Monitoring Flow at the Sacramento Deep Water Ship Channel

Shawn Mayr
DWR - Central District

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Acknowledgments

- **Clients:** *DWR-Division of Environmental Services, Maureen McGee, and Roger Churchwell*
- **Field Operators:** *DWR-Central District, Dave Huston, Karen Lam Fat Chong Him, John Ho, Dave Schaap, Leiji Liu*
- **Data Scientists:** *DWR-Central District, Dave Huston, and Karen Lam Fat Chong Him*

Two Talks

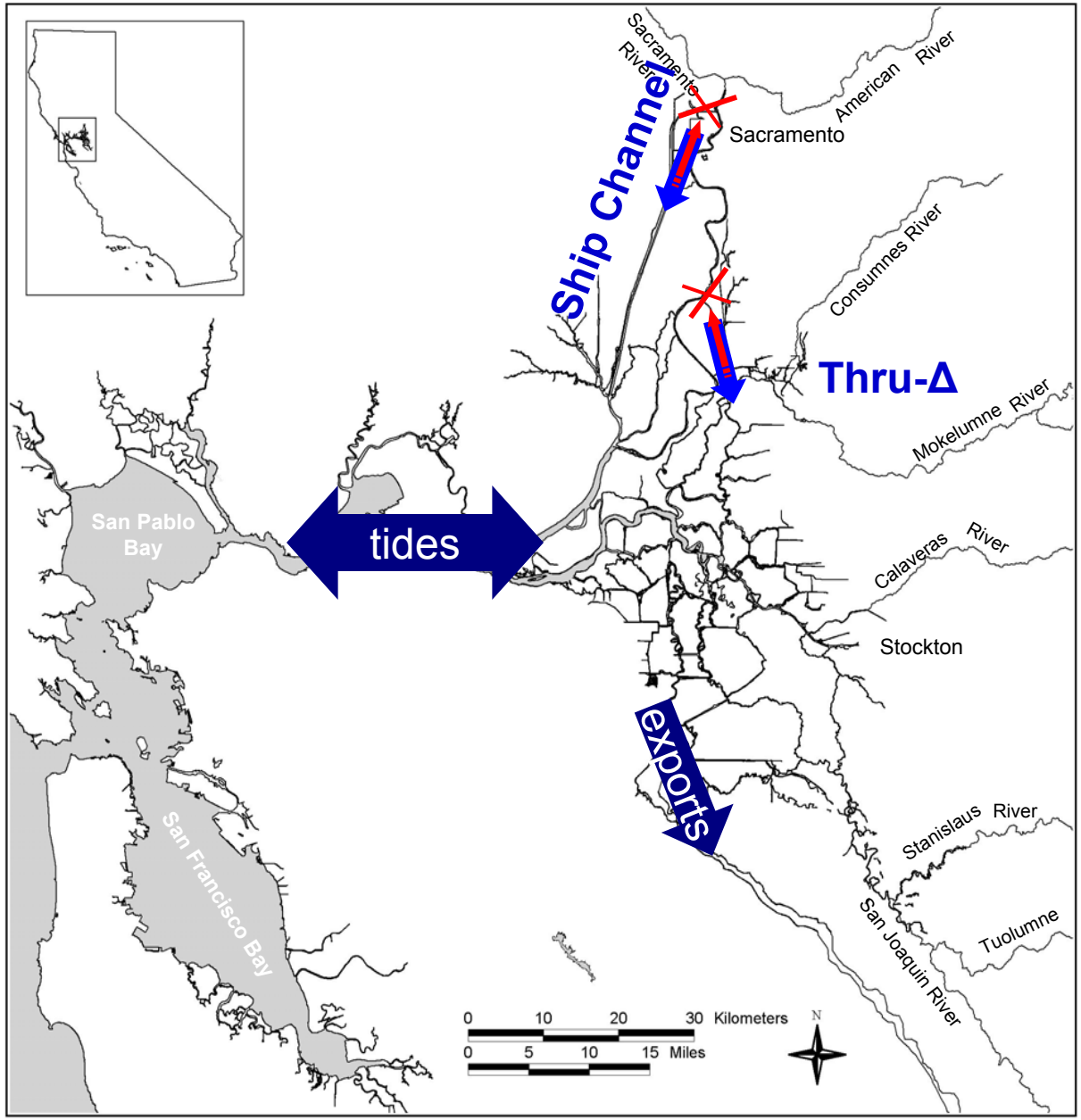
- Part 1: Ship Channel Flow Investigation
- Part 2: Current Events in DWR Flow Monitoring
  - New Monitoring Stations
  - Increased Accuracy
  - Increased Safety
  - Improved Telemetry and Data Storage

