

# FloodSAFE California Overview

Water Plan Update 2013 Plenary  
California Water Plan Update

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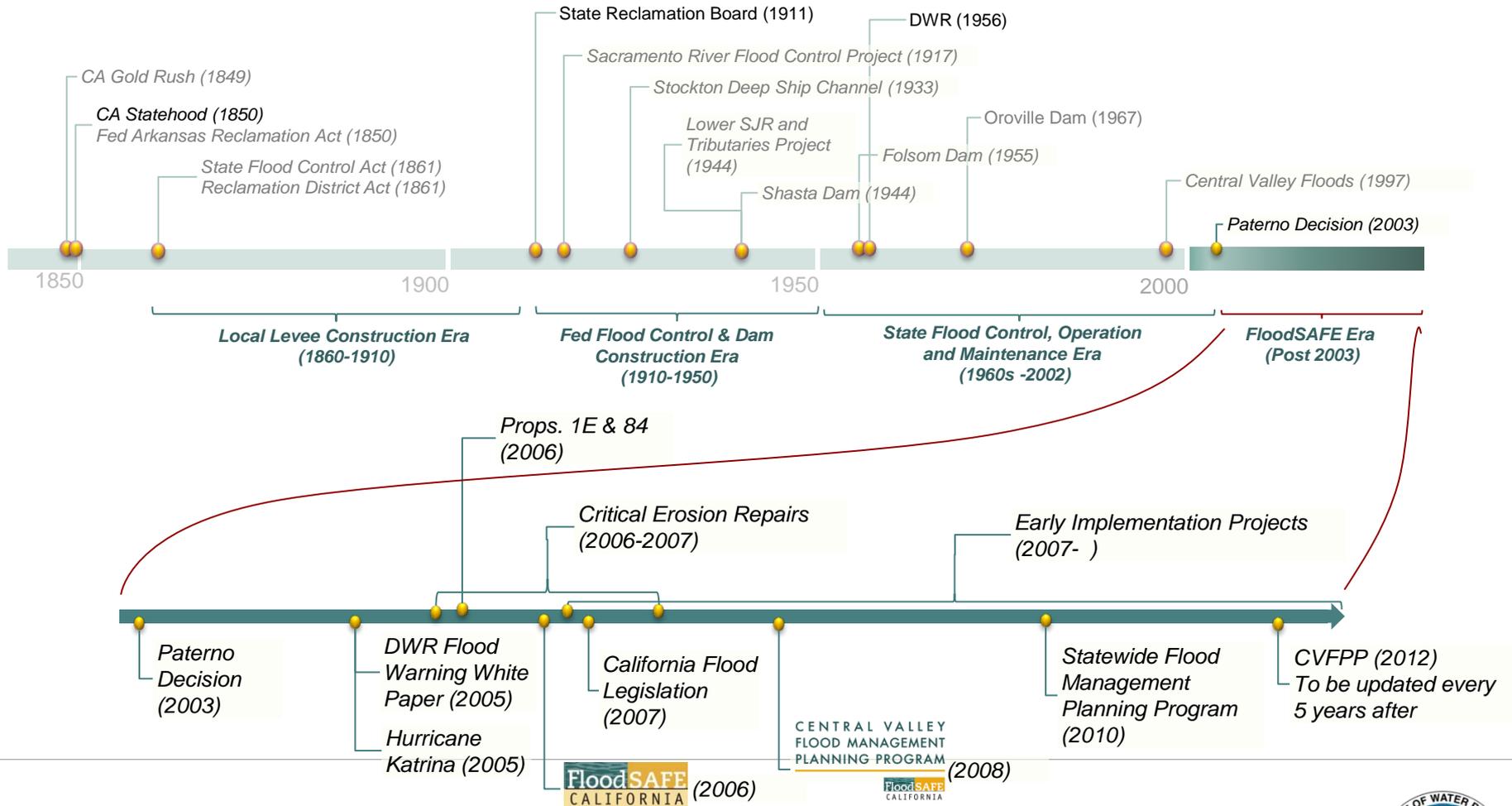
October 27, 2011

**PUBLIC SAFETY**

**ENVIRONMENTAL STEWARDSHIP**

**ECONOMIC STABILITY**

# Timeline of Central Valley Flood Issues



# Historical C.V. Flood Consequences

Event / Region	1986		1997	
	Statewide <sup>1</sup>	Central Valley <sup>2</sup>	Statewide <sup>1</sup>	Central Valley <sup>2</sup>
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)

# 2006 Flood Bonds

	<b>Prop 1E</b>	<b>Prop 84</b>	<b>Total</b>
Bond Totals	\$4.09B	\$800M	\$4.89B
Appropriated (FY10/11)	\$2.45B	\$746M	\$3.19B
Remaining Funds	\$1.64B	\$54M	\$1.70B

# Key FloodSAFE Related Legislation

Legislation	Major Statewide DWR Flood Initiatives	Year
<b>AB 142</b>	<ul style="list-style-type: none"> <li>Levee &amp; Flood System Repair</li> </ul>	2006
<b>AB 140</b>	<ul style="list-style-type: none"> <li>Disaster Preparedness and Flood Prevention Bond Act of 2006</li> </ul>	2006
<b>Prop 1E</b>	<ul style="list-style-type: none"> <li>Disaster Preparedness and Flood Protection Bond Act of 2006 (\$4.09B)</li> </ul>	2006
<b>Prop 84</b>	<ul style="list-style-type: none"> <li>Safe Drinking Water, Water Quality and Supply, Food Control, River and Coastal Protection Bond Act of 2006 (\$5.39B)*</li> </ul>	2006
<b>AB 739</b>	<ul style="list-style-type: none"> <li>Storm water discharge</li> </ul>	2007
<b>SB 27</b>	<ul style="list-style-type: none"> <li>Sacramento-San Joaquin Delta Emergency Preparedness Act of 2008</li> </ul>	2008

\* \$800M of Prop 84 for Flood Risk Reduction

# Key FloodSAFE Related Legislation

Legislation	Major Central Valley DWR Flood Initiatives	Year
<b>SB 5</b>	<ul style="list-style-type: none"> <li>• Develop preliminary 100-yr &amp; 200-yr floodplain maps for C.V.</li> <li>• Propose building code standards in areas protected from a 1-in-200 chance of flooding event</li> <li>• Develop a Central Valley Flood Protection Plan (CVFPP) for adoption by the Central Valley Flood Protection Board (CVFPB)</li> <li>• Urban Level of Flood Protection (1-in-200 chance of flooding) for Central Valley will apply to future development in urban areas</li> </ul>	2007
<b>SB17, SB5</b>	<ul style="list-style-type: none"> <li>• Document &amp; update status of State Plan of Flood Control (SPFC)</li> </ul>	2007
<b>AB 5</b>	<ul style="list-style-type: none"> <li>• Develop new local cost share formulas for repairs / improvements</li> </ul>	2007
<b>AB 70</b>	<ul style="list-style-type: none"> <li>• Cities &amp; counties share costs associated with potential flood damages in previously undeveloped areas protected by SPFC</li> </ul>	2007
<b>AB 156</b>	<ul style="list-style-type: none"> <li>• Send annual flood risk notifications to property owners protected by levees</li> <li>• Prepare project levee status reports</li> </ul>	2007
<b>AB162, SB5, AB156</b>	<ul style="list-style-type: none"> <li>• Cities &amp; counties amend their general plans</li> </ul>	2007

# FloodSAFE California Initiative

In 2006 DWR launched the FloodSAFE California Initiative to improve public safety through integrated flood management.

