Monitoring Contaminant Transport in the Columbia River Basin

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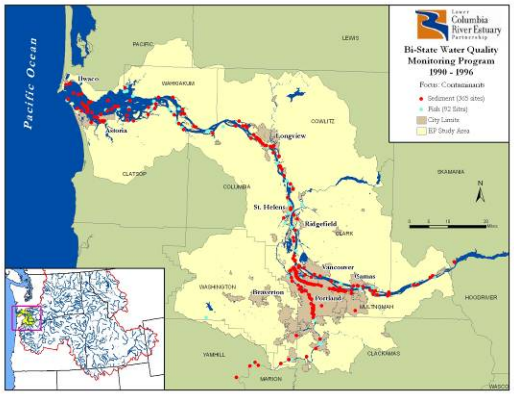
National Water-Quality Monitoring Council July 22, 2009

Results from Bi-State Water Quality Program



- Contaminants impair water, sediment, fish, and wildlife
- Sediment contaminant was highest near urban and industrial areas, with levels of concern for PCBs, DDE, dioxins/furans, and PAHs
- Mink and river otter have reproductive abnormalities associated with contaminants
- DDE and PCBs are bioaccumulating at harmful levels and impairing reproduction in nesting eagles
- Amount of riparian habitat, tidal swamps, and marshes has decreased 75% from historical levels
- The river's beneficial uses are impaired
- Bi-State remains the most comprehensive study to date
- Study led to Columbia's acceptance into EPA's National Estuary Program and formation of Lower Columbia River Estuary Partnership

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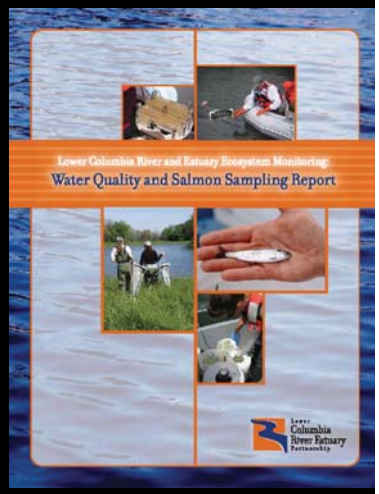
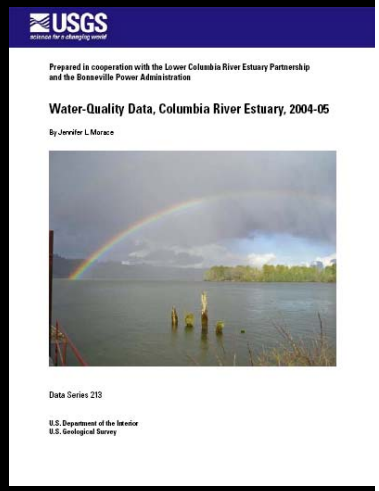
Key Findings from Integrated USGS, NOAA Fisheries, Estuary Partnership Monitoring, 2004-05

- Pesticide concentrations in the Columbia River were low—dilution is a key factor
- Sublethal effects should be of concern—particularly with copper concentrations
- Juvenile salmon are exposed to estrogen-like compounds in the lower river
- PCBs, PAHs, and PBDEs are widespread in the lower river, both geographically and in the food chain
- The urban and industrial portions of the lower river contribute significantly to juvenile salmon's toxic loads
- Juveniles from upriver salmon stocks are absorbing toxic contaminants during their time in the lower Columbia River





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Columbia River Contaminants and Habitat Characterization

Occurrence and effects of polybrominated flame retardants and endocrine disrupting compounds