Summary

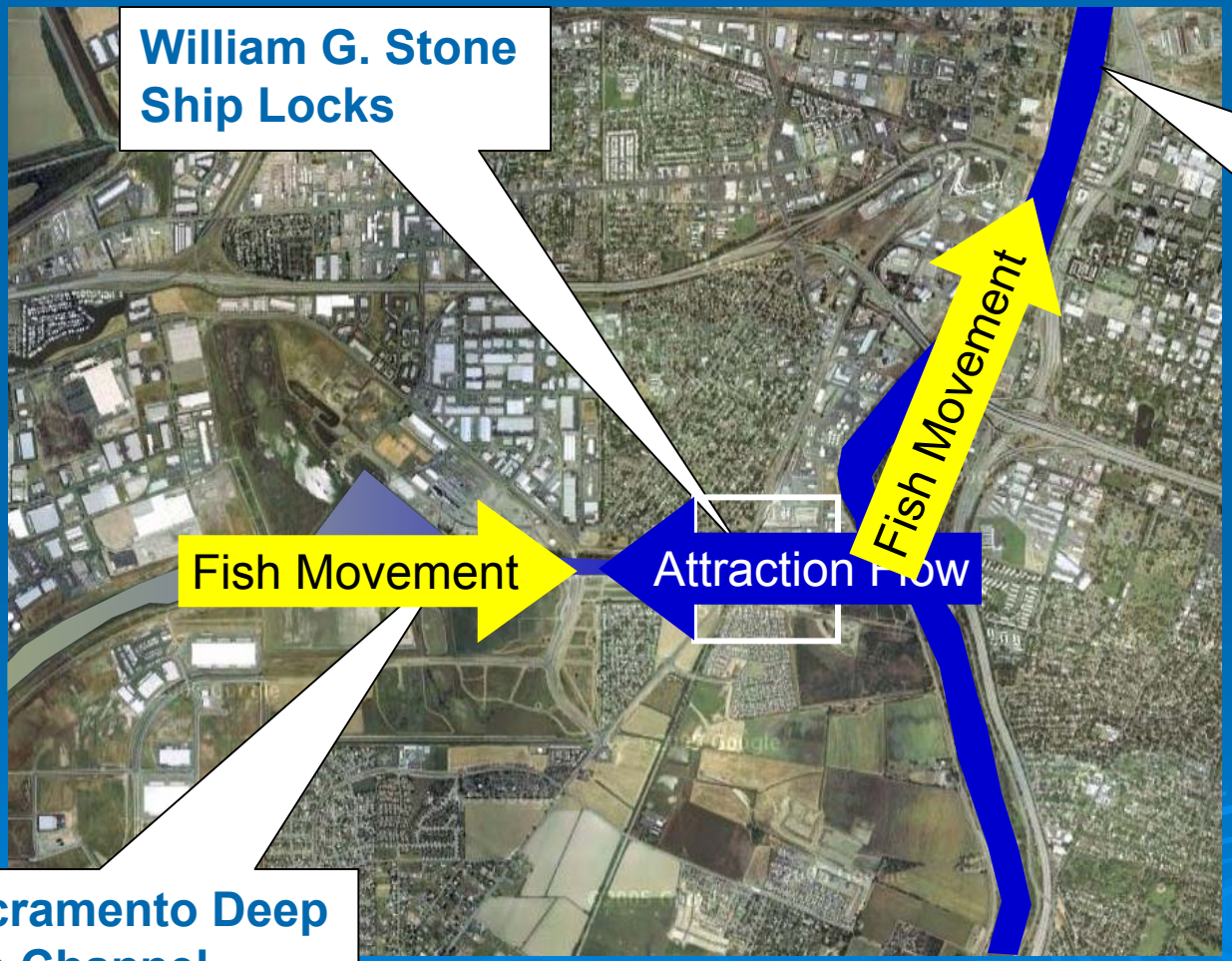
- Purpose: A fish migration study needed flow monitoring at the Sacramento Deep Water Ship Channel.

- Two flow estimation approaches were evaluated.
  1. Velocity Index Method (Acoustic Doppler)
  2. Orifice + Vertical Slot Equations (Acoustic Doppler Calibration)