## Accomplishments

- ✓ Core Flood Management Programs
- ✓ Regional Projects
- ✓ System-Wide Investments



# FloodSAFE is about

## Public Safety

- Making communities safe
- Planning ahead to achieve best collaboration
- Emergency planning and response

## Environmental Stewardship

- Helping ecosystems thrive
- Creating healthier communities by enhancing the environment
- Responsible and reasonable balance between protecting people and the environment

## Economic Stability

- Providing for our families' future
- Protecting businesses and investments
- Enhancing communities

# General FloodSAFE Focus Areas

## Delta



## Central Valley



## Statewide



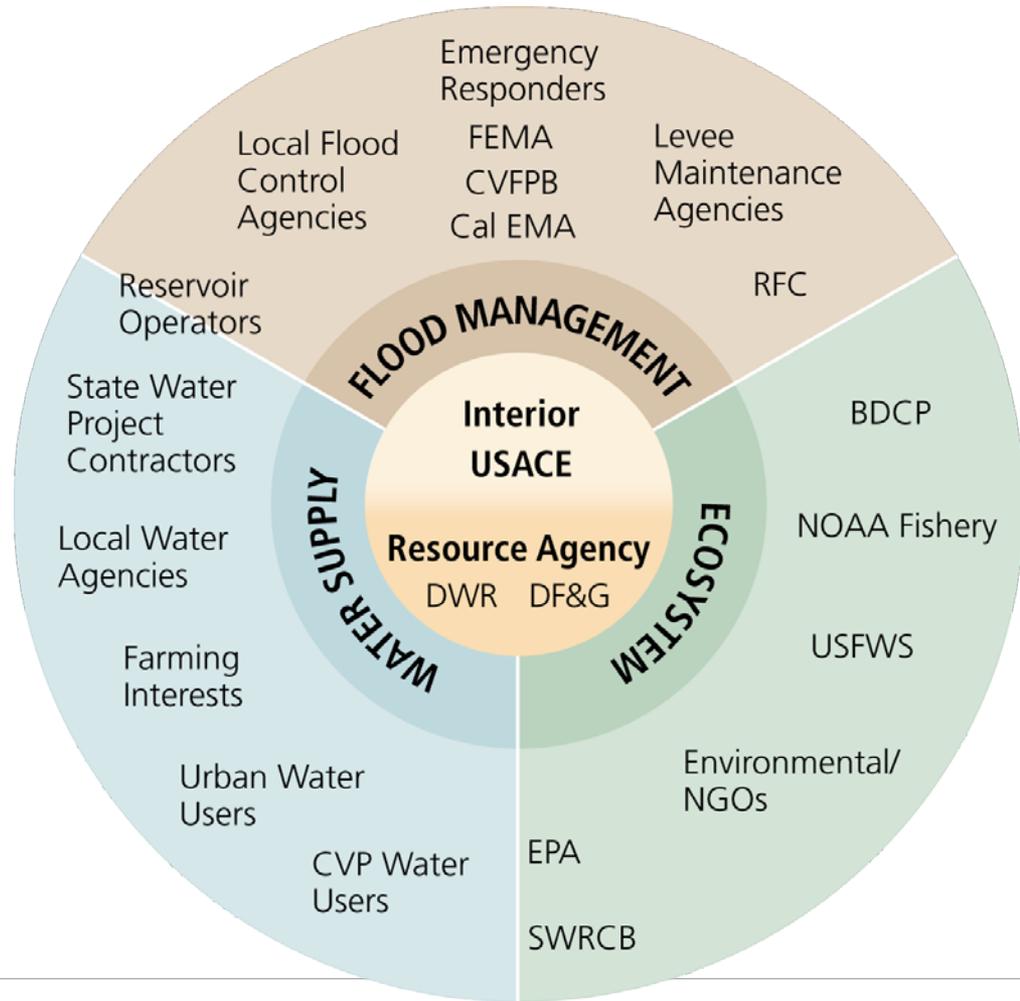
# Integrated Water Management Concept

## Major Water Management Objectives:

- ✓ Public Safety
- ✓ Water Supply Quantity & Quality
- ✓ Ecosystem

## Many Responsible Parties:

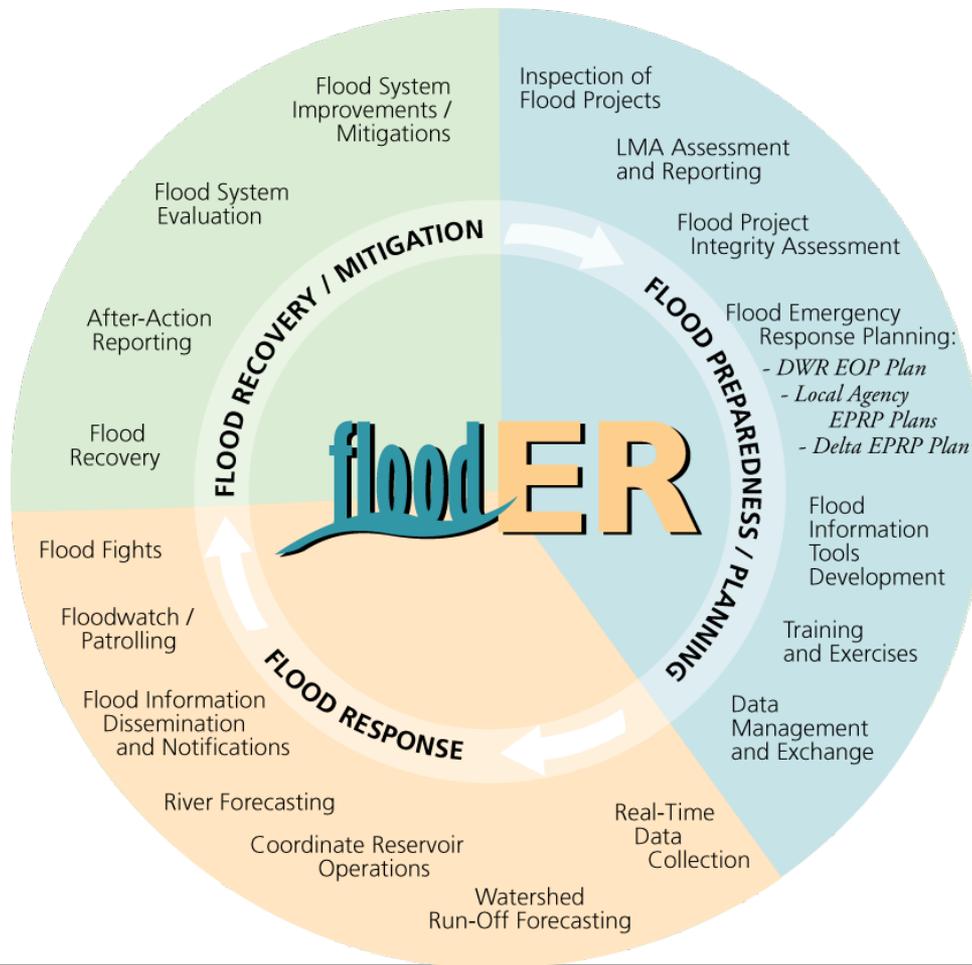
- ✓ Local
- ✓ State
- ✓ Federal

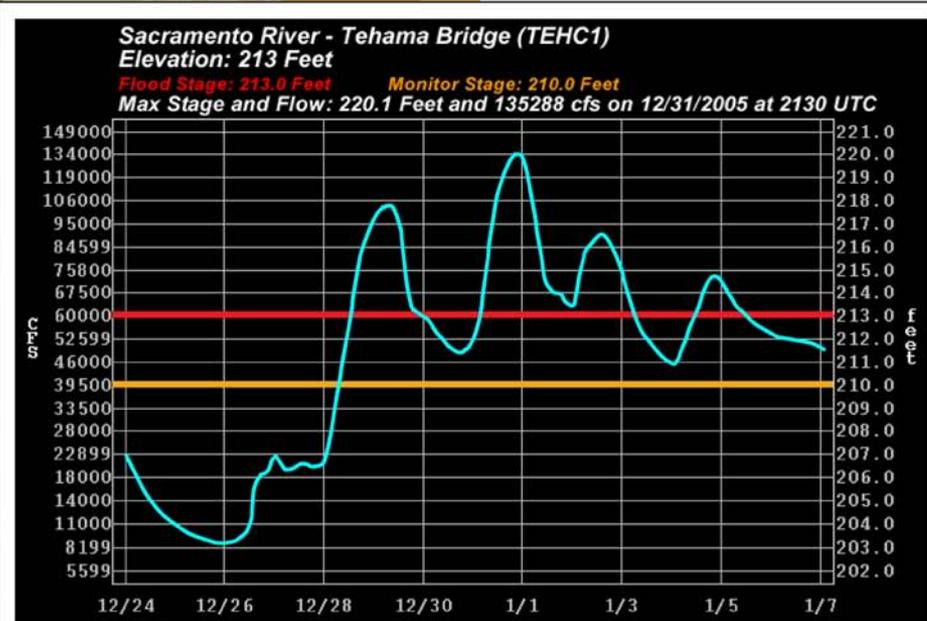
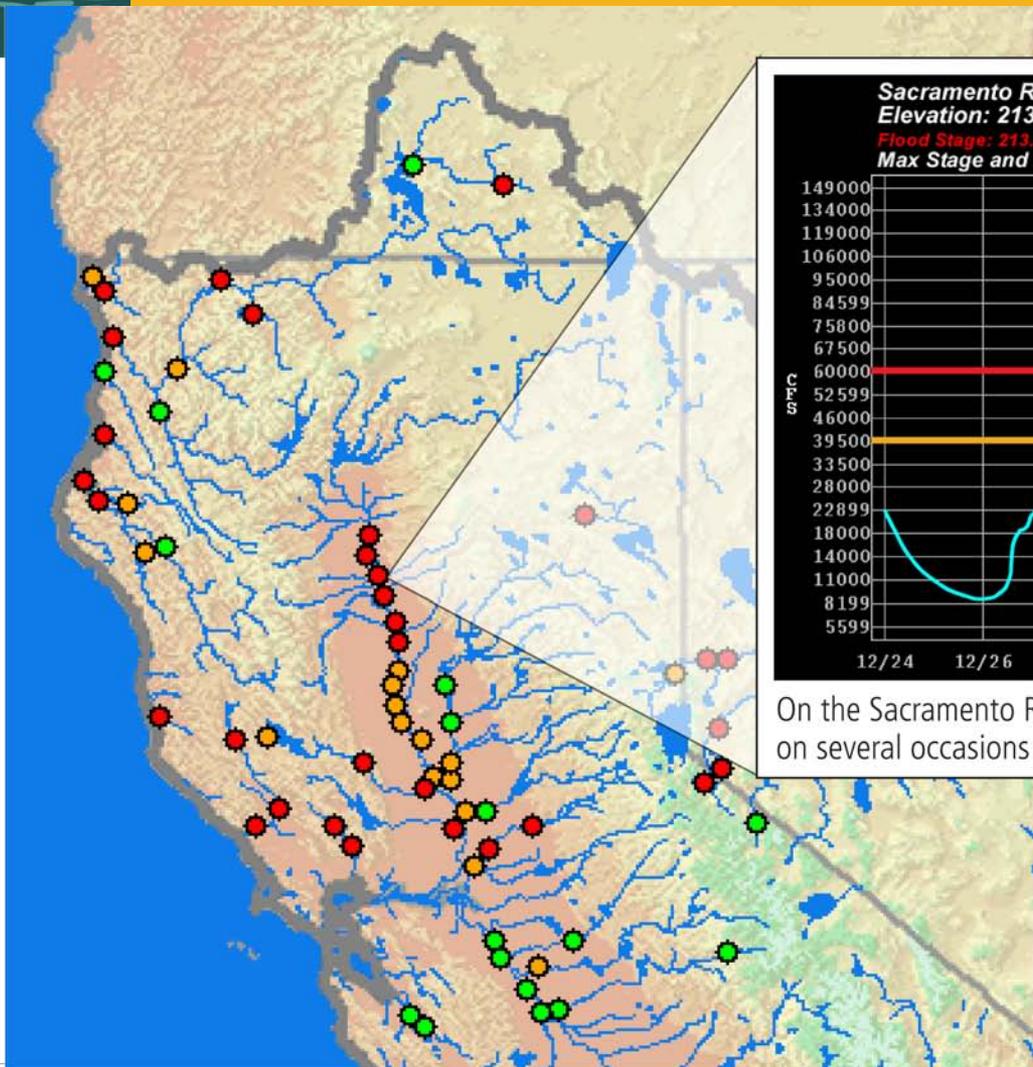


# Flood Management Functional Areas



# Flood Emergency Response





On the Sacramento River at Tehama Bridge, flows exceeded flood stage on several occasions during that period.

- Above Flood Stage (31 gages observed)
- Above Monitor Stage (17 gages observed)
