DEPARTMENT OF WATER RESOURCES

Western Regional Dam Safety Forum

Design Flood Selection for Proposed Upper San Creek Dam, Case Study

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Purpose of the Study

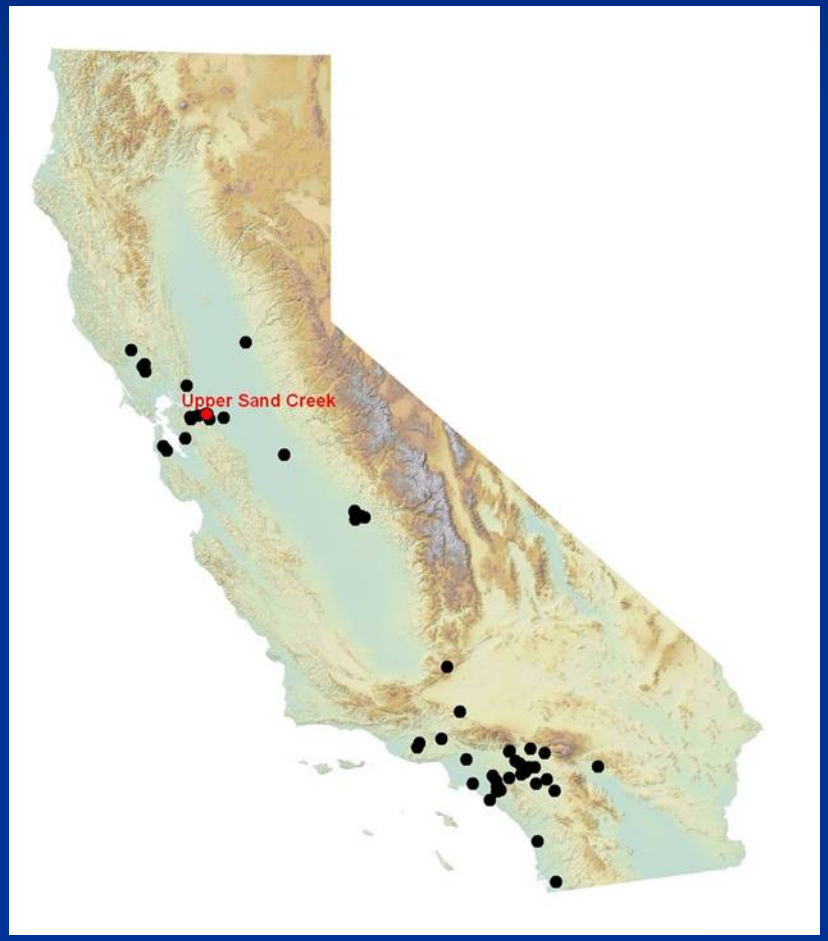
- For hydrology update program, this Study will give some insight about the Inflow Design Flood (IDF) analysis
- DSOD procedure gives very high design Storm (4.5 mil-yr) for this small storage (850 ac-ft) dam

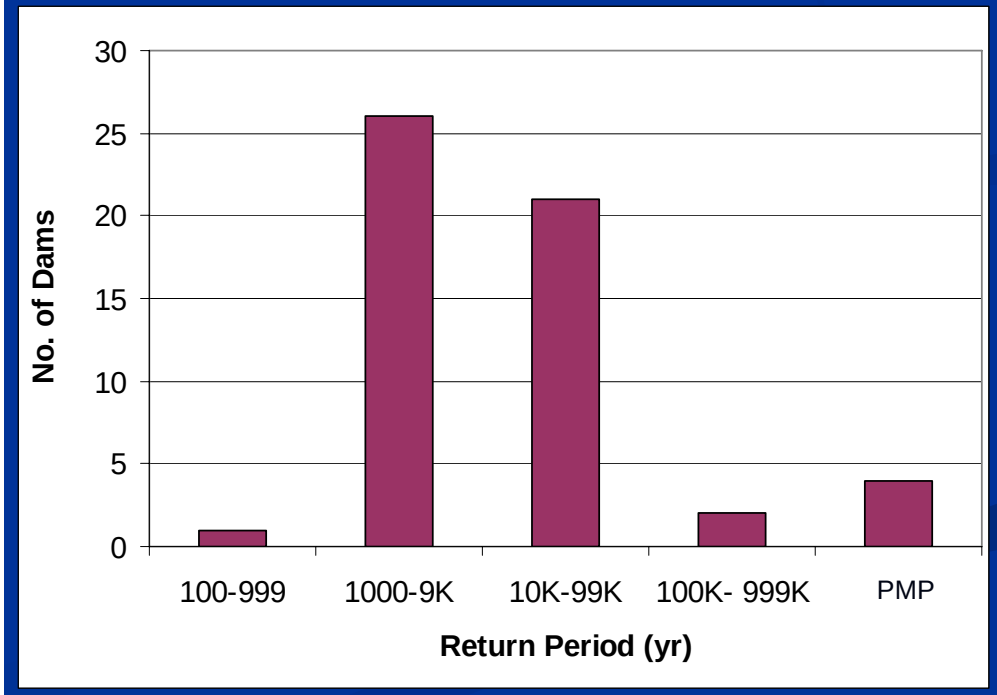
Outline

- Introduction and Project Information
- DSOD Procedure for Design Strom Selection
- Brief Introduction to Inflow Design Flood (IDF) Method
- Analyses and Results
- Conclusions

