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Managing Water in the West

Water Resources Research Laboratory

Self-Guided Tour:

Overhead West Walkway, Station 3

U.S. Department of the Interior
Bureau of Reclamation

Prattville Intake
Lake Almanor, California

A hydraulic model study to determine water quality enhancement improvements for a reservoir intake structure

Tracy Vermeyen

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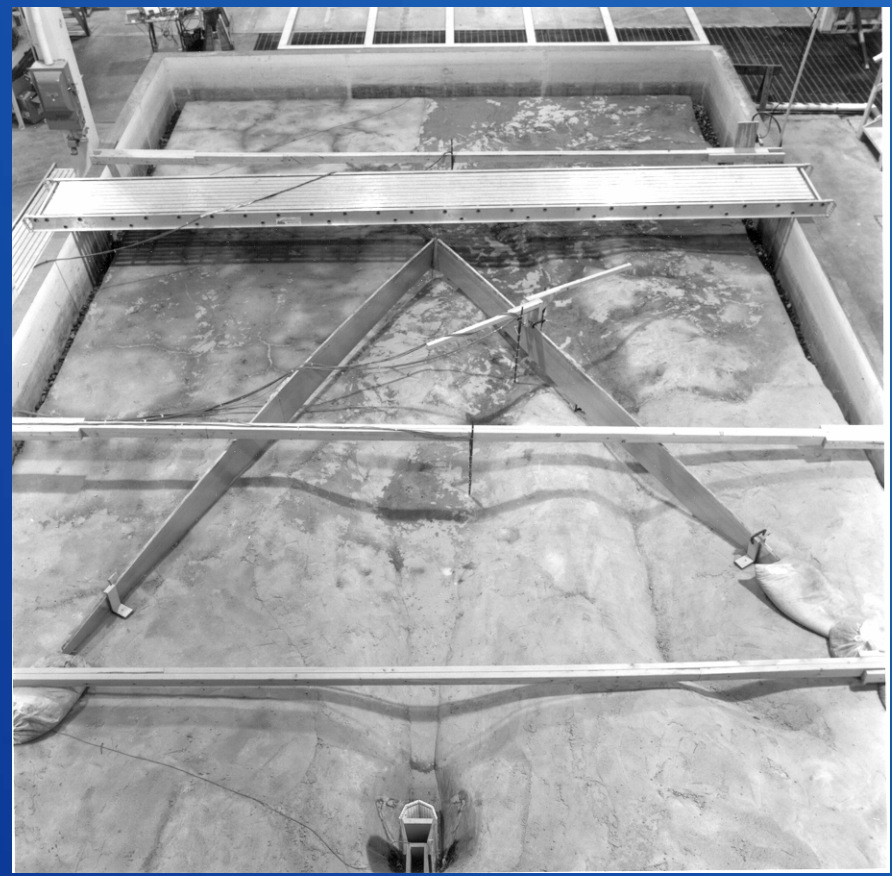
1:40 Scale Physical Model

- **A physical model was used to evaluate several water quality enhancement alternatives for an existing reservoir intake structure**



Photograph of a triangular-shaped temperature control curtain alternative

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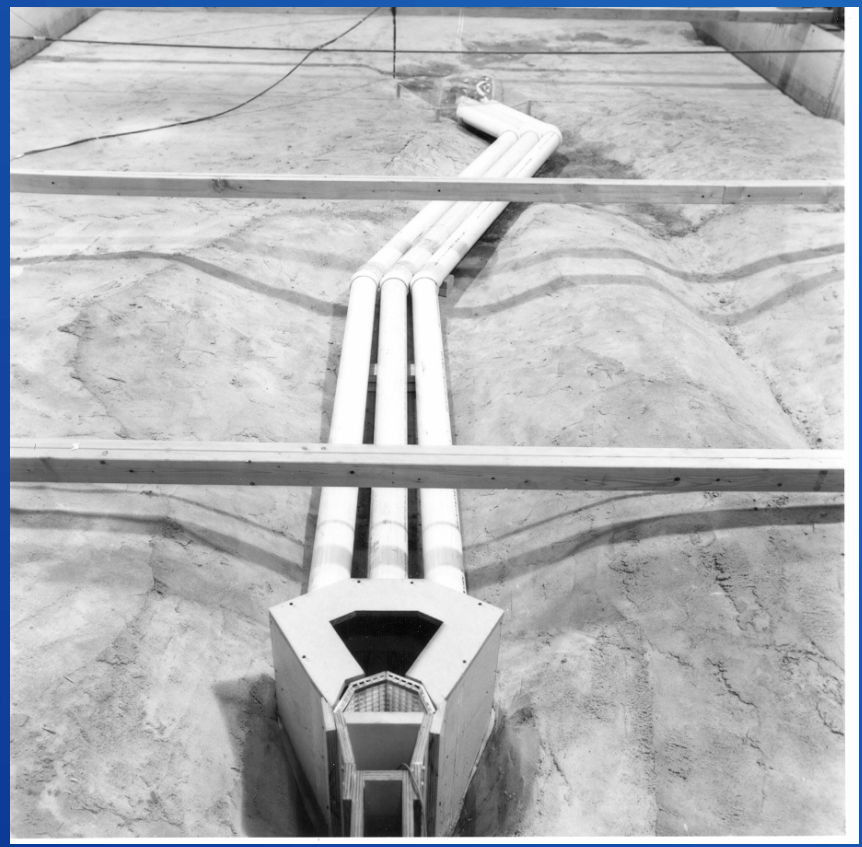
1:40 Scale Physical Model

