Water Management Applications of Advanced Precipitation Products

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Presentation at
7th Biennial Bay–Delta Science Conference
Ecosystem Reconciliation:
Realities Facing the San Francisco Estuary
Sacramento, CA
17 October 2012

Outline

- HMT and NWS Observational and Forecast Services
  - 21st Century Observational Network – White
  - Pacific Atmospheric Rivers – Reynolds
  - Advanced Precipitation Products - Cifelli
  - Soil Moisture Monitoring - Zamora
  - Distributed Hydrological Modeling – Hsu (poster)
- Water Management Applications
- Case Studies:
  - Sonoma County
  - San Francisco Wastewater Enterprise
- Conclusions
  - Valuation of hydromet products
  - Efficiencies of product use

HMT Observational and Forecast Services (http://hmt.noaa.gov)

How much rain is falling

- Gap-filling weather radars and other sensors

How much rain will fall:

- Identification and tracking of atmospheric rivers (ARs) from offshore
- High resolution numerical weather prediction (NWP) models

How much rain will runoff:

- Distributed hydrological modeling

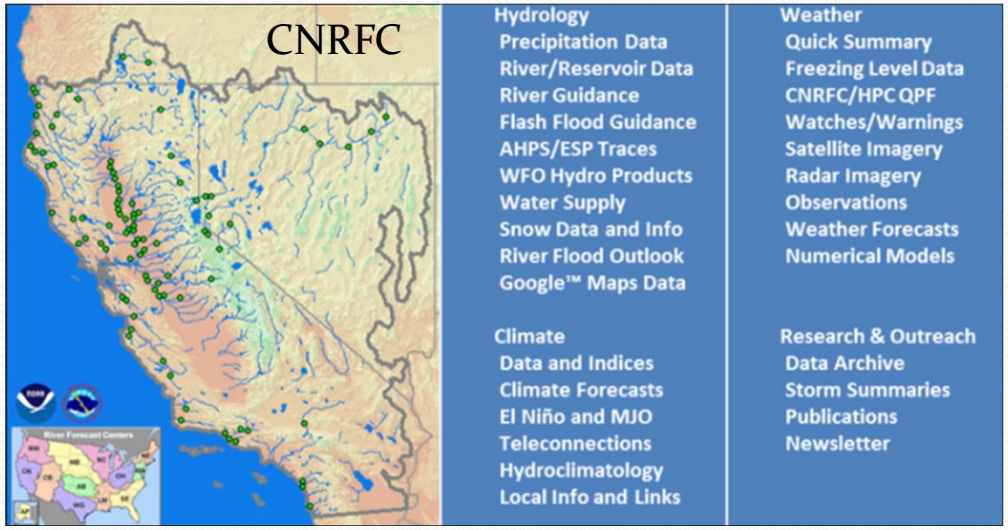
Delivery

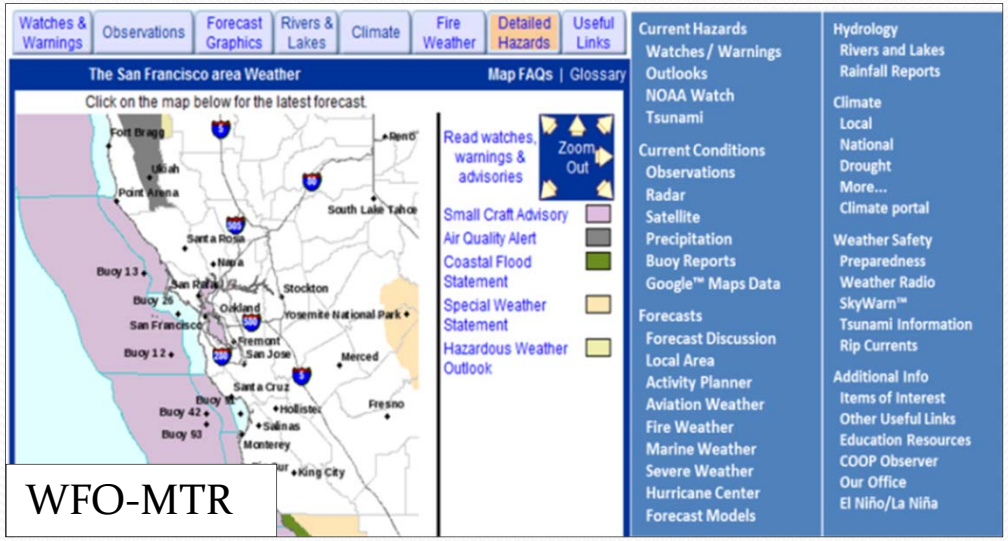
- System integration for decision support

D1

Partners and Customers for Advanced Precipitation Products

- NOAA Forecast Offices
  - NWS California-Nevada River Forecast Center
  - NWS Weather Forecast Offices (SF Bay Monterey, Sacramento, Ukiah)
- State and local agencies
  - DWR EFREP
  - SCWA
  - SFPUC





Slide 4

D1 I assume NWS, DWR, SCWA and SFPUC are the customers for these advanced HMT products ?? Slide a little confusing how it is laid out...

