Magnolia Dam
Lake Level Management

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Magnolia Dam

- Jurisdiction of CA Division of Safety of Dams
  - CA Dam # 1302 / National ID # CA00966
  - Application # 1300 approved September 8, 1966
  - 'Guidelines for the Design and Construction of Small Embankment Dams'

- Key Elevations
  - 1515'0" - Dam crest and top of second weir
  - 1511'6" - Lowest permissible elevation of permitted building
  - 1510'0" - Bottom of second weir / top of first weir ***(Flood)***
  - 1507'0" - 'Normal Pool Elevation' lake level / First spill
  - 1465'0" - Low Level Outlet

CA Division of Safety of Dams

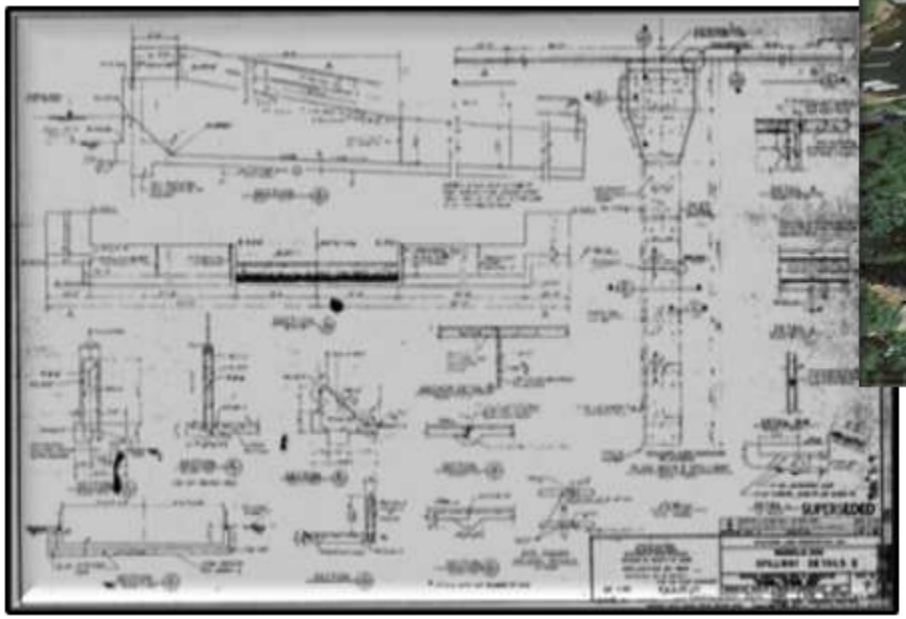
- Guidelines for the Design and Construction of Small Embankment Dams
  - Purpose and Scope: *"The purpose of these guidelines is principally to provide those potential owners of small dams with a fairly complete description of the legal and engineering requirements that they must meet if they desire to construct and own a small dam in California"*
  - Chapter V – Outlets: ***"A low level outlet is required for emptying or lowering the reservoir in case of emergency: for inspection and maintenance of the dam, reservoir, and appurtenances: and for releasing waters to meet downstream water rights"***

Lake Level Management

- Spillway
  - ***Designed to manage lake level and flood control***
  - Uncontrolled double weir ogee design
- Low Level Outlet
  - ***To be used for emergency drawdown or for dam maintenance***
  - 24” Waterman Model SC-50(M) cast iron sluice gate (Modified for 55’ head) with spigot back and bronze seat (circa 1966)