- Normal Conditions (17 gages observed)

Highest observed stage at gage locations during the Dec. 24, 2005 through Jan. 07, 2006 period.



# Routine System Maintenance

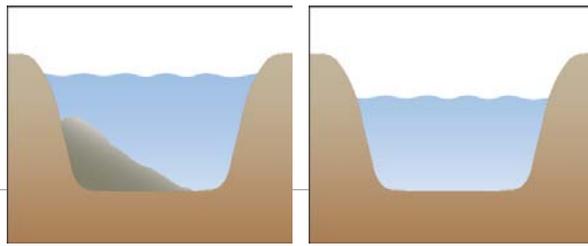
## FLOOD

SYSTEM SUSTAINABILITY



Operations and Maintenance is performed on the Sacramento River Flood Control Project from the Sutter Maintenance Yard which is responsible for the portion of the project north of Knights Landing and the Sacramento Maintenance Yard which is responsible for the portion of the project south of Knights Landing.

### Channel Maintenance – Sediment Removal



Before

After

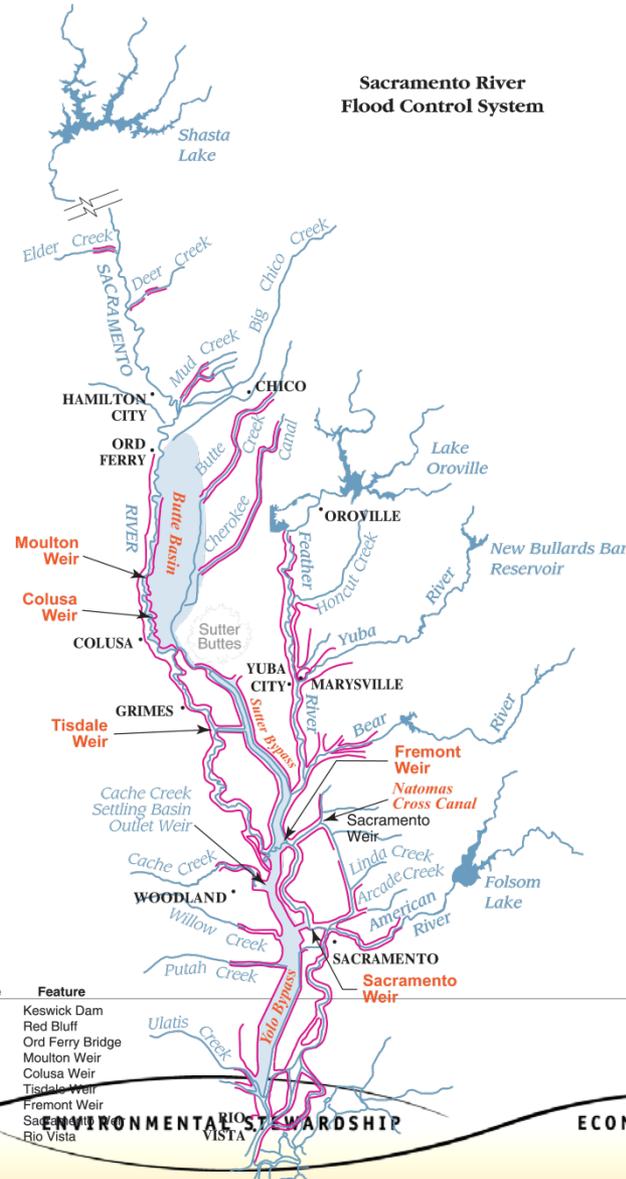


PUBLIC SAFETY

ENVIRONMENTAL STEWARDSHIP

ECONOMIC STABILITY

River Mile	Feature
302	Keswick Dam
245	Red Bluff
184	Ord Ferry Bridge
158	Moulton Weir
146	Colusa Weir
119	Tisdale Weir
82-84	Fremont Weir
63	Sacramento Weir
12	Rio Vista



## FEMA's floodplain mapping includes:

- Flood Insurance Rate Maps (FIRM)
- Digital Flood Insurance Rate Maps (DFIRM)

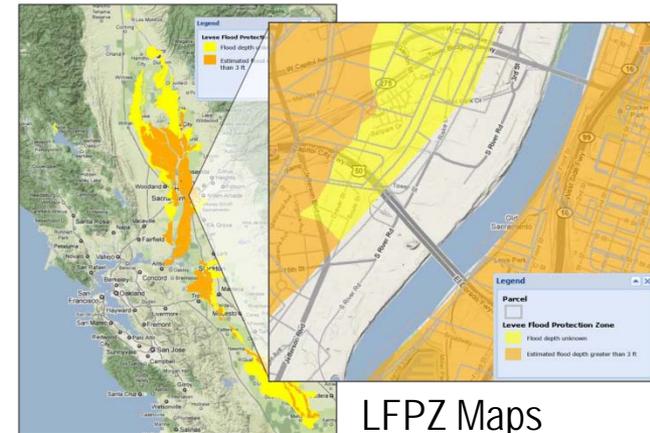
## DWR's floodplain mapping includes:

- Awareness Floodplain Maps
- Best Available Mapping (BAM)
- Levee Flood Protection Zones (LFPZ) Maps
- Central Valley Floodplain Evaluation and Delineation (CVFED) Maps
- Alluvial Fan Floodplain Evaluation and Delineation (AFFED) Maps