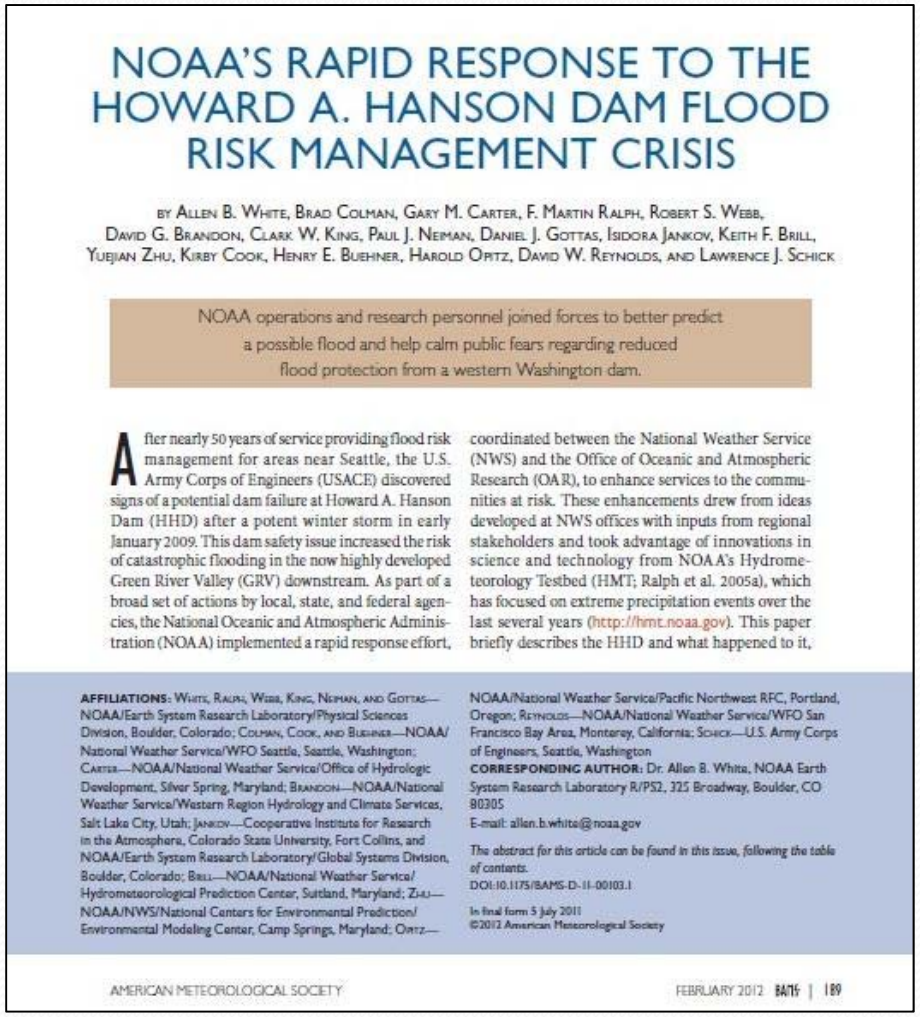
Dave, 10/8/2012

Water Management Actions

Time Frame / Purpose	Nowcast (0 min – 6 hrs)	Near Real-time (6 hr – 1 day)	Short-term (1 day – 1 week)	Near-term (1 wk – 3 mon)	Mid-term (6 mon – 2 yrs)	Long-term (5 years+)
Flood Mitigation	Flood status assessment	FF warning; Response deploy; System opt.	Flood warning; Response deploy; Reservoir FBO	Flood warning; Response deploy; Reservoir FBO	Over-year storage allocation	Flood frequency; Capacity devel; Climate adapt.
Water Supply	Status assessment; Intake operations	Intake and outlet operations	Reservoir FBO; Emergency conservation	Delivery sched.; Reservoir FBO; Conservation	Over-year drought mit.; Conservation	Capacity devel; Demand mana; Climate adapt.
Hydro-Power	Release operations	Reservoir FBO	Reservoir FBO; Demand sched.	Reservoir FBO; Demand sched.	Over-year drought mit.	Capacity devel.; Climate adapt.
Ecosystem Enhancement	Status assessment	Threat assess; River & Reservoir FBO	Threat assess; River & Reservoir FBO	Threat assess; River & Reservoir FBO	Threat assess; Capacity devel; Drought mit.	Ecosystem & Capacity devel; Climate adapt.
Water Quality	Status assess; Real-time control	WW capture & treatment	Threat assess; Sys. optimize	Threat assess; Capacity devel; Sys. optimize	Threat assess; Capacity devel; Sys. optimize	Capacity devel; Climate adapt.
Recreation	Weather status; Warning	Event scheduling	Reservoir FBO	Reservoir FBO	Capacity development	Capacity development

HMT Impacts

Recent Example of Use of Atmospherhic River Observatory (ARO) Data by USACE



NOAA'S RAPID RESPONSE TO THE HOWARD A. HANSON DAM FLOOD RISK MANAGEMENT CRISIS

BY ALLEN B. WHITE, BRAD COLMAN, GARY M. CARTER, F. MARTIN RALPH, ROBERT S. WEBB, DAVID G. BRANDON, CLARK W. KING, PAUL J. NEIMAN, DANIEL J. GOTTAS, ISIDORA JANKOV, KEITH F. BRILL, YUEJIAN ZHU, KIRBY COOK, HENRY E. BUEHNER, HAROLD ORTZ, DAVID W. REYNOLDS, AND LAWRENCE J. SCHICK

NOAA operations and research personnel joined forces to better predict a possible flood and help calm public fears regarding reduced flood protection from a western Washington dam.

