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Managing Water in the West

Water Resources Research Laboratory

Self-Guided Tour:

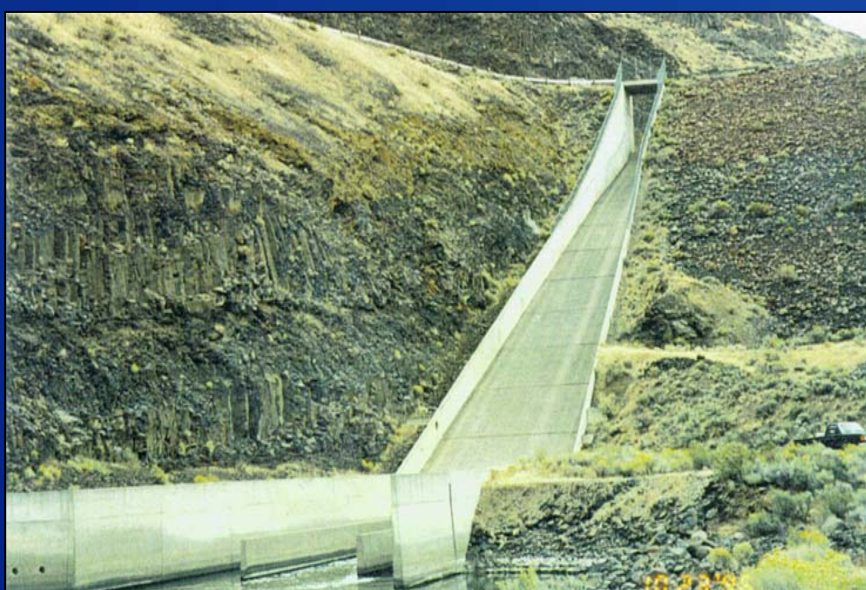
Overhead West Walkway, Station 2

U.S. Department of the Interior
Bureau of Reclamation

A. R. Bowman Dam, 1:24 Scale Model

Connie DeMoyer
Kathy Frizell

Laboratory Scale Model



Prototype

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A. R. Bowman Dam, 1:24 Scale Model

Model Features:

- 1/3 crest length of dam
- Outlet works tunnel & gates
- Spillway crest & chute
- Stilling basin
- Upstream and downstream topography

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A. R. Bowman Dam, 1:24 Scale Model

Hydraulic Model Objective:

Recommend potential modifications in 3 areas:

1.) Dam Safety modifications for overtopping

Prevent overtopping by raising dam and/or increasing existing spillway capacity for larger floods

2.) Low flow bypass/O&M modifications

Provide minimum bypass flow while providing safe access to gate chamber, outlet tunnel, and stilling basin for inspections, maintenance and repairs

3.) Modifications to improve water quality

Design modification to reduce total dissolved gas (TDG) levels to below state standards of 105% during high spring flows.

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A. R. Bowman Dam, 1:24 Scale Model

Potential Dam Safety Modifications

Spillway crest, chute, and chute wall modifications to increase capacity

Increase reservoir storage capacity with 4 – 6 ft parapet wall

Concrete deck overtopping protection studied by P.Hensley & C.Hennig (1991)

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A. R. Bowman Dam, 1:24 Scale Model

Potential Low Flow Bypass/O&M Modifications

Design splitter wall inside outlet tunnel front gate chamber to stilling basin

Design connection between new splitter wall in outlet tunnel and existing splitter walls in the stilling basin.

Determine configuration of walls to extend past existing splitter walls in stilling basin.

Observe basin performance for abrasion potential, flow through spillway-outlet tunnel junction, aeration in tailwater.

