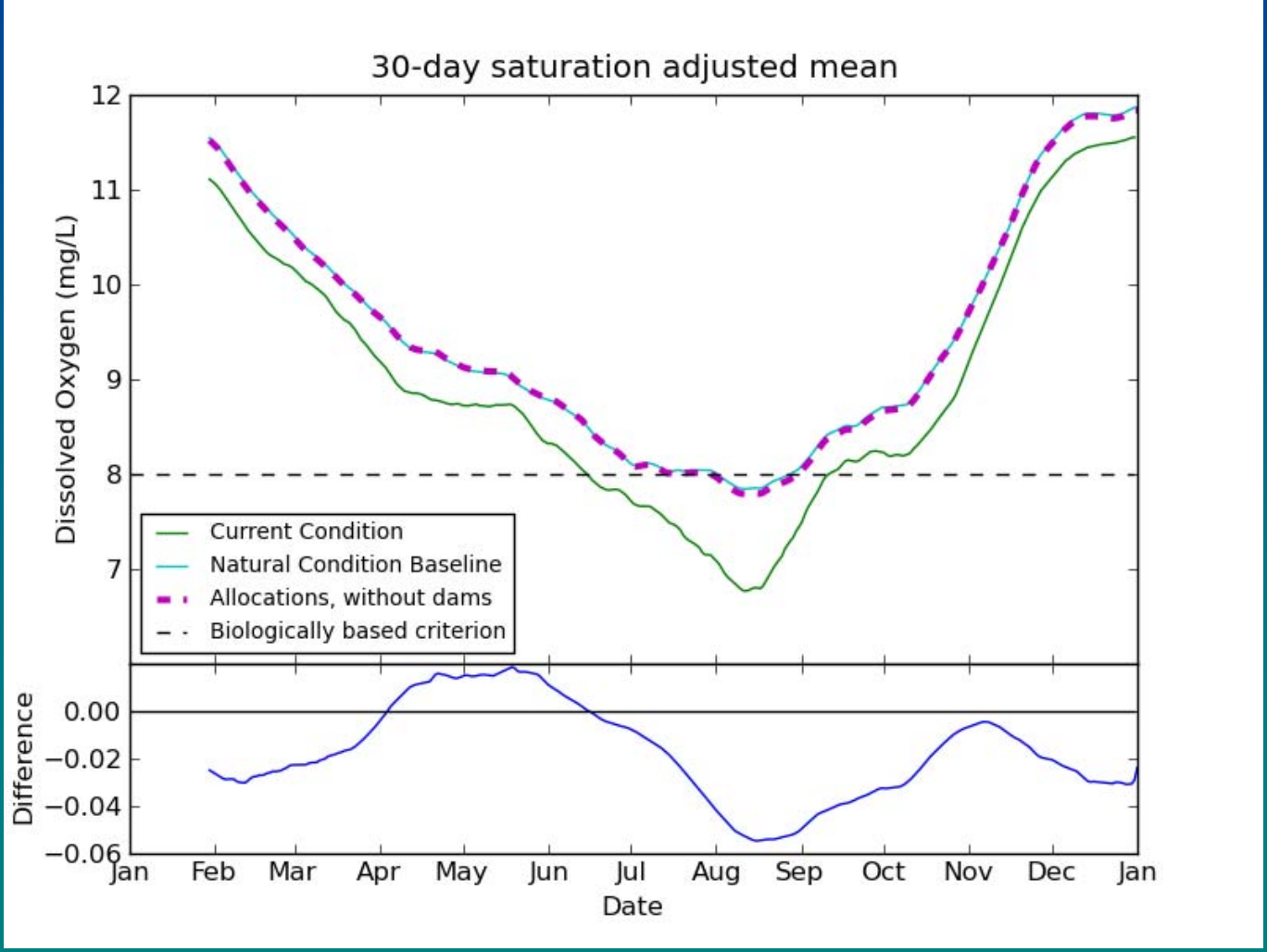
Allocations are based on a specified degradation of natural:

Temperature: + 0.3 °C

Dissolved Oxygen: - 0.2 mg/L

pH must not exceed 9.0 or 0.1 units greater than natural

Predicted DO (30-day metric) in Klamath River at stateline



Uncertainty in Modeling Analysis

Data limitations

Science limitations

+ Cost & Time Constraints = Model Uncertainty

Draft Allocations
Klamath River

Source	Total Phosphorus Percent Reduction	Total Nitrogen Percent Reduction	BOD5 Percent Reduction
Upper Klamath Lake	TMDL Loads	TMDL Estimate	TMDL Estimate
Lost River Diversion*	**89%**	**83%**	**88%**
Klamath Straits Drain	**92%**	**87%**	**92%**
Other NPS	--	--	--
Springs (natural)	0%	0%	0%
Klamath Falls WWTP	**93%**	0%	0%
South Suburban WWTP	**90%**	0%	**34%**
Collins Products	0%	0%	0%
Columbia Forest Products	0%	0%	0%

*Lost River Diversion Channel flows, load, and concentration averages are presented for days the flow is into the Keno impoundment.
BOD5 = 5-day, Biochemical Oxygen Demand

Keno impoundment and JC Boyle Reservoir Load Allocations, averaged by month

Month	Keno impoundment Average DO Augmentation (mg/L)	JC Boyle Reservoir Average DO Augmentation (mg/L)
January	--	--
February	--	--
March	--	--
April	--	--
May	--	--
June	--	--
July	0.01	0.12
August	--	0.24
September	--	0.24
October	--	0.07
November	--	--
December	--	--

Keno Impoundment and JC Boyle Reservoirs Temperature Allocations

Month	Keno impoundment Temperature Offset, measured at outfall (°C)	JC Boyle Dam Temperature Offset, measured at stateline (°C)
June	0.33	0
July	0.66	0.57
August	0.55	0.71
September	0.41	0.14

Draft Allocations, Lost River System

- Reduce dissolved inorganic nitrogen by approximately 50%
- Reduce carbonaceous oxygen demand loading by approximately 50%
- Augment dissolved oxygen in impoundments.

Dissolved Oxygen Offsets for Lost River Impoundments in Oregon

Impoundment	Necessary DO Increase (mg/L)		
	Min	30-day	7-day
Wilson Reservoir	3.13	3.88	3.88
Anderson Rose Impoundment	1.85	0.48	1.58
Klamath Straits Drain	N/A	0.75	N/A

Nonpoint Source Temperature Allocations

Temperature TMDL targets system potential effective shade as the surrogate measure for nonpoint sources on the Klamath River downstream of Keno Dam and on tributaries.

Human use allowance is $0.25^{0}C$, and the cumulative effects of human-caused heating cannot exceed this allocation.

Allocations to PacifiCorp and other dams / reservoirs

Klamath River TMDL Participants and Designated Management Agencies

- California RWQCB
- Oregon DEQ
- EPA Region 9
- EPA Region 10
- State Water Resources Control Board
- U.S. Bureau of Reclamation
- U.S. Fish and Wildlife Service
- NOAA Fisheries
- U.S. Forest Service
- Bureau of Land Management
- Klamath Basin Refuges
- Klamath Basin Fisheries Task Force
- California Department of Water Resources
- California Department of Fish and Game
- California Department of Forestry
- Oregon Department of Agriculture
- Oregon Department of Transportation
- Oregon Department of Forestry
- Oregon Department of Fish and Wildlife
- Klamath Tribes
- California Tribes
- Upper Basin Working Group
- Klamath Basin Intertribal Fisheries Council
- County governments
- Klamath Environmental Coalition
- Municipalities
- Water Districts
- Landowners
- Watershed Restoration Councils
- Irrigation Districts
- Natural Resources Conservation Service
- Resource Conservation Districts
- University Cooperative Extension

TMDL Implementation Strategy

- DEQ will implement TMDL in accordance with Oregon administrative rule OAR 340-042
- Recommendations to guide activities to improve water quality
  - MOA between responsible implementation entities
  - Actions to reduce nutrient and thermal loads
  - Monitoring to document changes and to track progress
  - Adaptive management approach
  - Support development of a water quality accounting and tracking program