After nearly 50 years of service providing flood risk management for areas near Seattle, the U.S. Army Corps of Engineers (USACE) discovered signs of a potential dam failure at Howard A. Hanson Dam (HHD) after a potent winter storm in early January 2009. This dam safety issue increased the risk of catastrophic flooding in the now highly developed Green River Valley (GRV) downstream. As part of a broad set of actions by local, state, and federal agencies, the National Oceanic and Atmospheric Administration (NOAA) implemented a rapid response effort, coordinated between the National Weather Service (NWS) and the Office of Oceanic and Atmospheric Research (OAR), to enhance services to the communities at risk. These enhancements drew from ideas developed at NWS offices with inputs from regional stakeholders and took advantage of innovations in science and technology from NOAA's Hydrometeorology Testbed (HMT; Ralph et al. 2005a), which has focused on extreme precipitation events over the last several years (http://hmt.noaa.gov). This paper briefly describes the HHD and what happened to it,

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The abstract for this article can be found in this issue, following the table of contents.
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In final form 5 July 2011

- USACE was considering taking over flood operation of Hanson Dam during a recent storm
- Based partly on HMT-ARO observations, USACE decided the storm was about to end, so they did not take over flood operations from the local water agency
- See White et al. (February 2012; Bulletin of the American Meteorological Society)

Sonoma County Water Agency

- State Special District (1949) for water supply, flood control, sanitation
- 600,000 North Bay residents
- 1,500 mi² Russian River watershed
  - Also, Petaluma River (drains to SF Bay)
- Lake Mendocino (1959), Lake Sonoma (1983)
- Army Corps Flood Control (winter/spring)
- SCWA Water Supply (summer)
- ESA listed Coho, Chinook, Steelhead
- $8 Billion Wine Industry (63,000 ac)

Challenges: Flooding

New Years 2005

Challenges: Biological Opinion

RRIFR
Russian River Instream Flow and Restoration

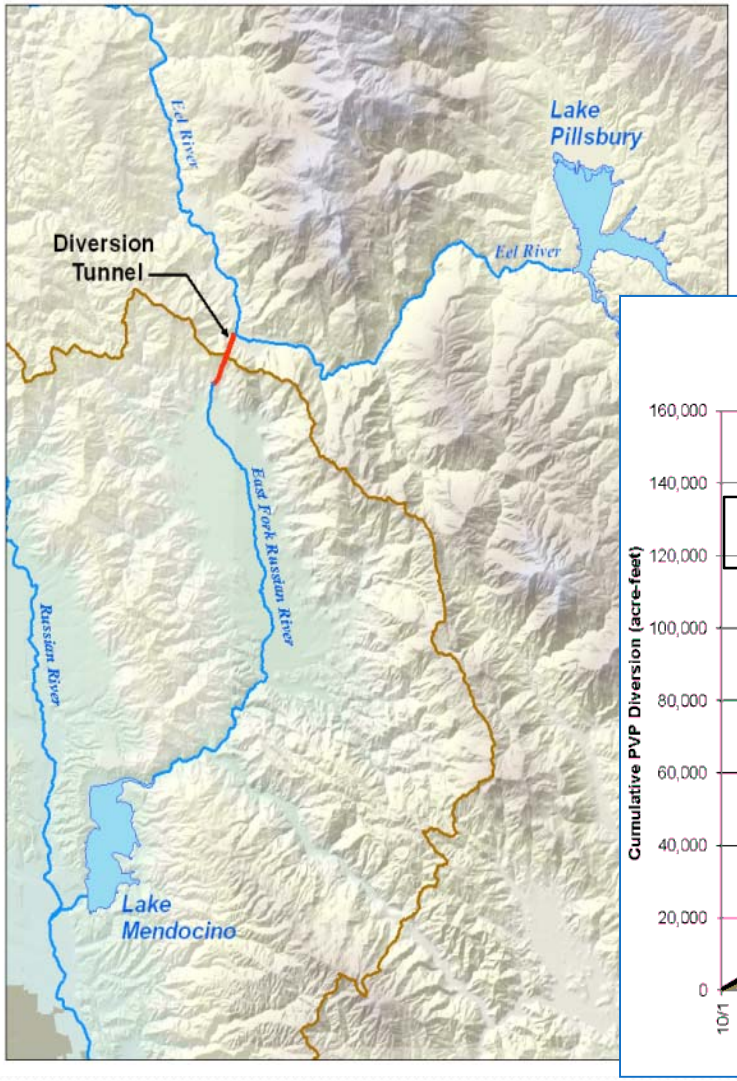
"Continued water supply, flood control operations, and channel maintenance operations of the USACE and the SCWA are likely to jeopardize the continued existence of threatened steelhead and endangered Coho salmon and adversely modify their critical habitats."