Dewatered stilling basin

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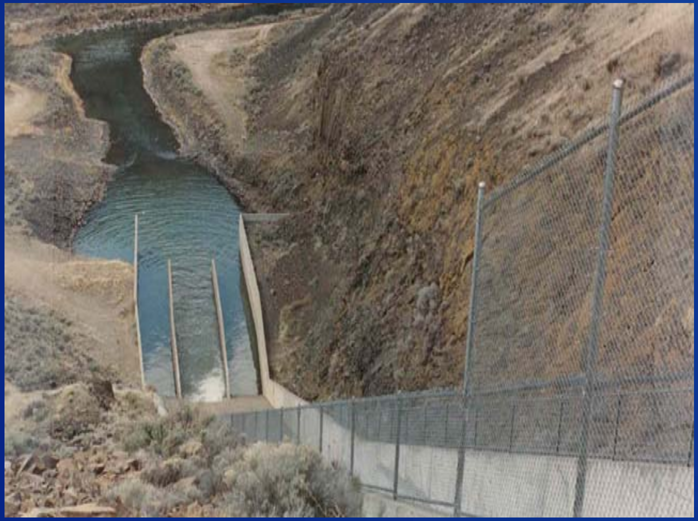
A. R. Bowman Dam, 1:24 Scale Model

Options for Improving Water Quality

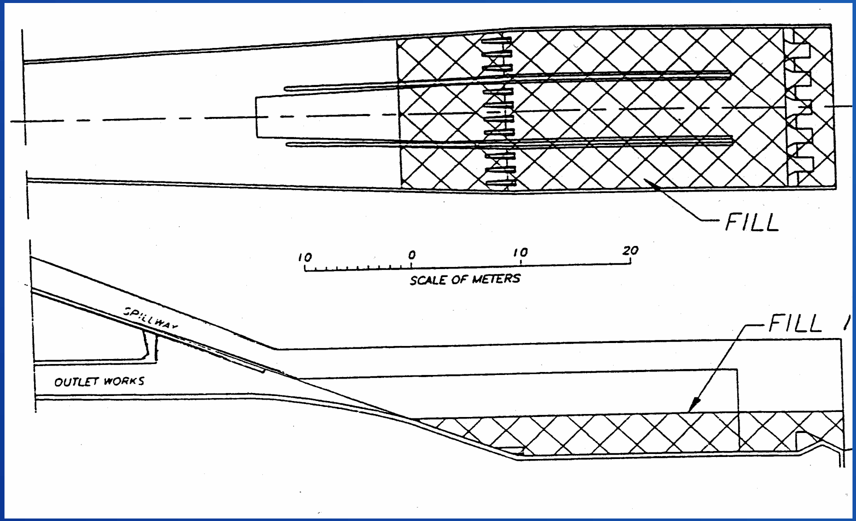
Install downstream weir to strip gas from water

PROBLEMS: flat river gradient; may produce increased tailwater at dam; may be ineffectual if submerged at high flows



Raise stilling basin floor by 15 ft (P. Johnson, 1992)

PROBLEMS: sweep-out of hydraulic jump at high flows; downstream erosion



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A. R. Bowman Dam, 1:24 Scale Model

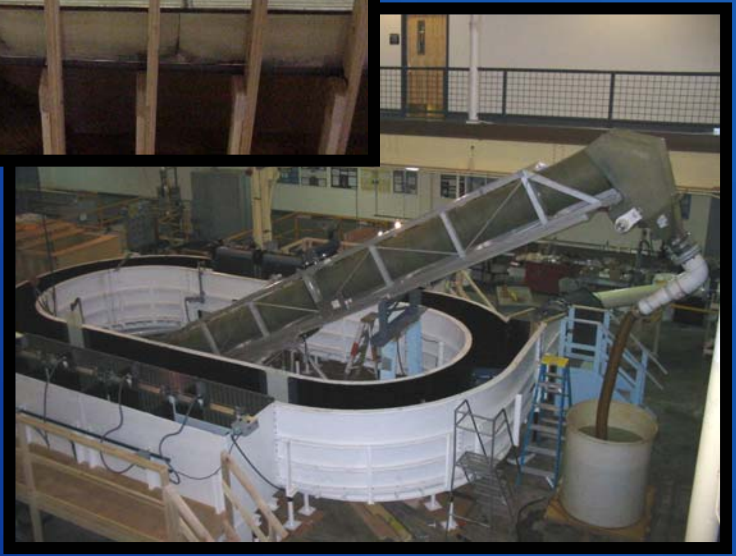
Current Modeling Status

- Initial model testing results were used in a risk assessment. Additional work is currently underway in order to meet the risk criteria.