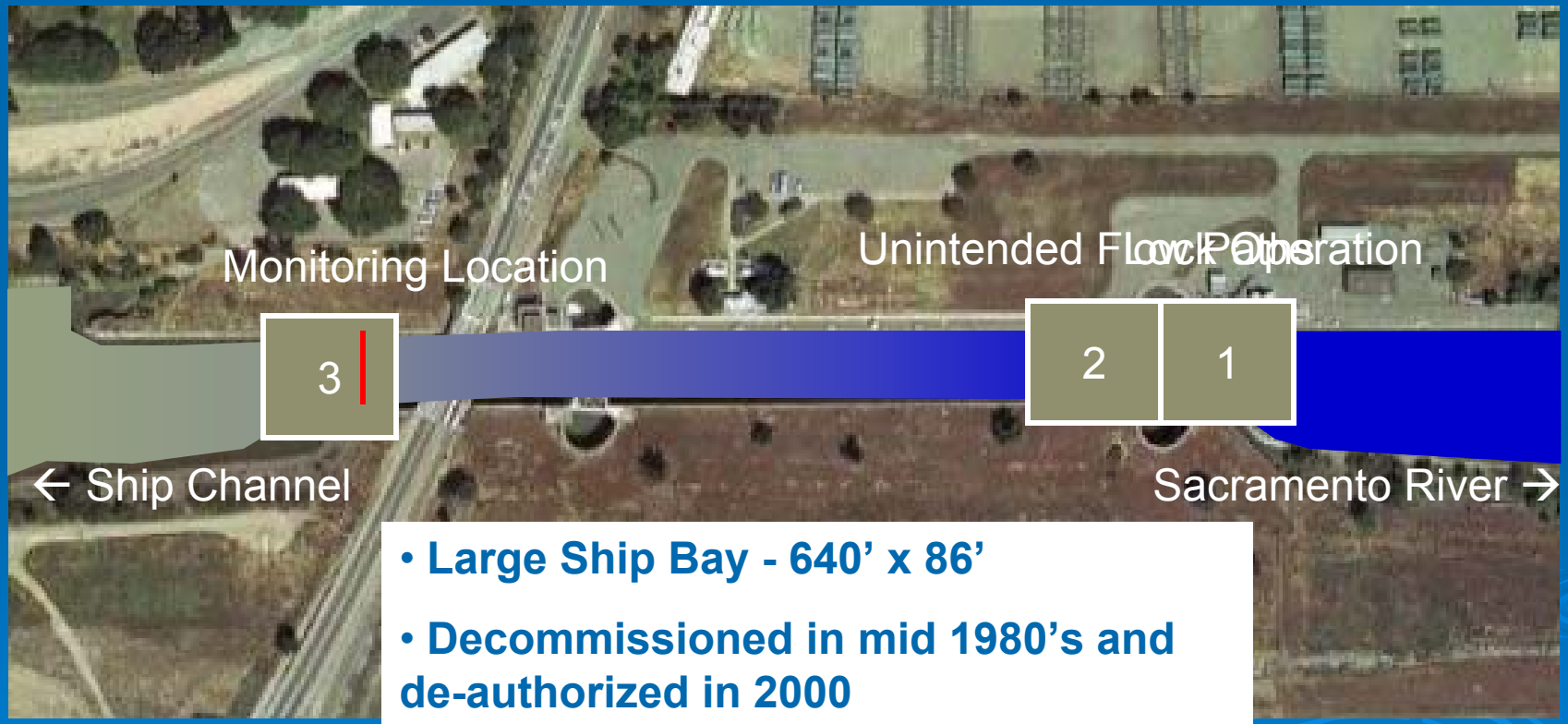
Study Purpose – Fish Migration



Head of the Sacramento Deep Water Ship Channel



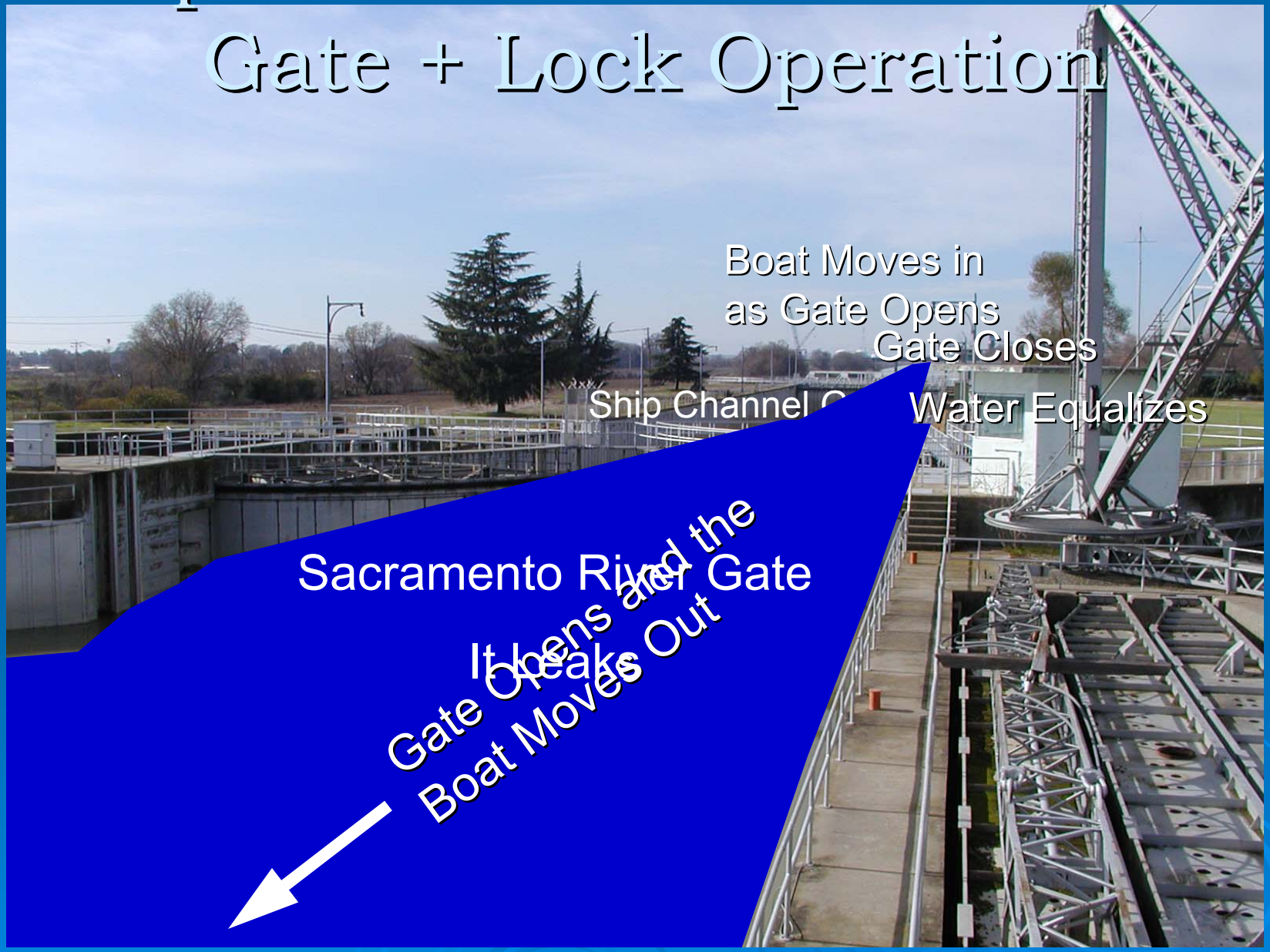
William G. Stone Ship Locks



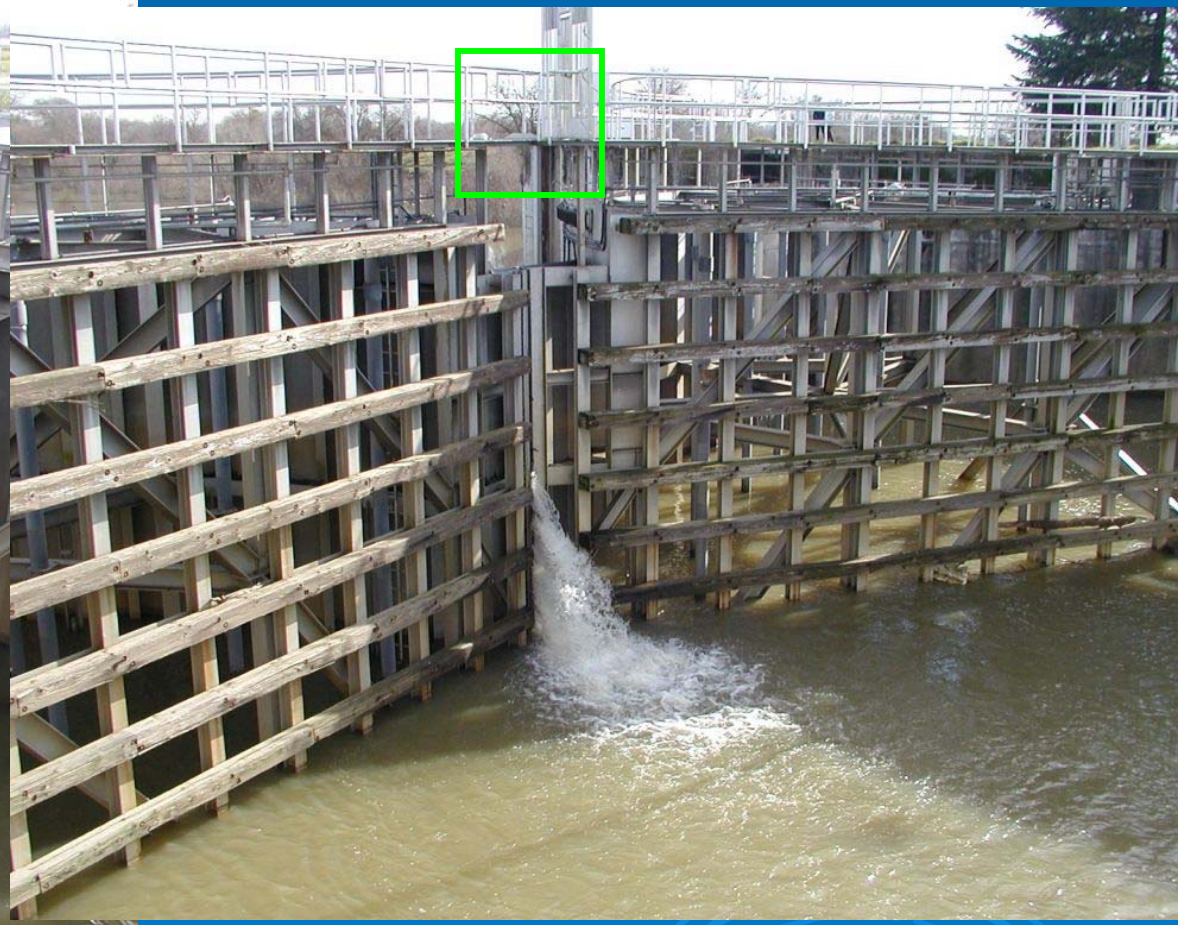
- **Large Ship Bay - 640’ x 86’**
- **Decommissioned in mid 1980’s and de-authorized in 2000**
- **Reactivated for fish passage study in 2003 and 2004**
- **Currently non-operational**