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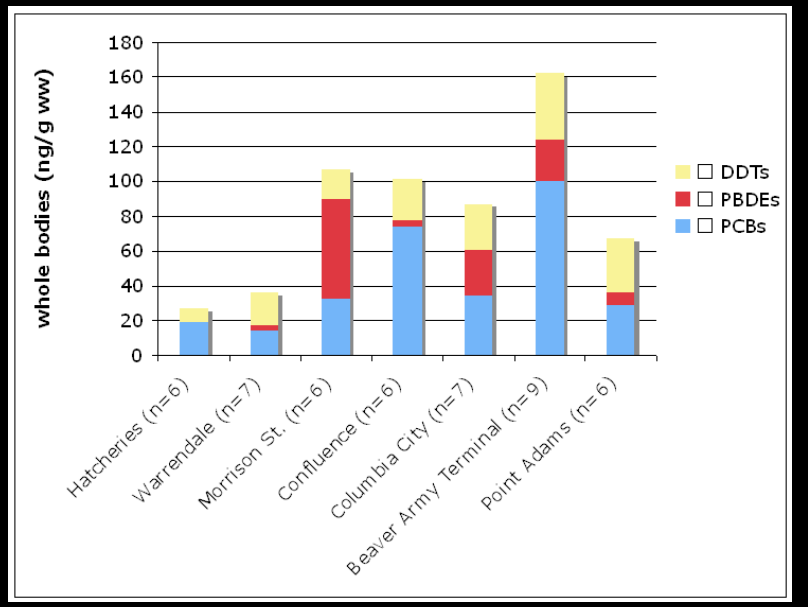
Motivation

- PBDEs doubling in fish in upper Columbia R every 1.6 yrs
  (Rayne et al. 2003)
- PBDEs adversely affecting osprey reproduction
  (young produced per nest)
- PBDEs widespread in lower river
  (LCREP 2007)
- Urban/industrial signal in salmon bodies



LCREP 2007

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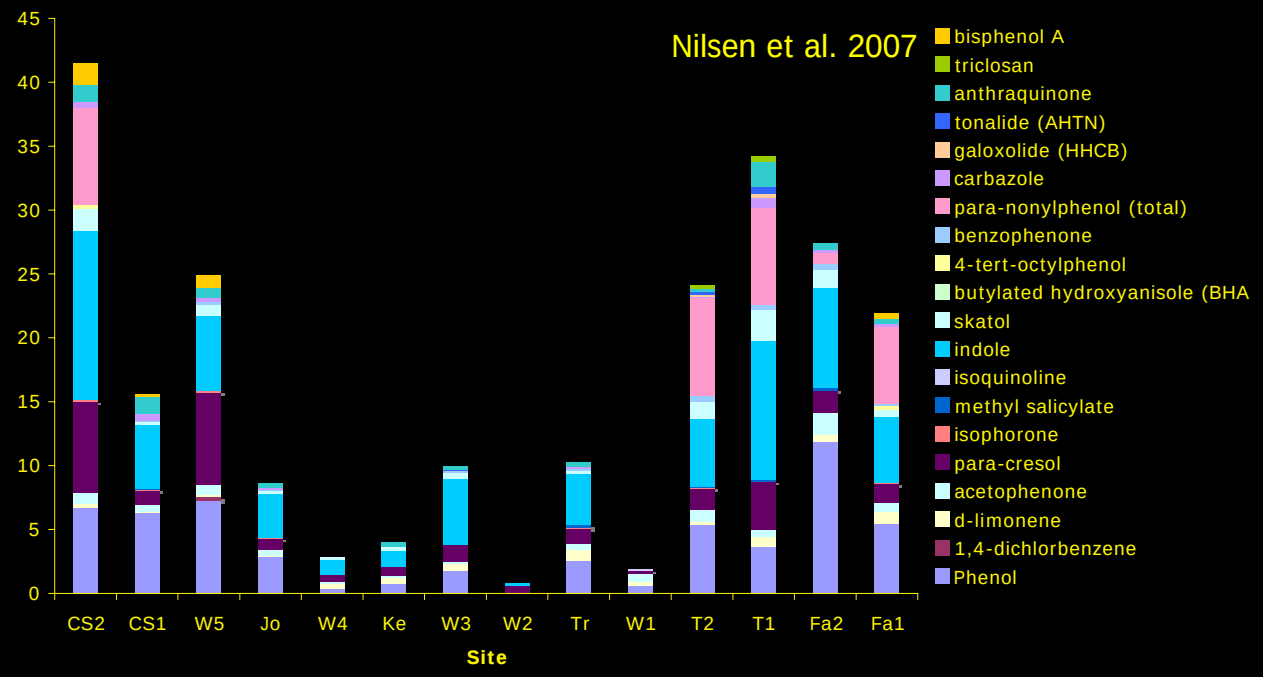
Motivation