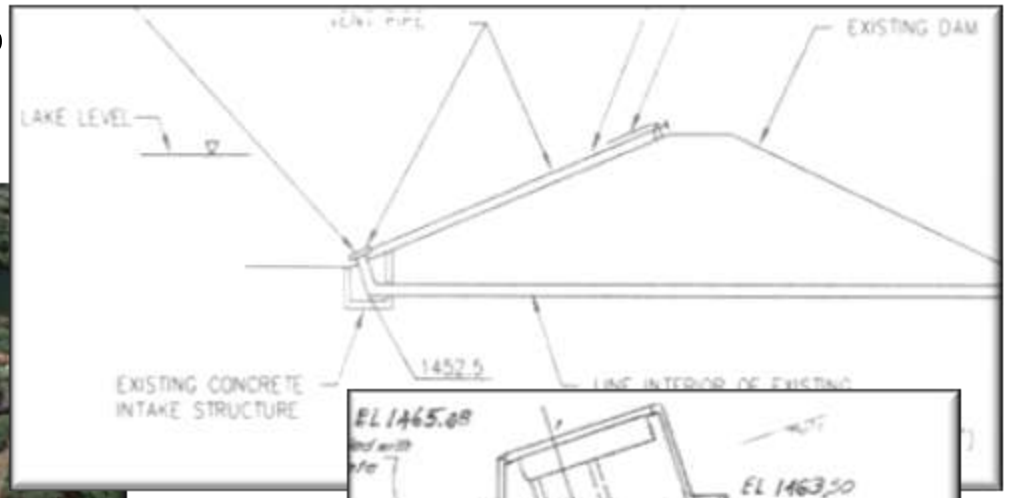
Magnolia Dam Spillway

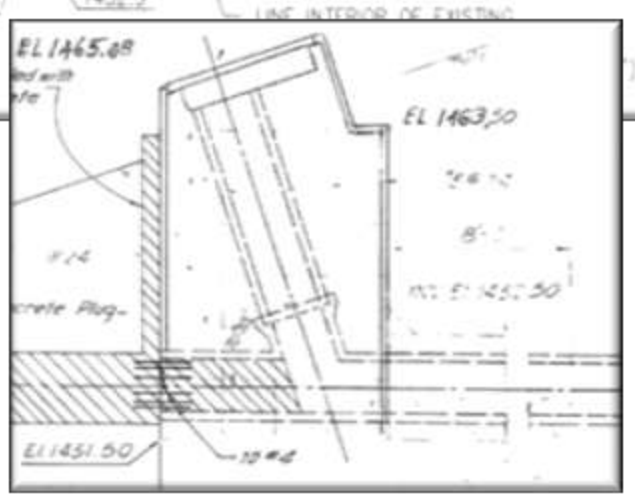
- Double weir ogee design (uncontrolled)
  - First weir – 3’ x 25’ (10% of overall capacity)
    - Top @ flood stage (1510’)
  - Second weir – 5’ x 150’
  - Built for 1,000 yr storm



Low Level Outlet (LLO)

- Steel liner w/21.5” ID installed 1994 (24” originally)
  - ***0.28%*** cross-section of spillway (less than 1/3 of one per cent)
  - Reduced capacity ~30%





Approx 45’ under normal lake level

Types of Flow

Laminar Flow

- Occurs when a fluid flows in parallel layers
- Desired outcome in most situations, especially when trying to move fluids
  - Spillway/Weir

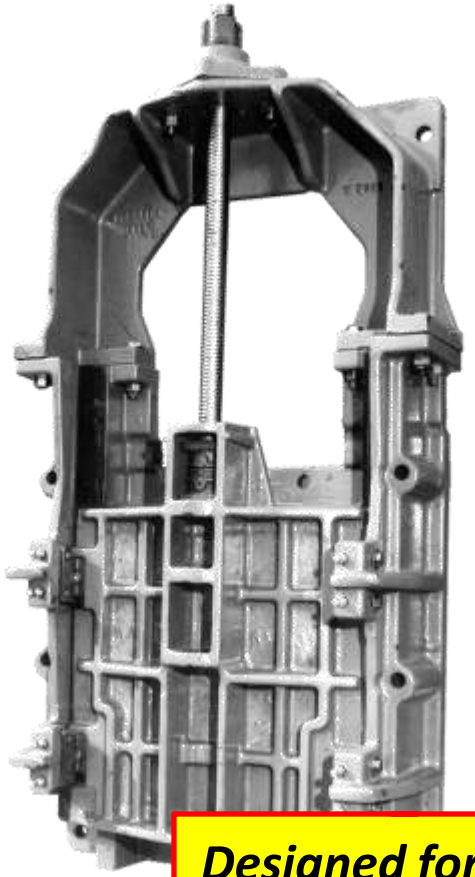
Turbulent Flow

- Characterized by chaotic changes in pressure and flow velocity
- Most applications turbulence is undesirable when trying to move fluids
  - Valves

Gate Valve (Sluice)

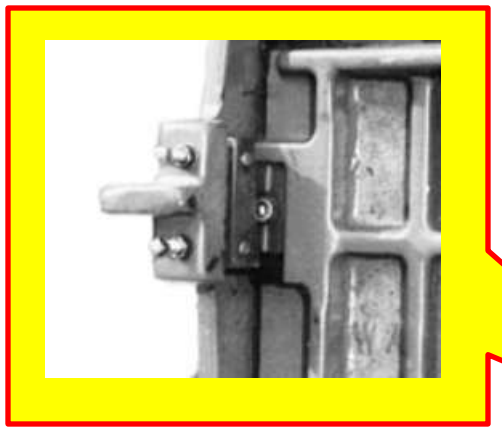
Gate valves are primarily used to permit or prevent the flow of liquids, but typical ***gate valves should NOT be used for regulating flow***, unless they are specifically designed for that purpose.

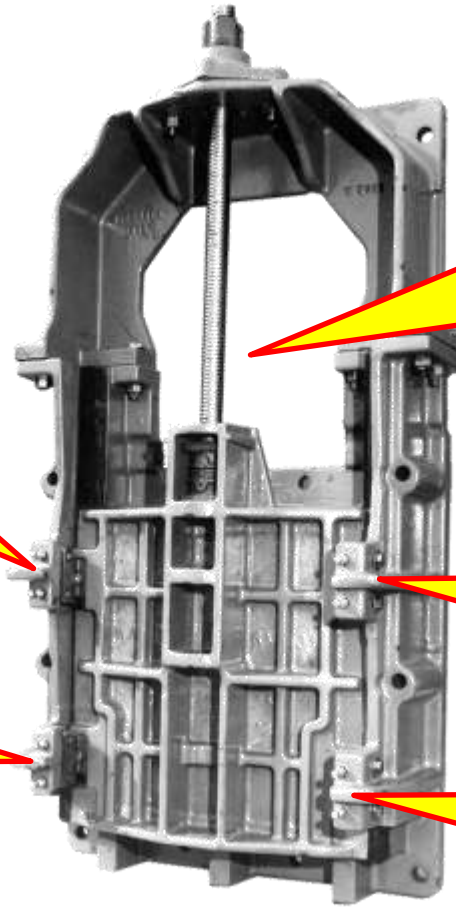
A partially open sluice gate ***tends to vibrate from the fluid flow***. Most of the flow change occurs near shutoff with a relatively high fluid velocity ***causing gate and seat wear and eventual leakage if used to regulate flow***.



