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2012 Central Valley Flood Protection Plan

Presentation at the Public Workshop on Climate Change, Extreme Weather, and Central Valley Floods

Michael Mierzwa

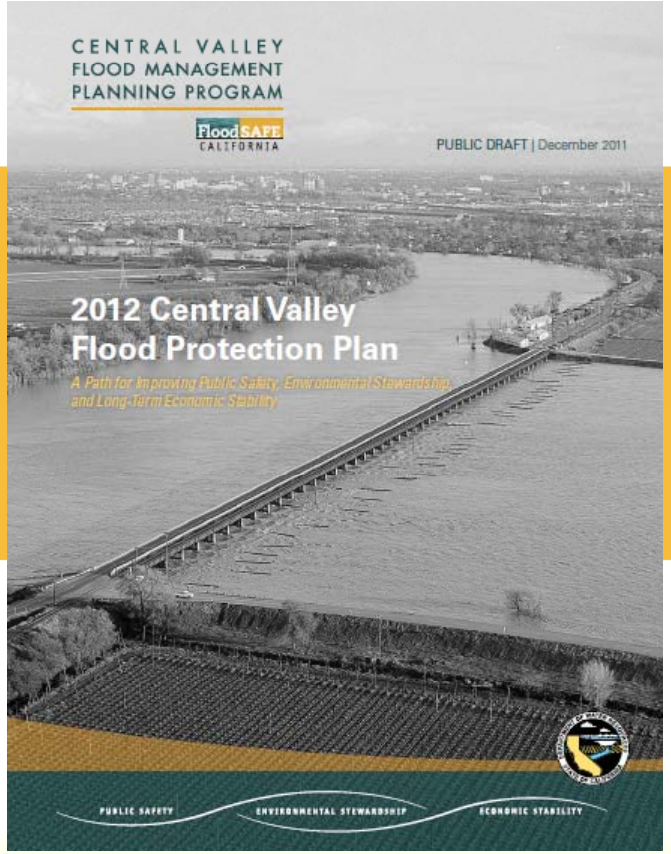
Department of Water Resources

February 14, 2012

PUBLIC SAFETY ENVIRONMENTAL STEWARDSHIP ECONOMIC STABILITY

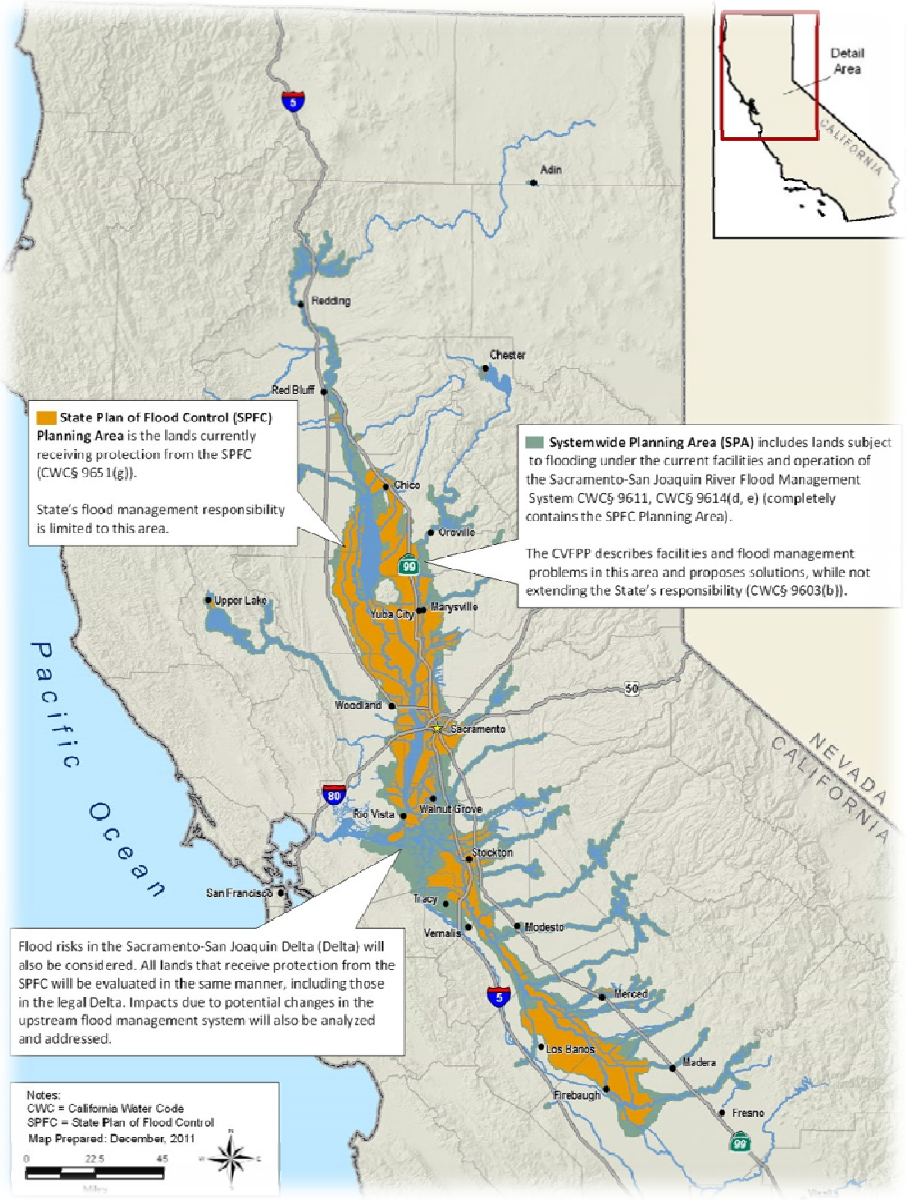
CVFPP Overview

The 2012 CVFPP reflects the State's ***systemwide investment approach*** *for flood management improvements in the Central Valley*



CVFPP Geographic Scope

- Focuses on lands protected by facilities of the State Plan of Flood Control
- Addresses major flood management reservoirs and local facilities that effect the operation of the SPFC
- Coordinates with other major flood management efforts and related resources

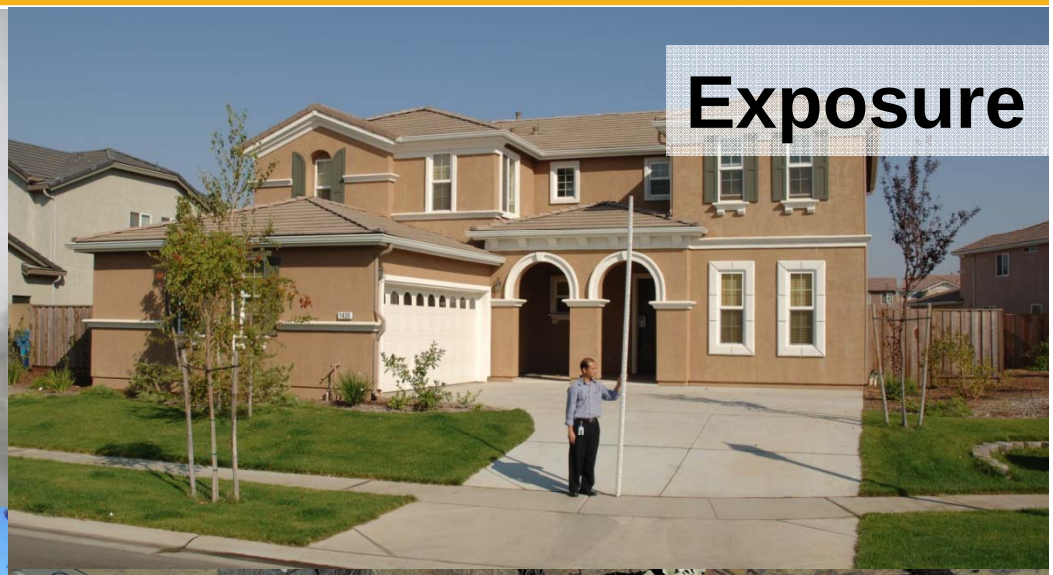


Historical C.V. Flood Consequences

Event / Region	1986		1997	
	Statewide[1]	Central Valley[2]	Statewide[1]	Central Valley[2]
Estimated losses	$720M	$466M	$2,400M	$686M
Fatalities	13	1	8	?
Homes	13,829	7,194	23,000	9,052
Businesses	1,152	639	2,000	1,105

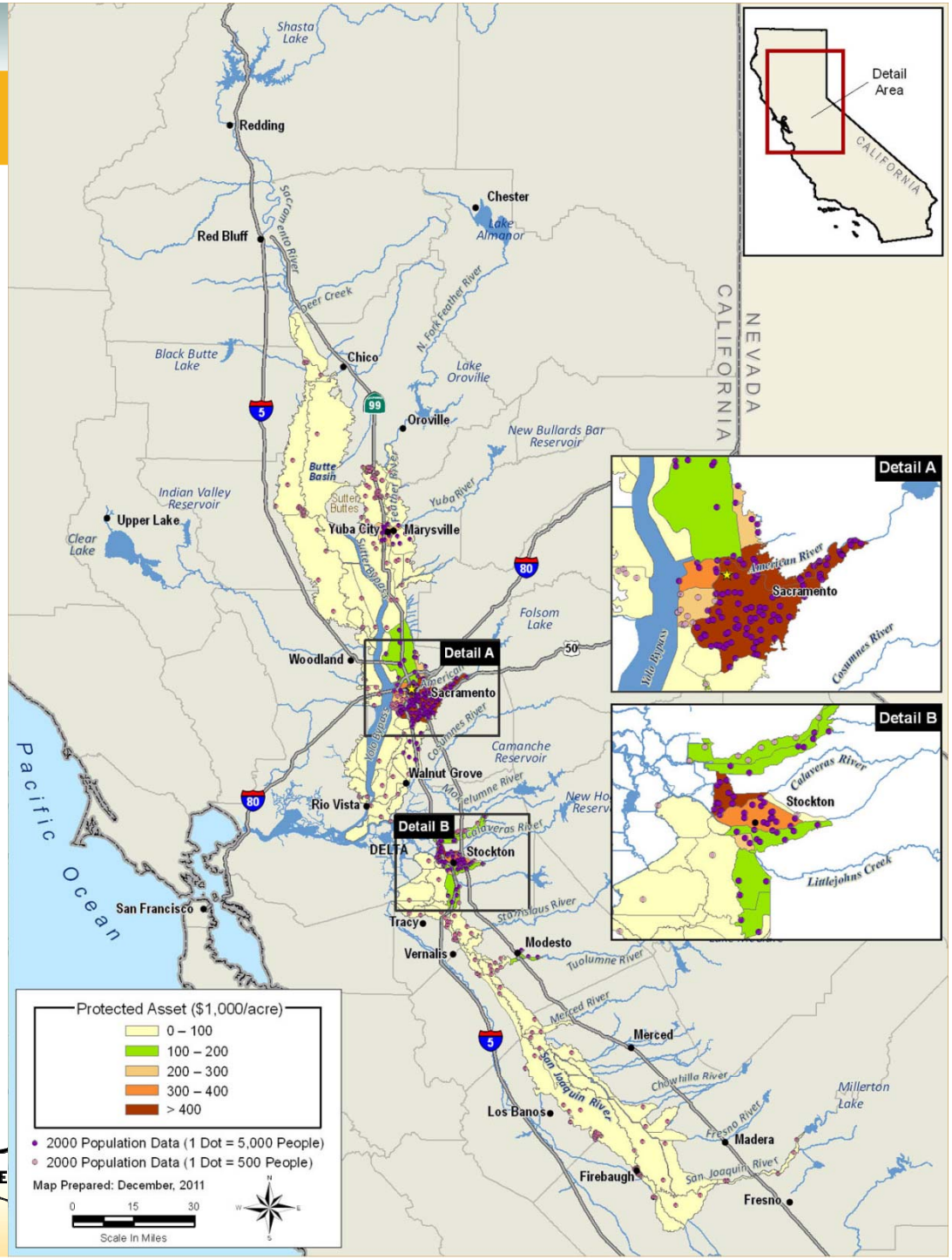
1. Cal-OES,
2. USACE Post Flood Assessment (1999)