1. Upstream Side of Sacramento

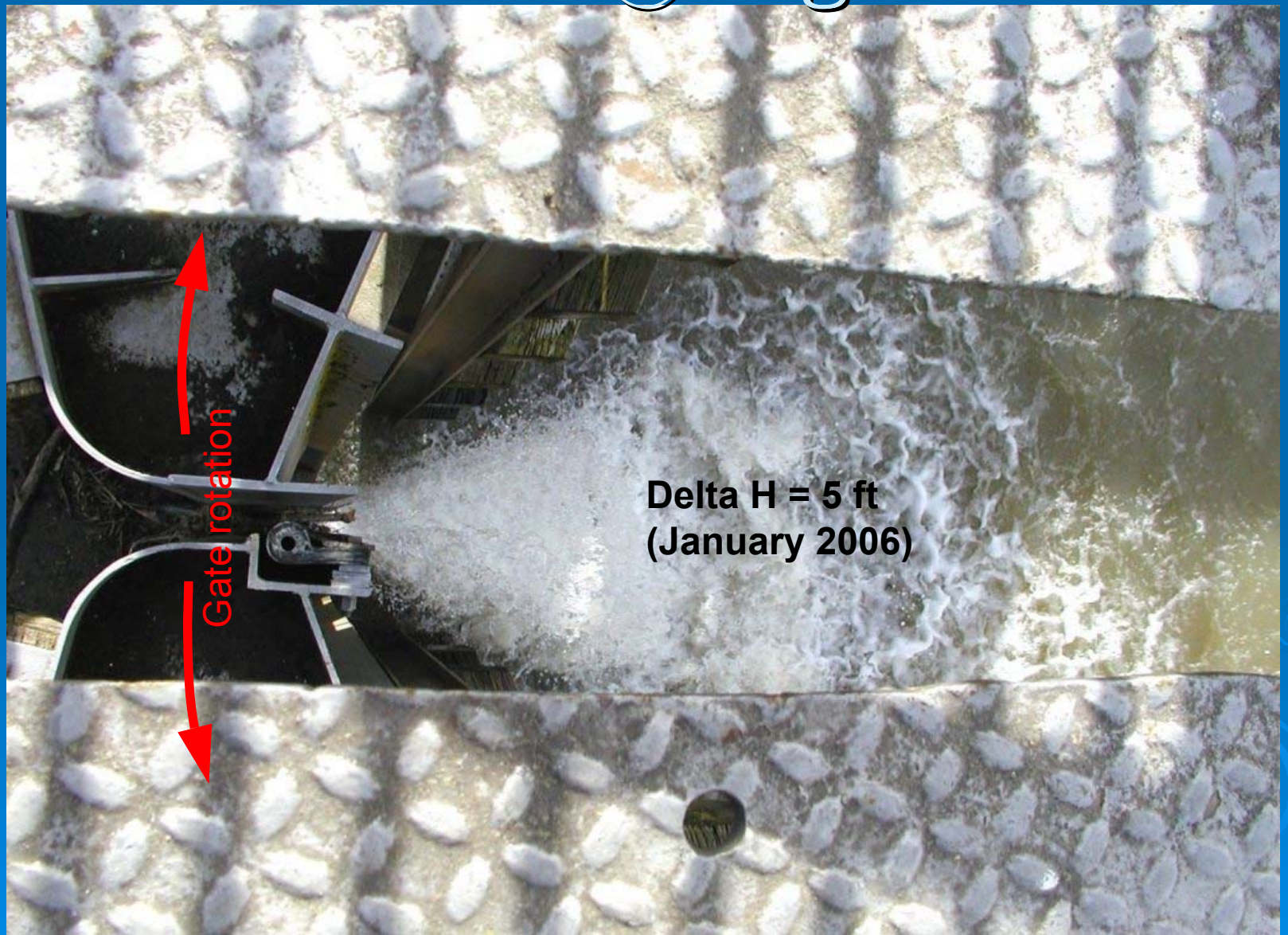
Gate + Lock Operation



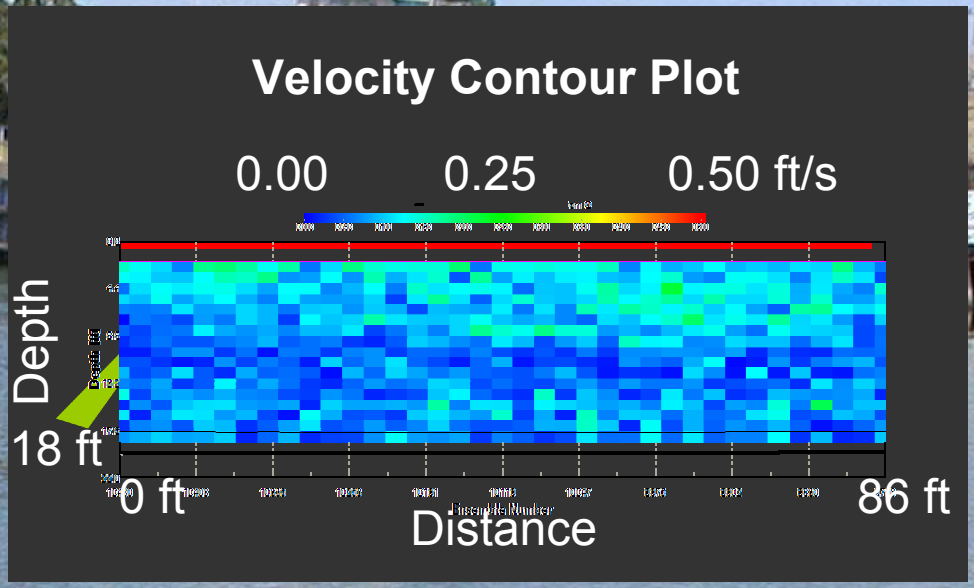
2. Downstream Side of Sacramento Gates + Unintended Flow Paths