- A corrective action study and supporting model testing is slated for 2006.

Working Toward the Future
Handling Fish, Water and Debris

Leslie Hanna
Ray Bark
Bent Mefford



Fish Separation is desired to protect endangered or listed species from predatory species while being held in holding tanks.

Scale model holding tank
for separated fish

Prototype holding tank
For separated fish

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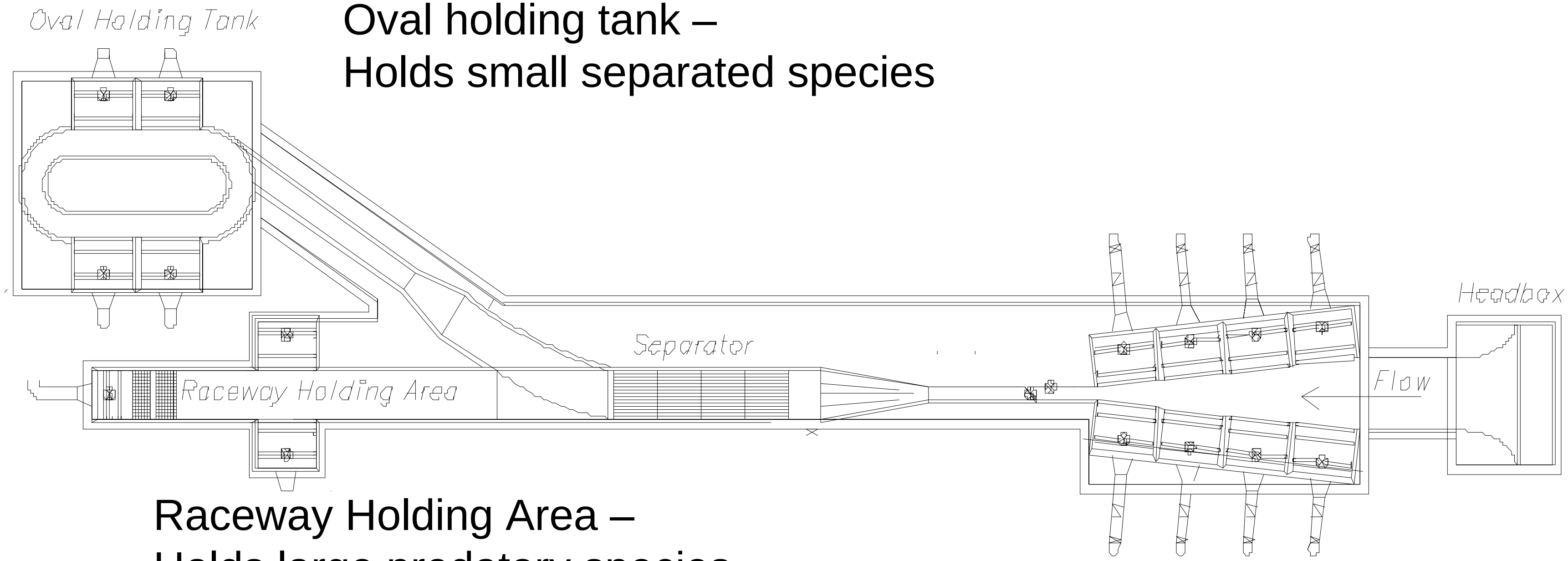
Proposed Tracy Fish Test Facility
1:3 Geometric Scale