- **The intake extension alternative was determined to have the best performance characteristics.**

- **As of July 2005, no action has been taken to modify the Prattville Intake.**



Photograph of an intake extension alternative that consisted of three 12-ft diameter pipes which extended 750 ft into Lake Almanor.

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Flow Deflectors for Preventing Stilling Basin Abrasion Damage

Leslie Hanna
Water Resources Research Laboratory

U.S. Department of the Interior
Bureau of Reclamation

A stilling basin uses a hydraulic jump (shown modeled in the Denver laboratory) to “still” high velocity flow exiting downstream from a Dam before it enters the downstream river channel

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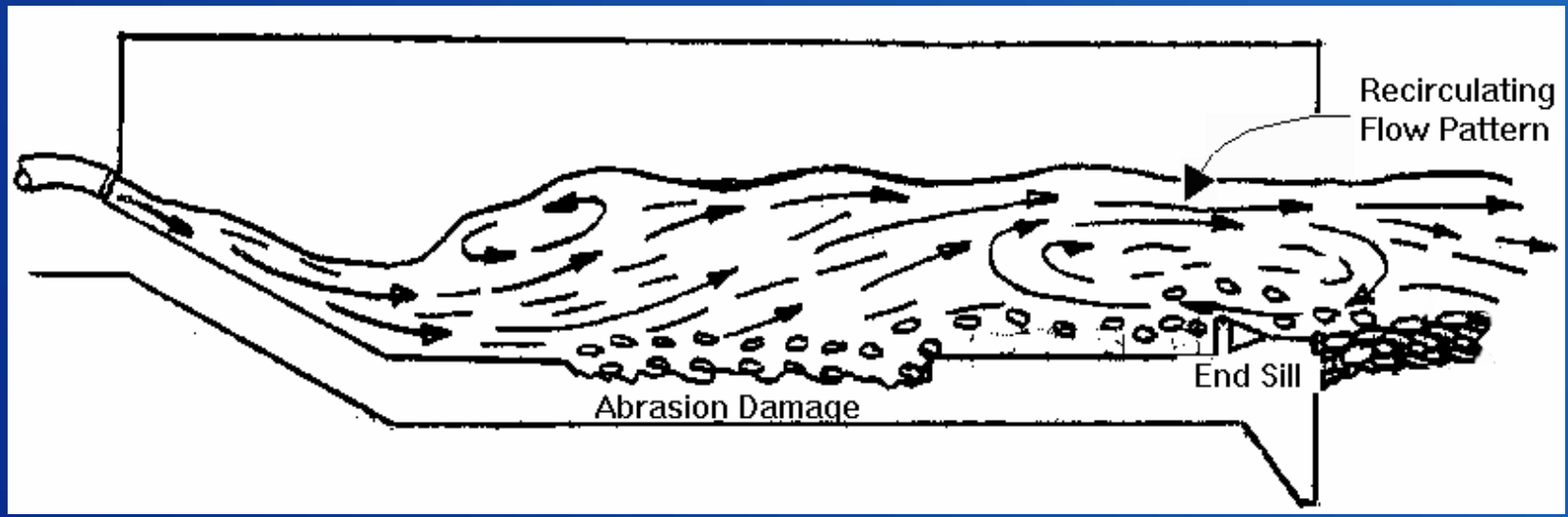
Typical Flow Pattern for a Hydraulic Jump Stilling Basin