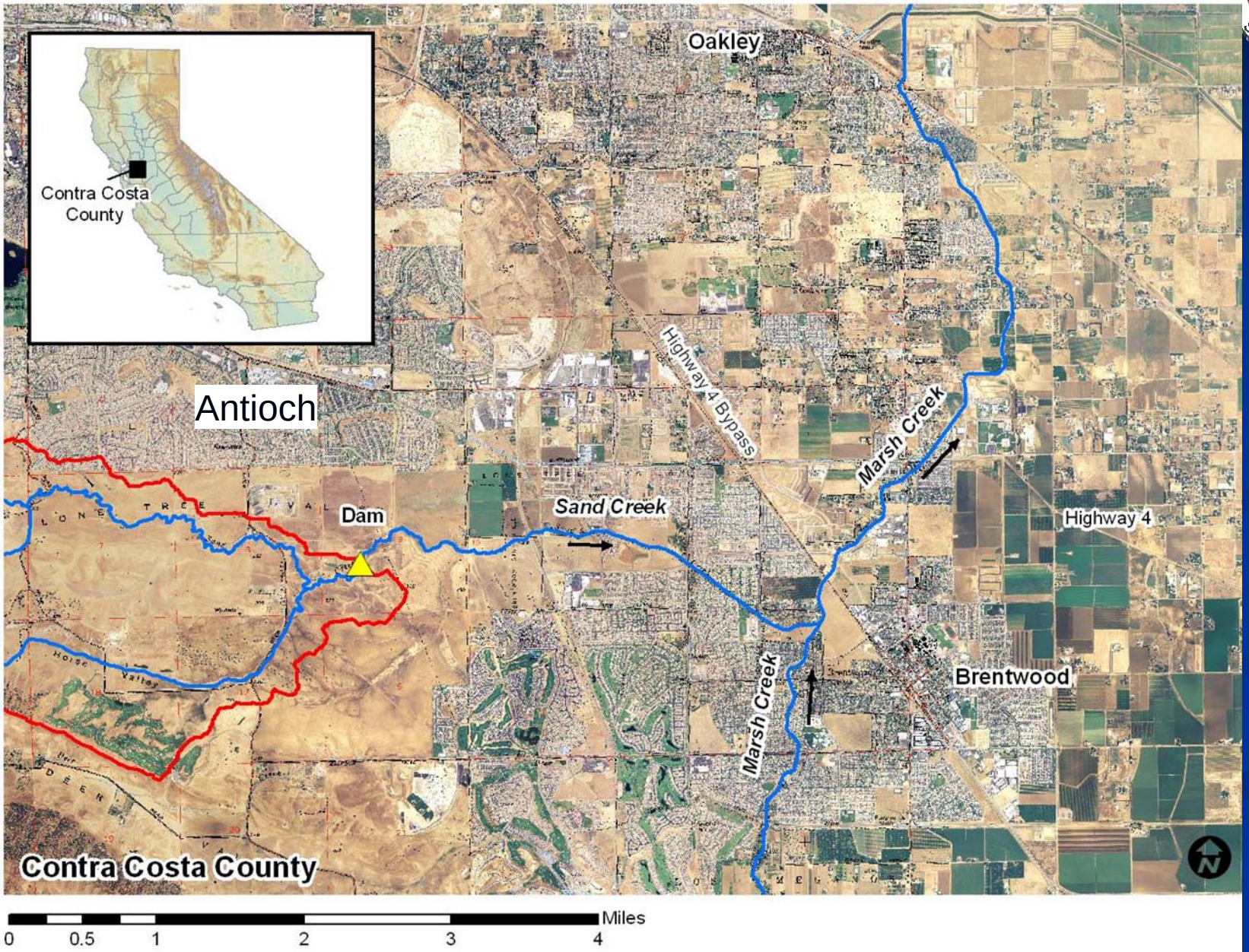
DSOD Jurisdictional Flood Control Dams

Total No. of Jurisdictional Dam ~ 1200
No. of Flood Control Dams ~ 60 (5%)