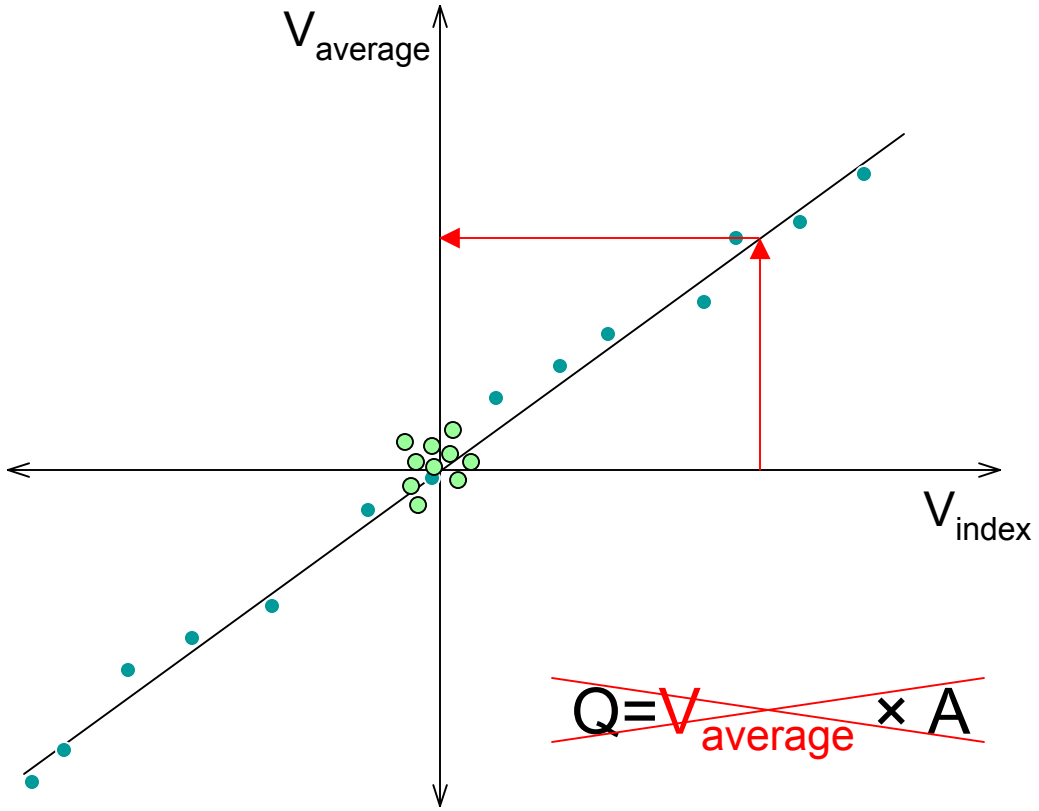
2. Center Gap in the Sacramento River Gate @ High Flow



3. Downstream Side of Ship Channel Gate @ Low Flow



Index Velocity Approach



$$Q = V_{average} \times A$$

Head Difference Approach

- Orifice Equation (Eq. 1)