Plan View of Model

Oval holding tank –
Holds small separated species



Raceway Holding Area –
Holds large predatory species

Passive Separator
Tested in WRRL Laboratory

Separator Bar Rack openings are sized to allow only the desired species to pass through and below the separator

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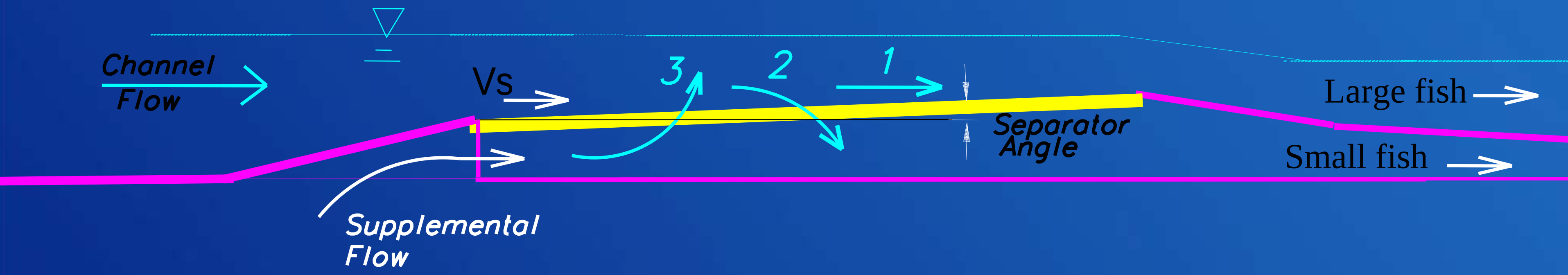
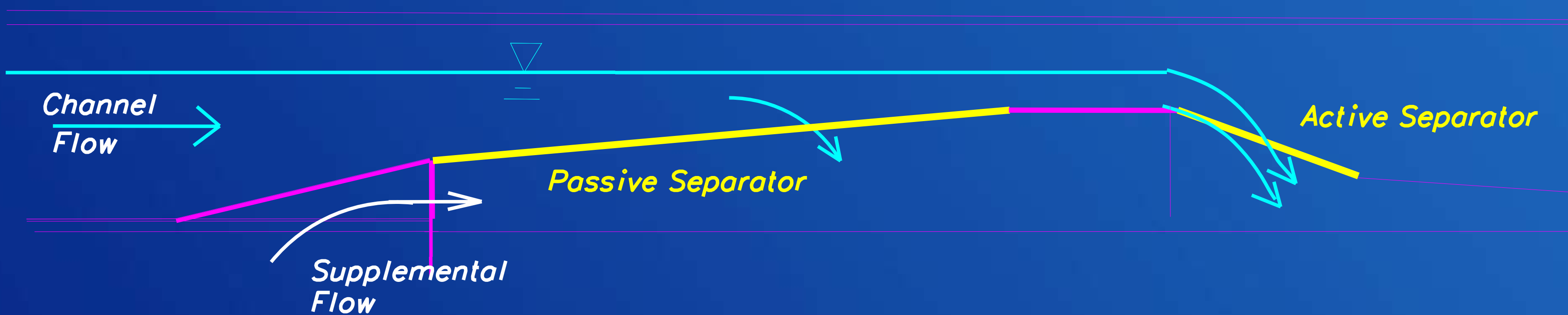
Passive Separator



Conditions were tested to determine which variables are most effective in producing desired fish behavior (i.e. to influence smaller species to pass through fish separator):

- **Channel/Separator sweeping velocity (Vs)**
- **Separator angle**
- **Separator approach velocity Channel Geometry:**
  1) **Even - No net flow transfer across separator**
  2) **Downwelling flow**
  3) **Upwelling flow**