- This stilling action produces a recirculating flow pattern near the end of basin.
- If the recirculation extends beyond the basin, flow in the upstream direction near the bed can carry streambed materials back into the basin
- Entrained bed materials abrade the concrete walls and floor of the basin

No Deflector

Strings placed on the end sill (arrow) in the model indicate flow is upstream into the basin; thereby allowing damaging materials to be carried in

Choke Canyon

Abrasion Damage

Damaging materials found within the basin

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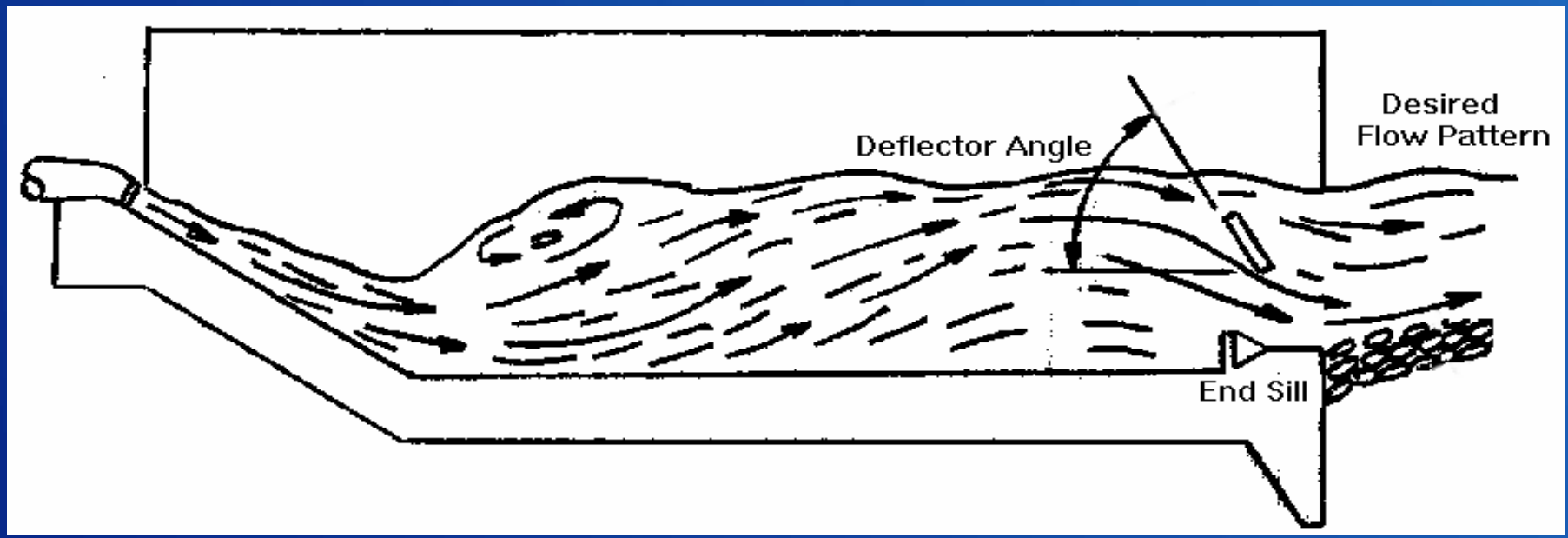
Desired Basin Flow Pattern



The desired flow pattern is produced by adding a flow deflector near the downstream end of the basin