- Forty-nine wastewater indicator contaminants recently detected in CR basin sediments
- Endocrine disrupting compounds (EDCs) detected at 22 of 23 sites sampled



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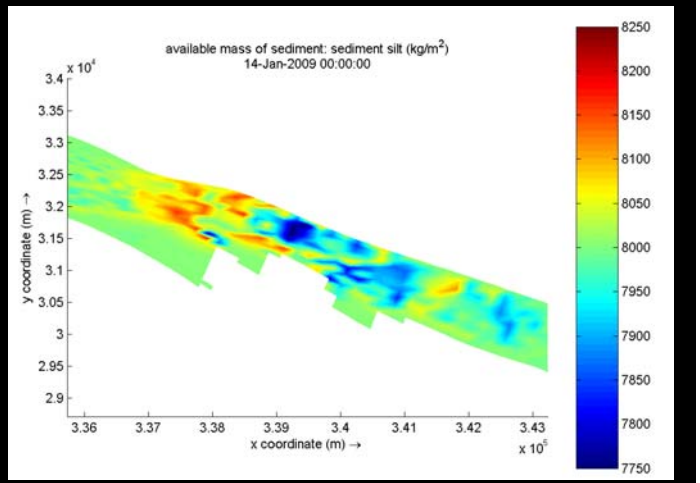
Objectives

- Investigate contaminants in the environment and in multiple levels of the foodweb
- Examine biological effects on fish and osprey
- Investigate the transport of fine-grained sediments and associated contaminants
- Achieve insight and unique results through an interdisciplinary approach with the future intent of partnering with cooperators to expand into an integrated monitoring strategy