Risk = Hazard + Exposure + Performance + Consequences



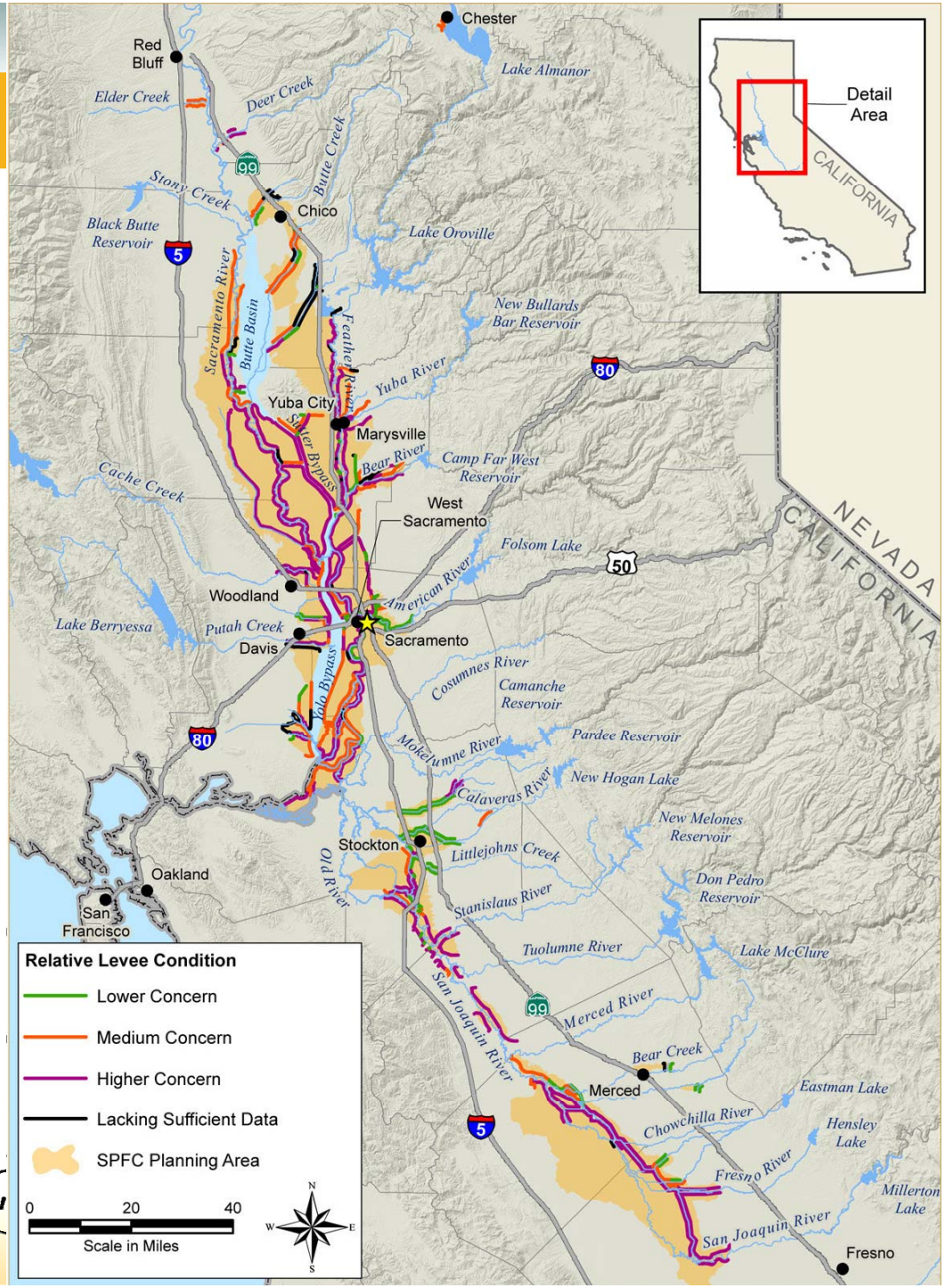
Exposure

- 1 million people
- $69B assets
  - Structures
  - Crops
- Urban, Small, & Rural-Ag Communities
- Critical Habitat (Terrestrial, Riparian, Tidal, Aquatic, etc.)

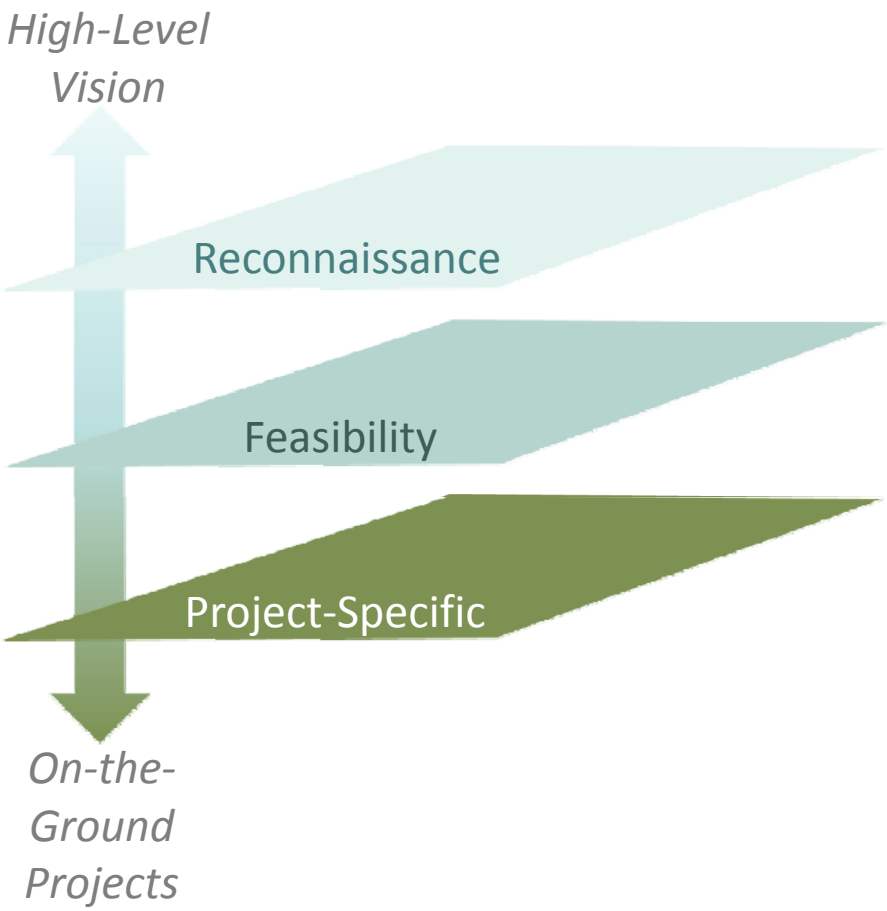


Performance

- ~50% of 300 miles of SPFC urban levees do not meet design criteria
- ~60% of 1,200 miles of SPFC non-urban levees have high potential for failure