A flow deflector is modeled in Denver's Water Resources Research Laboratory

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With Deflector

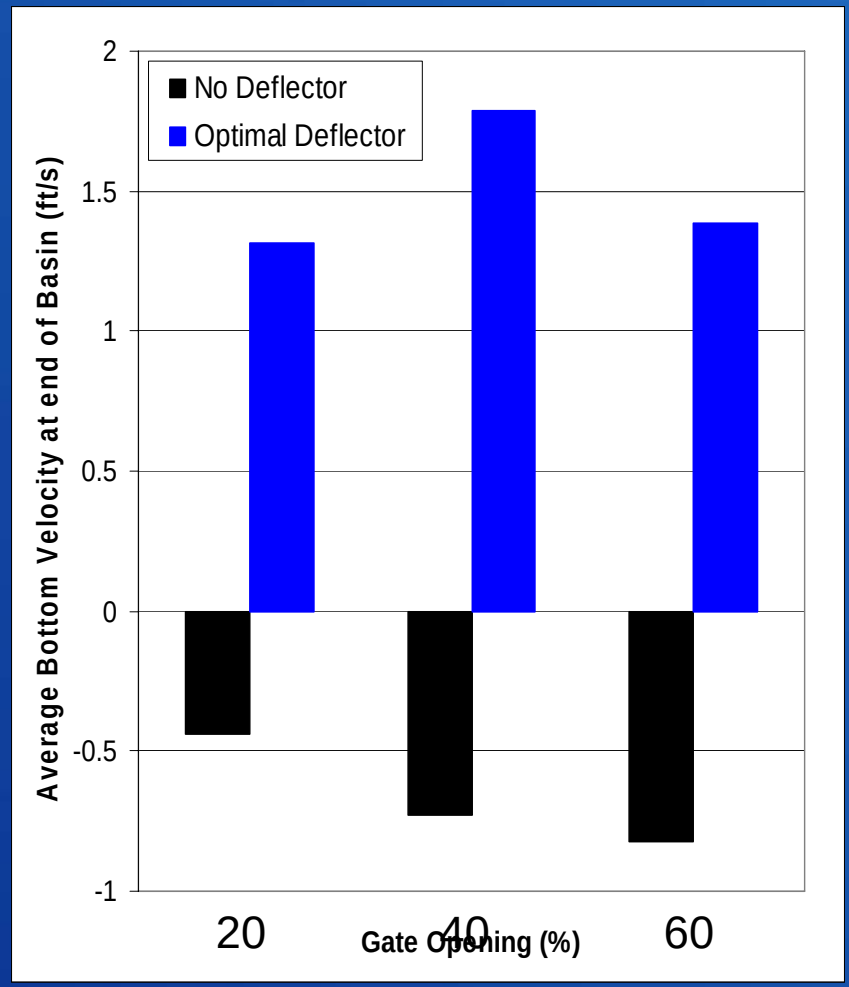
Strings indicate flow over the end sill is downstream away from basin,
Thus preventing damaging materials from being carried into the basin

Average Velocities measured at the downstream end of basin indicate that the flow over the end sill has been redirected from:

upstream (-)

to downstream (+)

in direction, with a flow deflector in place



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Prototype Deflector

Installed at Mason Dam, Oct 2002

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Continuing Studies

Model Studies

- Reclamation Type III Basins
- Tail water effects
- Two tiered/staggered deflectors

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MODELING FOLSOM DAM MODIFICATIONS