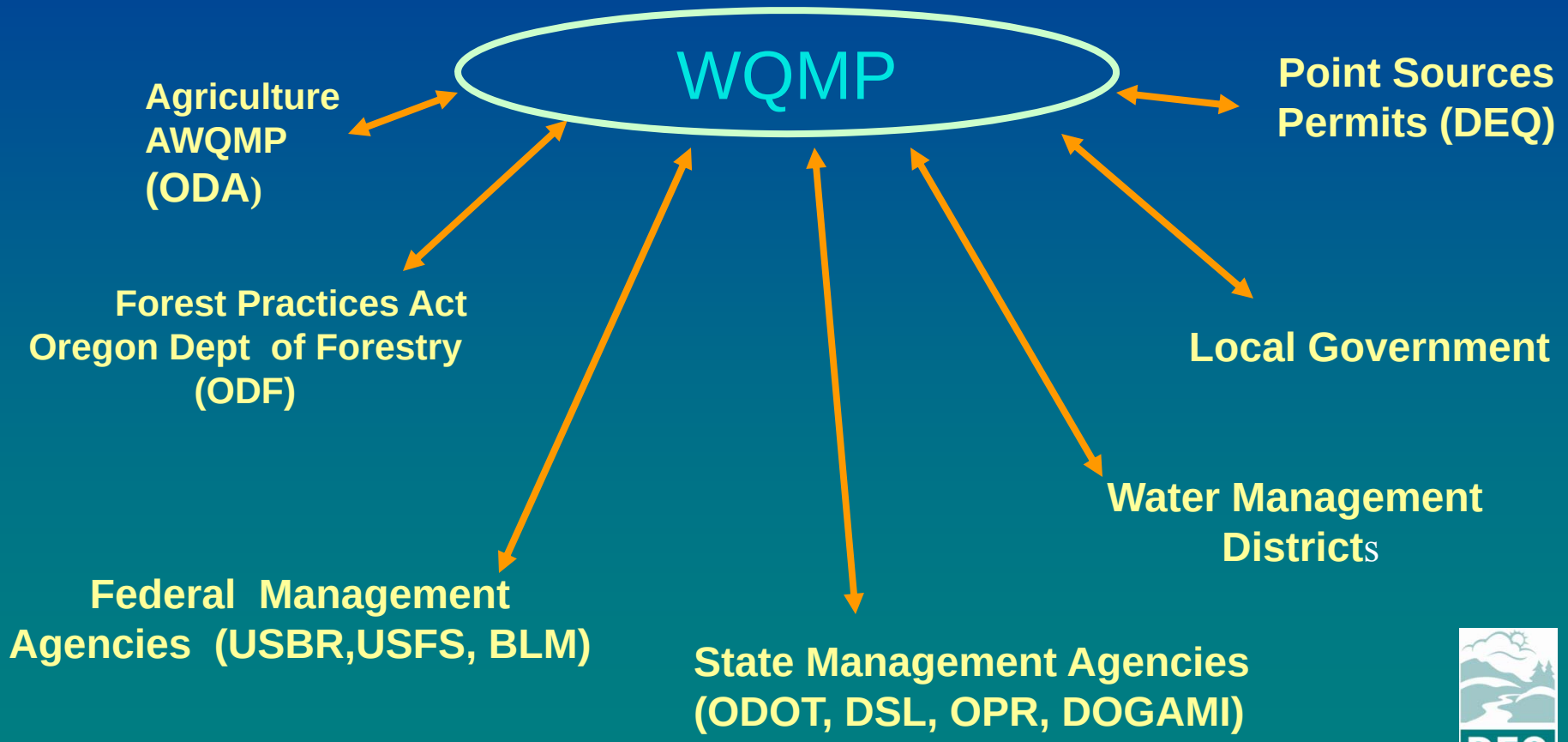
DEQ
State of Oregon Department of Environmental Quality

Coordinated Implementation Approach:

Developed a bi-state MOA in conjunction with US EPA Regions 9 and 10

http://www.deq.state.or.us/wq/tmdls/klamath.htm

Upper Klamath and Lost River Subbasins TMDL Implementation



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TMDL Implementation Plan Elements

- Management strategies that DMAs will use to reduce pollutants
- A timeline for implementing strategies and a schedule for completing measurable milestones
- Performance monitoring with provisions for periodic review and revision of the implementation plan
- Evidence of compliance with statewide land use requirements
- Any other analyses or information as required in the WQMP