$$Q = AK\sqrt{2g\Delta h}$$

- Simplified to

$$Q = AK\sqrt{\Delta h}$$

where,

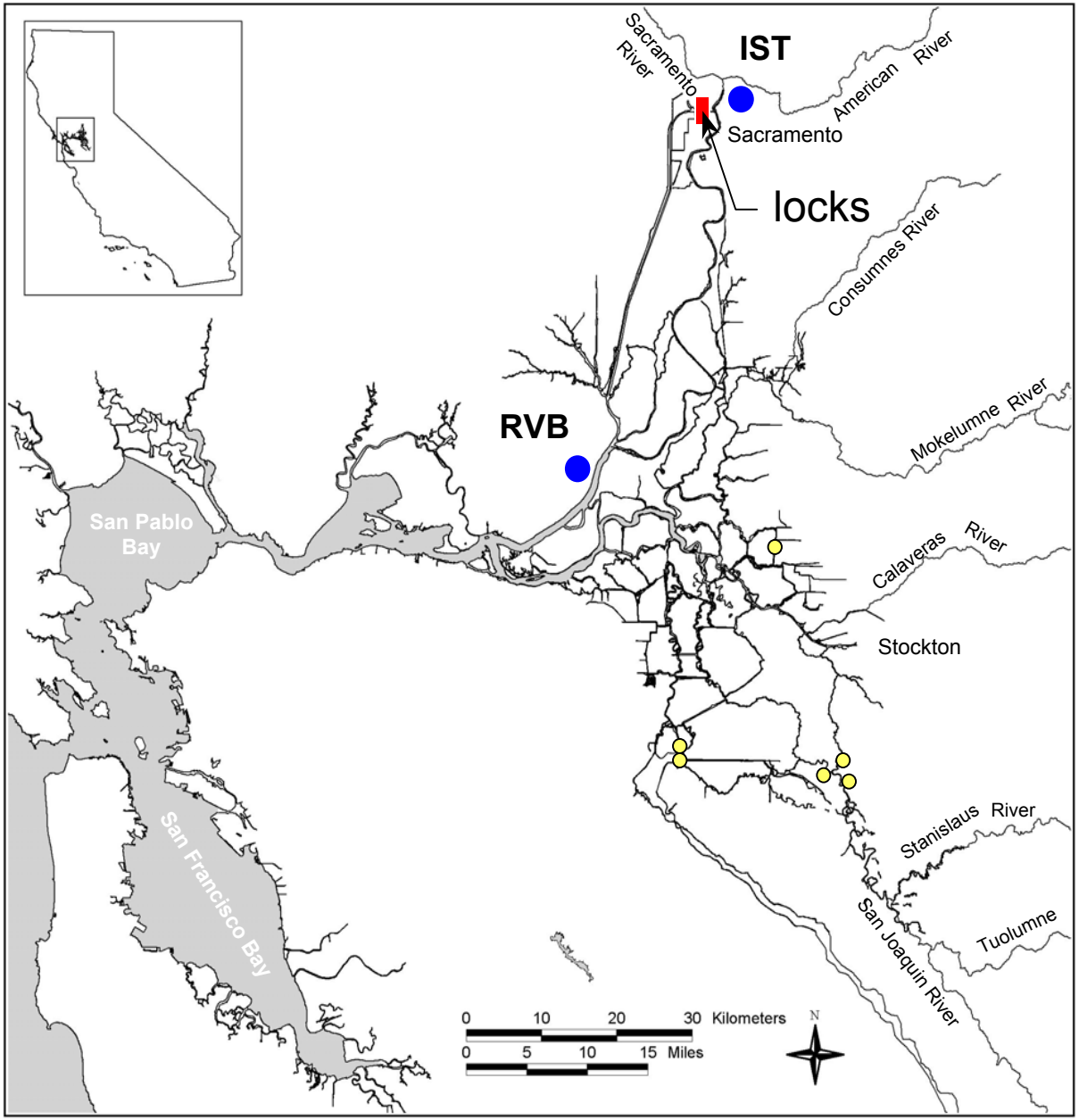
A = area = 1’ x stage

K = 2.5 (from boat measured flow)

Δh = head difference

- Δh = Sacramento River Elevation – Ship Channel Elevation

Translation of Known Elevation Data



Water Surface Elevation Translation

- Stage data for Eq. 1 required
- General linear regression equation used:

$$y = 1.22x - 2.2$$

where,

y = stage at boat lock

x = stage at RVB

2.2 = empirical number created to make the stage a the boat lock and IST equivalent at zero flow

Fish Ladder Flow Equation

- Vertical Slot Equation (Eq. 2[1])