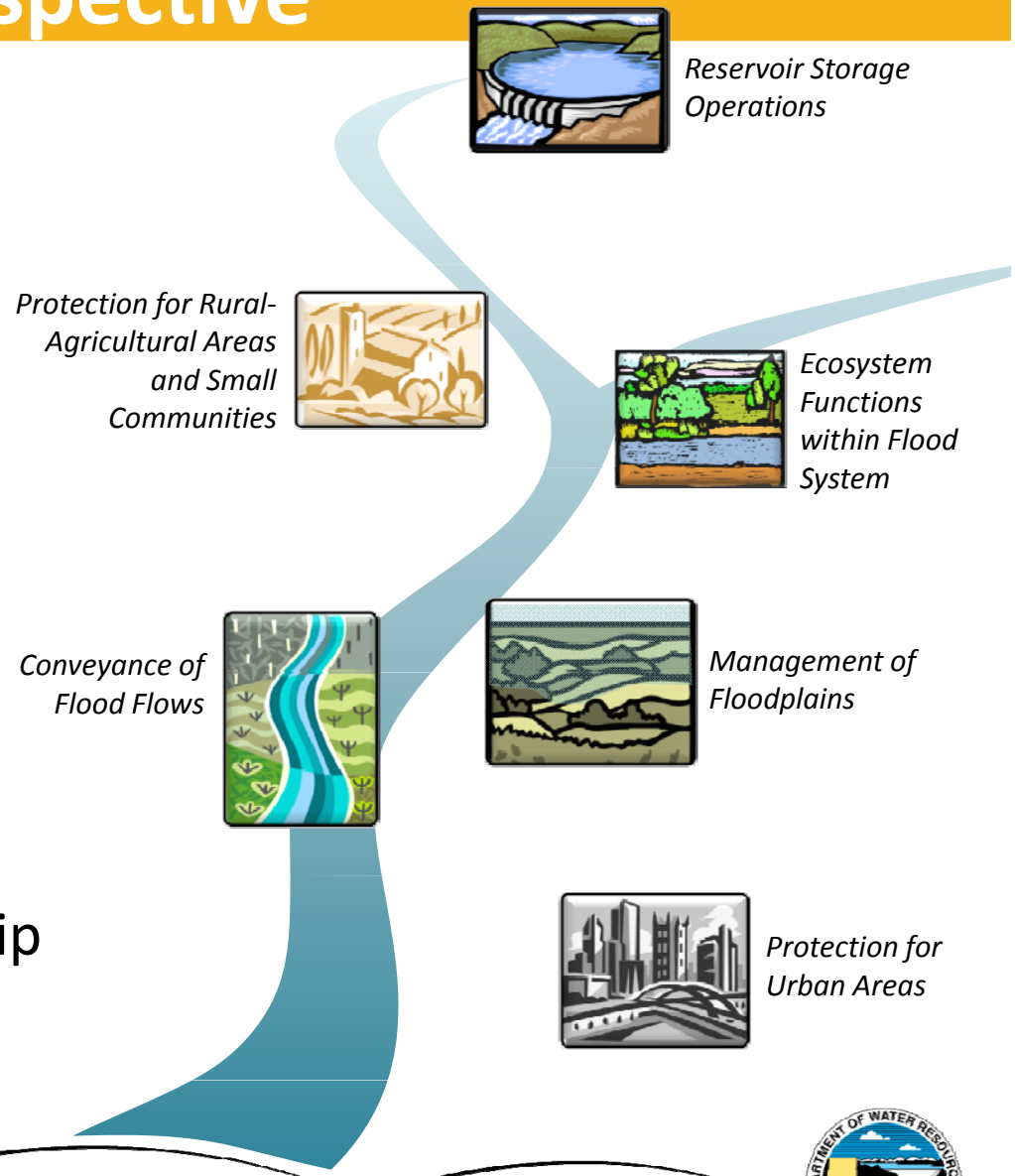
Level of Detail



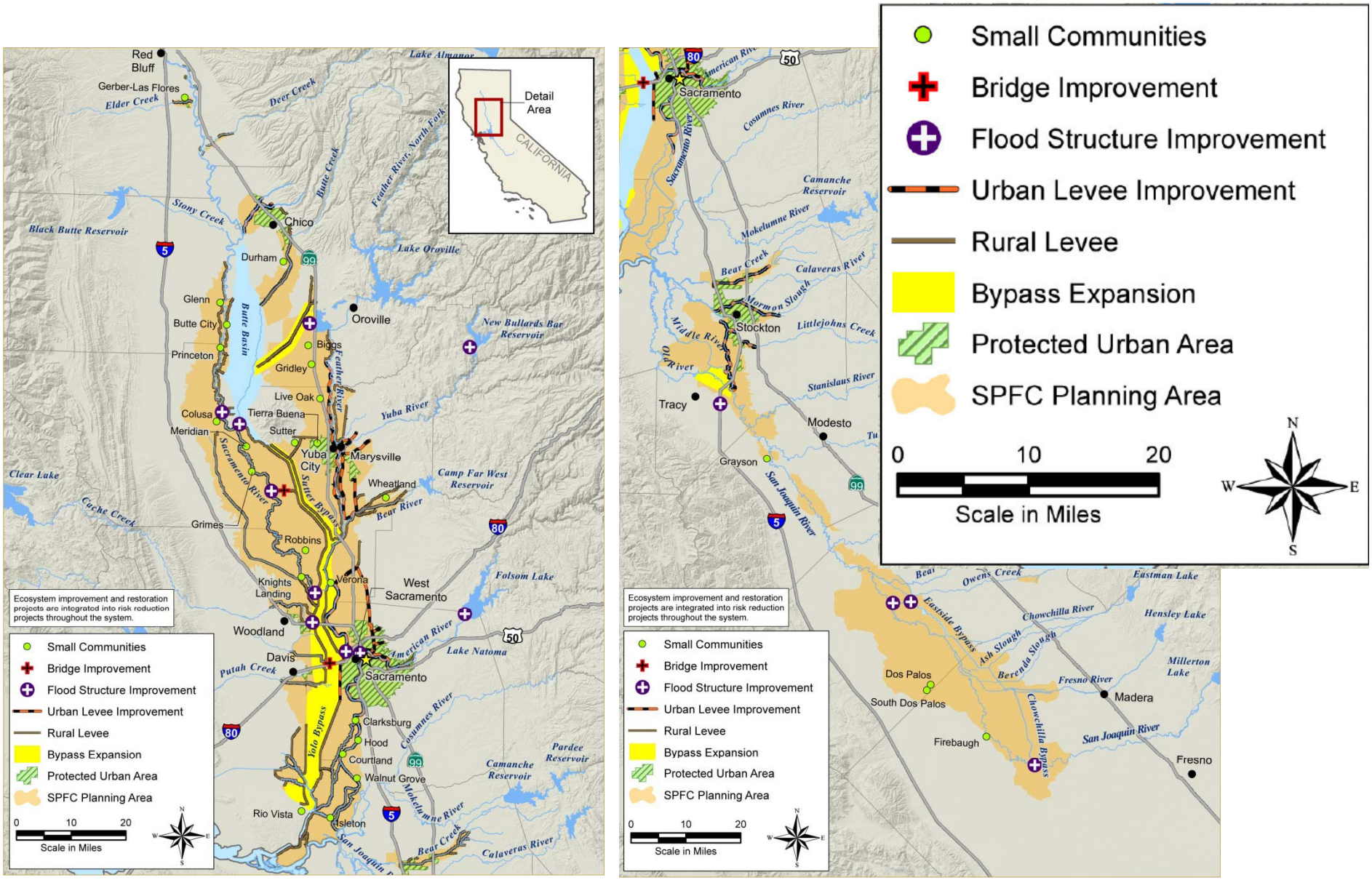
- **2012 CVFPP**
  - Descriptive document
  - Reconnaissance level data and analyses
- **Project implementation requires:**
  - Project-specific studies and design
  - Environmental reviews
  - Financing

Systemwide Perspective

- Considers the Central Valley flood system as a whole
- Focuses on State Plan of Flood Control
- Recognizes State's fundamental interests
  - Public safety
  - Environmental stewardship
  - Economic stability



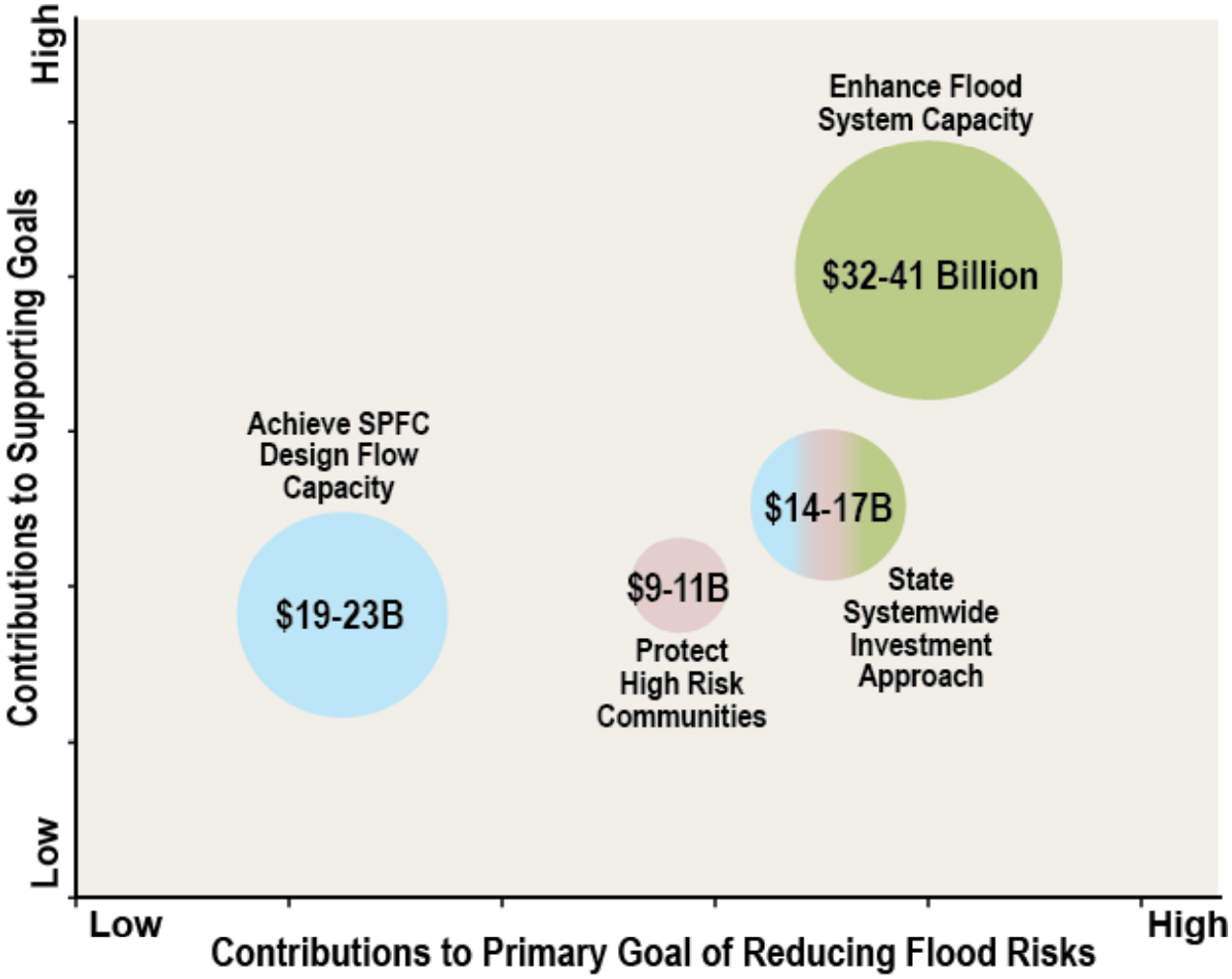
Physical Features of the SSIA



SSIA Benefits Highlights

- 67% overall reduction in expected annual flood damages
- Construction to increase economic output by $900 million and generate over 6,500 jobs annually
- Avoided business losses to increase long-term economic output by over $100 million
- 49% reduction in life risk
- 10,000 acres of new habitat and 25,000 acres of habitat-compatible crops
- Sustainable rural-agricultural lifestyle
- Resiliency and adaptability to future changes

State Systemwide Investment Approach



Next Steps

- 2012 CVFPP
  - Jan 27, Presentation to the Board
  - Mar, Draft PEIR release
  - April, Public hearings for CVFPP and PEIR
  - June/July, Final CVFPP and PEIR, Board adoption
- 2012-2017
  - Implementing CVFPP
    - Regional planning
    - Basin-wide feasibility studies
    - CV Flood System Conservation Strategy
  - Details under development

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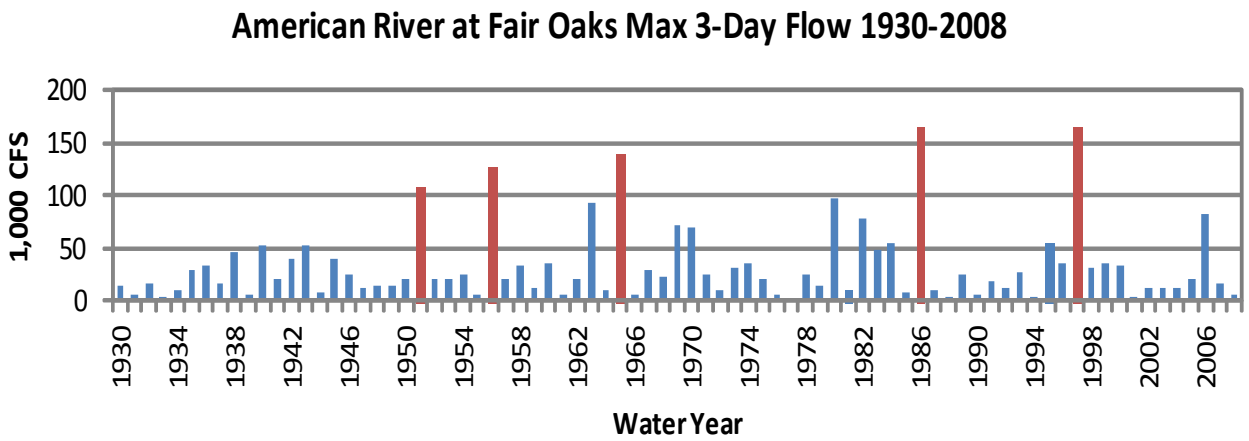
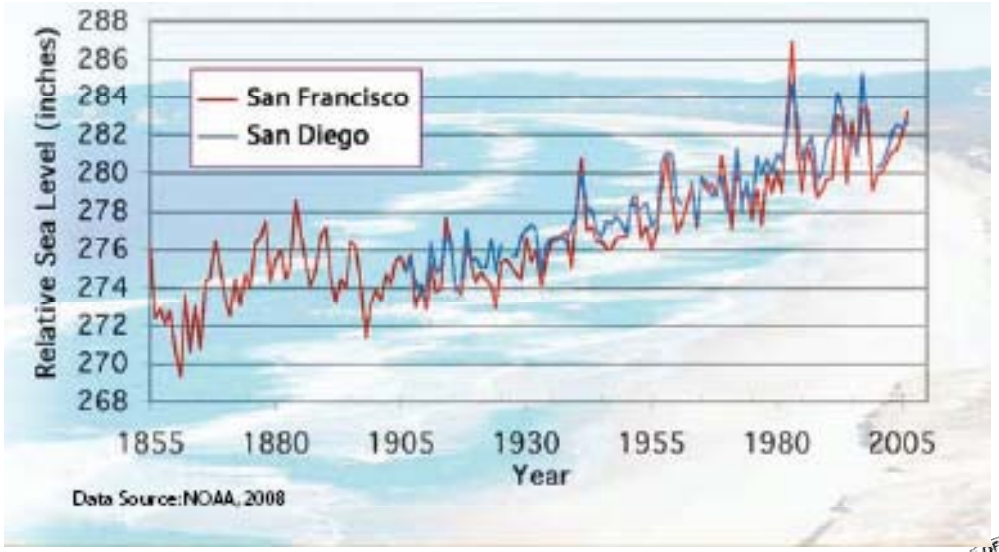
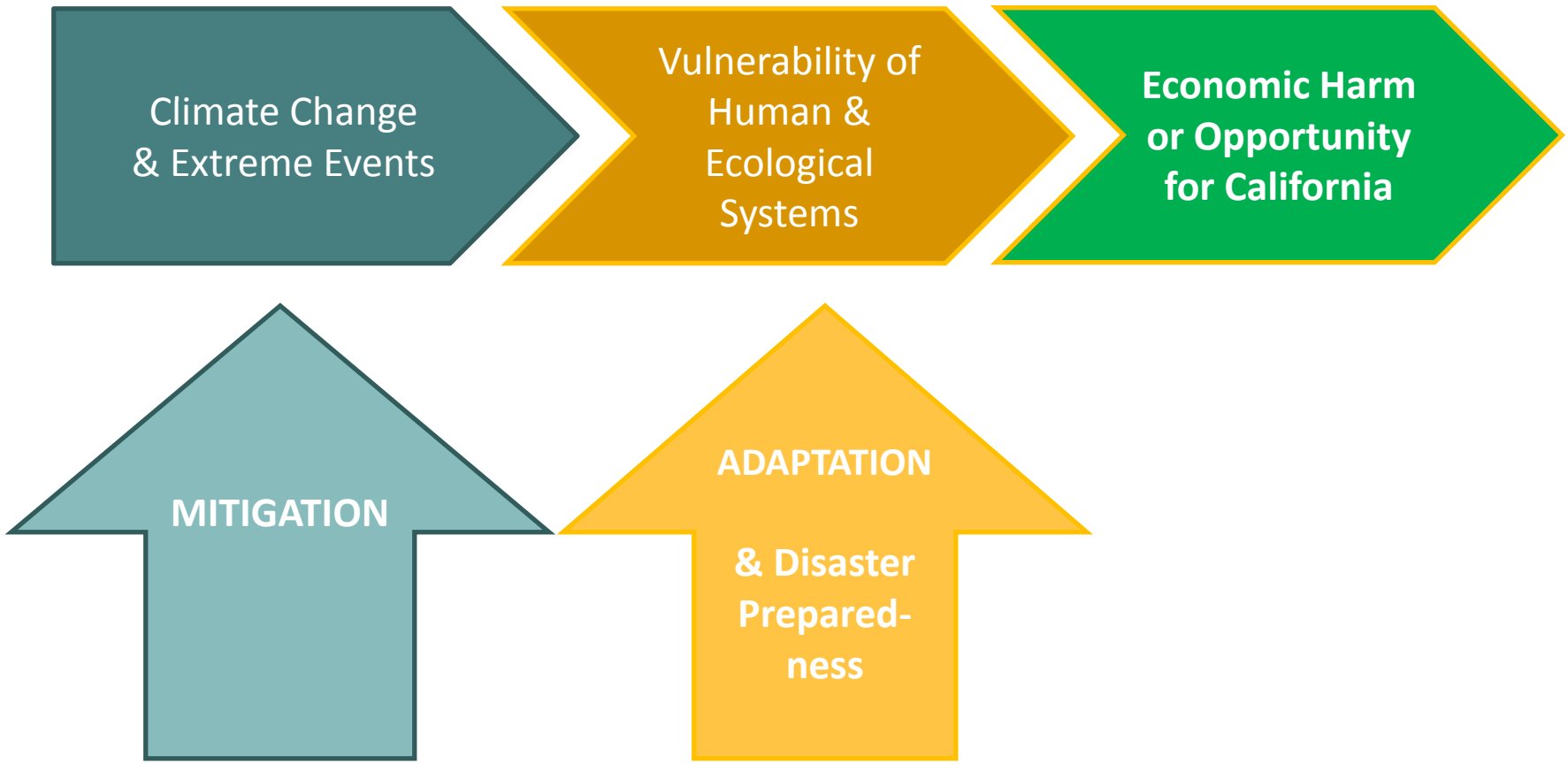
Climate Change Considerations in CVFPP