Enlarging Outlets for Enhanced Flood Control

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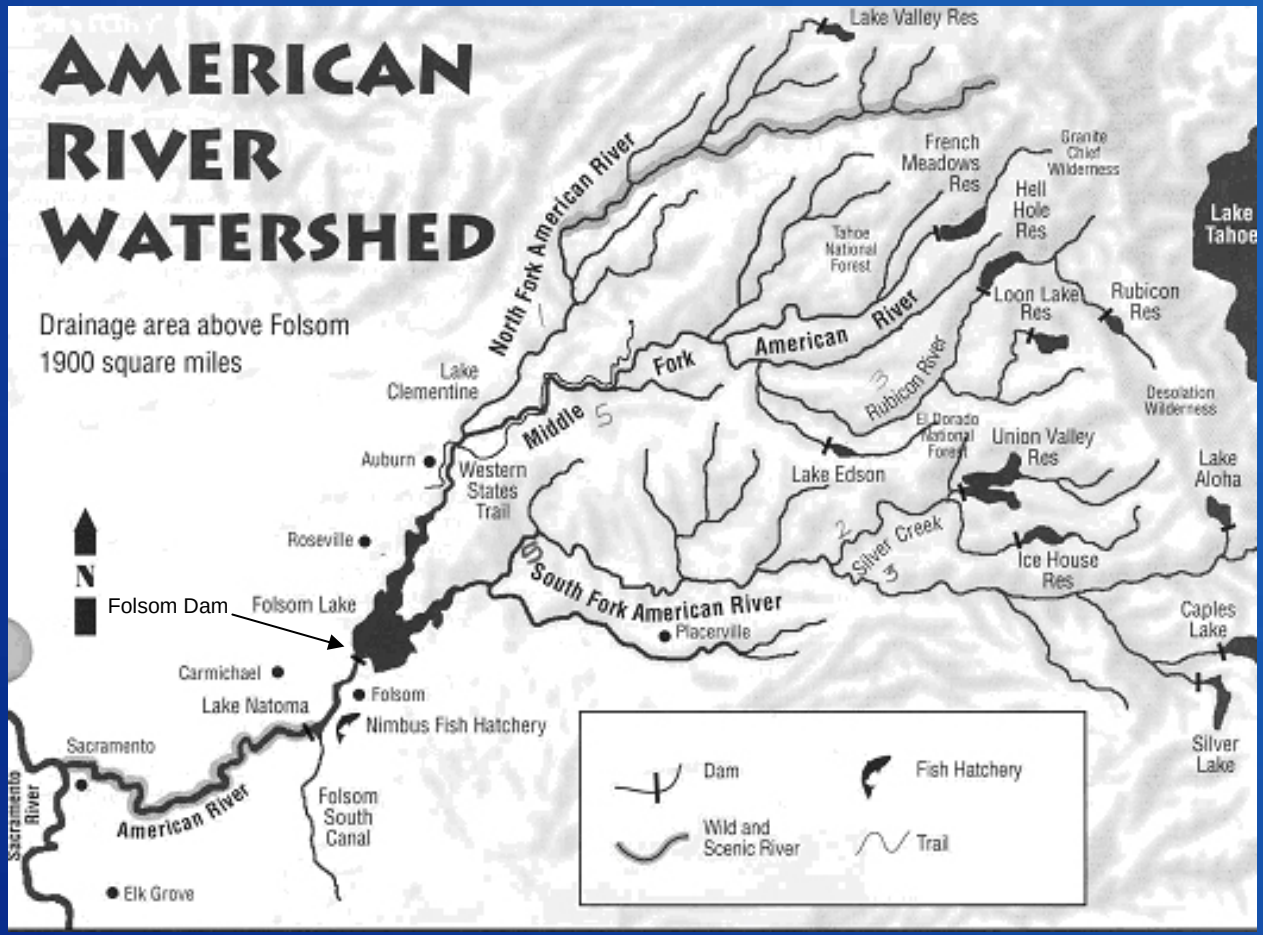
Folsom Dam



- **Located on the American River**
- **15 miles upstream of Sacramento, CA**

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Folsom Dam Project Benefits

- Hydropower
- Flood Control
- Water Supply
- Recreation

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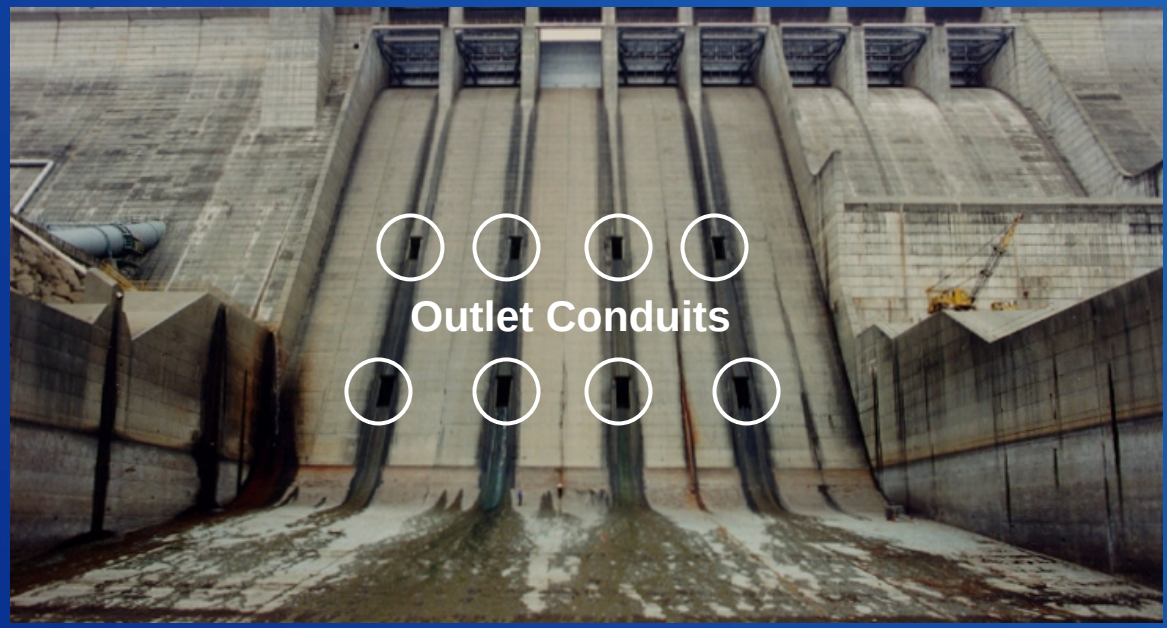
Sacramento Flood-Control Concerns