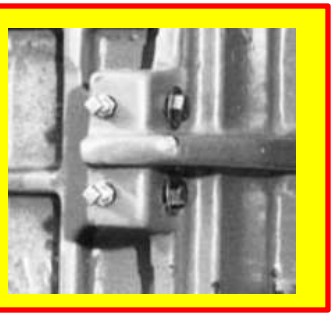
Designed for full open/closed applications

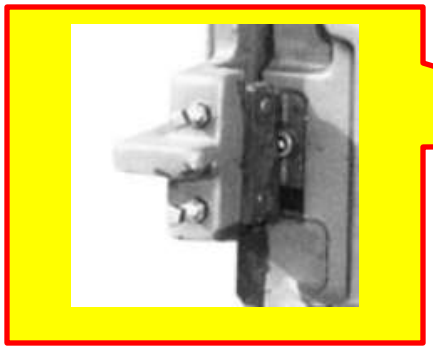
Gate Valve (Sluice)

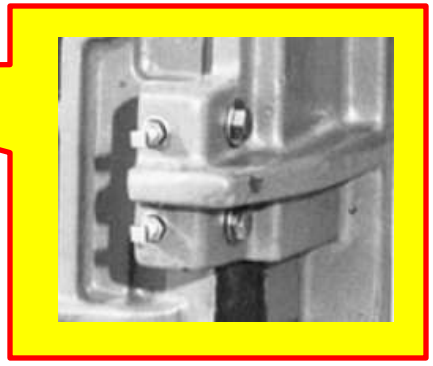




Extended partial openings lead to excessive wear/damage due to vibrations from turbulence



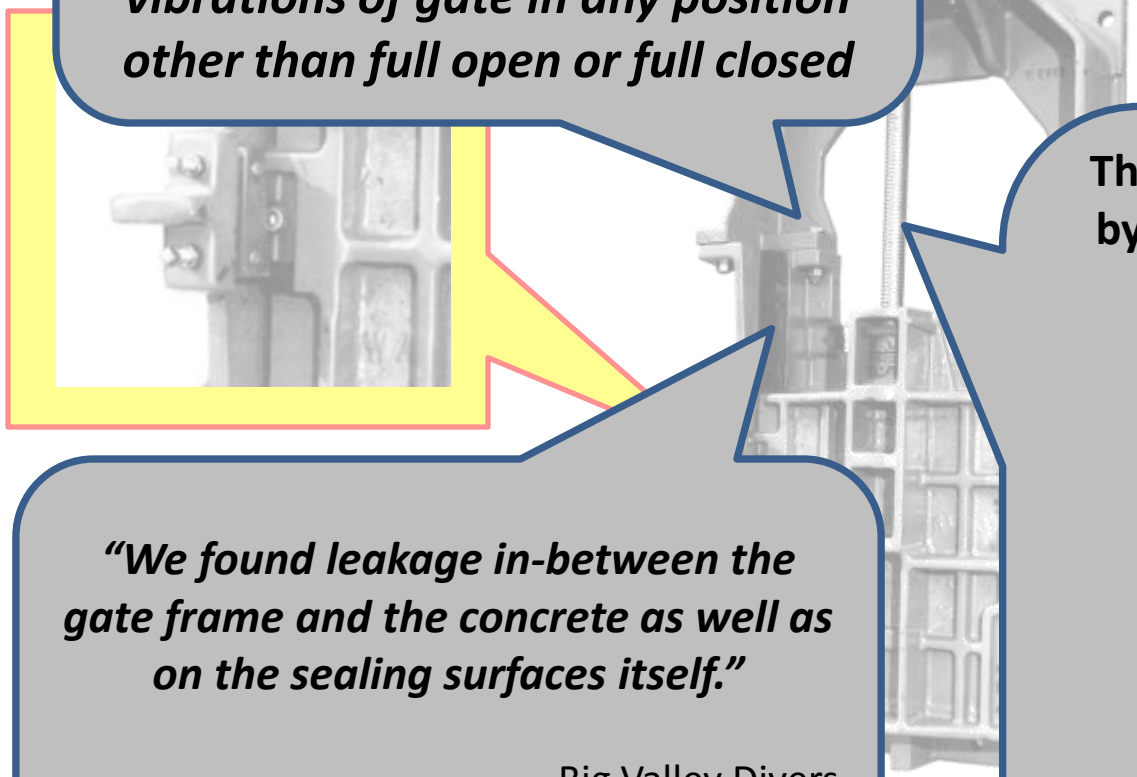




As the gate closes, the wedges pull the top and bottom seats into contact.
Gate out of turbulent flow when fully open

e (Sluice)

Very basics of fluid dynamics prove 'Turbulent Flow' introduced into valve by the extended partial opening of valve resulting in vibrations of gate in any position other than full open or full closed



"We found leakage in-between the gate frame and the concrete as well as on the sealing surfaces itself."