The Future is Now





Two-Pronged Approach



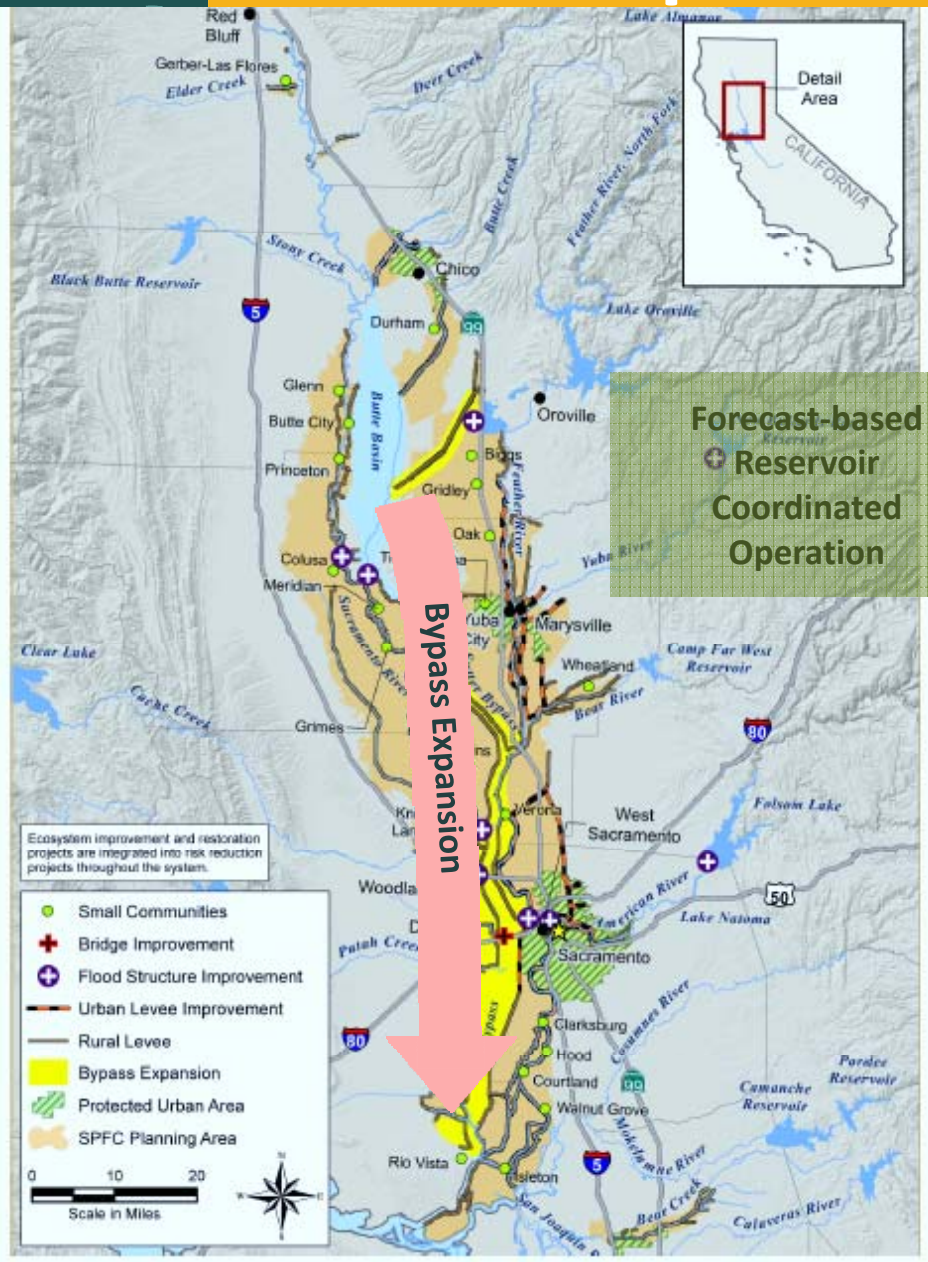
Climate Change Considerations

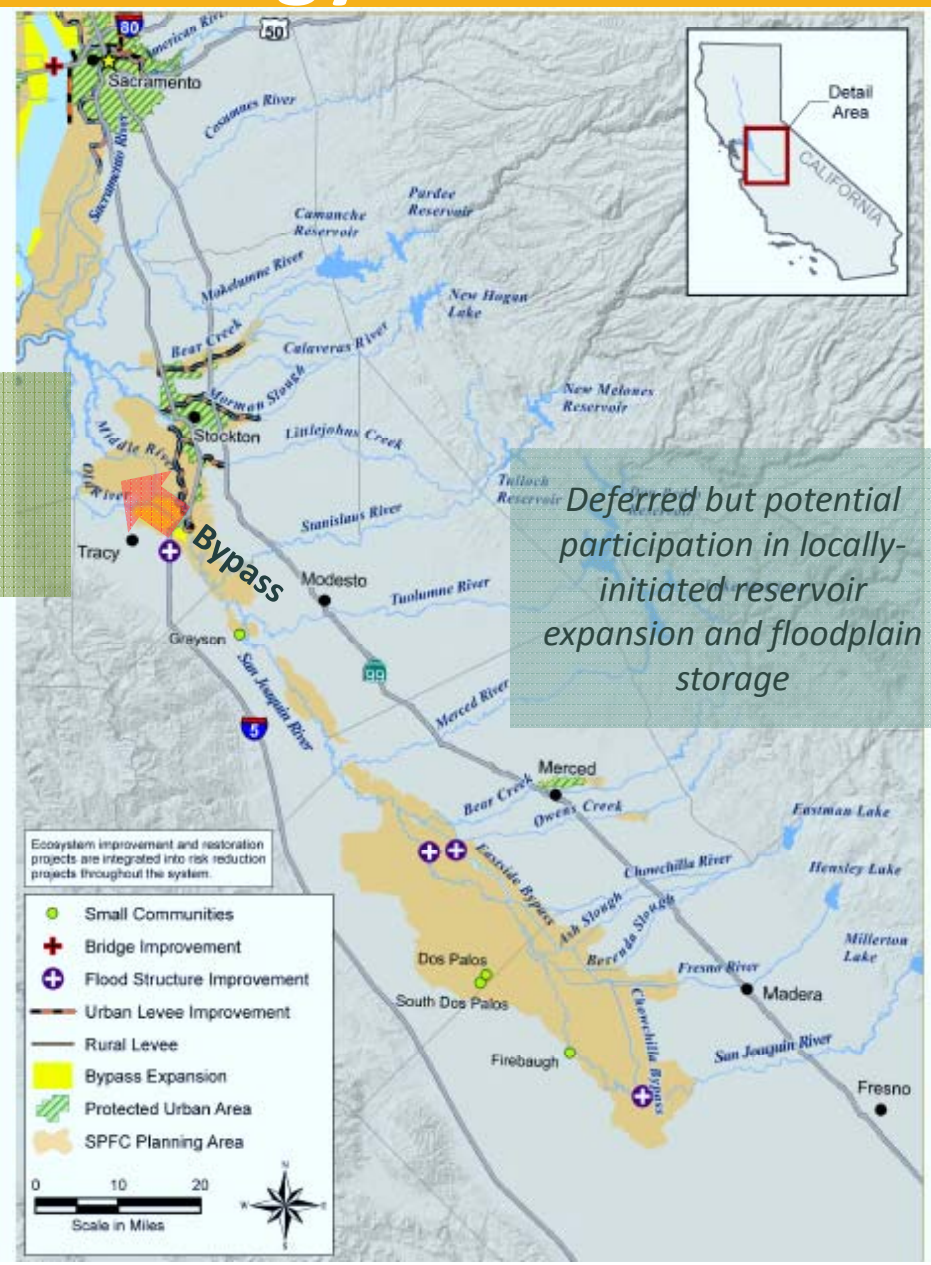
- SB 5 requires DWR to consider climate change in CVFPP development.
  - Data/Tools/Research not complete for extreme events
- 2012 CVFPP
  - Program level adaptation strategy
  - Surrogate parameters for analyses
  - New methodology and pilot study

CVFPP Adaptation Strategy

- CVFPP includes allowances for potentially higher flows due to climate change
- Expanded bypasses would increase flow-carrying capacity and flexibility to manage future higher flows.
- Changes in reservoir operations provide flexibility and adaptability.
- Deferred but possible State's participation in locally-initiated reservoir expansion projects and floodplain storage