SONOMA COUNTY WATER AGENCY

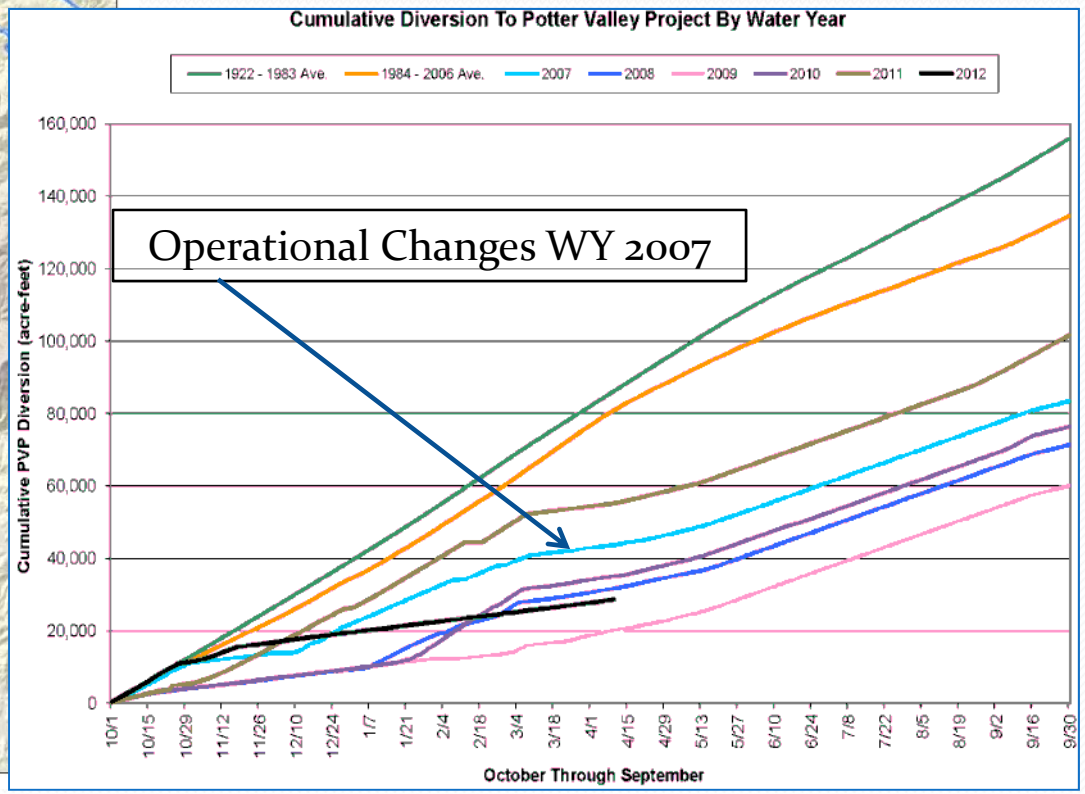
US Army Corps of Engineers®

NOAA
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

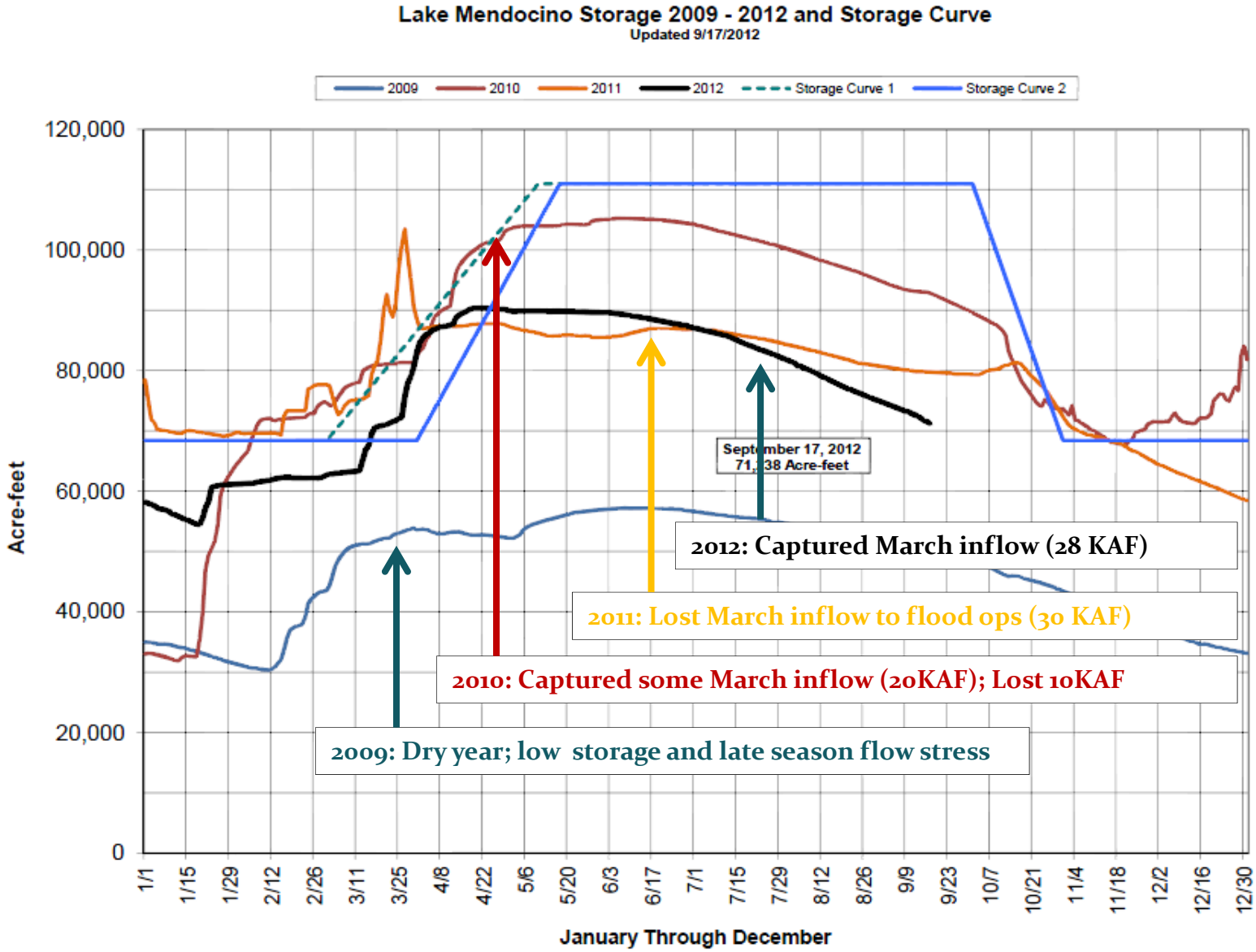
Challenges: Potter Valley Project



2004 FERC License Amendment
25-55% Eel River Diversion Reduction

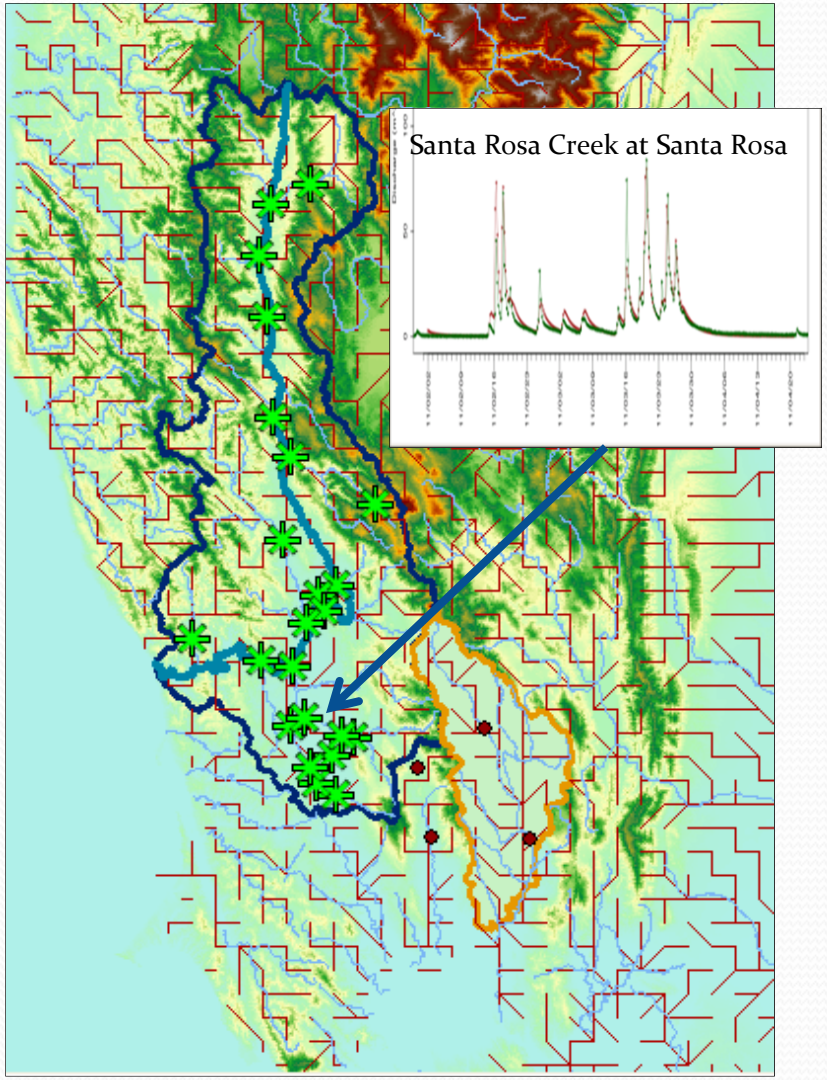


Potential for Forecast Based Operations



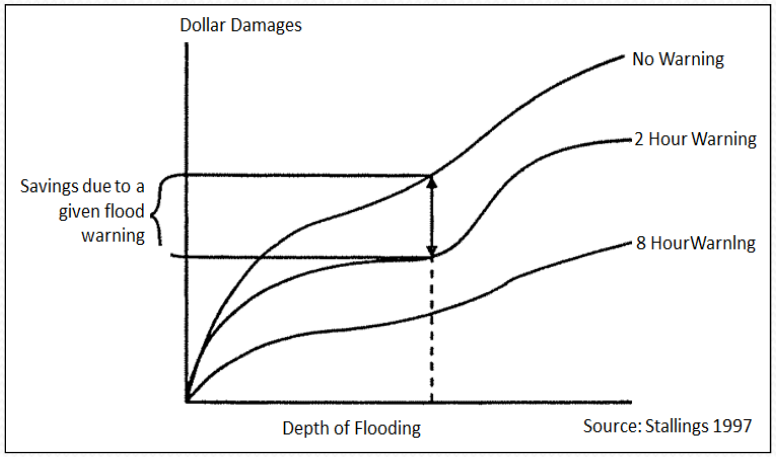
Russian-Napa Basins 2-D Model

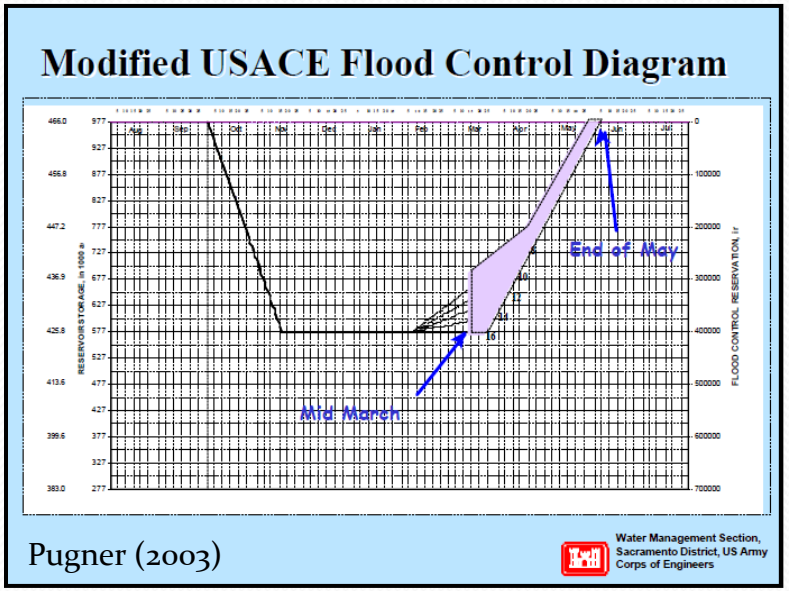
- Purpose:
  - Account for spatial distribution of rain, topography, soils, land use and runoff