Big Valley Divers
24" Sluice Gate Inspection Report

This concern has been confirmed by every expert/professional we have consulted with

Lake and Parks Committee Members
Lake of the Pines Assoc

Principal Mechanical Engineer
Waterman USA

Dam Safety Engineer
Nevada Irrigation District

Regional Engineer
CA Division of Safety of Dams

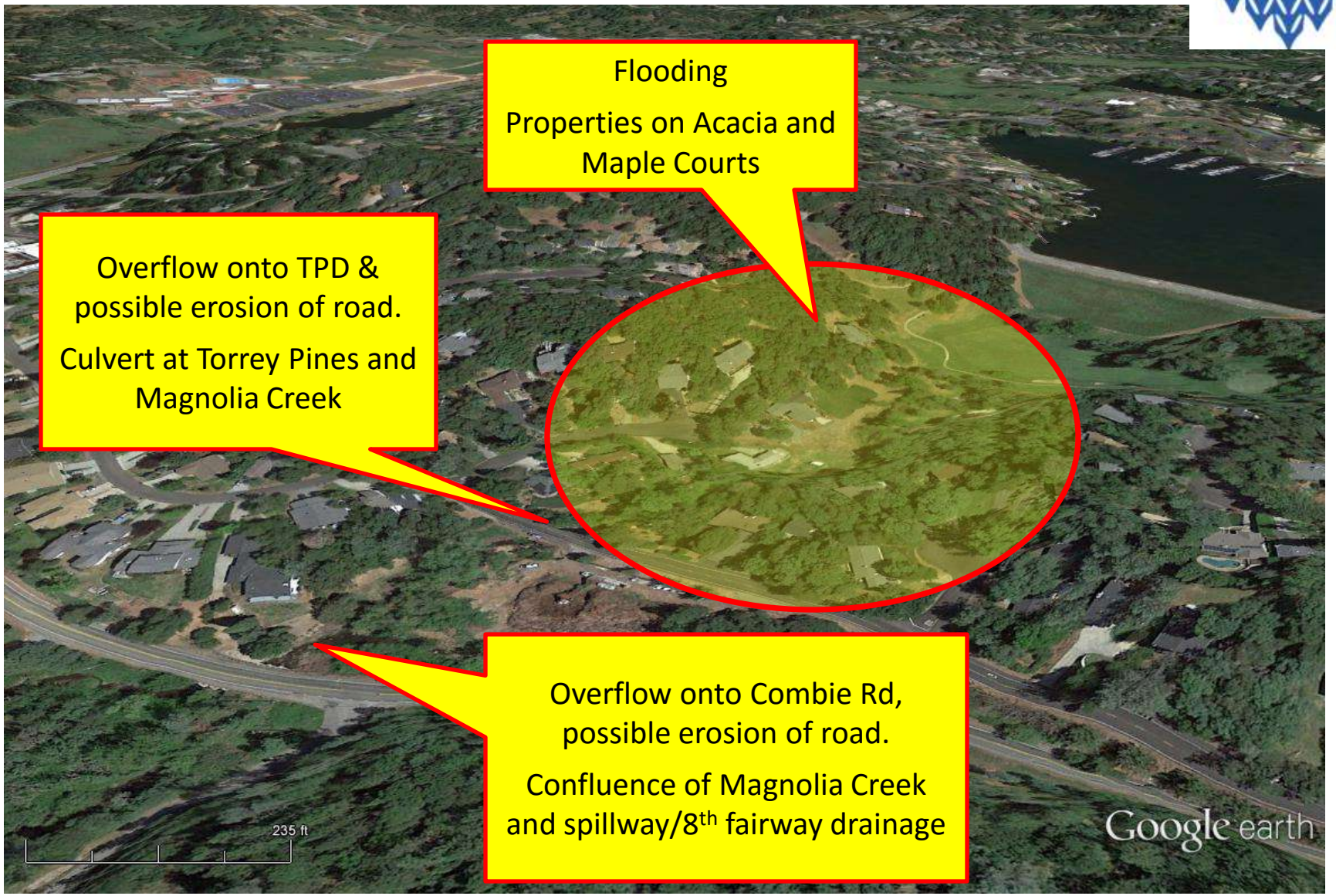