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Foodweb Sampling Design

Passive samplers

-contaminant analyses
-estrogen screen

Sediments

-contaminant analyses
-sediment transport modeling

Invertebrates

-contaminant analyses
-community assessment

Largescale Suckers

-contaminant analyses
(organs and whole bodies)
-biomarkers

Osprey

-contaminant analyses
-productivity assessment
-well bird blood analyses

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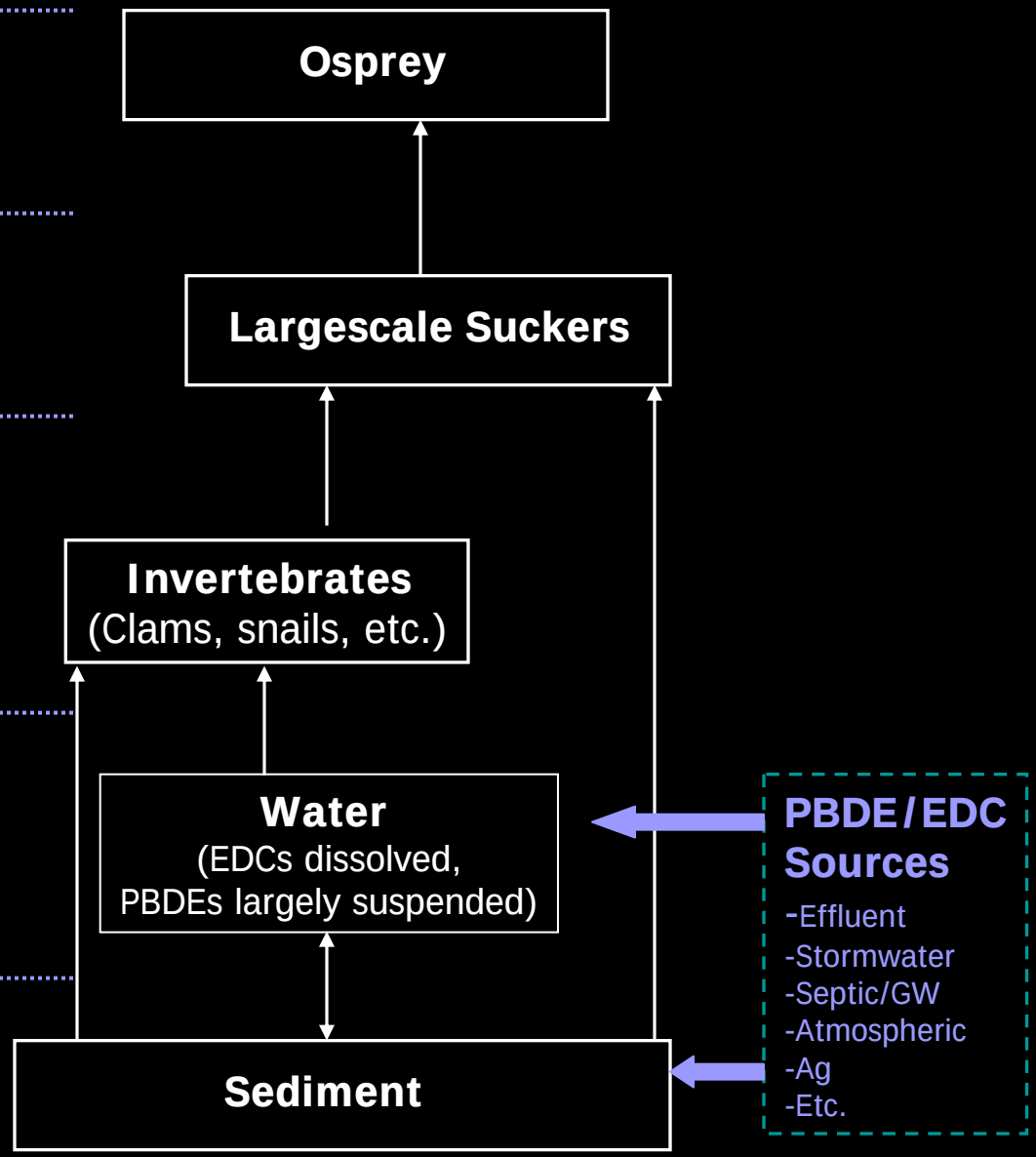
Foodweb Sampling Design

Analyses	Effects Assessment
Egg Chemistry	Blood Panels, Biomagnification Factors
Tissue Chemistry	Biomarkers Biological metrics
Tissue Chemistry	Community Assessment
Passive Sampler Chemistry	Estrogenicity Assay
Sediment Chemistry	Sediment Transport, Grain Size Distribution



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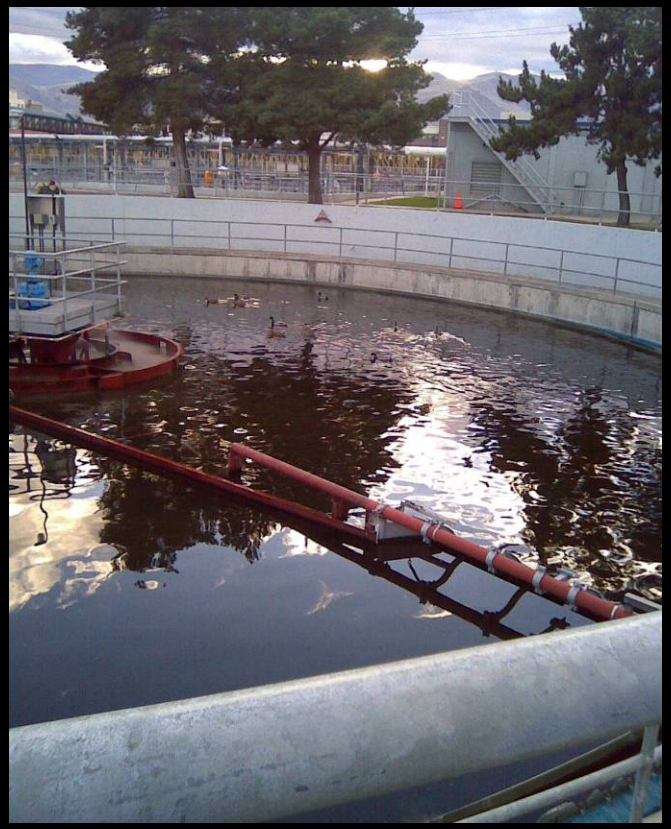
Columbia River Inputs Study