  - Tool to assess QPE/QPF products
- Research Distributed Hydrologic Model (RDHM)
  - 2-D using HRAP grid (~4.2 km side)
  - Gridded precipitation and surface temperature
  - Sacramento Soil Moisture Accounting Model (SAC-SMA) in each grid cell
  - Connectivity derived from DEM
  - Runoff (overland and channel) routed by kinematic wave equations
  - Soils parameters based on SSURGO
  - Channel routing based on USGS field measurements
  - Soil moisture linked to observations



SCWA Forecast Benefits

- Flood Mitigation
  - Lead time for moving residential contents (Day/Carsell)
  - 12-hr lead time, 5% reduced damages, $100K content value, 3000 residences, 80% efficiency
  - Value $12M for 2005 event
- Water Supply
  - Reservoir operations in March 2012 secured an extra volume of 30 KAF carried into the summer season
  - Potential FBO value for municipal water supply at $900/AF is $27M/yr
- Fishery Flows
  - Reservoir releases to sustain fisheries enabled by FBO captured water in March
  - Potential FBO value of 30 KAF at $25/AF is $750,000/yr

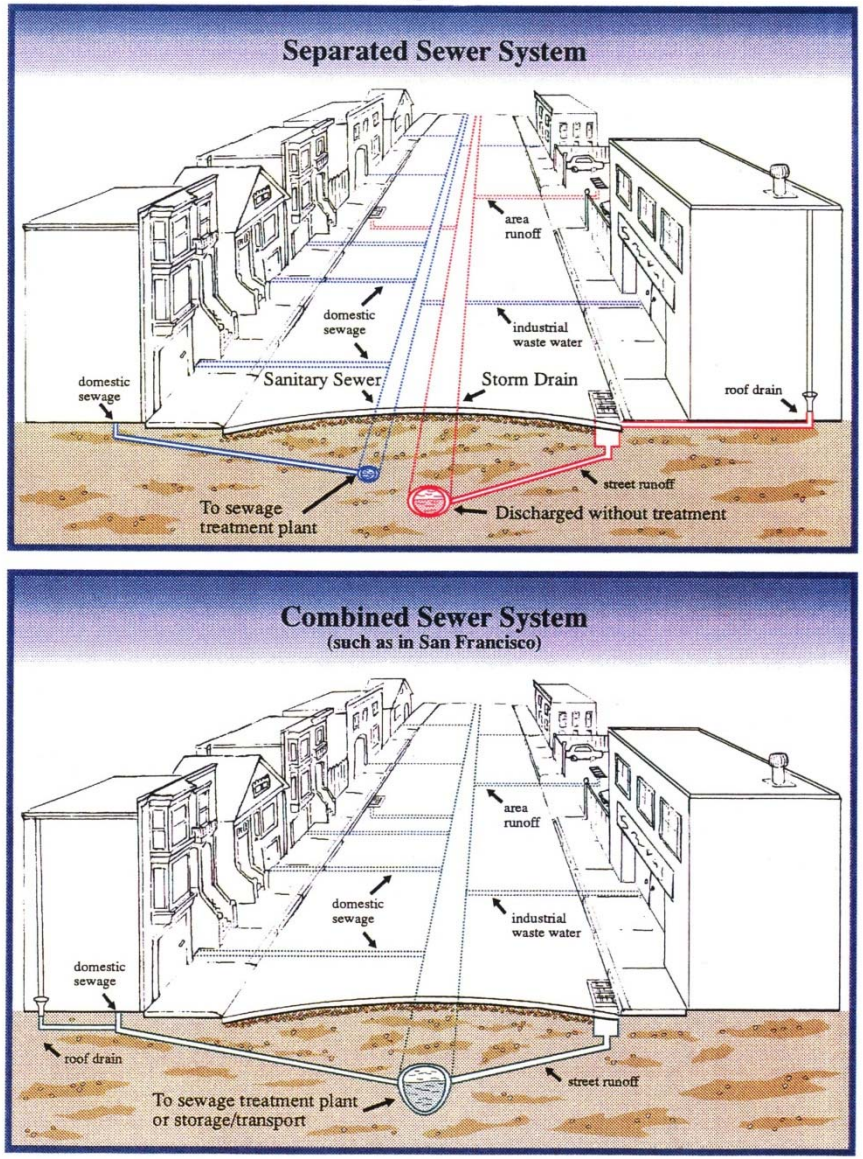




San Francisco Wastewater

- Combined Sewer System
- Before 1972 Clean Water Act had 50-60 combined sewer overflows a year