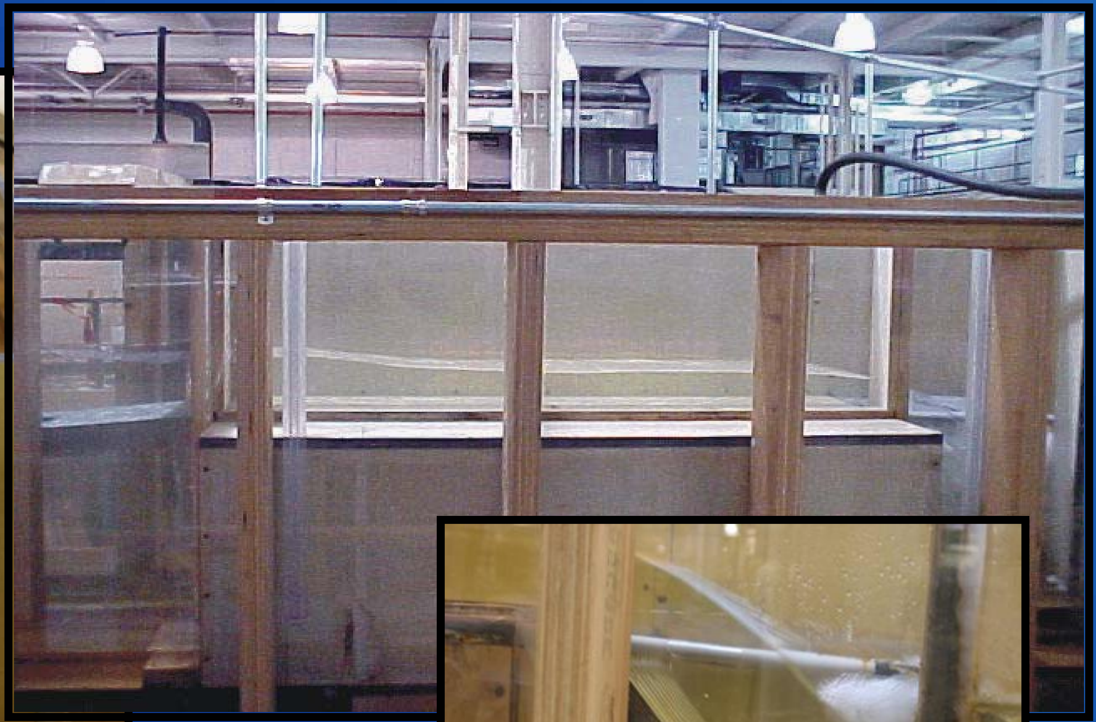
Passive-Active Separation



For more effective separation an Active Separator is added:

- Smaller species that do not pass through the passive separator of their own volition, are forcefully separated from predators through Active separation.
- Large fish slide on top of active separator into a separate holding area

Passive/Active Separator Modeled in the WRRL Lab



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Passive Separator in Action

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Passive Separator in Action

Passive Separator Experiments
Results based on Average Efficiencies:

- Splittail, Rainbow Trout, and Fathead Minnows:
  - Best overall efficiencies occur with the following combined conditions (Average Separator efficiencies were greater than 84%)
    - Downwelling flow
    - Separator angled at 5 degrees
    - 4 ft/s channel velocity
  - Poorest overall efficiencies occurred
    - Upwelling flows

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Passive Separator Experiments
Statistical Results

- Strong downwelling condition promotes efficiency for a poor swimmer
- Angle was not statistically significant
- Channel Velocity is a significant influence on Rainbow Trout. Higher velocities produce higher efficiencies

Debris Removal from Separators

Injected Debris collects on Passive and Active Separators in the laboratory tests

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Debris Removal from Separators

Passive Separator Rollers

Rotating Rollers remove debris so that it can be carried by downstream flow past the separator

Debris Removal from Separators

Active Separator Roller

Rotating Rollers remove debris so that it can be carried by downstream flow past the separator

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Debris is removed from oval holding tank by a vertical traveling screen

Acknowledgements

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End of Station 2 Presentation

Please proceed south along walkway to Station 3

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