CVFPP Adaptation Strategy





Forecast-based Reservoir Coordinated Operation

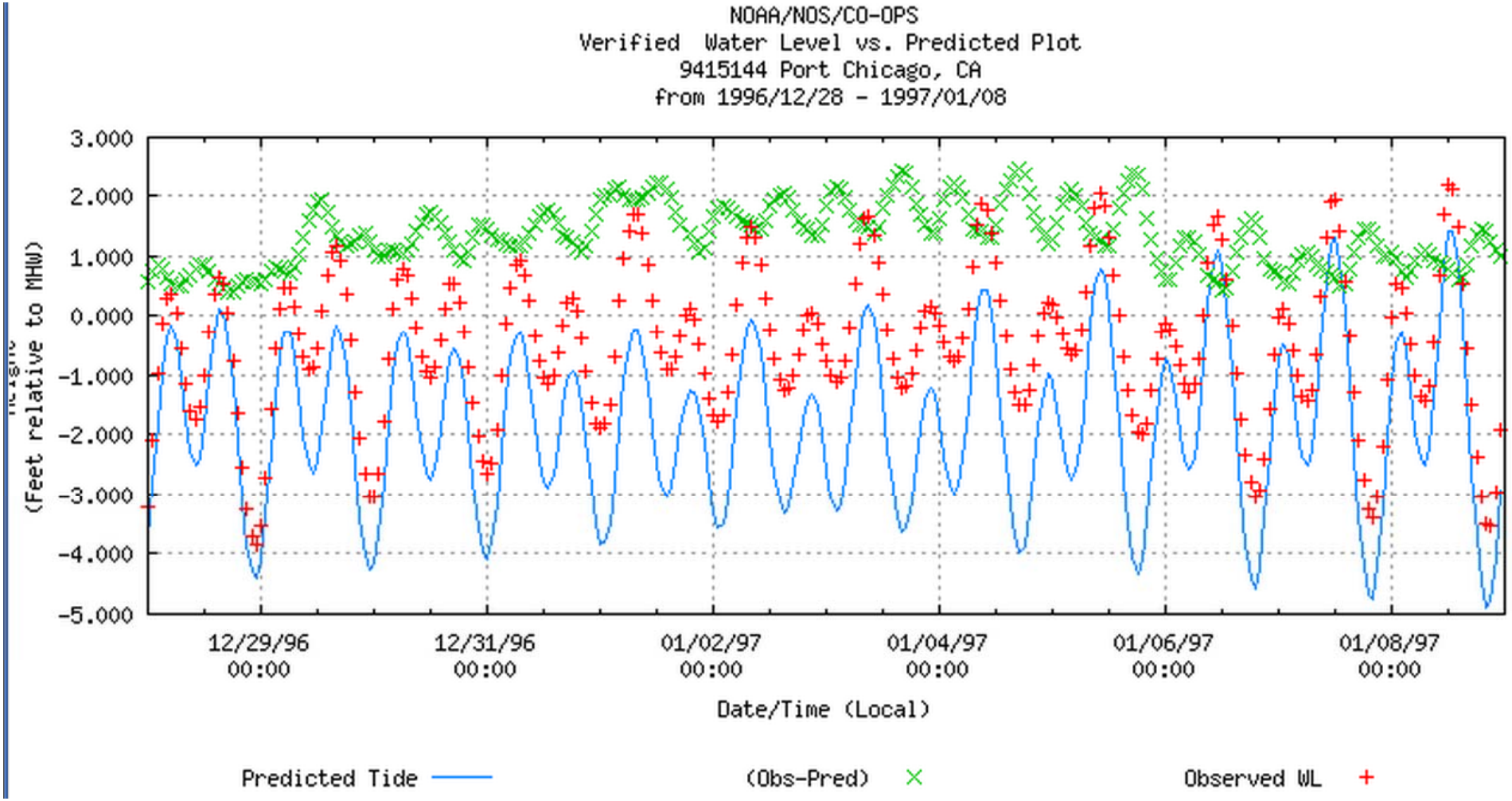
Bypass Expansion

Deferred but potential participation in locally-initiated reservoir expansion and floodplain storage

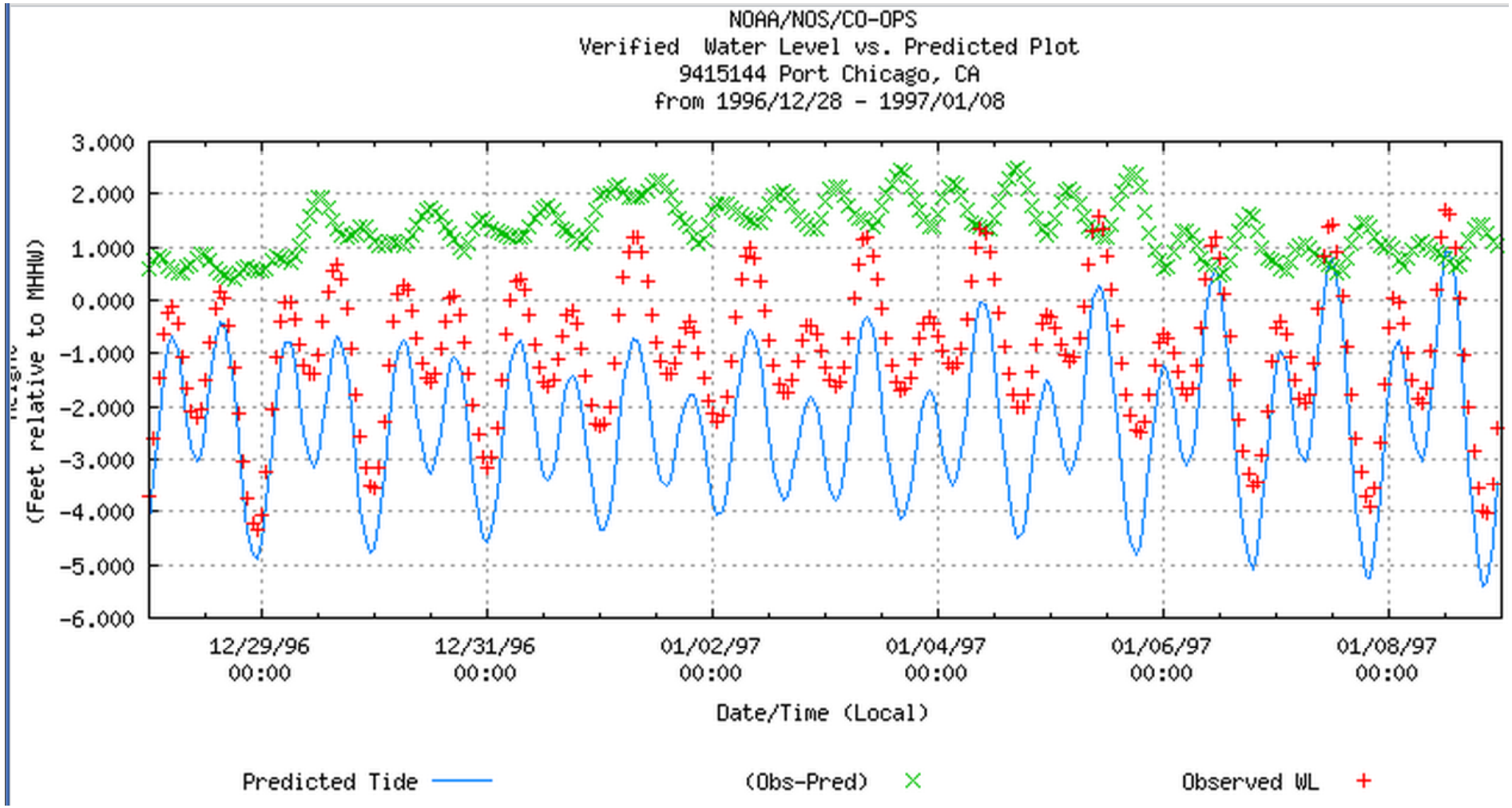
Surrogates for Analytical Purposes

- High tide conditions during the 1997 flood used as downstream boundary conditions
  - Two feet higher than would normally be expected
  - Surrogate for sea-level rise
  - NRC review of average sea-level rise expected in 2012, but not applicable in extreme events
- Comprehensive Study storm-centering hydrology used before products from Central Valley Hydrology Study become available.

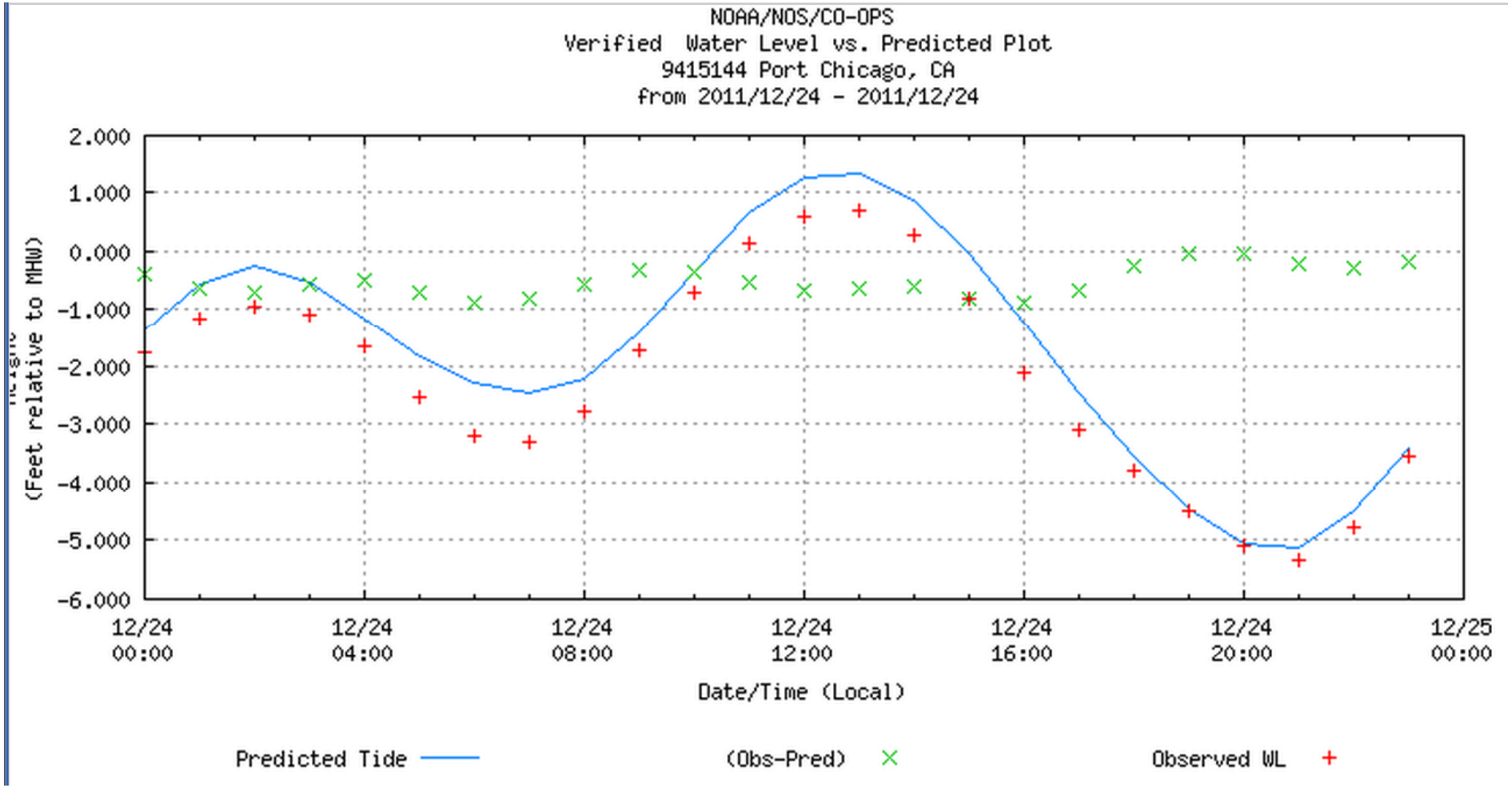
1997 Water Level Relative to MHW



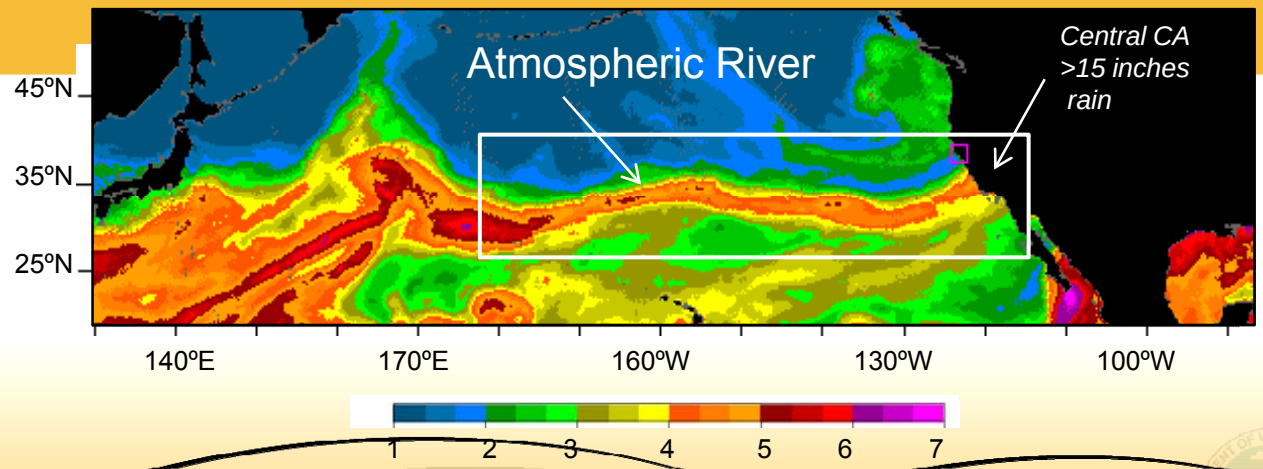
1997 Water Level Relative to MHHW



WY2011 King Tide (relative to MHW)