- Characterize pathways contributing directly to the Columbia River



- WWTP effluent

- Stormwater runoff

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First Steps...

- Targeted at known knowledge gaps
- Characterize important pathways of contaminant transport to Columbia River
- Begin to offer information on a broad suite of toxics that will help water managers and policy makers make informed decisions
  - Wastewater-indicator compounds, pharmaceuticals, PCBs, PBDEs, OCs, mercury, estrogenicity

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If you build it, they will come

CRITFC
Columbia River Inter-Tribal Fish Commission

COLUMBIA RIVERKEEPER®
Clean Water ~ Healthy Rivers ~ Our Future

NEDC
NEDC Northwest Environmental Defense Center

Lower Columbia River Estuary Partnership

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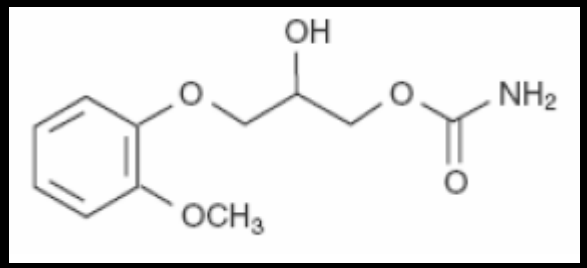
science for a changing world

Chelan
Seattle
Bellevue
Wenatchee
Kent
Tacoma
Federal Way
Washington
Olympia
Aberdeen
Richland
Yakima
Richland
Longview
Astoria
Columbia City
Hood River
Umatilla
Vancouver
Portland
The Dalles
Beaverton
Portland
Salem

WWTP effluent - Pharmaceuticals

- Compounds detected at >1 μg/L
  - Gemfibrozil – to lower cholesterol
  - Methocarbamol – muscle relaxant
  - Oxycodone – opioid analgesic

cholesterol drugs



methocarbamol

3-(2-methoxyphenoxy)-1,2-propanediol 1-carbamate

oxycodone

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Loadings to the Columbia

- Wenatchee:
  - 5.5 mgd from WWTP
  - Columbia flow of 51,557 cfs
  - WWTP concentration of 1 ug/L
  - 20 g/day (0.05 lbs/day) of compound
  - Could lead to Columbia concentration of 0.2 ng/L or 0.0002 ug/L
  - 20 ug/L → 1 lb/day → 4 ng/L

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Loadings to the Columbia

- Portland:
  - 72 mgd from WWTP
  - Columbia flow of 79,436 cfs
  - WWTP concentration of 1 ug/L
  - 270 g/day (0.6 lbs/day) of compound
  - Could lead to Columbia concentration of 1.4 ng/L or 0.0014 ug/L
  - 20 ug/L → 12 lbs/day → 28 ng/L

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Implications for sampling

- Most compounds would not be quantifiable in the main stem using conventional methods (0.01 ug/L)

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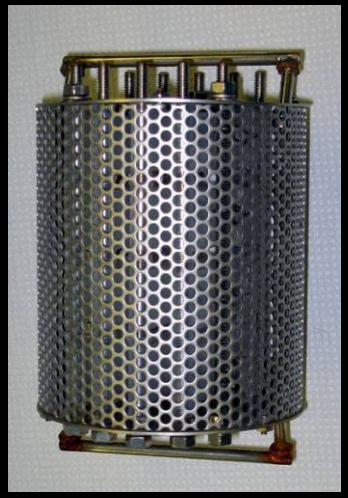
Implications for sampling