Figure 1

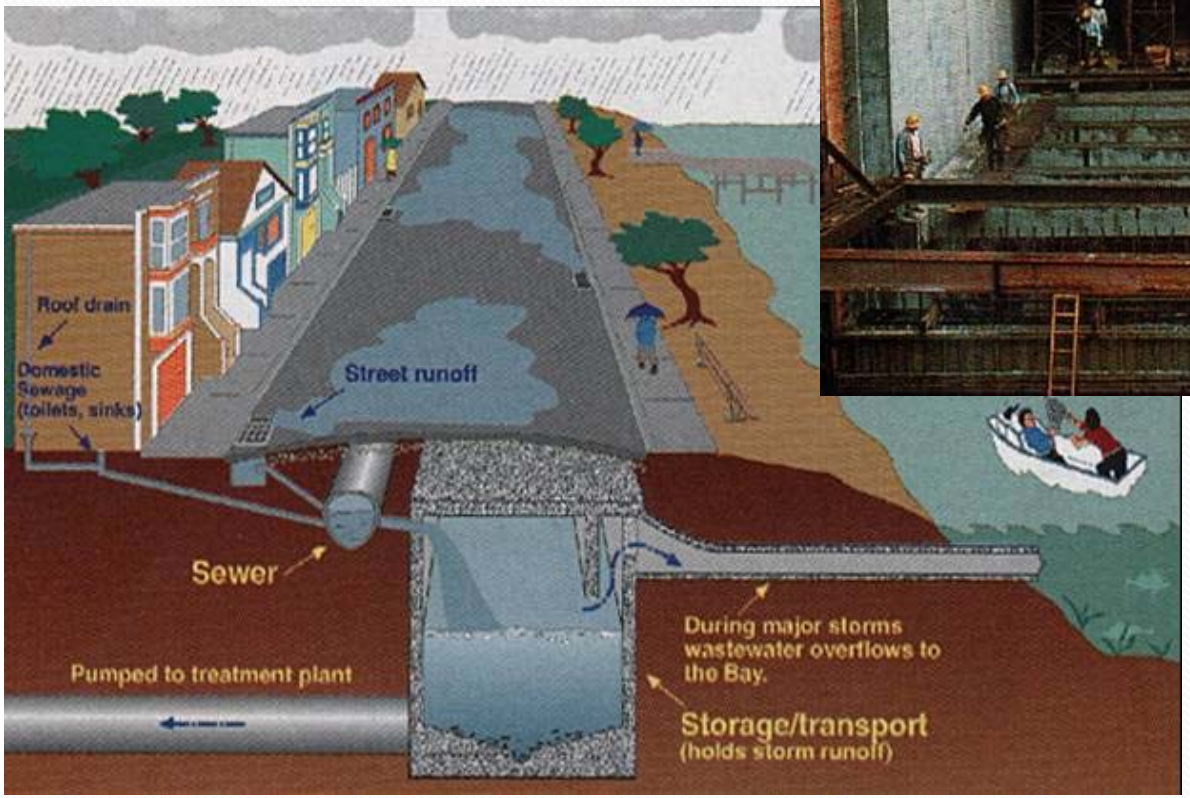


San Francisco Wastewater

- Clean Water Act:
- Reduce Combined Sewer Overflows based on Beneficial Uses:
  - "bathing beaches"
  - Recreation
  - Shellfish
- 1978-1996: Built "Transport Storage" System
- Enlarged Treatment System

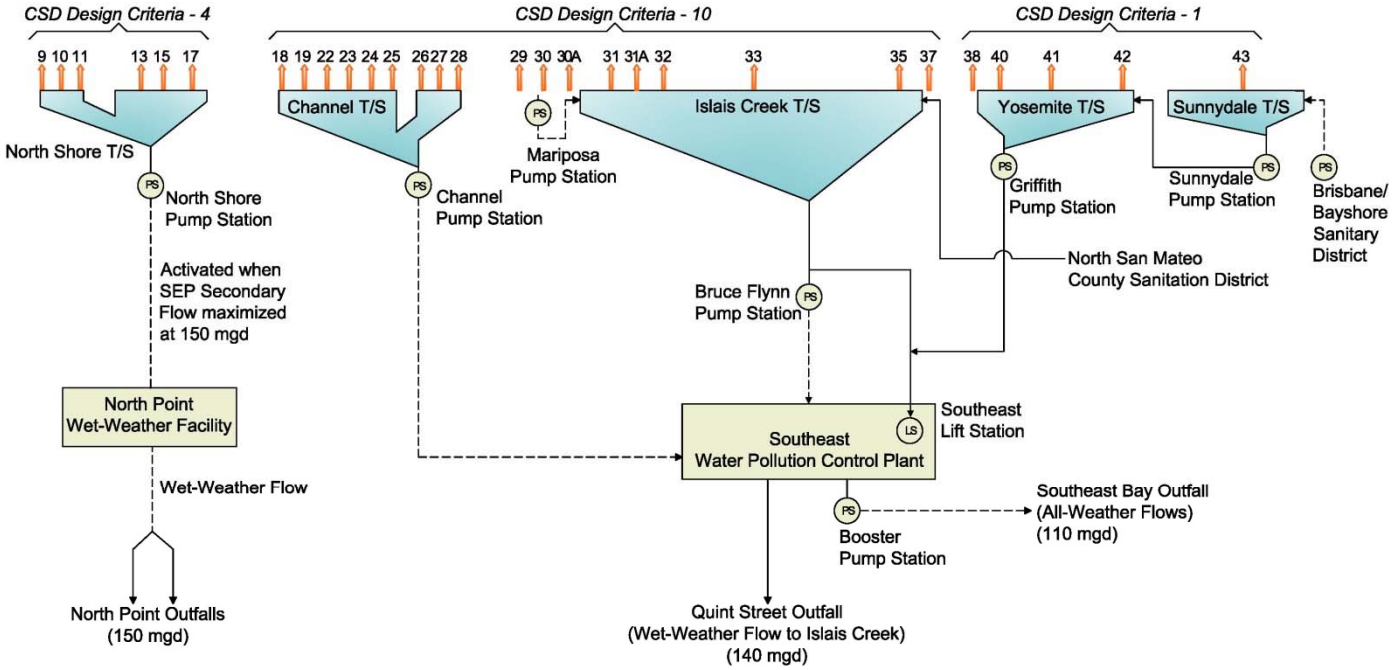
San Francisco transport and storage (T/S) control system