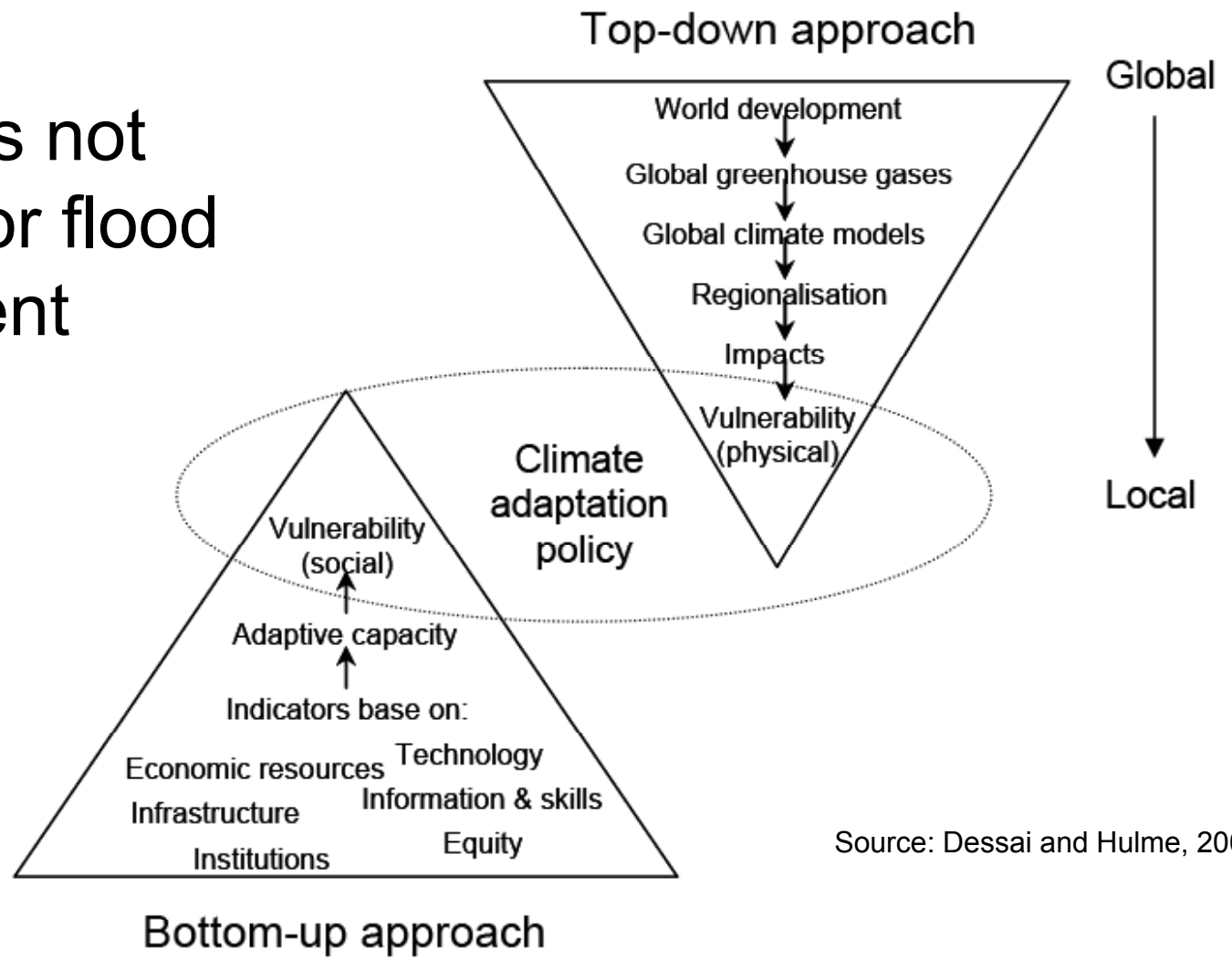


New Methodology – Threshold Analysis Approach



Existing analytical methods are not appropriate

Top-down approaches not workable for flood management



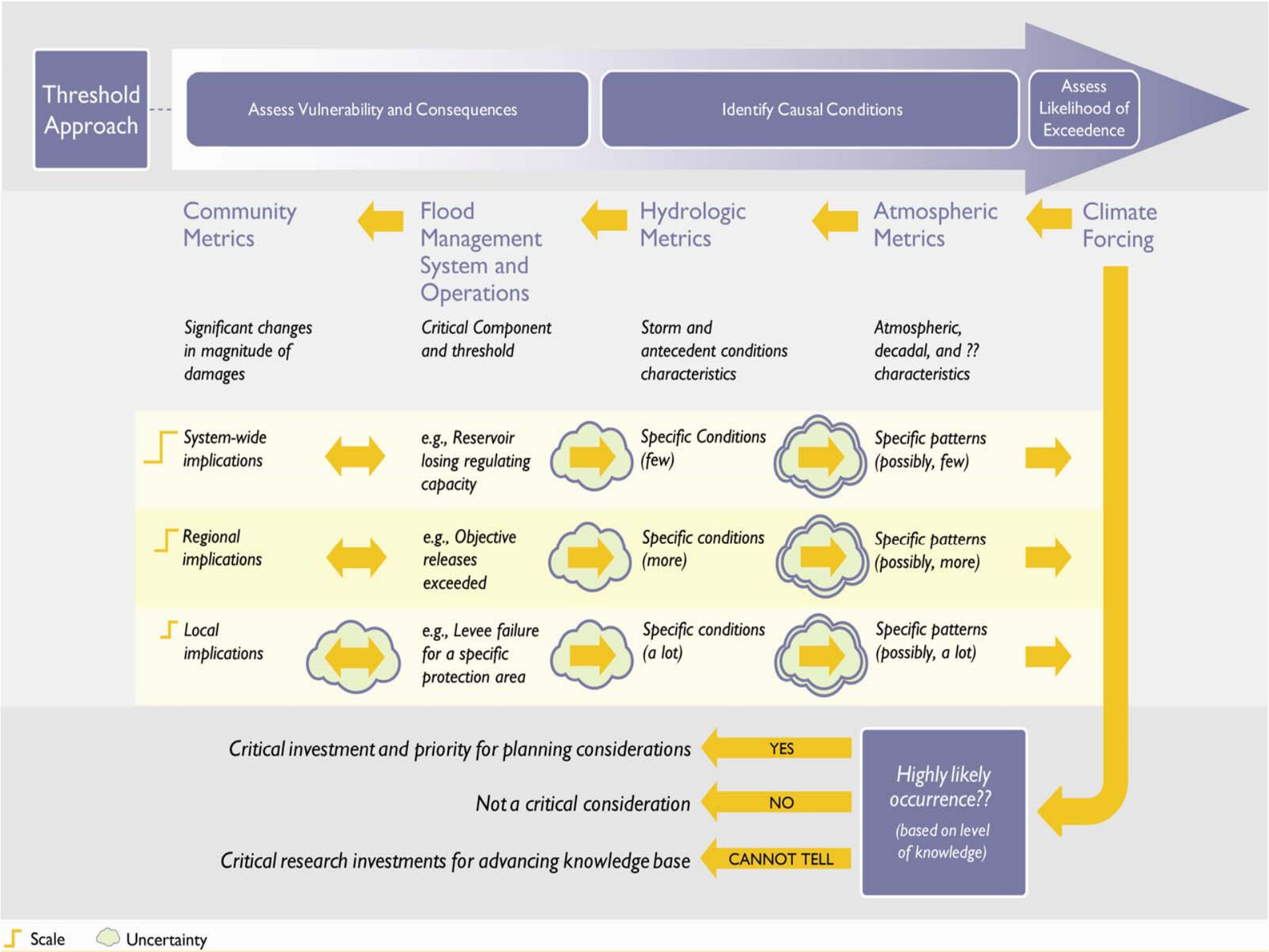
Source: Dessai and Hulme, 2003

Methodology Development

- Expert-assisted Development
  - USACE, USBR, USGS, NOAA, DWR, Others
- Focus
  - A “Bottom-up” approach to minimize the needs of probability for extreme event occurrence
  - Vulnerability assessments for easy connecting to adaptation actions
  - Potentially proceed with a Robust Decision Making methodology consistent with the investment viewpoint in the SSIA

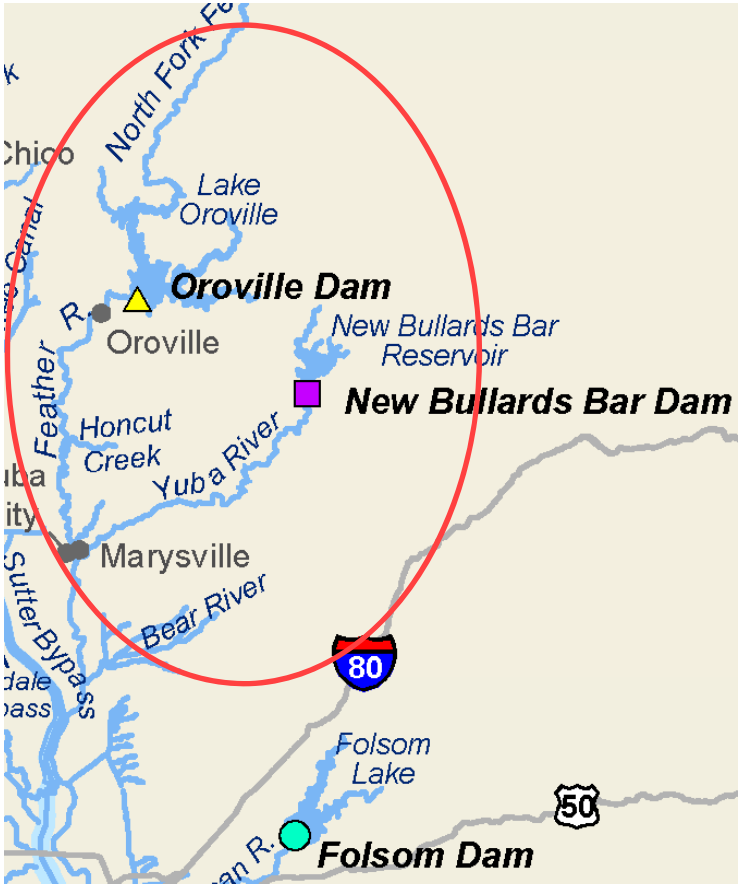
Threshold Analysis Approach

An analytical framework to identify vulnerability thresholds that may be exceeded in the next 50 years given the expected, although uncertain effects of climate change, warranting changes in investment strategy and priority for improving regional and/or systemwide flood management in the Central Valley.