$$Q = \alpha(y_0 / b_0) - \gamma,$$

where,

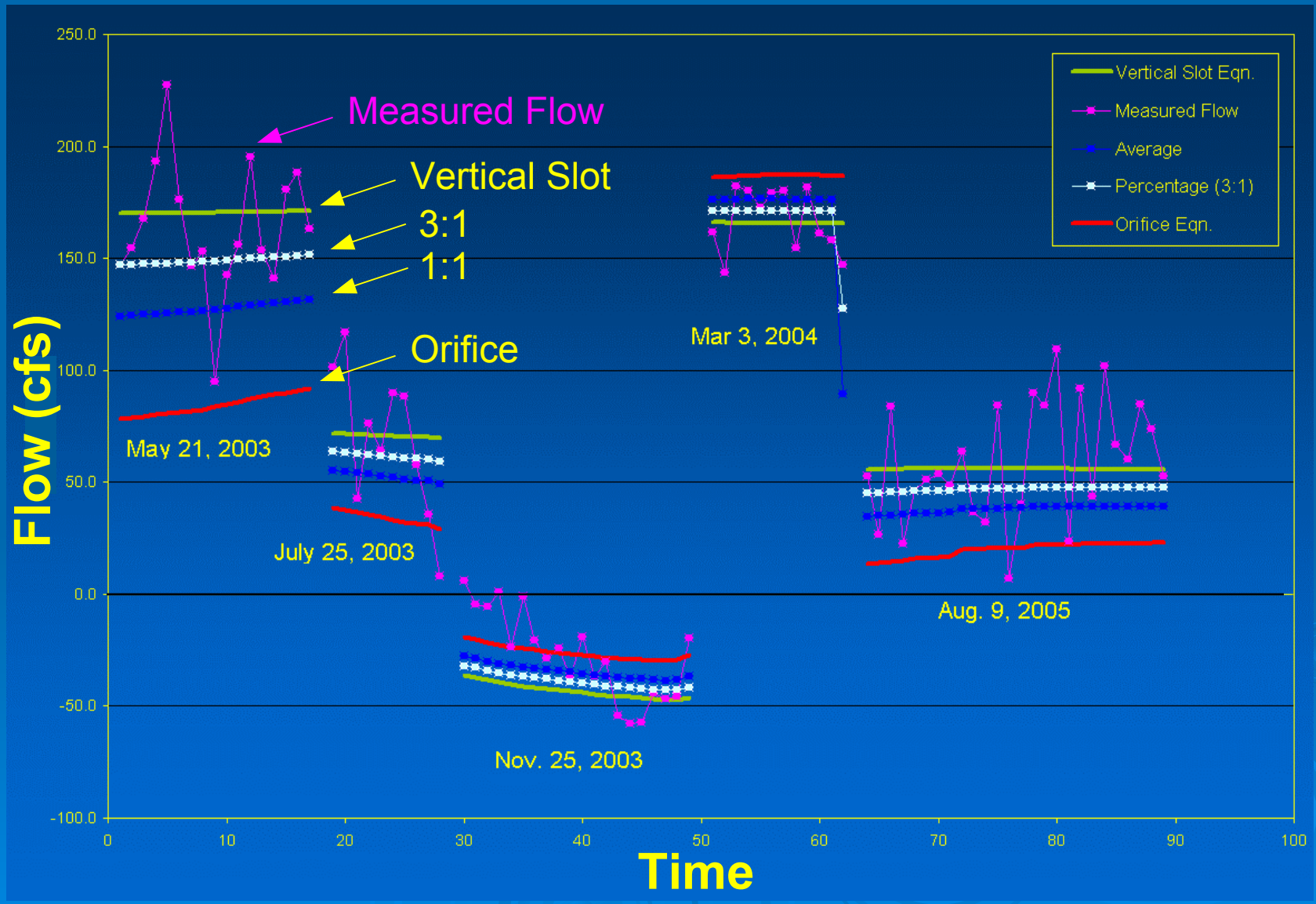
α & γ = 3.77 & -20

y_0 = water depth

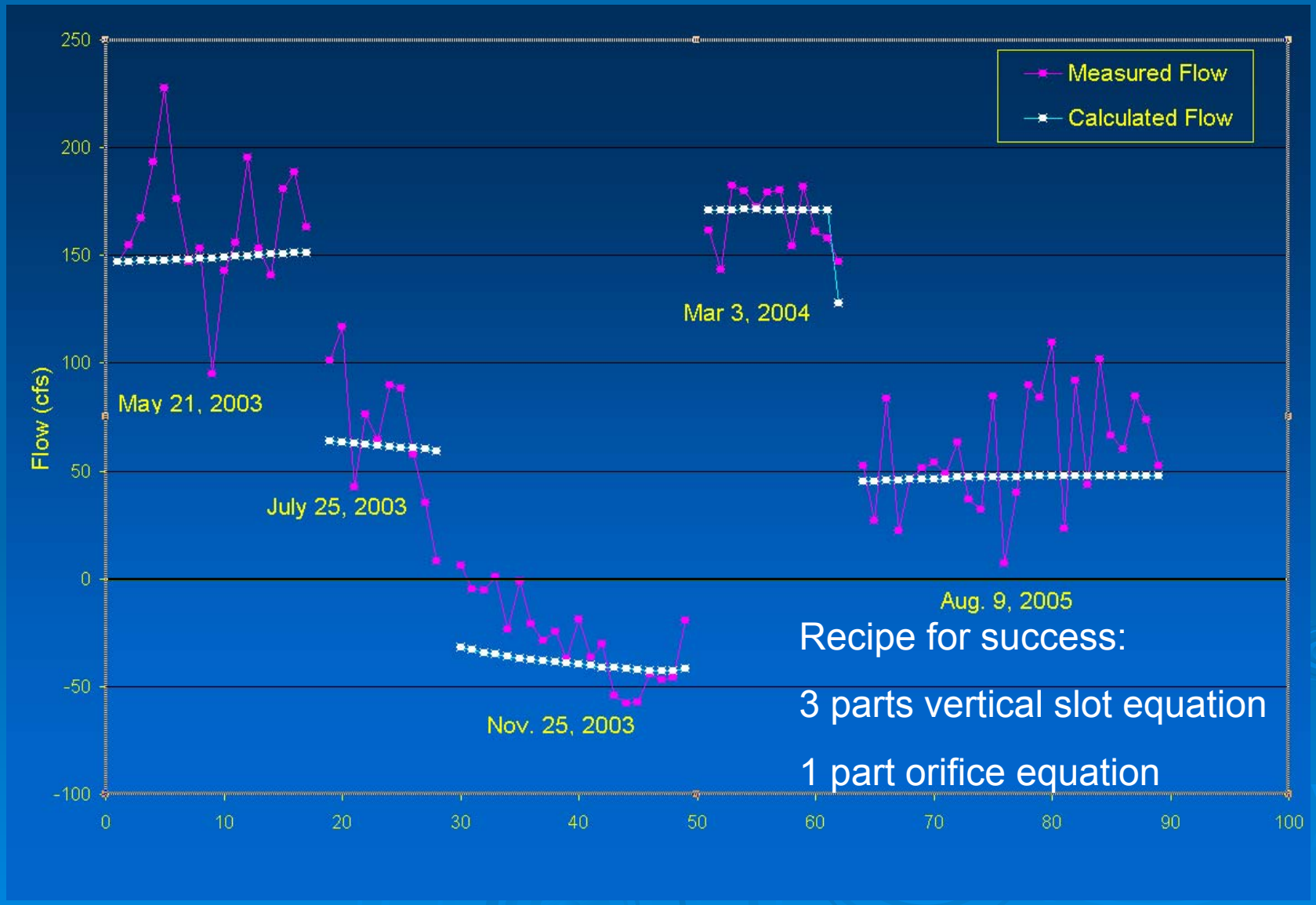
b_0 = slot width = 1 foot

1 - Rajaratnam N, Katopodis C & Solanki S (1992) New designs of vertical slot fishways. CanadianJournal of Civil Engineering 19(3): 402-414.

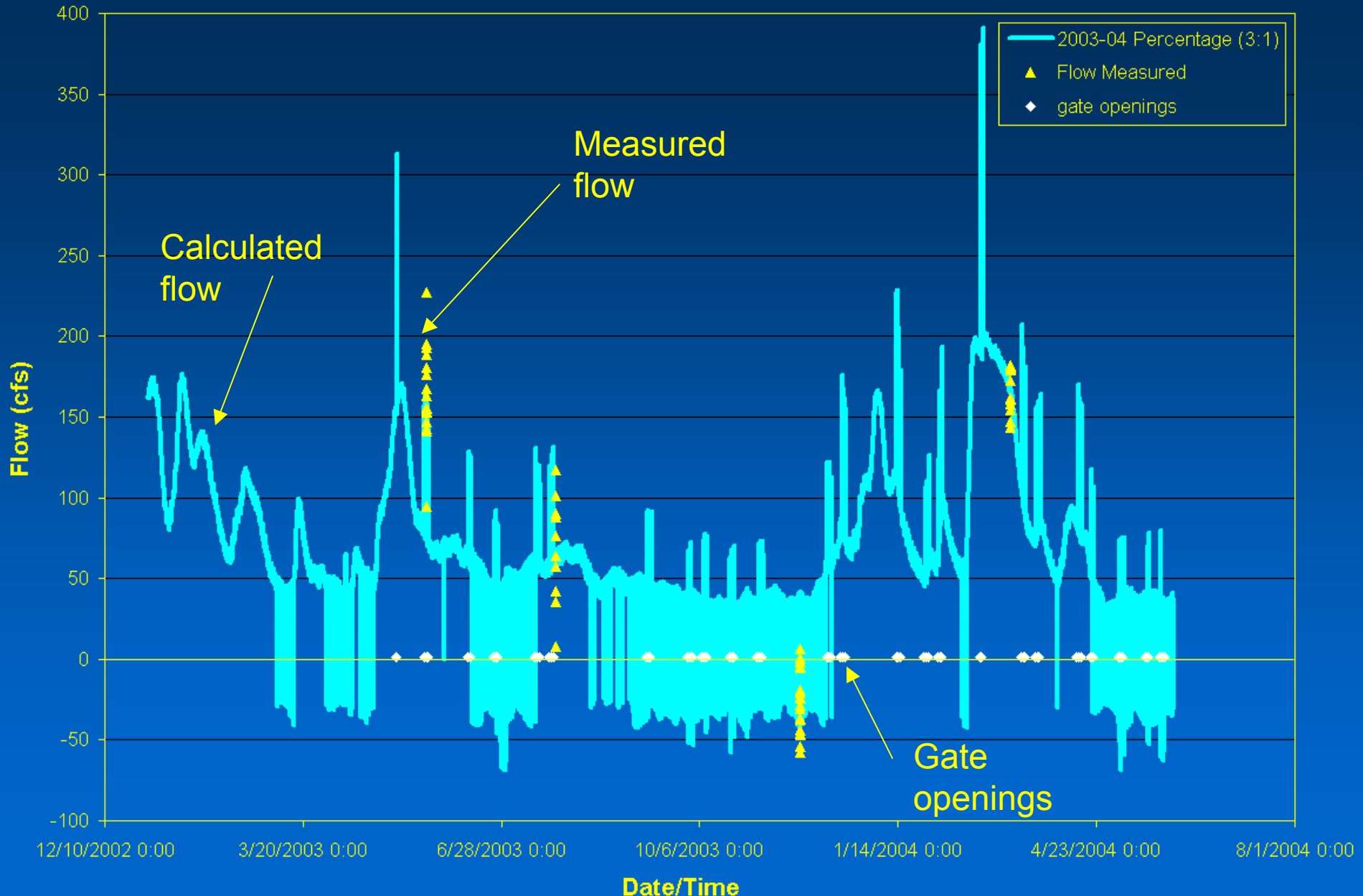
Predictions of Measured Flow: water elevation based