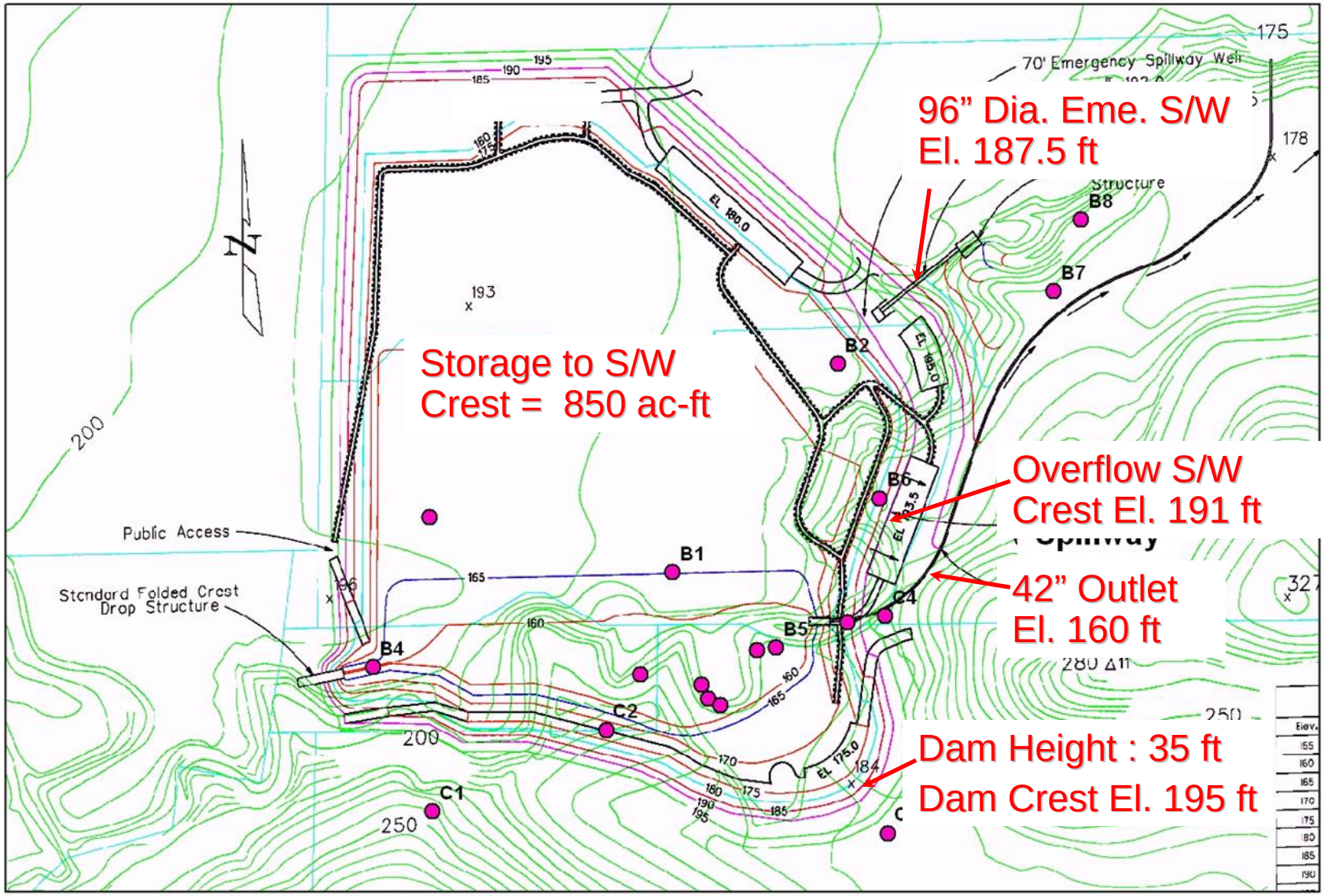




Proposed Dam Location



Proposed Upper Sand Creek Basin



Upper Sand Creek

Feet

0 125 250 500 750 1,000

DSOD Procedure

Hazard Classification
TCW >30?

No → Statistical Analysis → Design Storm 4.5 mill-yr → S/W adequate? No

Yes → HMR 58/59 for PMP

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES
Division of Safety of Dams

Hydrologic Classification for Flood Estimate and Spillway Analysis

Name of Dam _____ Type of Dam _____ Dam No. _____

County _____ Located on _____

Hydrologic Class

	Extreme	High	Moderate	Low
Capacity _____ A.F. (circle weight)	100,000 & Over 6	1,000-99,999 4	100-999 2	15-99 0
Height_____ Ft. (circle weight)	150 & Over 6	100-149 4	50-99 2	6-49 0
Estimated Evacuation ___ (circle weight)	1,000 & Over 12	100-999 8	1-99 4	None 0
Potential D/S Damage (circle weight)	High 12	Moderate 8	Low 4	None 0

Weight-Range	0-6	7-18	19-30	31-36	Total Weight = 28
Class	I	II	III	IV	Class = _____

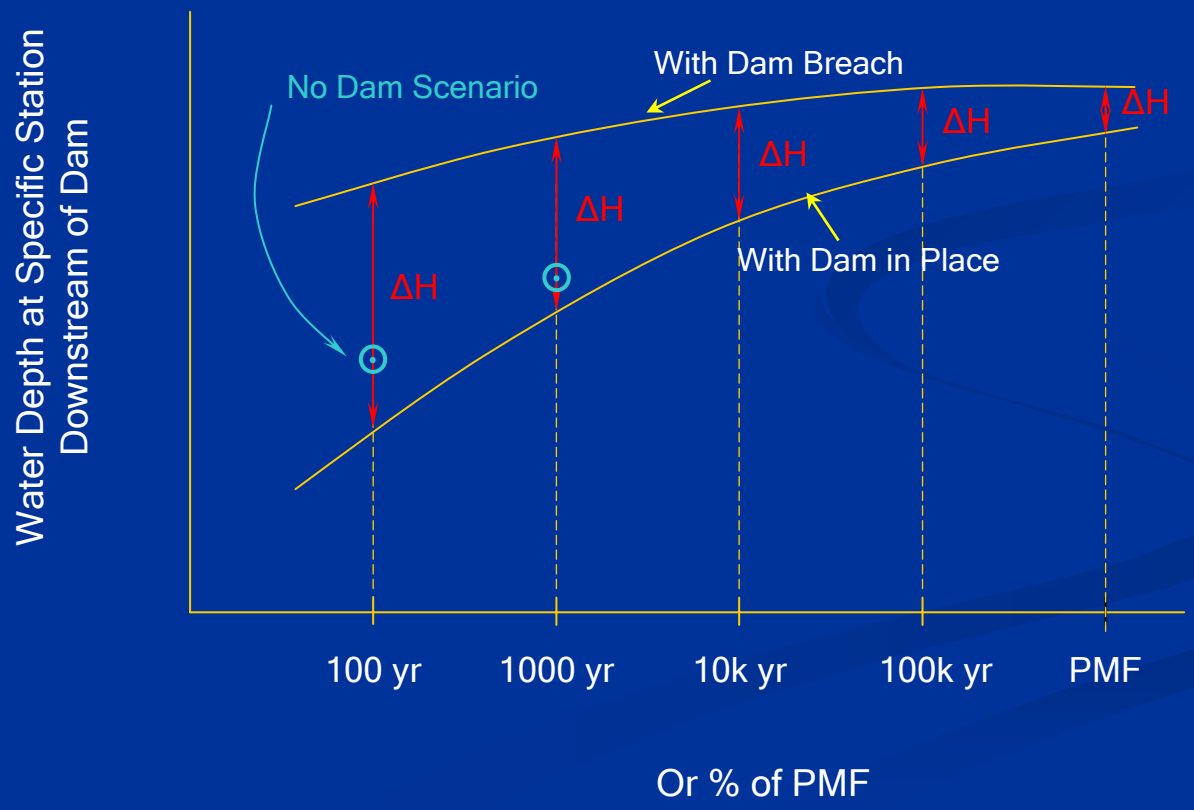
- For 4.5mil-yr storm the proposed dam will overtop by 1.0 ft.
- To pass the 1.5 ft residual freeboard requirement, s/w should be widen from 200 ft to 600 ft.