Threshold Approach
Assess Vulnerability and Consequences
Identify Causal Conditions
Assess Likelihood of Exceedence
Community Metrics
Flood Management System and Operations
Hydrologic Metrics
Atmospheric Metrics
Climate Forcing
Significant changes in magnitude of damages
Critical Component and threshold
Storm and antecedent conditions characteristics
Atmospheric, decadal, and ?? characteristics
System-wide implications
e.g., Reservoir losing regulating capacity
Specific Conditions (few)
Specific patterns (possibly, few)
Regional implications
e.g., Objective releases exceeded
Specific conditions (more)
Specific patterns (possibly, more)
Local implications
e.g., Levee failure for a specific protection area
Specific conditions (a lot)
Specific patterns (possibly, a lot)
Critical investment and priority for planning considerations
YES
Not a critical consideration
NO
Critical research investments for advancing knowledge base
CANNOT TELL
Highly likely occurrence??
(based on level of knowledge)
Scale
Uncertainty

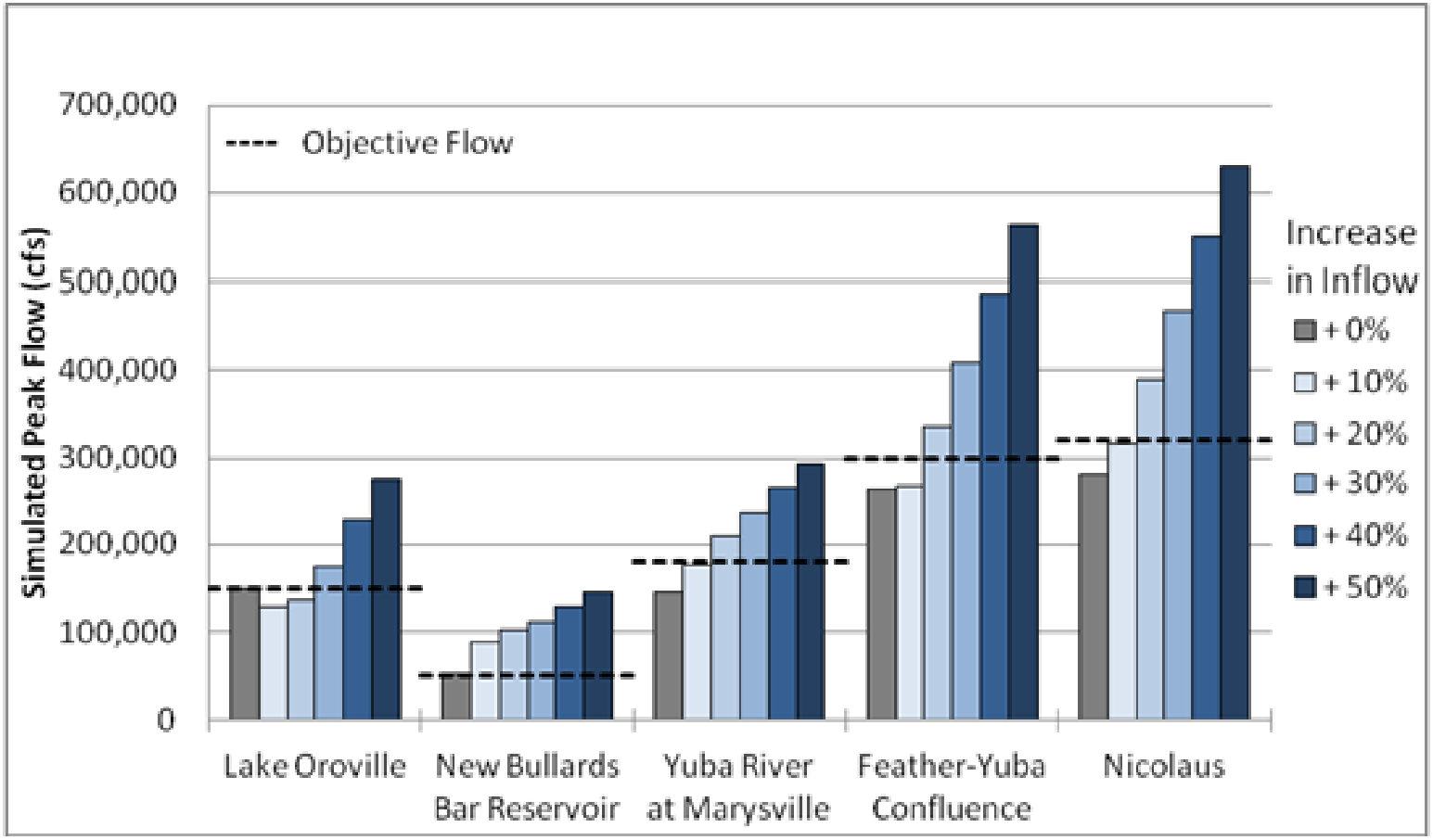
Pilot Study Methodology

- **Purpose:** Test the theory while elements are under development
- **Critical Threshold:** Objective release from Oroville Reservoir
  - Available synthetic hydrology with updated HEC-ResSIM
    - Initial focus on inflow volume
  - Meteorology: Atmospheric Rivers (Dettinger et al., 2011)
    - Integrated water vapor flux as a surrogate indicator