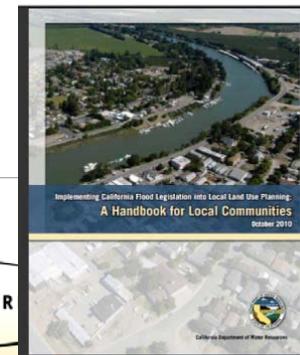
### FLOOD RISK NOTICE 2010



Risk Notification



LFPZ Maps



Handbook for Local Communities

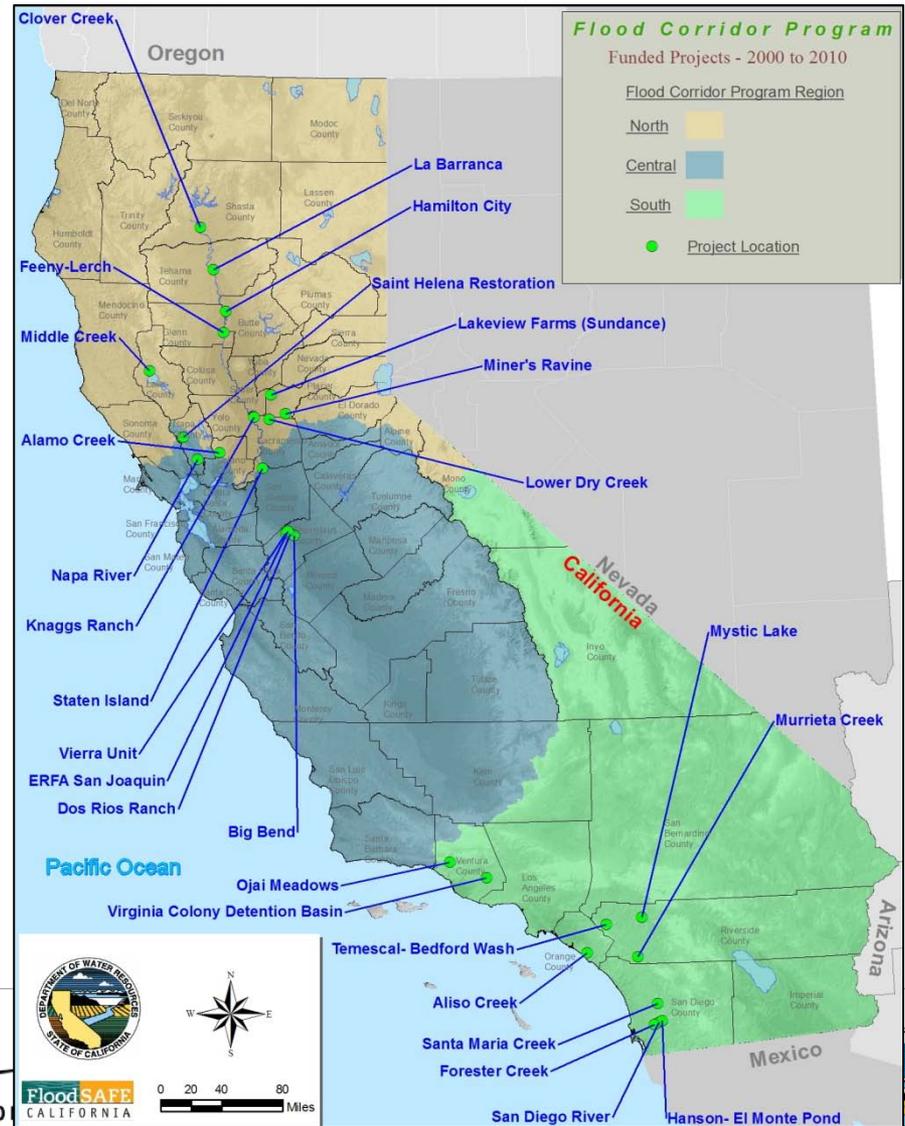
# Flood Grant and Special Projects

# FLOOD

## RISK REDUCTION PROJECTS



- USACE / CVFPB Projects
- USACE / CVFPB Feasibility Studies
- Early Implementation Program
- Flood Control Subventions Program
- Local Levee Assistance Program (LLAP)
- Flood Corridor Program
- Yuba-Feather Flood Protection Program



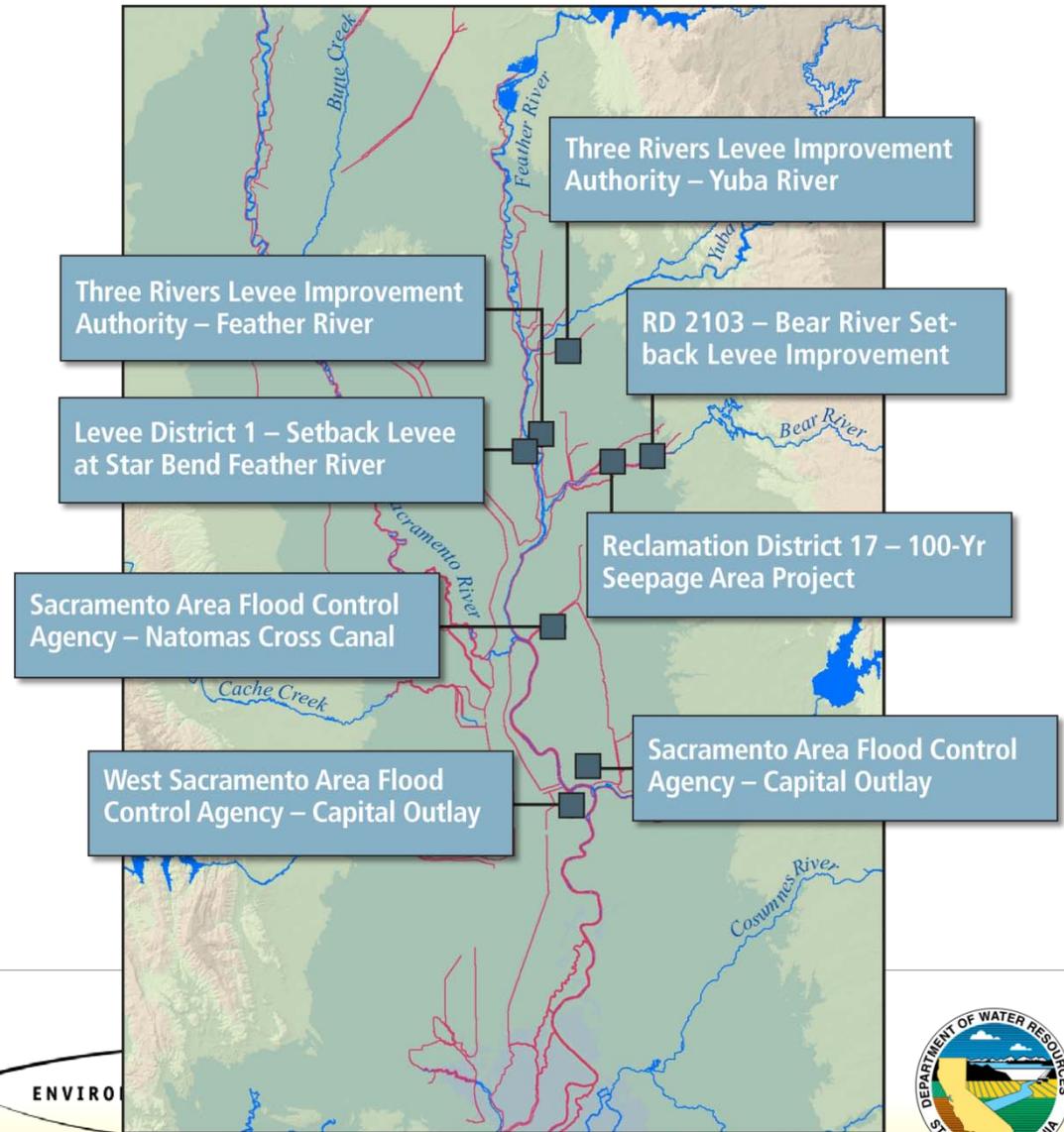
# Early Implementation Program

## FLOOD

RISK REDUCTION PROJECTS



High priority projects need to be implemented now, in advance of completion and adoption of the Central Valley Flood Protection Plan (the Plan) required by State legislation for completion and adoption in 2012.