What is Inflow Design Flood?

IDF is the *"flood flow above which the incremental increase in water surface elevation in downstream due to failure of a dam or other water retaining structure is no longer considered to present an* ***unacceptable*** *additional downstream threat"* (Federal Guidelines for Dam Safety, 2004).

Inflow Design Flood (IDF)

- Conduct HEC-RAS analysis for various storms (100 yr, 1000 yr, 10000 yr, 100000 yr, 1 Mil yr…PMP) or percentages of PMF
- At the critical locations, compare the results for each storm with and without dam break (see graph)
- Consider downstream incremental damage and select appropriate design storm



What is Acceptable?

The Federal guidelines indicate that *"**in general** the consequences of failure are considered acceptable when the incremental effects (depth) of failure on downstream structures are approximately **two feet or less**. However, two-foot increment is **not** an absolute decision-making point"* (Federal Guidelines for Dam Safety, 2004).

Analysis Steps

Precip. data
Various Storms

Basin
Parameters

S/W &
outlet data

Dam Breach
Parameters

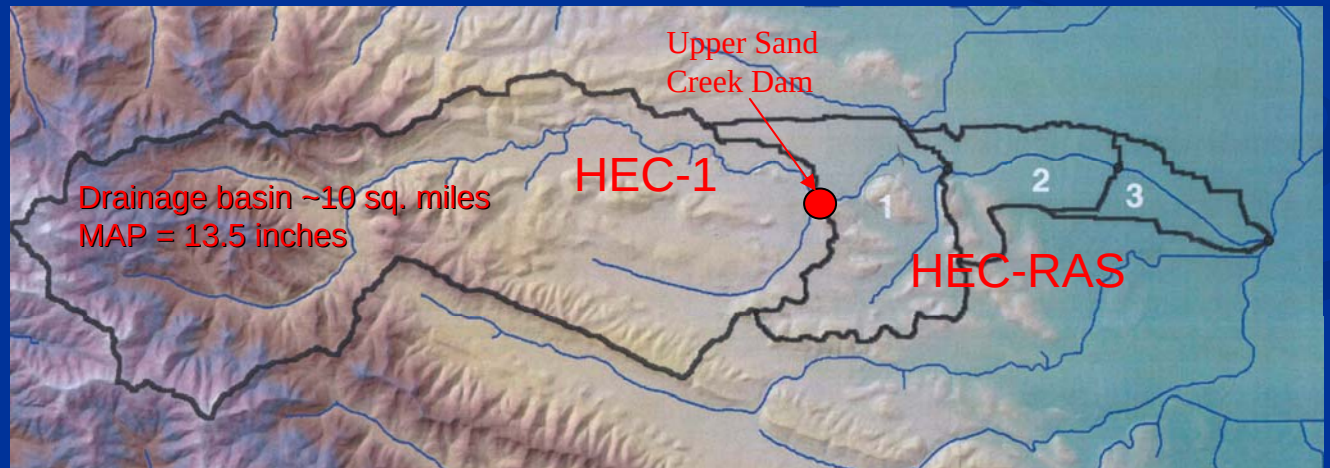
Channel Cross-
Sections (most
from owner)