San Francisco Wastewater



San Francisco Advanced QPI Benefits

- Reservoir Operations Optimization



Pump/Lift Stations	
Peak Wet-Weather Flows (mgd)[1]	
Name	Peak
North Shore	150
Channel	103
Mariposa	10
Sunnydale	50
Griffith	120
Bruce Flynn	110
Southeast	70
Booster	110

CSD Number and Name					
9	Baker Street	24	Fifth Street	32	Marin Street
10	Pierce Street	25	Sixth Street/North	33	Selby Street
11	Laguna Street	26	Division Street	35	Third Street/South
13	Beach Street	27	Sixth Street/South	37	Evans Street
15	Sansome Street	28	Fourth Street/South	38	Hudson Street
17	Jackson Street	29	Mariposa Street	40	Griffith Street/South
18	Howard Street	30	20th Street	41	Yosemite Avenue
19	Brannan Street	30A	22nd Street	42	Fitch Street
22	Third Street	31	Third Street/North	43	Sunnydale Avenue
23	Fourth Street	31A	Islais Creek/North		

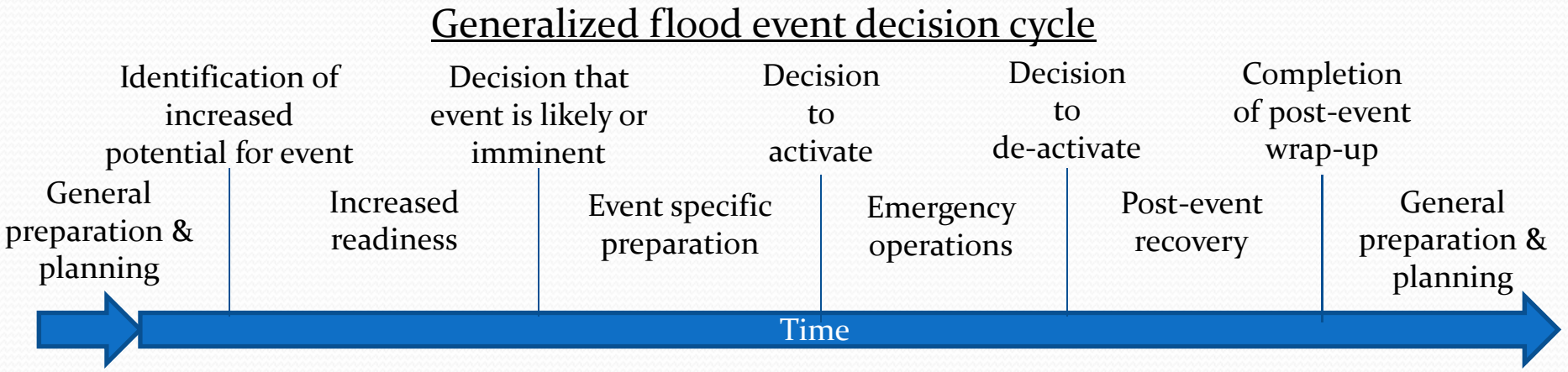
Transport/Storage Structures	
Name	Usable Storage (MG)
North Shore	24.0
Channel	38.0
Mariposa & 20th	0.9
Islais Creek	45.1
Yosemite	11.5
Sunnydale	6.2

Legend	
CSD	Combined Sewer Discharge
MG	million gallons
mgd	million gallons per day
T/S	Transport/Storage Structure
→	Force Main
→	Gravity Flow Lines
# ←	Combined Sewer Discharge
PS	Pump Station
LS	Lift Station

[1] As peak flows do not occur simultaneously throughout the collection system, operational flexibility is provided.

Realization of QPI Benefits

- Realization of benefits requires system reliability and response efficiency
- Example for flood damage reduction
- Da = Dp*R*Pa*Pr*Pe
  - Da = damages avoided
  - Dp = maximum potential flood damage avoided with a fully effective system;
  - R = reliability of the flood warning system
  - Pa = fraction of residents available to respond to a warning
  - Pr = fraction of households who will respond to a flood warning;
  - Pe = fraction of households who respond effectively
- Other water management actions require similar understanding and preparedness by stakeholders



Gracias!