# Early Implementation Program



Construction progress during the Feather River Setback Levee



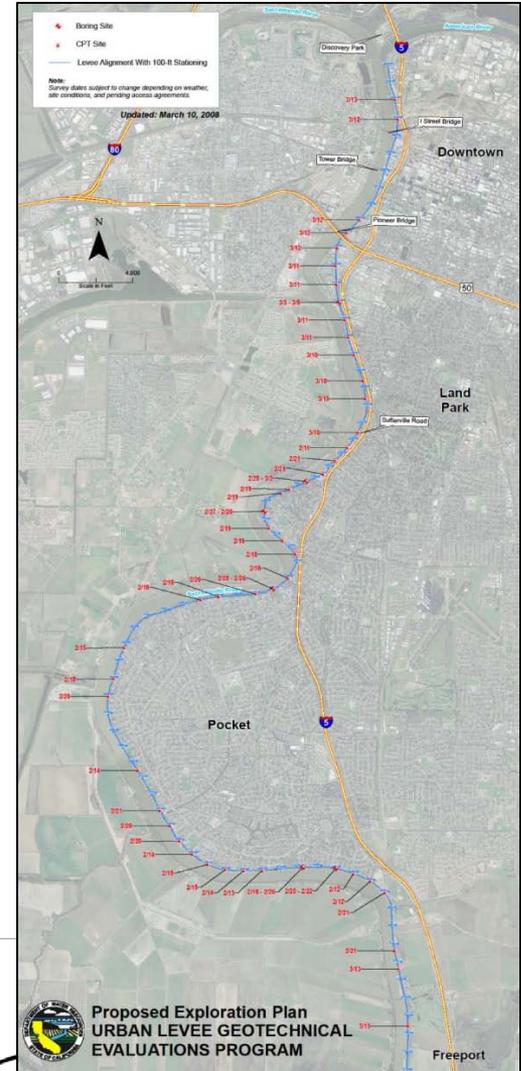
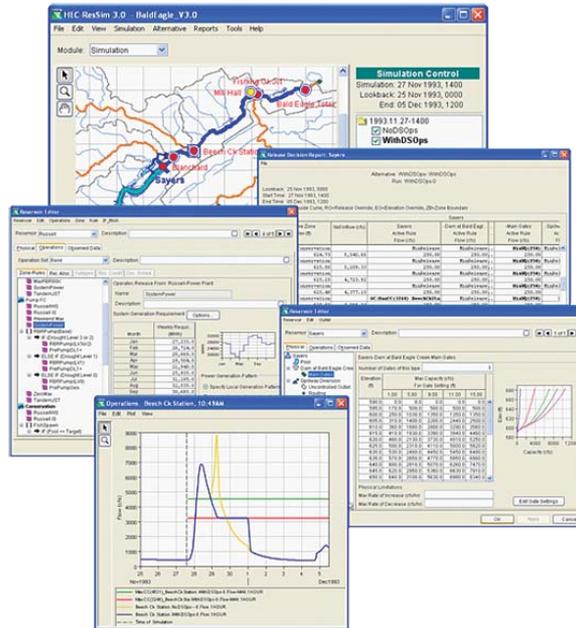
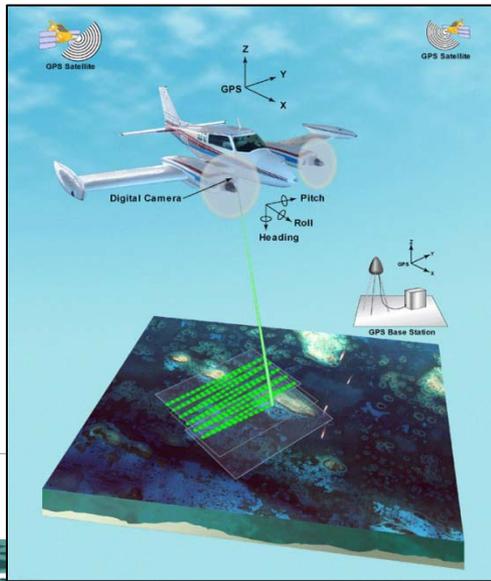
Setback Levee at Star Bend  
Feather River

# New Risk Assessment Efforts

<b>Program: Major Deliverable</b>	<b>Estimated Date</b>
<b>Central Valley Hydrology Study (CVHS)</b>	
Reservoir Models	Spring 2011
Unregulated Inflow Hydrology	Summer 2011
Regulated – Unregulated Transforms	Fall 2011
Regulated Stage – Flow Frequencies	Winter 2012
<b>Central Valley Floodplain Evaluation &amp; Delineation (CVFED)</b>	
Systemwide Hydraulic Models	Spring 2012
Impact Area Spreading / Inundation Models	Summer 2012
Composite Floodplains	Fall 2012
Reach Specific Water Surface Profiles	Winter 2013
<b>Central Valley Flood Protection Plan 2012 (CVFPP)</b>	
Impact Area Expected Annual Damages	Summer 2011
Impact Area Expected Annual Life Loss	Fall 2011
Systemwide Expected Annual Damages	Fall 2011
Systemwide Expected Annual Life Loss	Fall 2011

# Levee Evaluation and Flood Modeling

- Data Acquisition
- Levee Evaluation
- Modeling

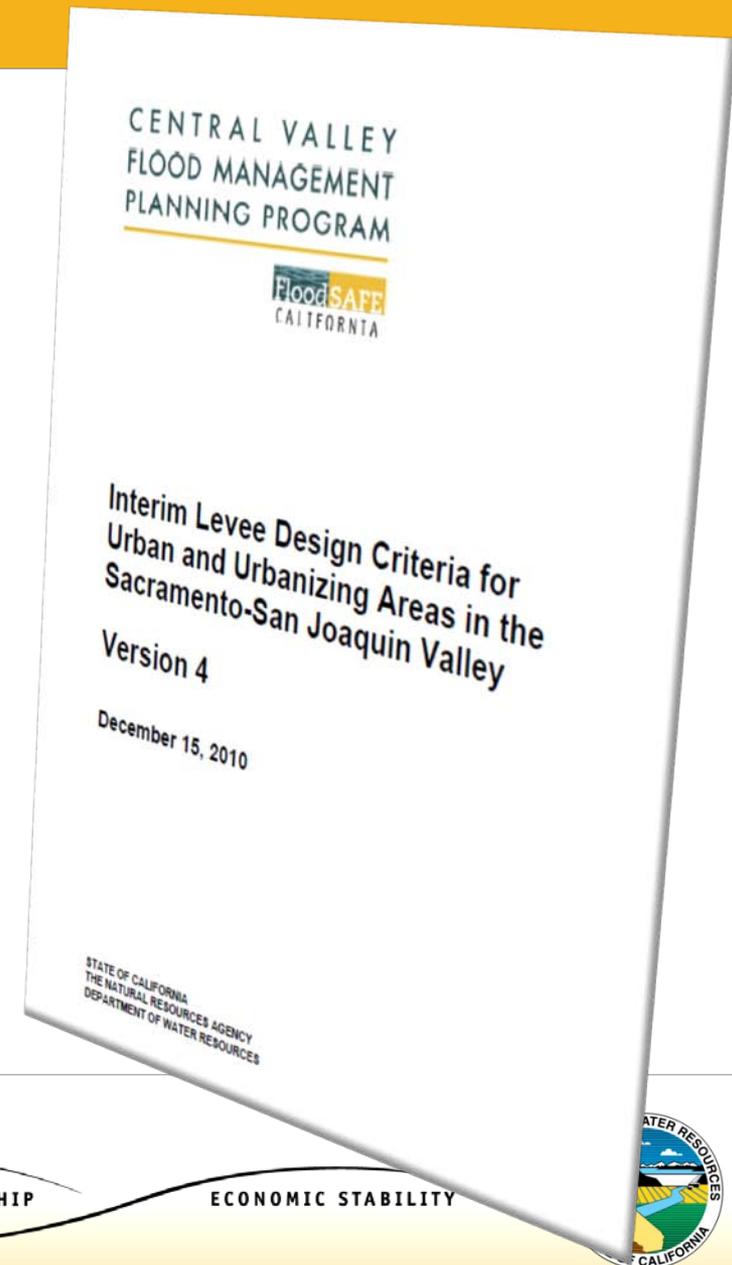


# Interim Levee Design Criteria (v4)

**Table 2. Levee Design Criteria Summary for Intermittently-Loaded Levees**

Parameter	Criteria			
DWSE (Option 1)	Median 200-year WSE			
DWSE (Option 2)	90% assurance 200-year WSE			
TOL (Option 1) for hydraulic criteria	Median 200-year WSE + higher of (1) 3 feet, or (2) height for wind setup and wave runup			
TOL (Option 2) for hydraulic criteria	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) for geotechnical criteria	Lower of (1) median 200-year WSE plus three feet, or (2) median 500-year WSE			
HTOL (Option 2) for geotechnical criteria	Lower of (1) median 200-year WSE plus three feet, (2) physical top of levee if it is equal to or higher than the 95% assurance 200-year WSE and at least two feet above the median 200-year WSE, or (3) median 500-year WSE			
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 $\geq 1.6$	$i \leq 0.6$	FS $\geq 1.3$
Seepage - Exit Gradient at Seepage Berm Toe	$i \leq 0.8$	FS $\geq 1.0$	<20% FS degradation for berms less than 100 feet	<10% FS degradation for berms less than 100 feet
Steady State Slope Stability	FS $\geq 1.4$		FS $\geq 1.2$	
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% assurance 200-year WSE, and the 95% 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.