- Emphasizes the utility of passive sampling techniques
  - Concentrates compounds
    - therefore, lower detection limits
  - Time-integrated sample



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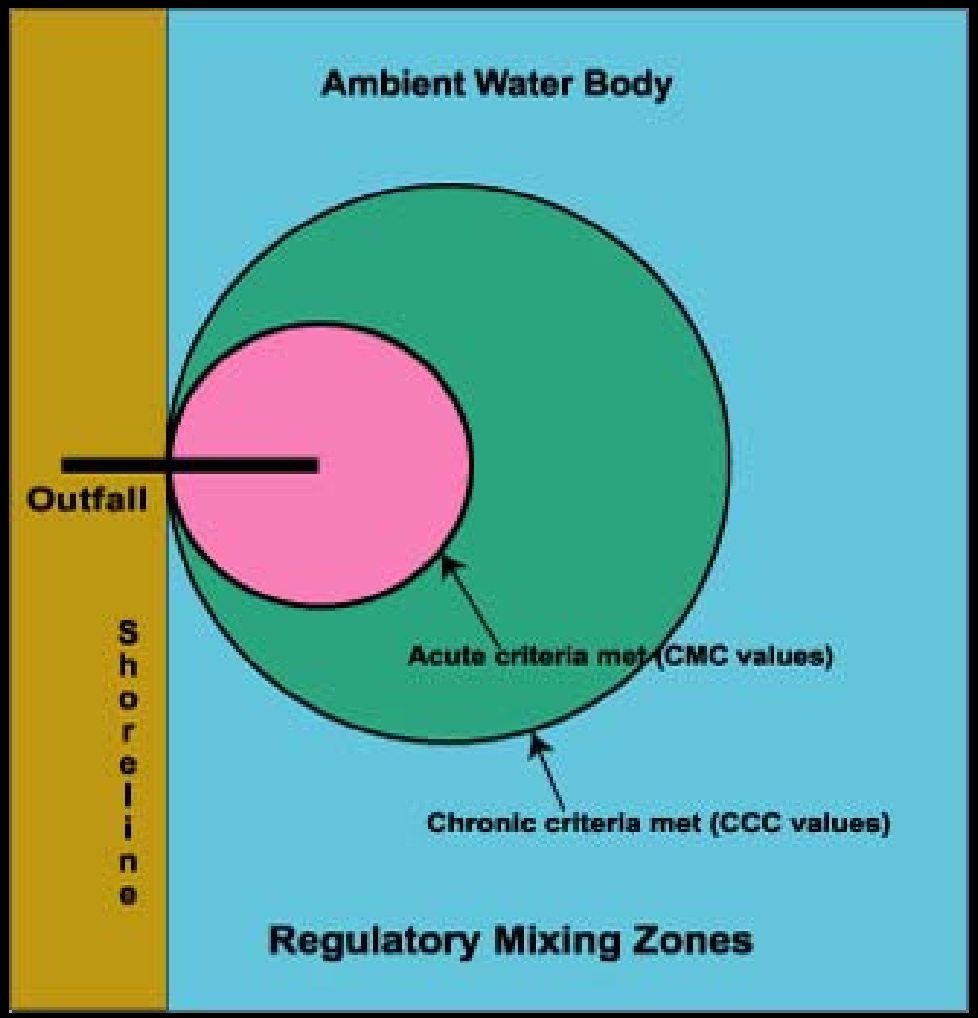
Pathways – Mixing Zones

- Criteria do not exist for any of the “newer” contaminants, therefore, no regulations as well
- Implications for fish and wildlife using the area??



Regulatory Mixing Zones adapted from: Technical Support Document For Water Quality-based Toxics Control EPA/505/2-90-001

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Questions?

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Website for
ConHab project:
http://or.water.usgs.gov/proj/Conhab/

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