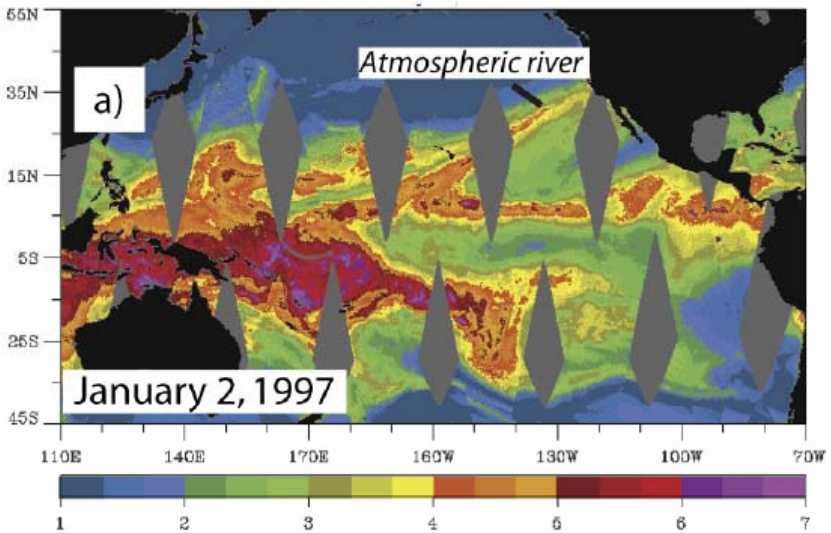


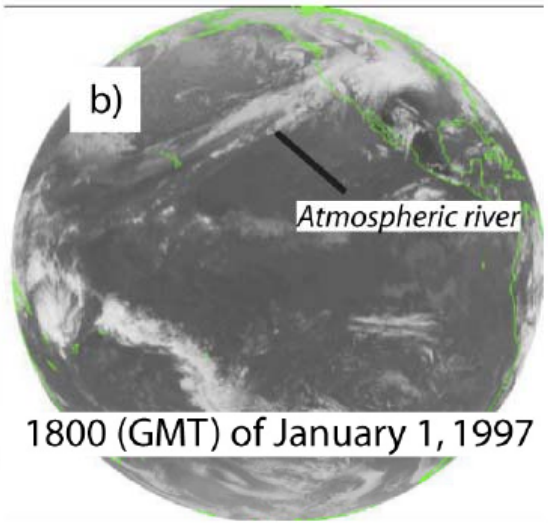
Results: Vulnerability Assessment

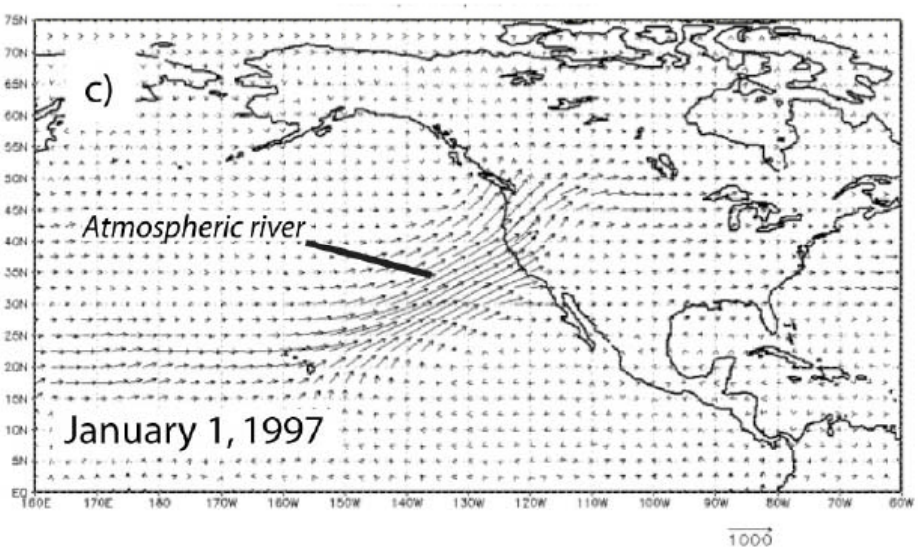
Simulated Peak Flow by Inflow Scenario



Connecting to the Source: Atmospheric Rivers



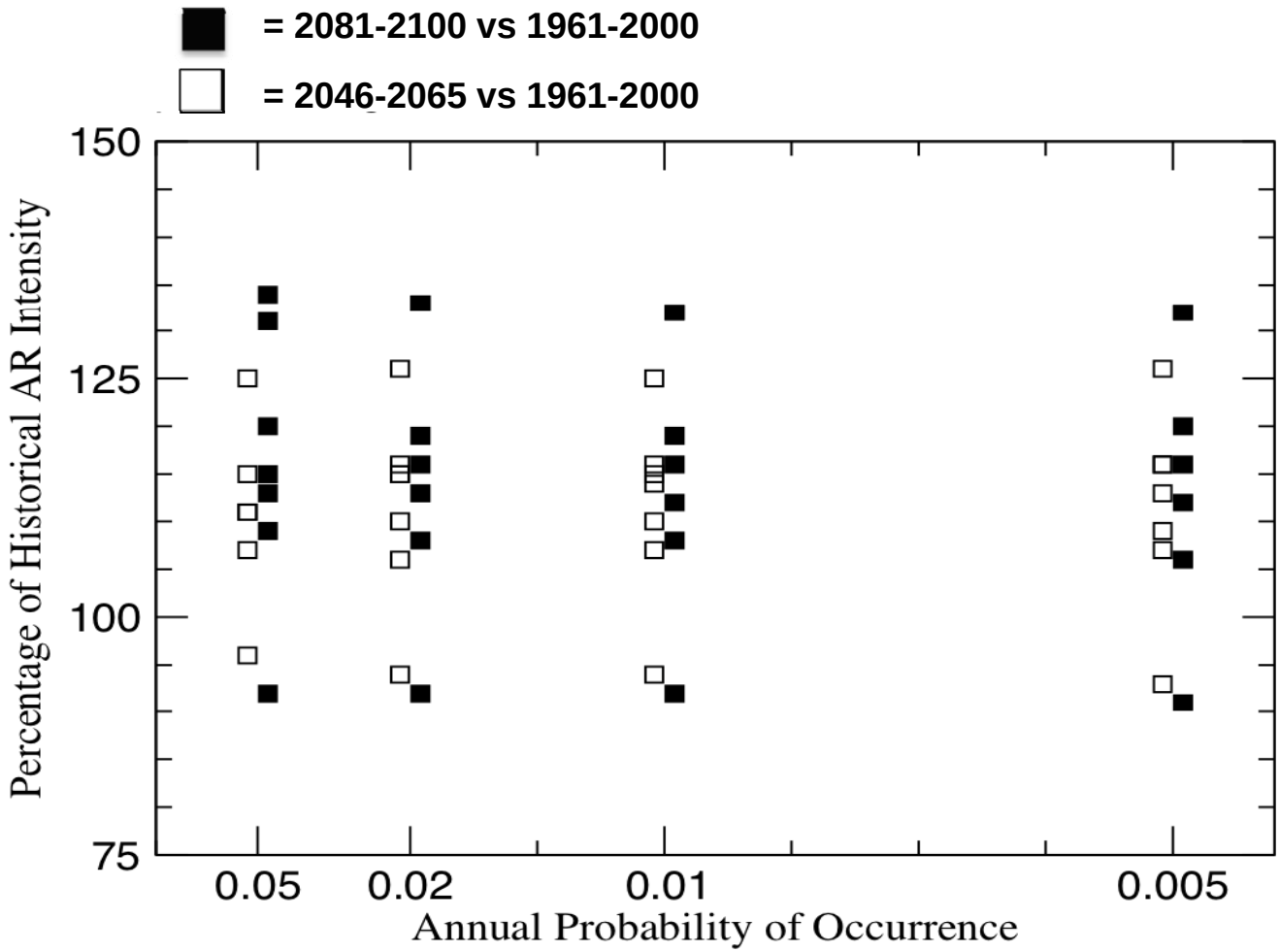




Source: Dettinger, 2011

Results: Likelihood Assessment

Changes in Atmospheric River Intensity



Findings

- Most vulnerable element
  - Yuba River system and in particular, New Bullards Bar Reservoir
  - Identified SSIA component
- Promising outcomes with technical gaps for full applications (2017 CVFPP update)
  - Relationship between AR and hydrology
  - Sea-level rise assumptions for extreme events
  - CVHS revised system model and hydrology
  - Putting all these together

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Climate Change Consideration in Implementation Activities

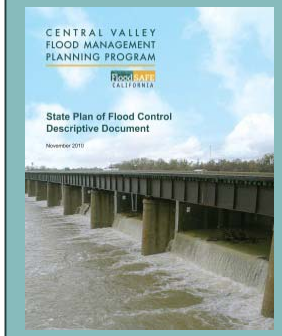
PUBLIC SAFETY ENVIRONMENTAL STEWARDSHIP ECONOMIC STABILITY

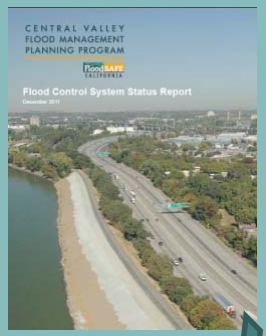
Senate Bill 5 (2007)

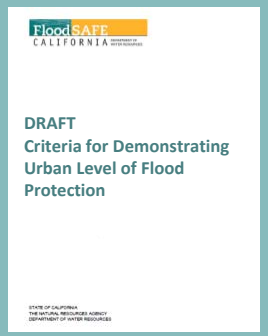
- Requires urban level of protection by about 2015, or adequate progress thereafter
  - Urban level of protection is 200-year level of protection using criteria consistent with, or developed by, DWR
  - Applies to urban areas (10,000 people) and urbanizing areas (10,000 within 10 years)
  - Without urban level of protection or adequate progress, no further development permitted in 200-year floodplain in Sacramento-San Joaquin Valley
  - "Adequate progress" not available after 2025 for areas protected by State-federal project levees

2012 CVFPP Organization

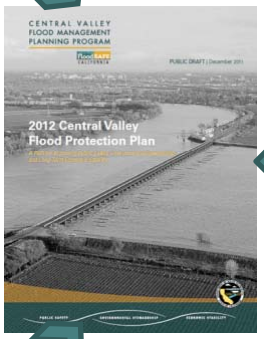
Documents Incorporated by Reference







2012 Central Valley Flood Protection Plan



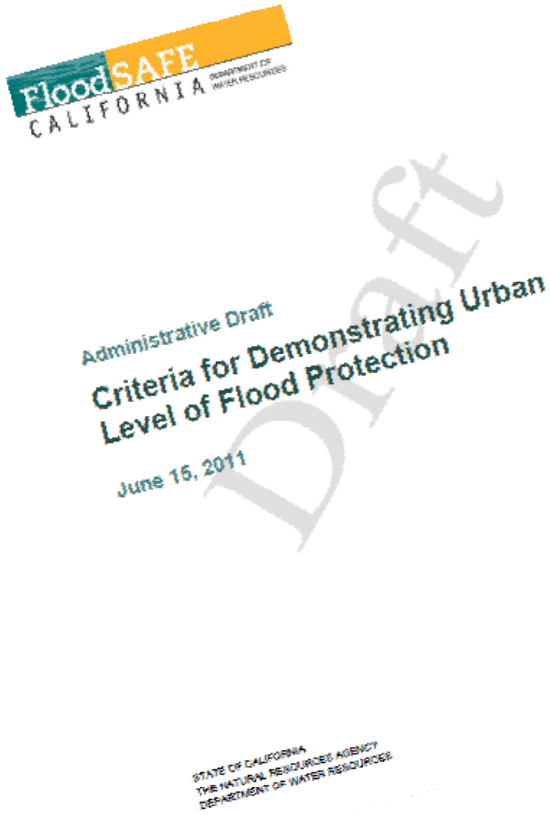
2012 CVFPP Program Environmental Impact Report (Public Draft - March)

Supporting Data, Analyses, Findings, and Technical Studies

- **CVFPP Attachment 1** — Legislative Reference
- **CVFPP Attachment 2** — Conservation Framework
- **CVFPP Attachment 3** — Documents Incorporated by Reference
- ...

The CVFPP and its companion documents collectively meet legislative requirements contained in the ***Central Valley Flood Protection Act of 2008***

Criteria Documents



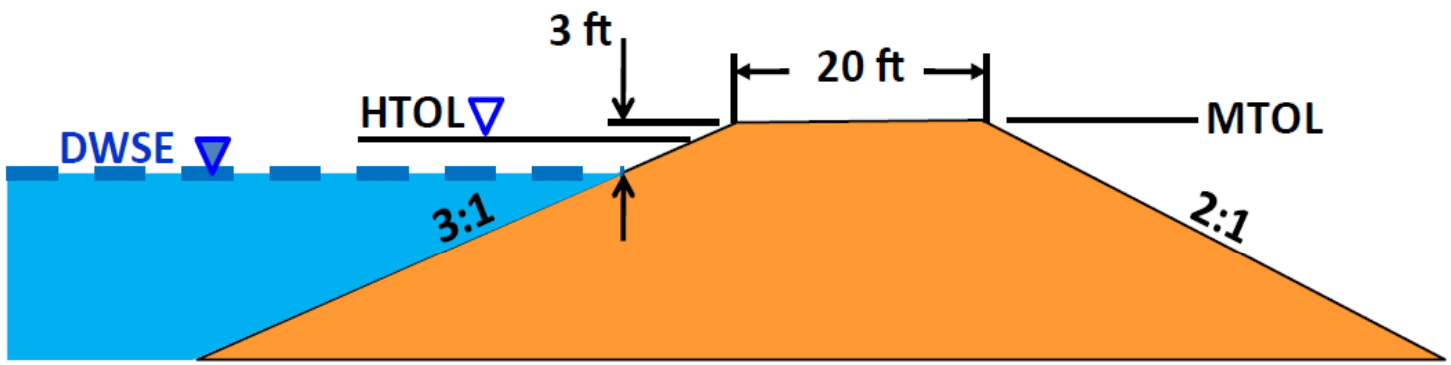
ULDC Development

- DWR has released the following versions of the Interim Levee Design Criteria (ILDC) and ULDC:
  - First Draft ILDC, December 7, 2007 (8 pgs)
  - Second Draft ILDC, August 22, 2008 (15 pgs)
  - Third Draft ILDC, May 15, 2009 (20 pgs)
  - Version 4 ILDC, December 15, 2010 (53 pgs)
  - Draft ULDC, November 15, 2011 (77 pgs)
  - ULDC expected March 2012
- Used for levee evaluations, planning studies, and Early Implementation Projects
- Collaboratively developed with engineers from throughout California, including USACE and FEMA

Levee Cross Section

Definitions:

- ✓ Design Water Surface Elevation (DWSE) is median 200-yr WSE
- ✓ Hydraulic Top of Levee (HTOL) is lower of: (1) median 200-yr WSE + 3 ft, or
  (2) median 500-yr WSE
- ✓ Minimum Top of Levee (MTOL) is median 200-yr WSE + 3 ft, or higher for waves



Levee Design Criteria Summary

Parameter	Criteria			
DWSE (Option 1)	Median 200-year WSE			
DWSE (Option 2)	90% assurance 200-year WSE			
MTOL (Option 1)	Median 200-year WSE + higher of (1) 3 feet, or (2) height for wind setup and wave runup			
MTOL (Option 2)	Lower of A or B, where: • A is the higher of (1) 90% assurance 200-year WSE, (2) median 200-year WSE plus three feet, or (3) median 200-year WSE plus height for wind setup and wave runup • B is the higher of (1) 95% assurance 200-year WSE, (2) median 200-year WSE plus two feet, or (3) median 200-year WSE plus height for wind setup and wave runup			
HTOL (Option 1)	Lower of (1) median 200-year WSE plus three feet, or (2) median 500-year WSE			
HTOL (Option 2)	Higher of A or B, where: • A is the lower of (1) median 200-year WSE plus three feet, (2) median 500-year WSE, or (3) MTOL (Option 2) • B is the DWSE			
Seepage - Exit Gradient at Levee Toe	For DWSE		For HTOL	
	$\gamma \geq 112$ pcf	$\gamma < 112$ pcf	$\gamma \geq 112$ pcf	$\gamma < 112$ pcf
	$i \leq 0.5$	FS ≥ 1.6	$i \leq 0.6$	FS ≥ 1.3
Seepage - Exit Gradient at Seepage Berm Toe	$i \leq 0.8$	FS ≥ 1.0	<20% FS degradation for berms less than 100 feet	<10% FS degradation for berms less than 100 feet
Steady State Slope Stability	FS ≥ 1.4		FS ≥ 1.2	
Seismic Vulnerability	Restore grade and dimensions for at least 10-year WSE plus three feet of freeboard or higher for wind setup and wave runup within eight weeks			
Levee Geometry	For new or extensive reconstruction on a major stream, minimum 20-foot-wide crown, 3h:1v waterside and landside slopes for all levees except bypass levees (4h:1v waterside slope)			

Note: The median 200-year WSE, the 90 percent assurance 200-year WSE, and the 95 percent assurance 200-year WSE in this table are assumed to have been increased appropriately to account for the potential for new, updated hydrology to yield higher flows.

ULDC Climate Change Considerations

- Before approving a development agreement, tentative parcel map, or a permit, cities and counties must make a "finding" of:
  - 200-yr protection is provided
  - Conditions imposed achieve 200-yr protection
  - Adequate progress toward 200-yr protection
- The required "finding" lasts up to 20 years
- 20-year renewal of "finding" requires reconsideration of H&H for climate change and sea level rise

ULDC Climate Change Considerations

- "Finding" based on civil engineer's report with:
  - Independent Peer Review (H&H and levee experts)
  - Public Review
  - Agency Review
- New hydrology under development to consider climate change
- Encourage adding levee height until then
- Hydraulic analysis is to consider future conditions

ULDC Climate Change Considerations

- Sea level rise
  - Ocean Protection Council Resolution (2011)
  - USACE EC 1165-2-211 (2009)
- Right-of-Way future needs area encouraged landward of levee (greater of 50 feet or 4 times levee height) beyond minimum right of way requirements (generally 20 feet)

Levee Resiliency

- Design Water Surface Elevation vs. Top of Levee
- Hydraulic top of levee in ULDC
- Further resiliency for extreme events noted in CVFPP:
  - Levees designed for overtopping
  - Compartmentalized floodplains
  - Bypasses (spillways) away from urban areas

Questions?