HEC-1

Inflow at
reservoir

HEC-RAS

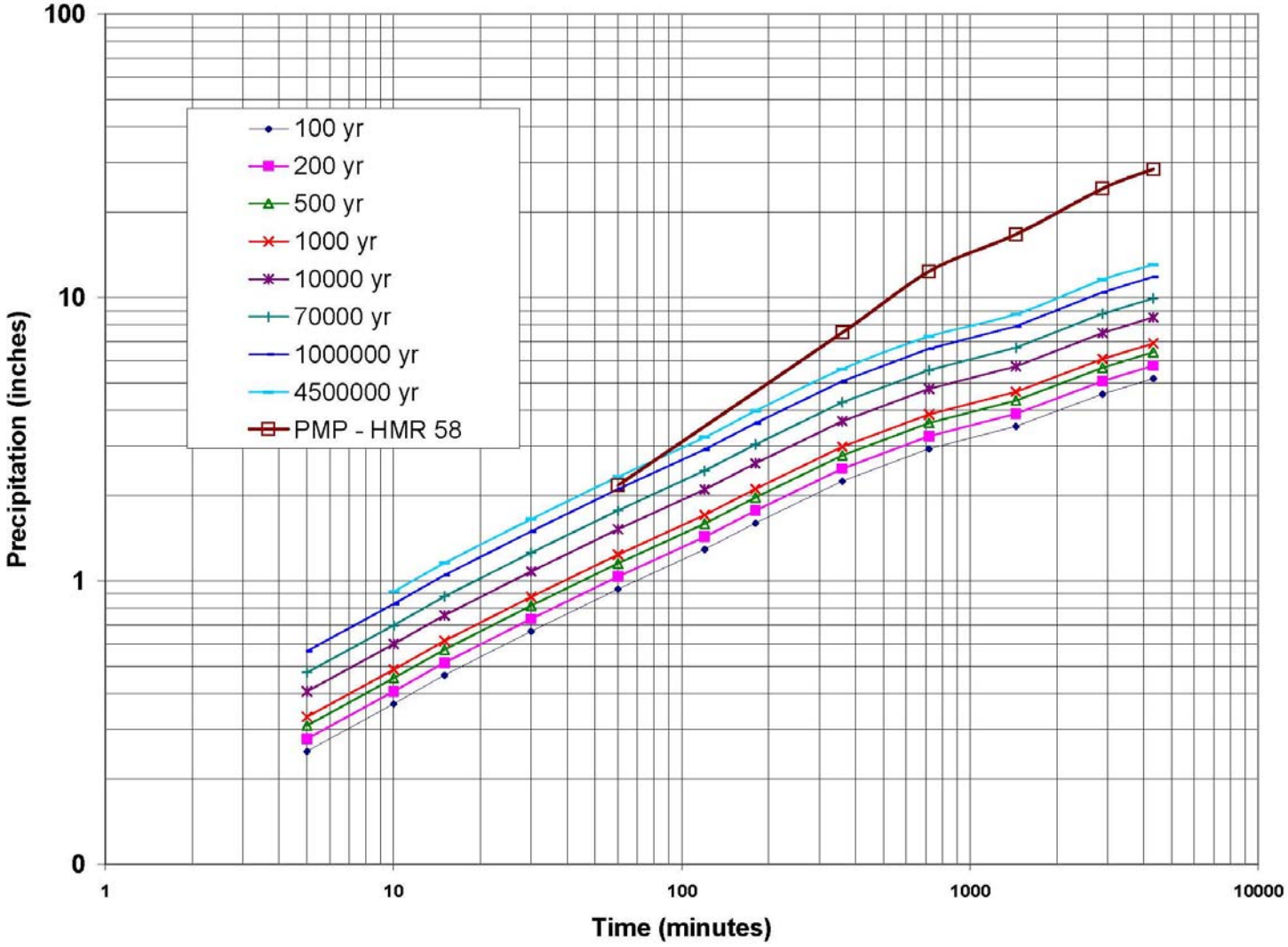
Lateral flow
to channel



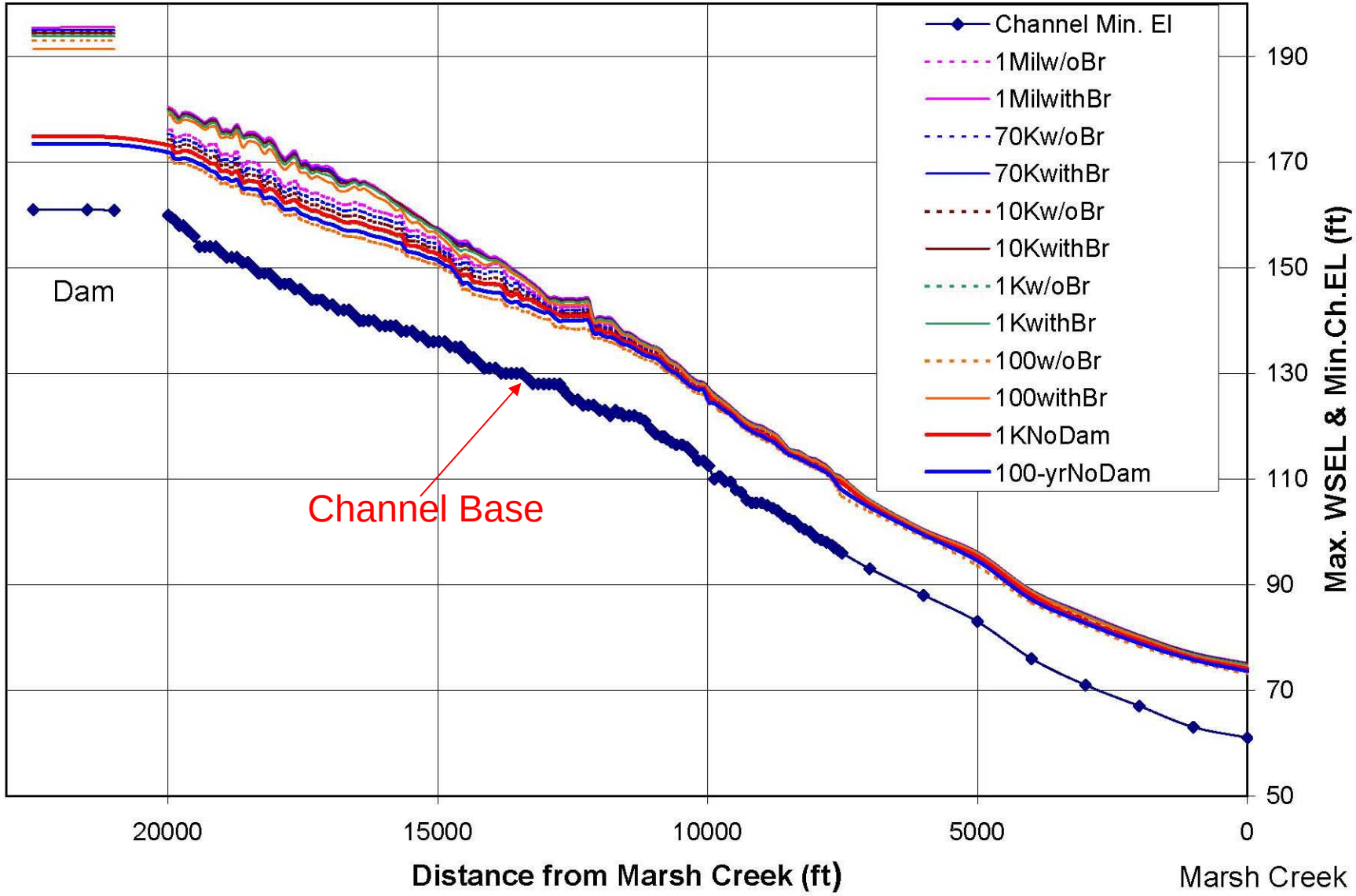
Precipitation data for Various Storms

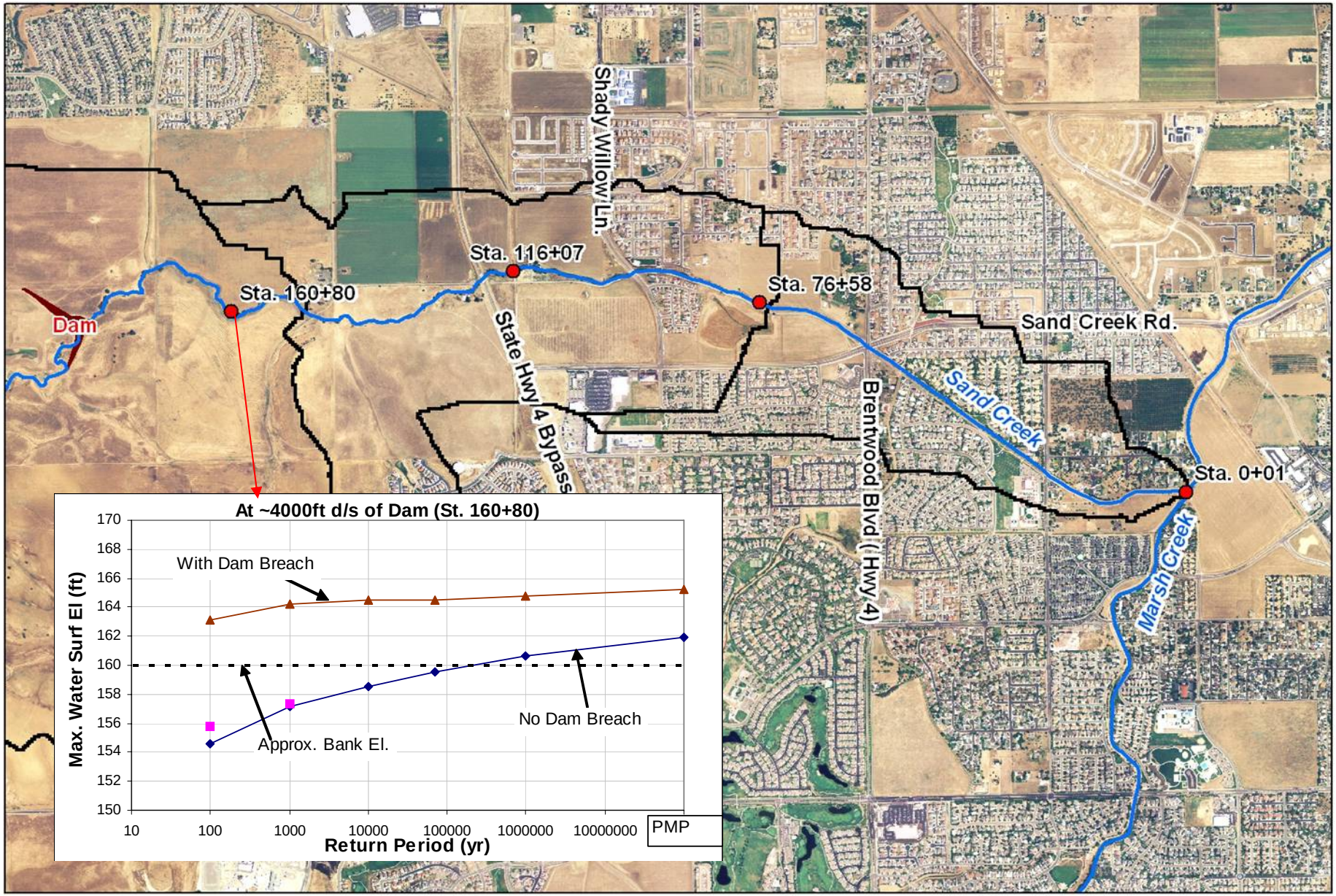
Precipitation	6 (hr)	12 (hr)	24 (hr)	48 (hr)	72 (hr)
Pij (inches) (100-yr)	2.25	2.92	3.51	4.56	5.18
Pij (inches) (1000-yr)	2.97	3.87	4.64	6.07	6.89
Pij (inches) (10,000-yr)	3.66	4.76	5.71	7.50	8.51
Pij (inches) (1 Mil-yr)	5.07	6.60	7.92	10.45	11.83
Pij (inches) (4.5 Mil-yr)	5.60	7.28	8.74	11.54	13.07
Pij (inches) (PMP)	7.52	12.37	16.71	24.23	28.40