es, the
the top and bottom seats

Using LLO considerations

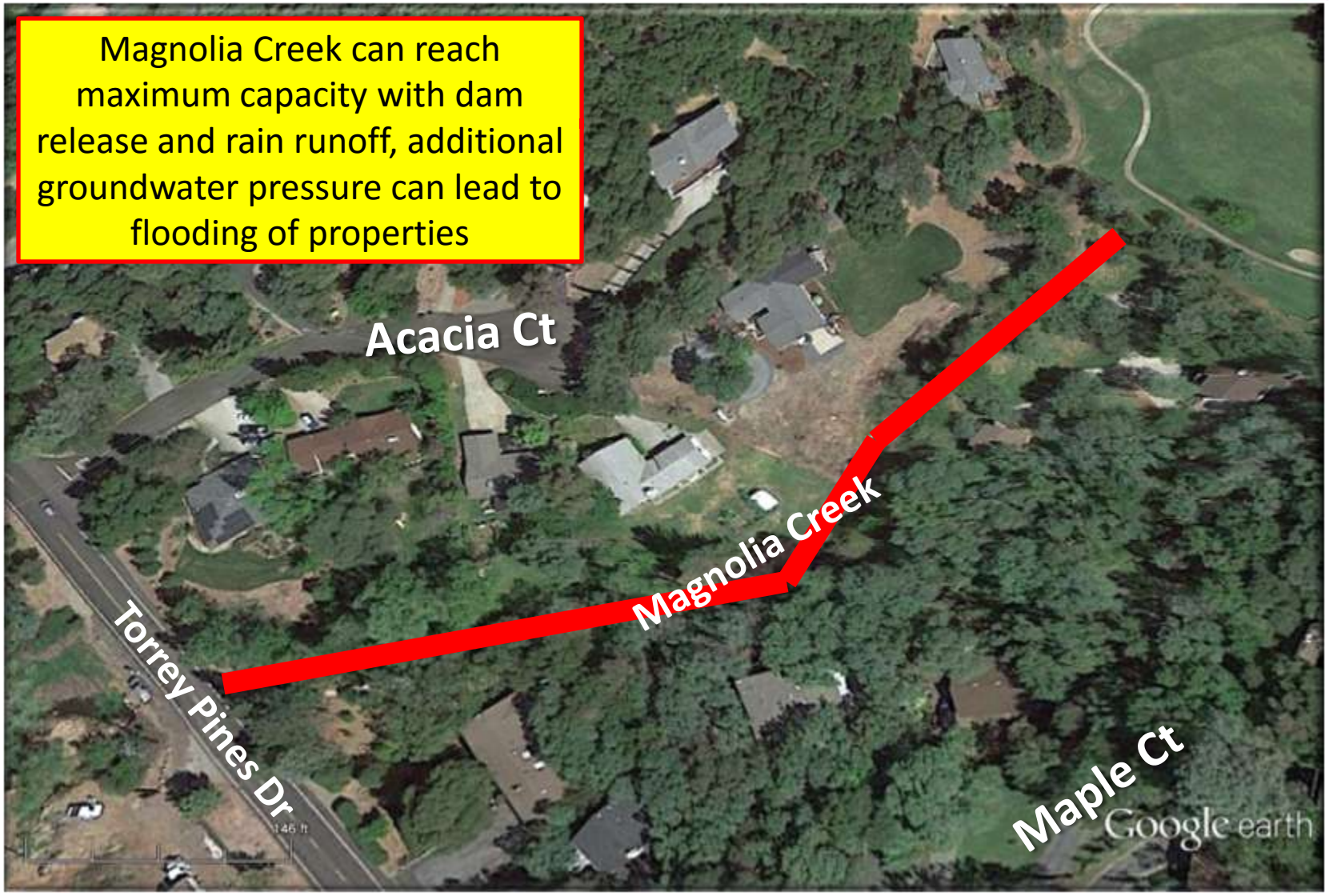
- Downstream Considerations
  - Flooding member's properties
  - Downstream culverts capacities

- Spillway vs LLO capacities
  - Spillway is designed for level management
    - Capacity is immensely greater than LLO
  - LLO very little impact on lake level during storm