# Flood Control System Status Report

**TABLE A ★ 2009 Report Card for America's Infrastructure**

Aviation	D
Bridges	C
Dams	D
Drinking Water	D-
Energy	D+
Hazardous Waste	D
Inland Waterways	D-
Levees	D-
Public Parks and Recreation	C-
Rail	C-
Roads	D-
Schools	D
Solid Waste	C
Transit	D
Wastewater	D-

**AMERICA'S INFRASTRUCTURE G.P.A. **D****

ESTIMATED 5 YEAR INVESTMENT NEED **\$2.2 TRILLION**

**NOTES** Each category was evaluated on the basis of capacity, condition, funding, future need, operation and maintenance, public safety and resilience

**A** = Exceptional  
**B** = Good  
**C** = Mediocre  
**D** = Poor  
**F** = Failing

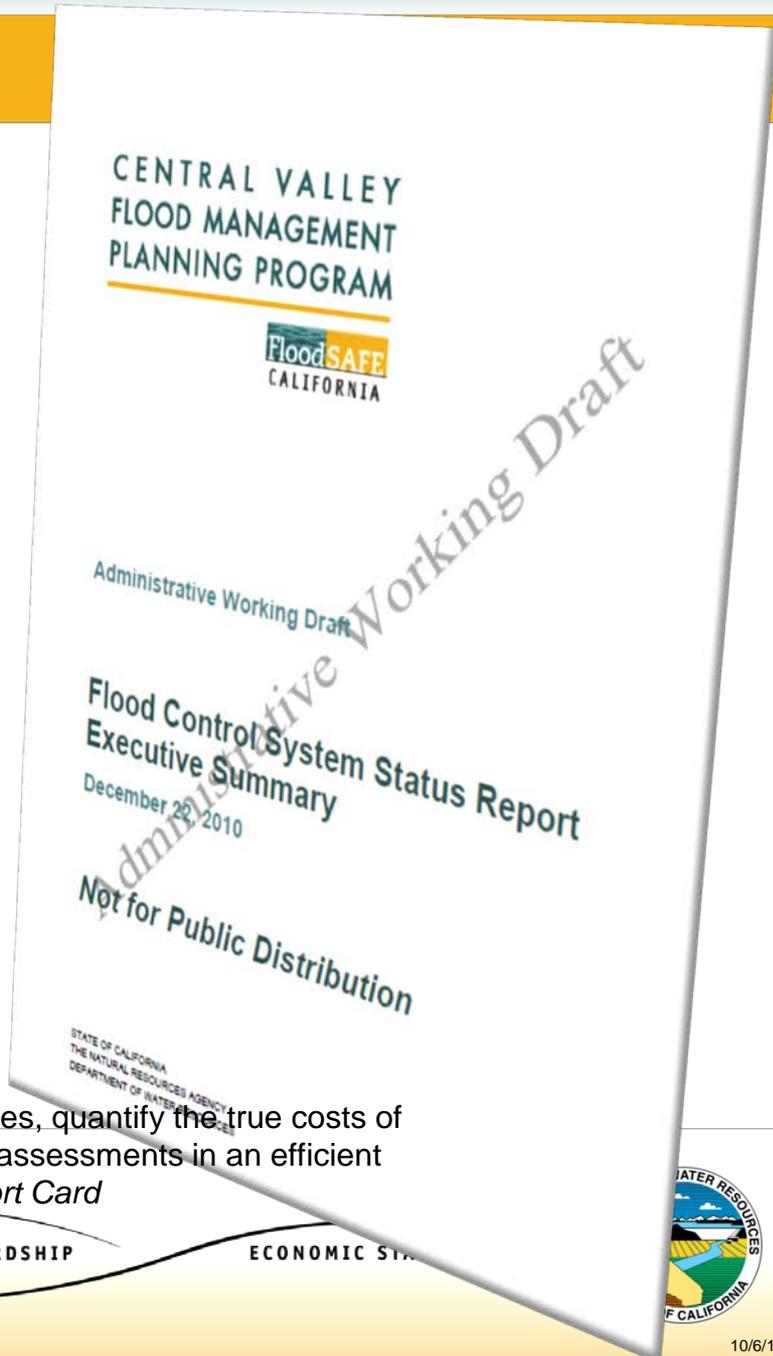
**MORE THAN LEVEES**

## Considers:

- Levees
- Channels
- Structures

## Describes Flood Hazard as:

- Low
- Medium
- High



“...baseline information ... to identify the most critical levee safety issues, quantify the true costs of levee safety, prioritize future funding, and provide data for risk-based assessments in an efficient or cost-effective manner.” – ASCE America's Infrastructure 2009 Report Card

# Systemwide Feasibility Studies

Establishing Investment Needs &  
Priorities:

Overview of the Central Valley Flood  
Protection Plan

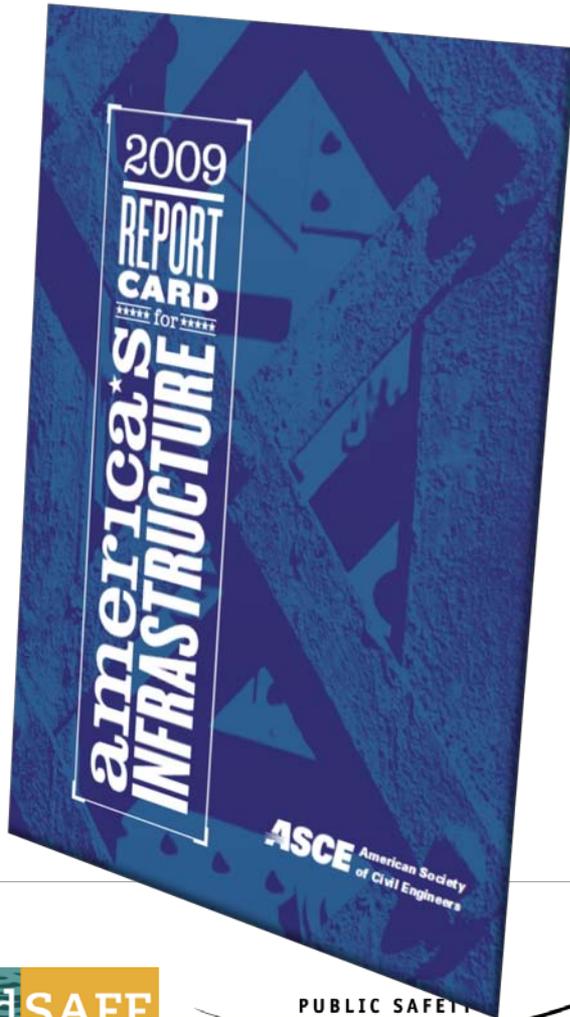
**PUBLIC SAFETY**

**ENVIRONMENTAL STEWARDSHIP**

**ECONOMIC STABILITY**

# Reducing Flood Risk in the United States

ASCE's 2009  
America's Infrastructure Report Card



WATER AND ENVIRONMENT  
LEVEES | 2009 GRADE | **D-**

## RAISING THE GRADES SOLUTIONS THAT WILL WORK NOW

- A = Exceptional
- B = Good
- C = Mediocre
- D = Poor
- F = Failing

AMERICA'S INFRASTRUCTURE G.P.A. **D**

### ESTIMATED 6-YEAR FUNDING REQUIREMENTS FOR LEVEES

Total investment needs  
**\$80 BILLION**

Estimated spending  
**\$1.15 BILLION**

Projected shortfall  
**\$48.87 BILLION**



- ★ **ADOPT** the following recommendations from the 2009 National Committee on Levee Safety:  
**ESTABLISH** a National Levee Safety Commission;  
**COMPLETE** the National Levee Inventory for both federal and nonfederal levees. The inventory must be regularly updated and maintained;  
**ADOPT** a hazard potential classification system;  
**CREATE** a strong education and outreach program to inform local leaders and residents about the level of protection they can expect from a nearby levee;²
- ★ **PHASE** in mandatory purchase of flood insurance with risk-based premiums for structures in areas protected by levees;
- ★ **INCREASE** funding at all levels of government to address structural and nonstructural solutions that reduce risk to people and property. Additionally, investments should be targeted to address life-cycle costs and research;
- ★ **REQUIRE** the development and exercising of emergency action plans for levee-protected areas;
- ★ **ENSURE** that operation and maintenance plans cover all elements of the system, recognizing that levees are part of complex systems that also include pumps, interior drainage systems, closures, penetrations, and transitions;
- ★ **ASSESS** levees using updated hydrology and hydraulic analyses that incorporate the impact of urbanization and climate change, particularly for coastal levees.