- Sacramento sits at the confluence of the American and Sacramento Rivers.
- Due to its proximity to these rivers, the Sacramento metropolitan area is susceptible to flooding.
- Levees and Folsom Dam provide some flood protection along the river system.
- Because of the risk of flood damage, flood insurance premiums for the area are estimated at over 2 million dollars per month.

Folsom Flood-Control Limitations

- **Without spillway overflow, current Folsom Dam release capacities are about ¼ of the levee-protected river capacity.**
- **Thus, during the early stages of flood events reservoir storage is being filled with flows that could otherwise pass downstream without damage.**
- **This means that at the peak of a large flood event the reservoir could be almost full and flows larger than the levee-protected river capacity could be released.**

Folsom Outlet Conduits



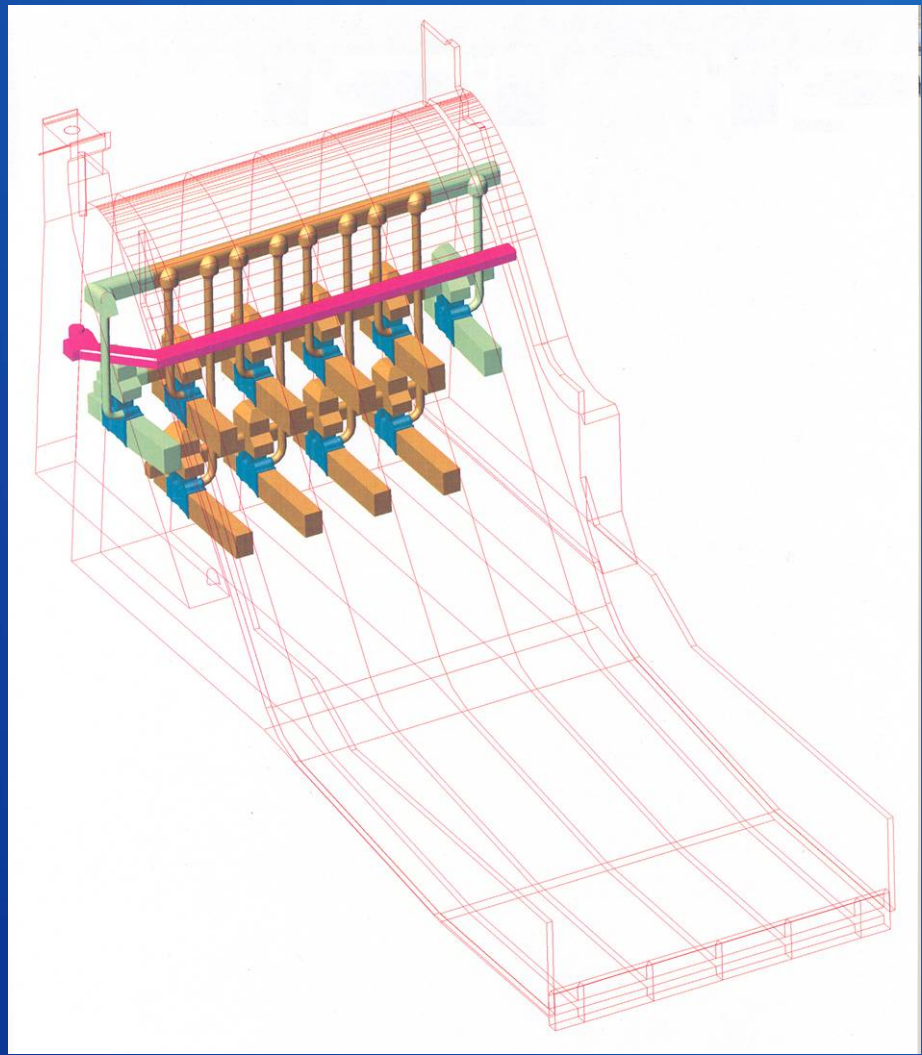
- Eight outlet conduits pass through the spillway, four each at an upper and lower level.