Prediction of Measured Flow



Gate Operation Events & 2003 -2004 Flow Data



Part 1 Conclusions

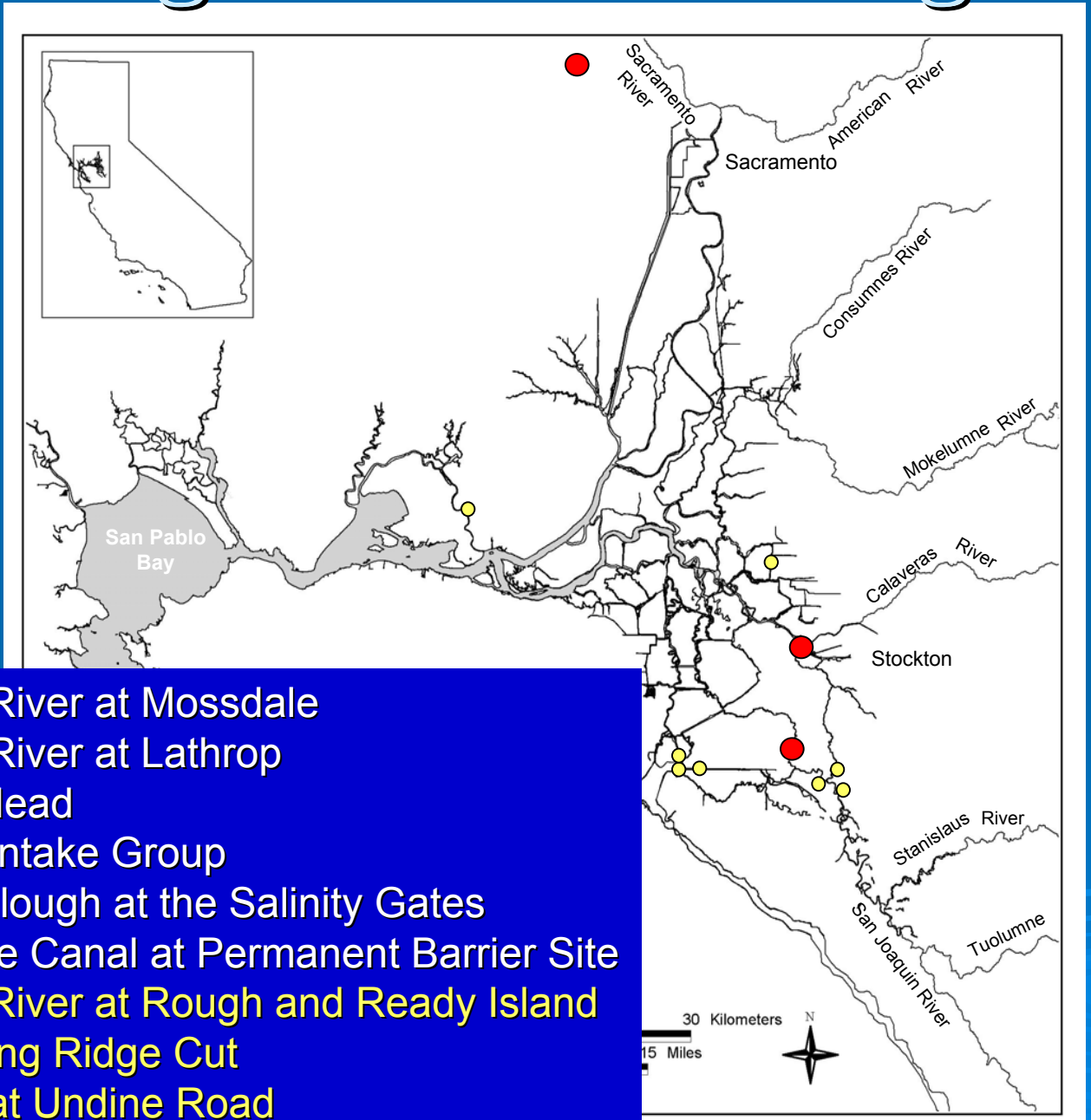
- Velocity Index Method was not judged appropriate for the velocities observed during the period of record.
- Water Surface Difference Method provided a reasonable fit of observed data.
- Recommendation: Future studies should include a stage monitoring at the Port of Sacramento.

Intermission

Part 2.

Current Events in DWR Flow Monitoring

Expanding Flow Monitoring Network



- San Joaquin River at Mossdale
- San Joaquin River at Lathrop
- Old River at Head
- Clifton Court Intake Group
- Montezuma Slough at the Salinity Gates
- West Grantline Canal at Permanent Barrier Site
- San Joaquin River at Rough and Ready Island
- Knights Landing Ridge Cut
- Middle River at Undine Road

Data Base and Telemetry

- Data Base and Processing – Hydstra
  - Specialized database for hydraulic and hydrologic data.
  - Improved storage, processing, and deliver of data.
- Telemetry
  - From GOES Satellite to Cell Modems.
  - Allows higher bandwidth and two way communications.
  - Lower cost maintenance and decreased downtime.

Shawn Mayr

Department of Water Resources

Central District

3251 S Street,

Sacramento, CA

916-227-7598

sdmayr@water.ca.gov