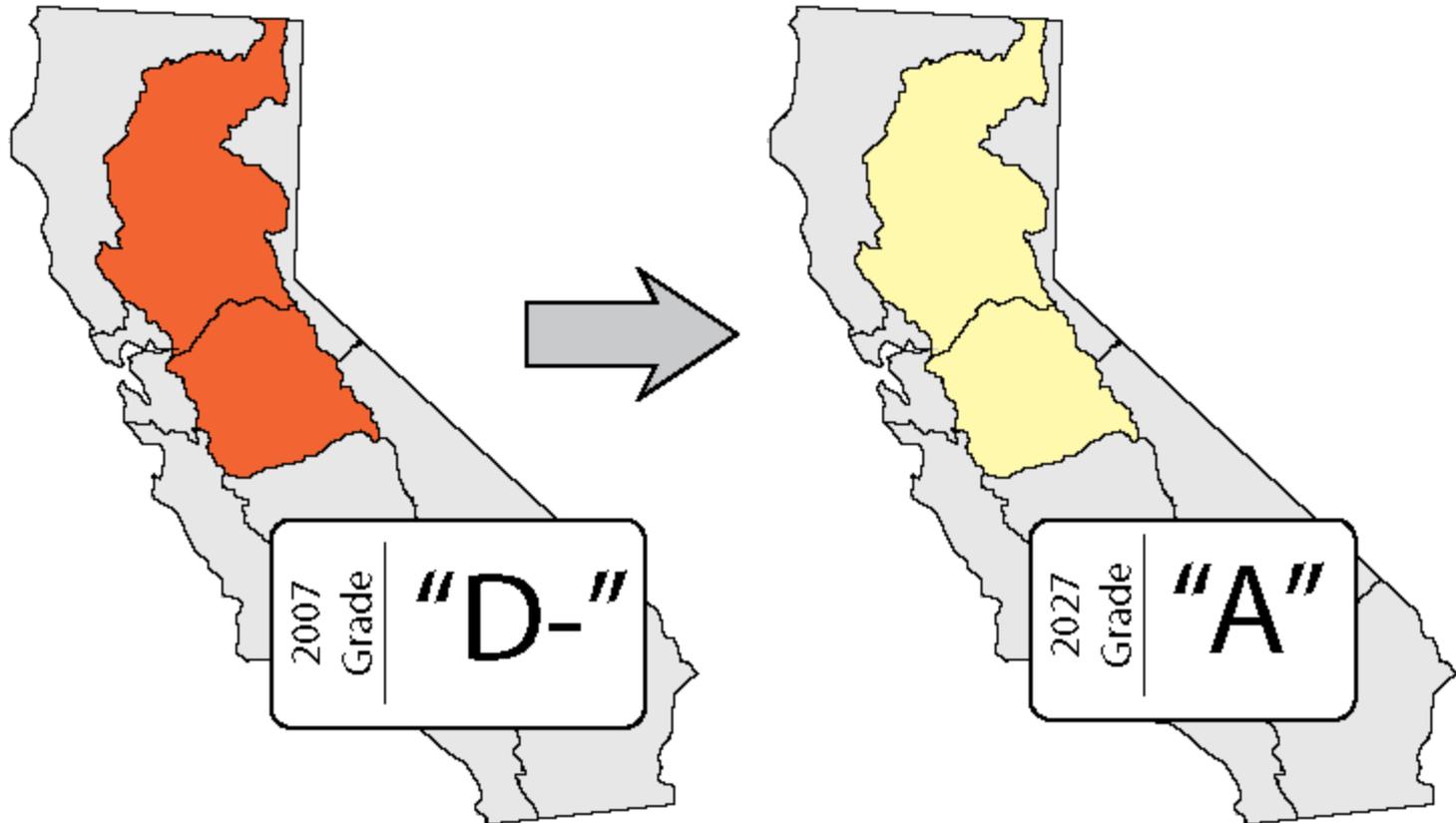
Facts About **LEVEES**

[www.asce.org/reportcard](http://www.asce.org/reportcard)

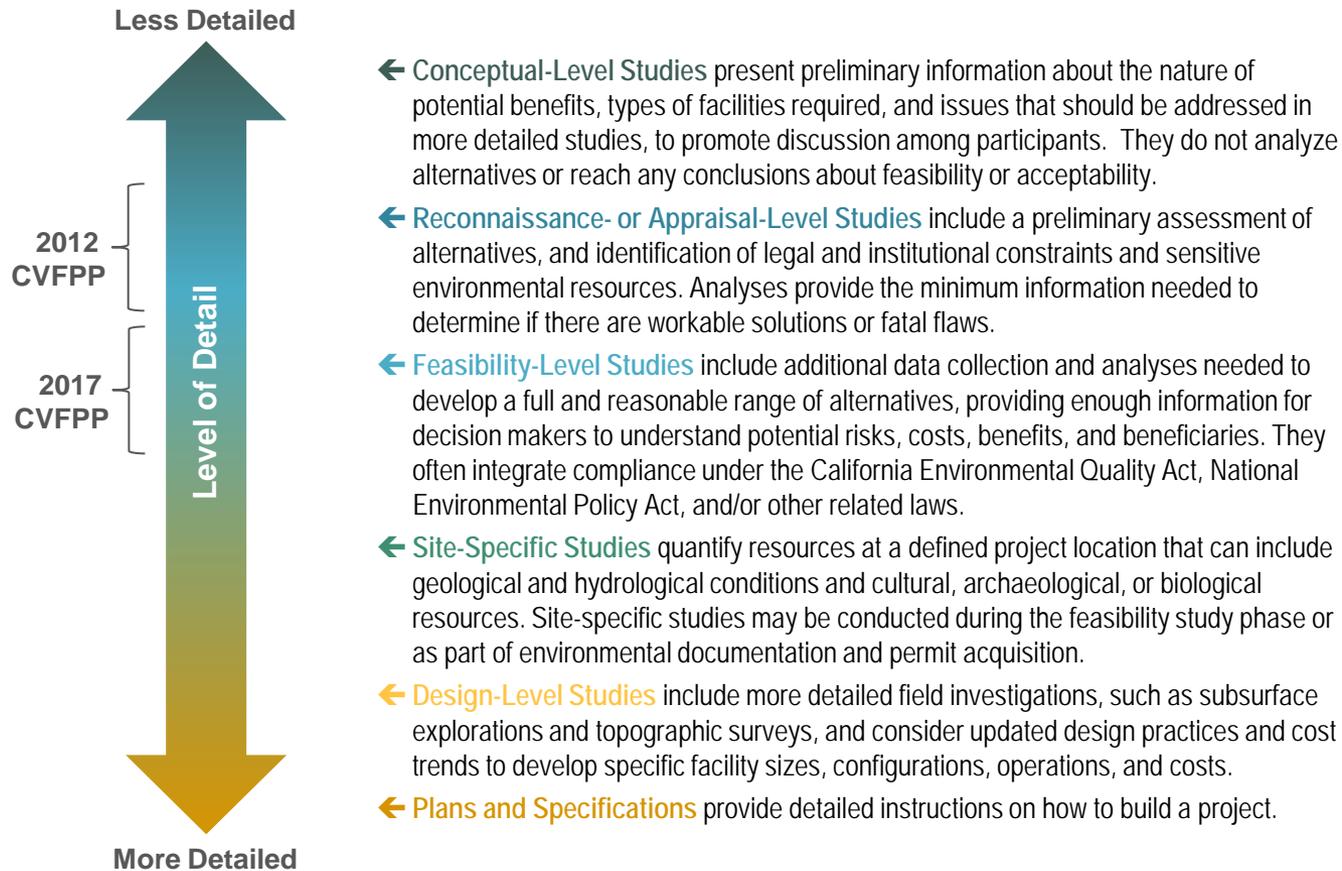
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# Improving CA's "Risk Reduction" Grade