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State of Oregon
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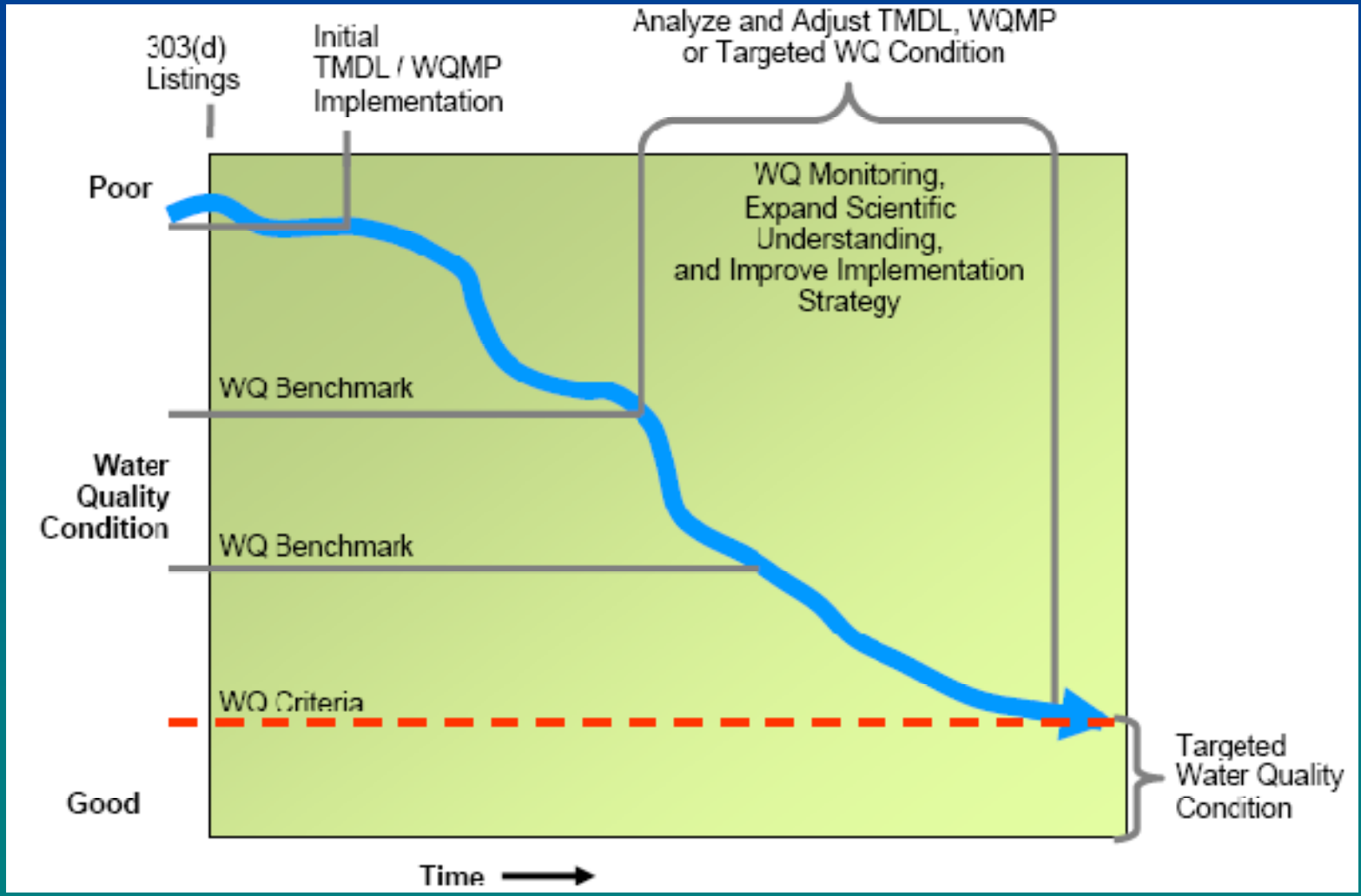
Quality

Milestone	OR	CA
Stakeholder meetings	Jul/Aug 2008	Jul/Aug 2008
Public Review -- 60 / 90-day	Feb 2010	Jan 2010
Public Meetings / Workshops	March 2010	Dec 2009
ODEQ Public Comment Hearing /	April 2010	
CA Regional Board Hearing - Adoption		March 2010
Anticipated Adoption OR TMDL	June 2010	
Adoption by CA State Board		Sept 2010
Anticipated USEPA Approval	July 2010	Dec 2010

Adaptive Management Process



For Further Information

http://waterquality.deq.state.or.us/wq/

http://www.waterboards.ca.gov/northcoast

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Thank You

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