Downstream Considerations

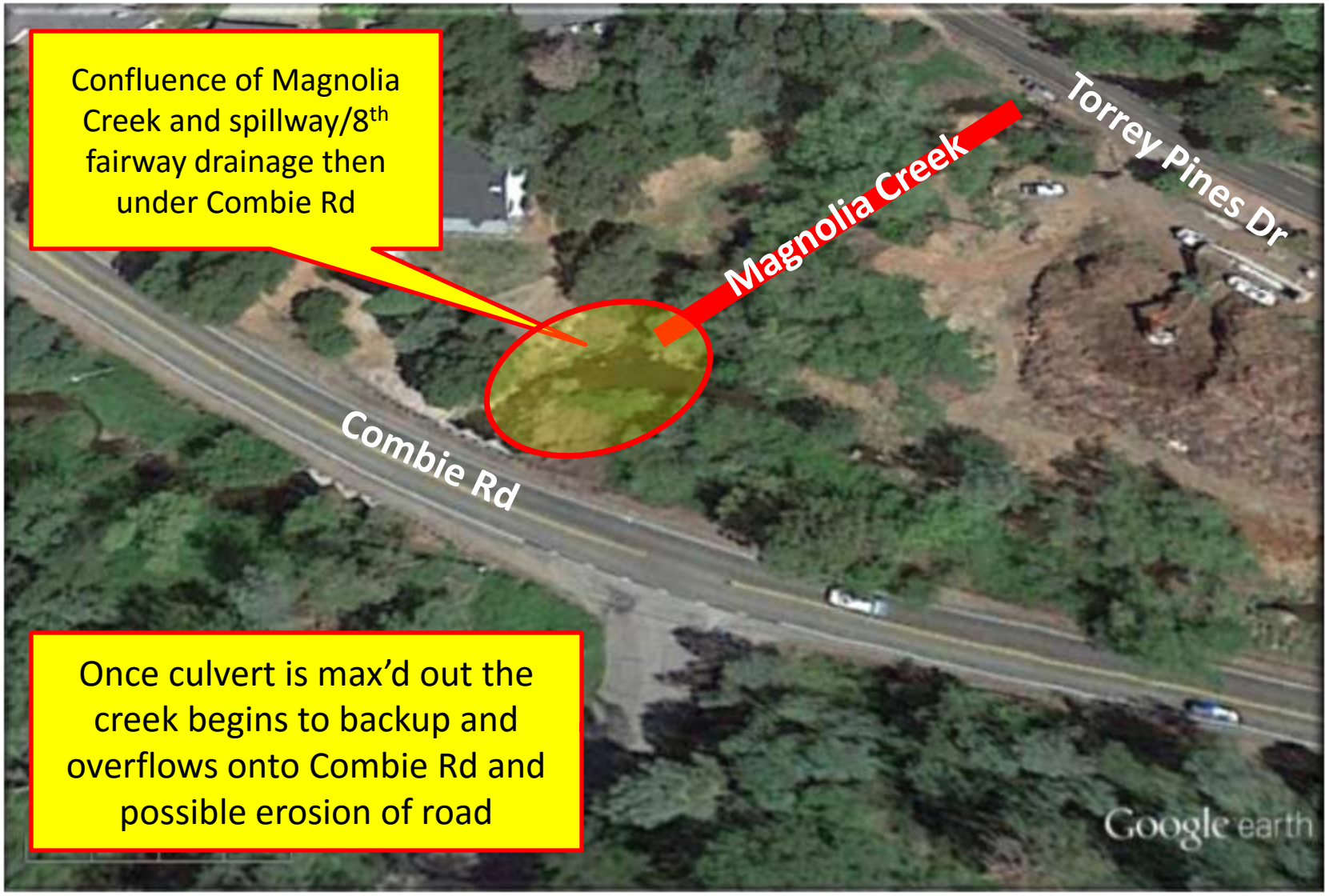


Flooding – Acacia/Maple Cts



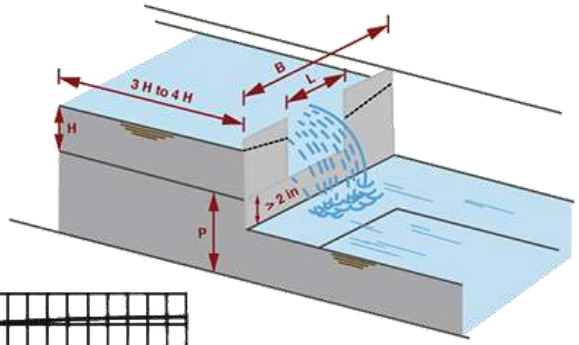
Culvert at Torrey Pines

Confluence @ Combie Rd



Formulas for Modeling

$$C_v = Q\sqrt{\frac{SG}{\Delta P}}$$



Formulas

$H_D = H_d + [V_a/(2g)]$

$\beta = H/H_D$ $\quad \beta_i = H_i/H_D$ $\quad H_i = \beta_i H_D$

$E_i = E + H_i$ $\quad C_i = (C_i/C_D)\ C_D$

$Q_i = C_i\ (2g)^{1/2}\ L\ H_i^{3/2}$

$Q = C_d A\sqrt{2gH}$

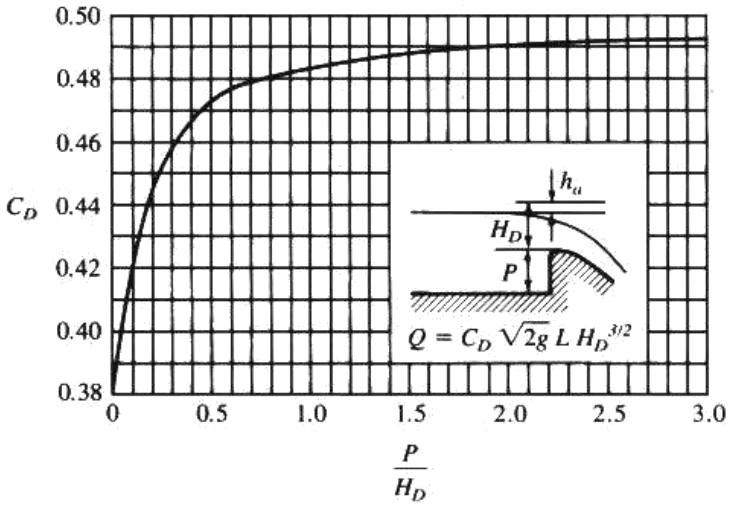
Where Q = Discharge, cubic feet per second