- Each conduit is 5-ft-wide by 9-ft-tall and discharges into the stilling basin.

Outlet Enlargement

- **Proposal:** to enlarge the eight existing outlet conduits, plus add two new conduits to the upper level.

- **Purpose:** to quadruple low-level discharge capacity and conserve storage in the reservoir during flood operations.



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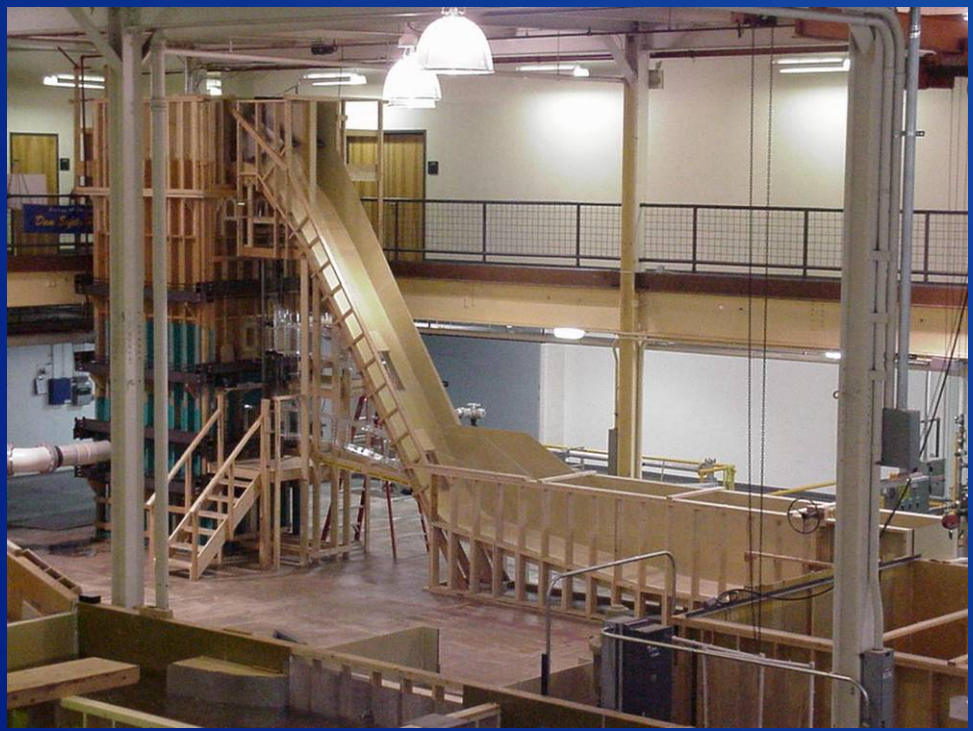
Hydraulic Models

- Two physical models were constructed to study the outlet works enlargement.



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1:17-Scale Model

- A 1:17-scale sectional model was used to look at the details of the conduit design, including the elliptic intakes and air vents.
- The model featured one upper and one lower conduit, plus a section of the spillway face.
- The large scale was chosen to properly simulate air demand in the conduits.

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Elliptic Intake Design Enhanced

As a result of the 1:17-scale conduit evaluations, the designs of the intake curves were modified to reduce the risk of cavitation.

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Stilling Basin Pressure Data

- Jets emanating from the enlarged outlets will produce greater dynamic pressures on the stilling basin floor.
- Electronic pressure transducers were used in the 1:17-scale model to collect data for analyses of the resulting forces.

1:36-Scale Model

- Using the results from the 1:17-scale model, a second model was constructed at a 1:36-scale.
- This model featured the entire spillway plus all 10 conduits and local topography.
- The scale was chosen to allow evaluation of “big picture” issues.

1:36-Scale Model

- **Issues evaluated in the 1:36-scale model included:**
  - **Reservoir approach conditions**

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  - **And, stilling basin performance under a variety of operating conditions**

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Study Results

- Improved conduit hydraulic design
- Design data for dynamic pressure force analyses
- Criteria for construction operations
- Stilling basin performance data
- Air vent system performance data
- Abutment splash/spray mitigation

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End of Station 3 Presentation

Please proceed south along walkway to Station 4

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