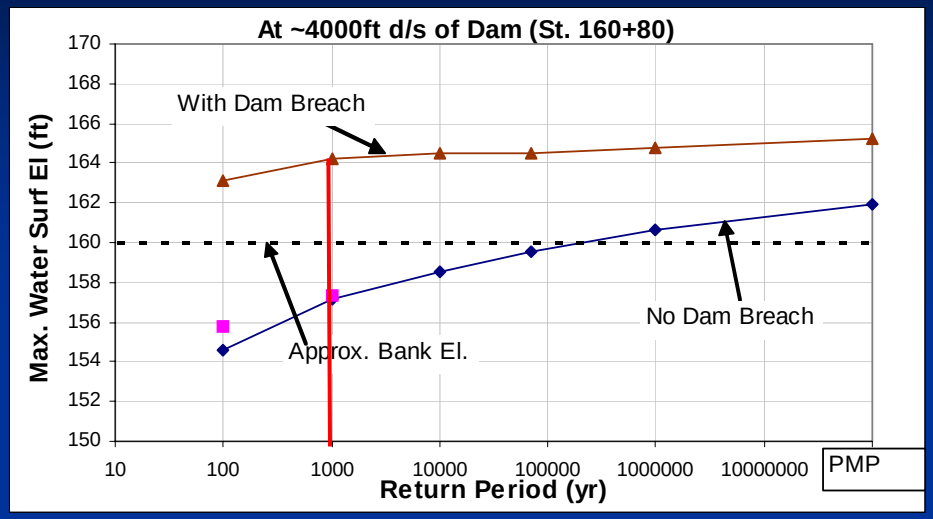
Depth Duration Curves

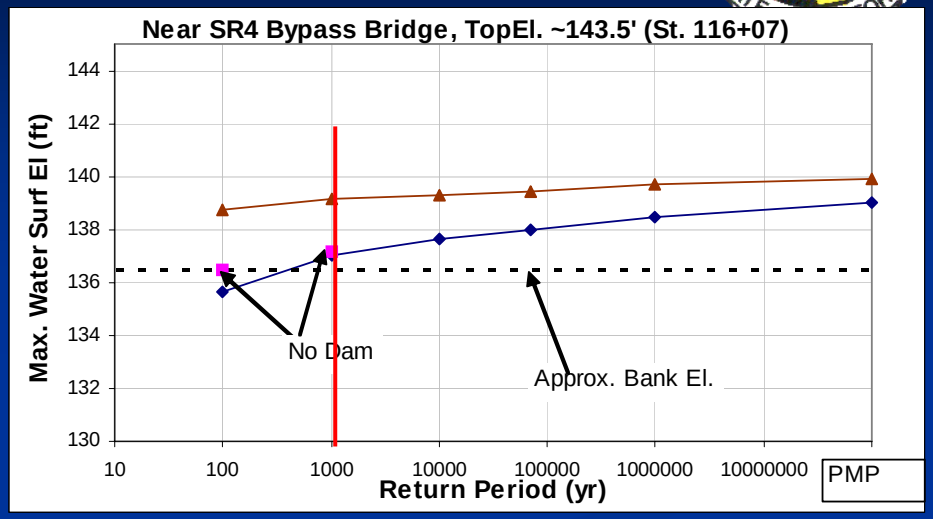


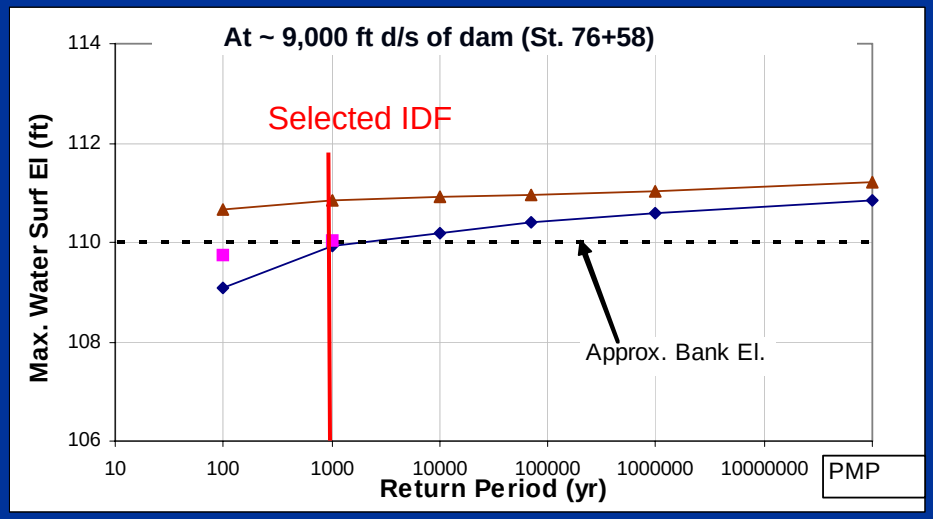
HEC-RAS Results

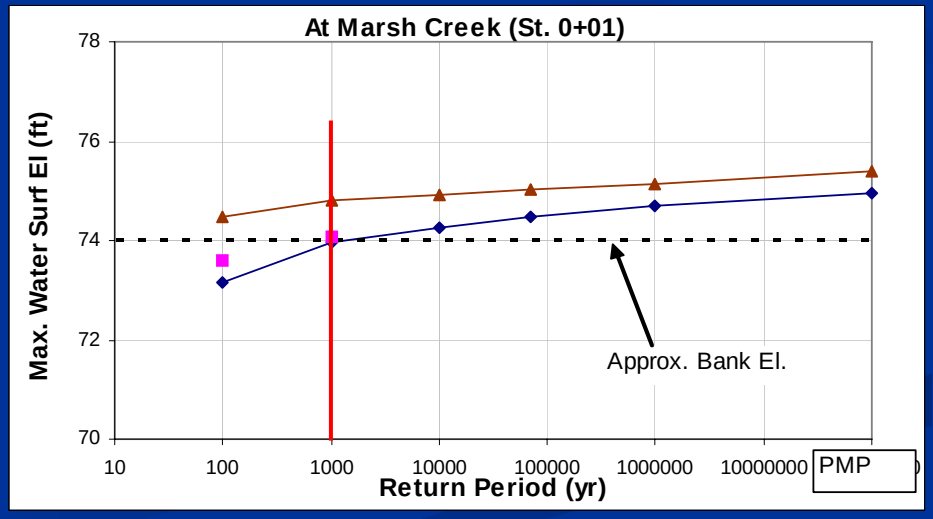


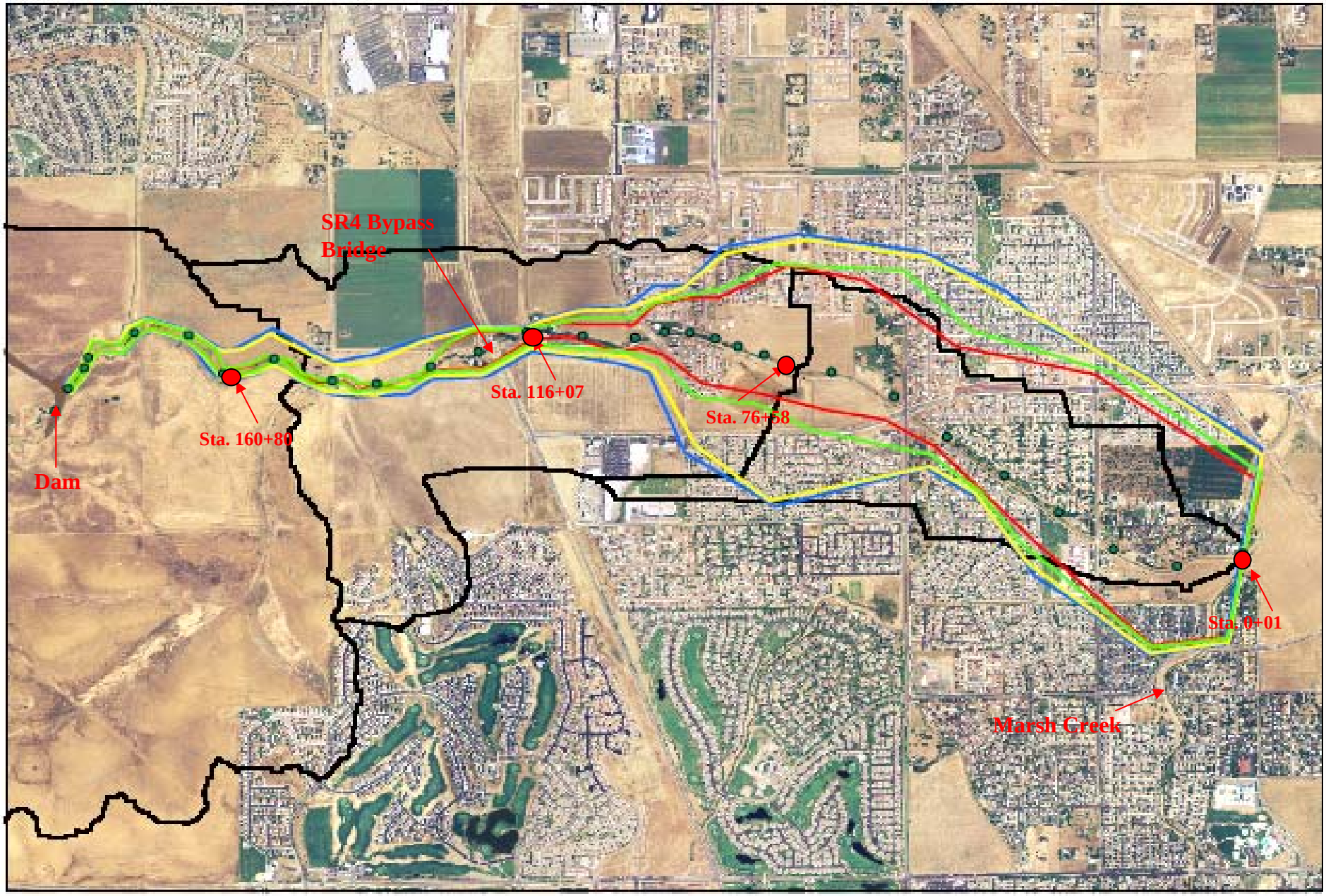

Shady Willow Ln.
Sta. 116+07
Sta. 160+80
Sta. 76+58
Dam
State Hwy 4 Bypass
Sand Creek Rd.
Sand Creek
Brentwood Blvd (Hwy 4)
Sta. 0+01
Marsh Creek
At ~4000ft d/s of Dam (St. 160+80)
Max. Water Surf El (ft)
170
168
166
164
162
160
158
156
154
152
150
With Dam Breach
No Dam Breach
Approx. Bank El.
10
100
1000
10000
100000
1000000
10000000
PMP
Return Period (yr)
N
Miles
0
0.125
0.25
0.5
0.75
1
Stations
Watershed


At ~4000ft d/s of Dam (St. 160+80)
Max. Water Surf El (ft)
170
168
166
164
162
160
158
156
154
152
150
With Dam Breach
No Dam Breach
Approx. Bank El.
10
100
1000
10000
100000
1000000
10000000
Return Period (yr)
PMP


Near SR4 Bypass Bridge, TopEl. ~143.5' (St. 116+07)
Max. Water Surf El (ft)
144
142
140
138
136
134
132
130
No Dam
Approx. Bank El.
10
100
1000
10000
100000
1000000
10000000
Return Period (yr)
PMP


At ~ 9,000 ft d/s of dam (St. 76+58)
Max. Water Surf El (ft)
114
112
110
108
106
Selected IDF
Approx. Bank El.
10
100
1000
10000