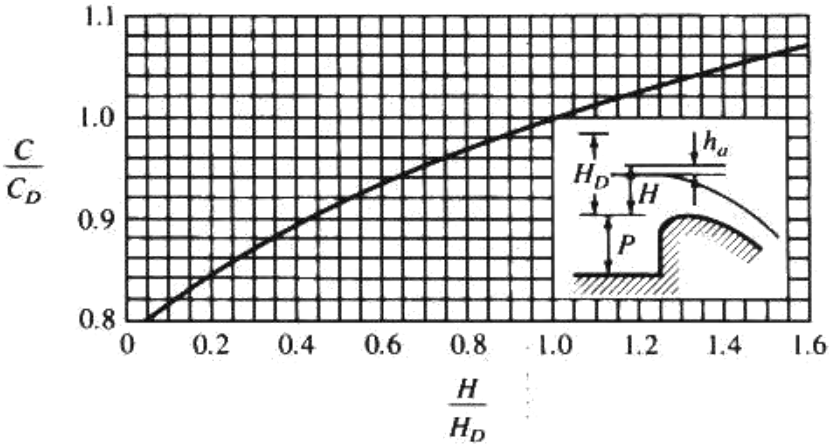
* 0.70 = C_d - Coefficient of Discharge

A = Area of opening, square feet

H = Head in feet above center line of opening

g = Acceleration due to gravity 32.2 feet/second²

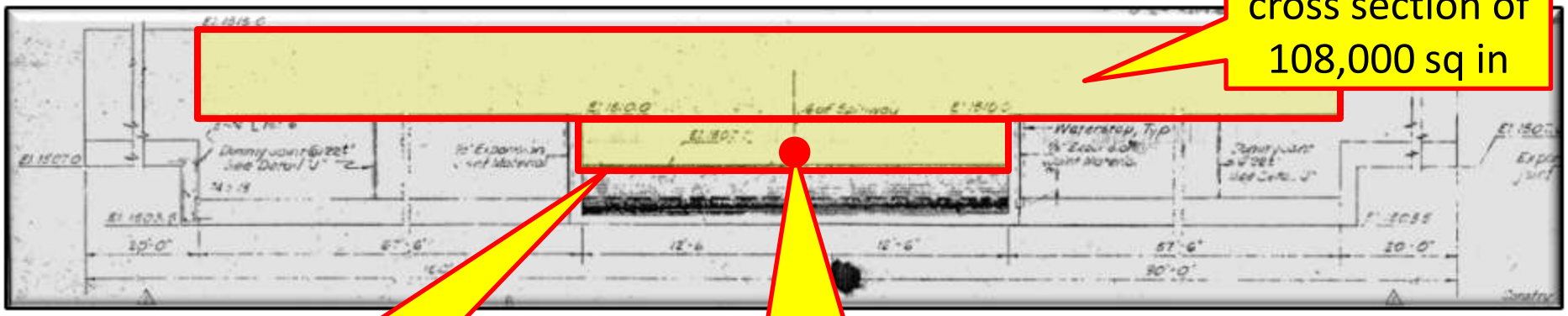




$$Q = C_e\ (L + k_b)\ (H + 0.003)^{3/2}$$

Spillway

- Weir structure (T shape) is 190’W x 12’H x 180’L
  - Weir has cross-section of 118,800 sq in
  - Promotes laminar flow = greater flow



2nd weir has cross section of 108,000 sq in

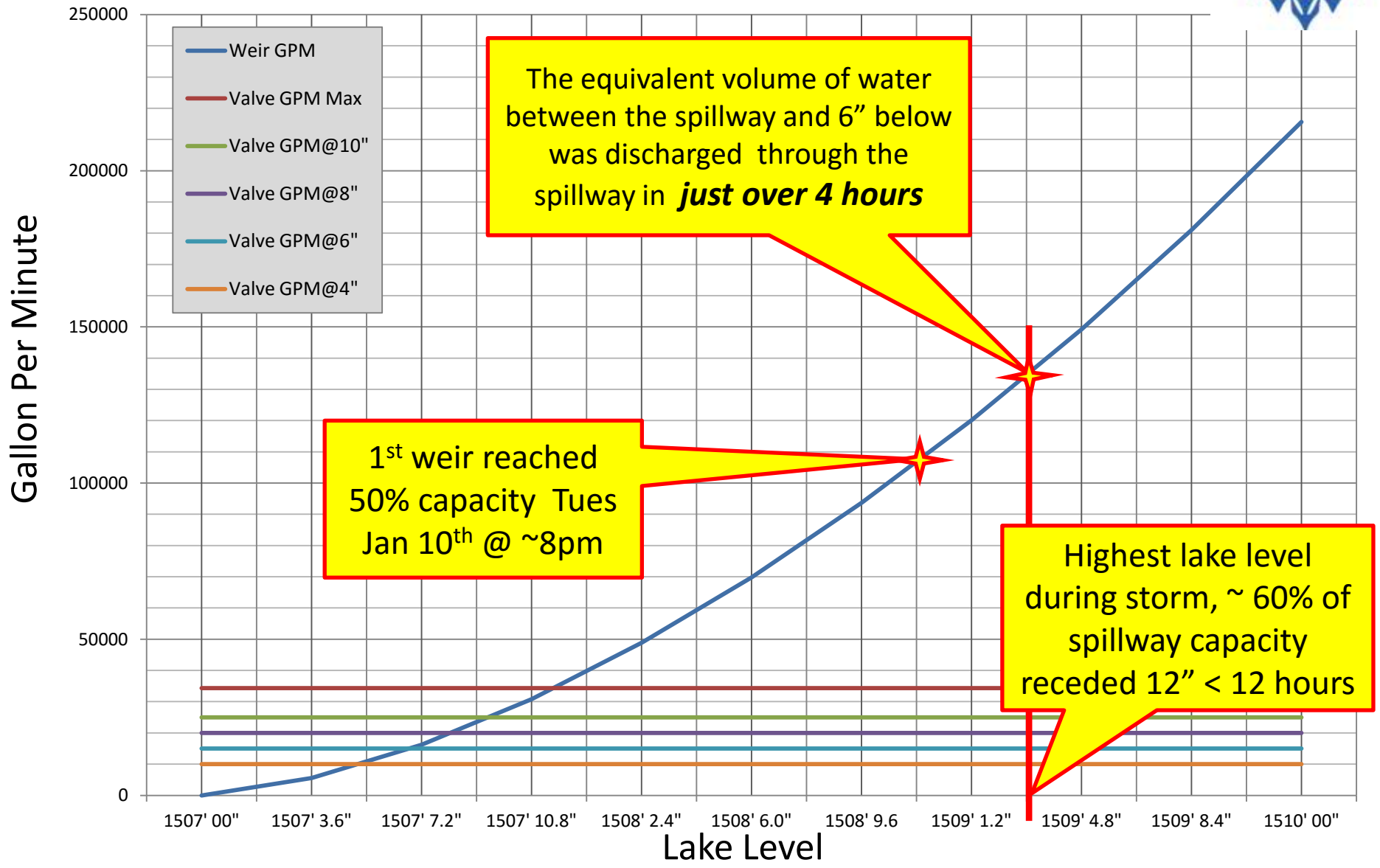
1st weir has cross section of 10,800 sq in