100000
1000000
10000000
Return Period (yr)
PMP


At Marsh Creek (St. 0+01)
Max. Water Surf El (ft)
78
76
74
72
70
Approx. Bank El.
10
100
1000
10000
100000
1000000
10000000
Return Period (yr)
PMP



N

0 625 1,250 2,500 3,750 5,000 Feet

10,000 yr without Dam Break

10,000 yr with Dam Break

1,000 yr without Dam Break

1,000 yr with Dam Break

Spillway Analysis Results

Storms	Results			
	Peak Inflow (cfs)	Peak Outflow (cfs)	Peak Reserv. El. (ft)	Residual Free-board (ft)
100-Year	2,629	1,147	192.3	2.7
1000-year	3,579	2,701	193.5	1.5
10,000-year	4,496	3,985	194.3	0.7
4.5 mil-year	7,132	6,930	195.8	-0.8
PMP (HMR58)	8,347	8,139	196.7	-1.7

Summary & Conclusions

- DSOD current procedure gives 4.5 million-yr Storm (~85% of PMP). To pass this, the spillway should be widen from 200 ft to ~ 600 ft
- IDF analyses indicate that incremental water depth in the developed area is < 1 ft for 1000-yr storm or larger
- The lateral extent of the inundation area due to dam breach is significant compared to the change in water depth
- 1000-yr design storm was selected for this dam

Acknowledgments

- John Vrymoed – Chief, Design Branch, DSOD – Retired
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Thank You