12,900,000 GPH before reaching flood

LLO has cross section of 330 sq in

1st weir has >32x the cross-section of LL0

Spillway(1st weir) vs LLO Efficiency

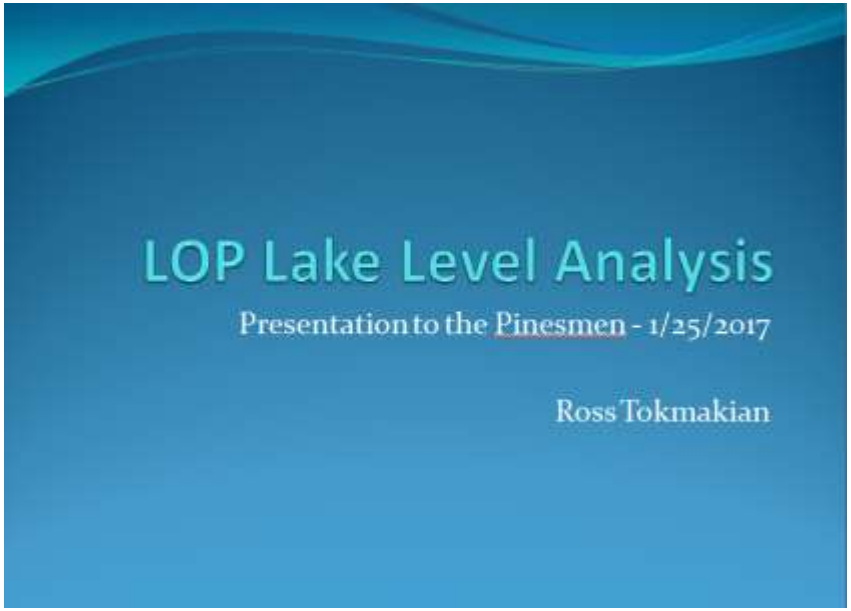


Summary

- The Low Level Outlet is not intended to manage lake level, nor is the gate valve designed for that purpose
  - Although the new LLO being built is better designed for partial openings, it still is not intended for lake level management,

- The longstanding belief the lake level can be effectively managed is unfounded, and it is ***NOT*** feasible to maintain the lake within +/- 6 inches
  - The LLO outlet discharge is not as effective as the spillway
  - Six inches below the spillway does ***NOT*** equal six inches lower lake level after the lake level is above the spillway for a period of time

Questions



If you would like more information regarding LOP Member Ross Tokmakian's presentation of "LOP Lake Level Analysis," please refer to the Pinesmen website or by following the provided link.

References

- CA Division of Safety of Dams (DSOD)
  - Conversations with the Regional Engineers and Inspector
  - 'Guidelines for the Design and Construction of Small Embankment Dams' March 1977 and reprinted January 1993
  - Western Lake Properties Application Number 1300 for Magnolia Dam to CA Division of Safety of Dams approved Sept 8, 1966
  - CA Division of Safety of Dams approved plans for Magnolia Dam
  - 'Inspection of Dam and Reservoir in Certified Status' dated July 22, 2016
- Nevada Irrigation District
  - Ongoing communication with their Operations Manager and Dam Safety Engineer,
  - Onsite visit by their Operations Manager and Dam Safety Engineer
- Waterman USA
  - Original valve documentation
  - Conversations with their Principal Mechanical Engineer and Senior Project Manager
- County of Nevada
  - Board of Supervisors Ordinance # #2234
  - Planning Department Zoning District Map 59
- Big Valley Divers Inc
  - Ongoing communication with their diver on-site
  - '24" Sluice Gate Inspection Report' dated June 12, 2015
- FEMA National Dam Safety Program
- U. S. Department of the Interior, Bureau of Reclamation, WATER MEASUREMENT MANUAL
- San Diego State University http://ponce.sdsu.edu/
- United States Society on Dams (USSD)