## Reducing Flood Risk in CA's Central Valley



# Level of Detail in a Study



## KEY

CVFPP = Central Valley Flood Protection Plan

# Types of Studies for Structural Applications

Analysis Type	Systemwide / Watershed Investment	Project Feasibility <sup>1</sup>	Project Design <sup>2</sup>	Project Implementation / Permitting
<b>Economic Accounting Focus</b>	National Economic Development (NED)			Regional Economic Development (RED)
<b>Level of Effort of Technical Analysis</b>				
<b>Capital Investment</b>	\$Bs	\$100s M		\$10s - \$1s M
<b>Total Soft Costs</b>	1 - 2%	10 - 15%	30 - 40%	
<b>Time to Complete Analysis</b>	3- 5 years	1 - 2 years	6 - 18 months	90 - 120 days
<b>Levee Performance Assumptions</b>				
<b>Upstream Levees</b>	<ul style="list-style-type: none"> <li>“Most Likely” Performance</li> </ul>	<ul style="list-style-type: none"> <li>“Most Likely” Performance</li> </ul>	<ul style="list-style-type: none"> <li>Top of Levee + Existing Freeboard</li> <li>Weir Overflow</li> </ul>	<ul style="list-style-type: none"> <li>Top of Levee + Existing Freeboard</li> <li>Weir Overflow</li> </ul>
<b>Improvement Project / At Site Levees</b>	<ul style="list-style-type: none"> <li>Probabilistic / Monte Carlo Performance</li> </ul>	<ul style="list-style-type: none"> <li>Probabilistic / Monte Carlo Performance</li> </ul>	<ul style="list-style-type: none"> <li>Proposed Top of Levee + Freeboard</li> </ul>	<ul style="list-style-type: none"> <li>Proposed Top of Levee + Freeboard</li> </ul>
<b>Downstream Levees</b>	<ul style="list-style-type: none"> <li>“Most Likely” Performance</li> </ul>	<ul style="list-style-type: none"> <li>“Most Likely” Performance</li> </ul>	n/a	<ul style="list-style-type: none"> <li>Top of Levee + Existing Freeboard</li> <li>Weir Overflow</li> </ul>

# Types of Studies for Non-Structural Applications

Analysis Type	Water Surface Profile	Composite Floodplain Mapping
<b>Study Focus</b>	Identify Water Surface Elevations	<ol style="list-style-type: none"> <li>1. Develop Depth Inundation Maps</li> <li>2. Estimate Flood Inundation Time</li> </ol>
<b>Level of Effort of Technical Analysis</b>		
<b>Time to Complete Analysis<sup>1</sup></b>	90 – 120 days	1 – 2 years
<b>Levee Performance Assumptions</b>		
<b>Upstream Levees</b>	<ul style="list-style-type: none"> <li>• “Most Likely” Performance</li> </ul>	<ul style="list-style-type: none"> <li>• Top of Levee + Freeboard</li> <li>• Weir Overflow</li> </ul>
<b>Improvement Project / At Site Levees</b>	<ul style="list-style-type: none"> <li>• Top of Levee + Freeboard</li> <li>• Weir Overflow</li> </ul>	<ul style="list-style-type: none"> <li>• Hydraulic Failure of Levee to Landside Toe (aka Removal)</li> </ul>
<b>Downstream Levees</b>	<ul style="list-style-type: none"> <li>• “Most Likely” Performance [?]</li> </ul>	n/a

1. Time to Complete Analysis assuming existing system hydraulic and floodplain models are available.

# Chapter 1:

## Establishing the Need for a Central Valley Flood Protection Plan

**PUBLIC SAFETY**

**ENVIRONMENTAL STEWARDSHIP**

**ECONOMIC STABILITY**

**Risk = Hazard + Exposure + Performance + Consequences**

**Hazard**



**Exposure**



**Performance**



12.29.2010

**Consequences**

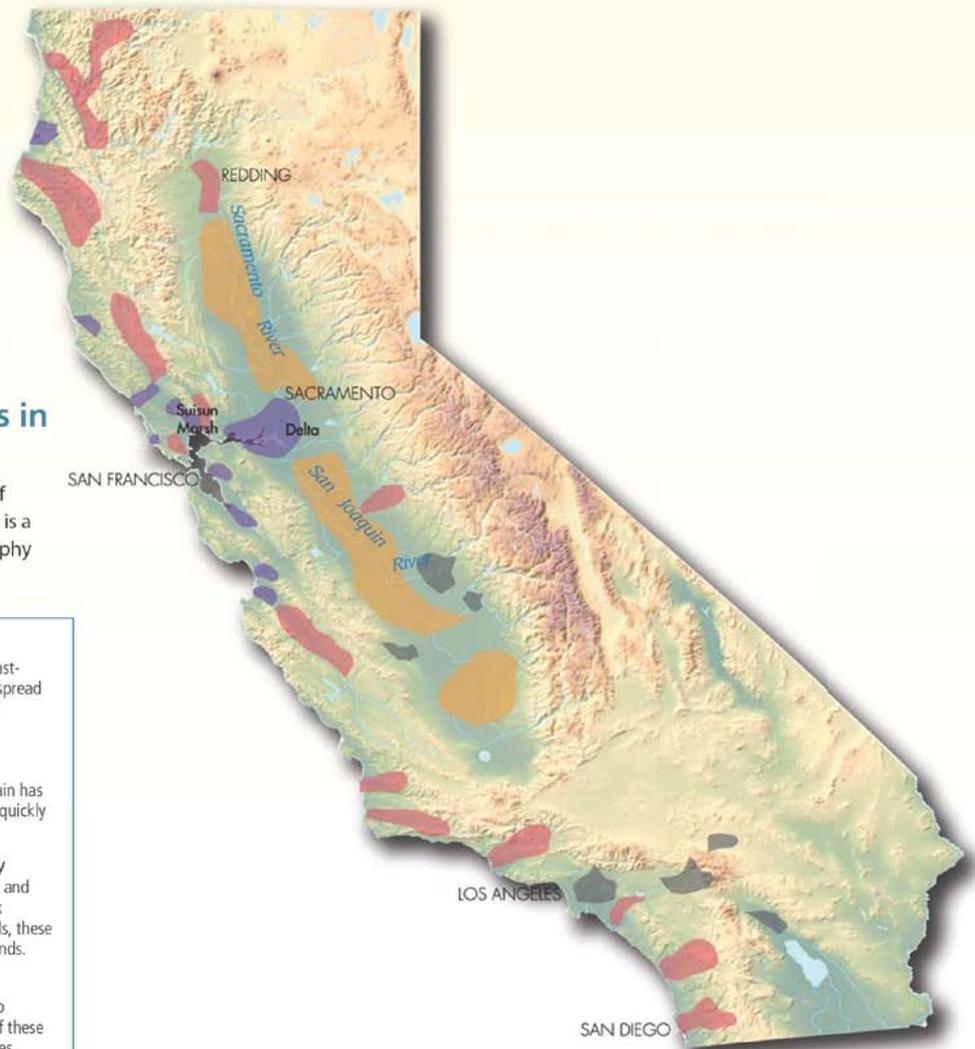


# Flood Hazard Types in California

## Flood Hazard Types in California

The duration and spatial extent of flooding in different hazard types is a function of both the local geography and hydrology.

-  **Alluvial Fans**  
Flooding can occur when fast-moving mountain streams spread as they reach flatter plains.
-  **Banked Rivers / Headwater Regions**  
Mountainous and hilly terrain has natural defined banks that quickly pass flood waters.
-  **Coastal / Tidal Estuary**  
Subject to daily tidal action and often comprising a complex network of braided channels, these areas form flood-prone islands.
-  **Deep Floodplain**  
These flatlands are prone to seasonal flooding. Many of these areas are protected by levees.



# Deep Floodplain Hazard Characteristics

Characteristic	Alluvial Fans	Banked Rivers / Headwaters	Coastal / Tidal Estuaries	Deep Floodplains
Time to Peak	Hours	Hours	Days	Days
Duration of Flood	Hours	Weeks	Seasonal	Weeks
Area Flooded	Small	Small	Medium	Large
Drainage Area	Small	Medium	Variable	Large
Characteristic Storm	Thunderstorm	Winter	Winter & Spring Tide	Winter & Snow Melt
High Sediment Load	Yes	No	No	No
Man-Made Levees	Rare	Rare	Variable	Common

## Chapter 2:

### Evaluating Preliminary Approaches Leading to State Systemwide Investment Approach

**PUBLIC SAFETY**

**ENVIRONMENTAL STEWARDSHIP**

**ECONOMIC STABILITY**

# Approaches Overview



**Achieve SPFC  
Design Flow Capacity**

*Address flow capacity and other conditions for existing SPFC facilities. No major changes to footprint or operation of SPFC facilities*



**Protect High  
Risk Communities**

*Focus on protecting life safety for populations at highest risk, including urban areas and small communities*



**Enhance Flood  
System Capacity**

*Seek opportunities to achieve multiple benefits through enhancing flood system storage and conveyance capacity*



**Policies and Guidance**



**State  
Systemwide  
Investment  
Approach**

## Chapter 3:

Evaluating the State Systemwide  
Investment Approach  
(i.e., Measuring the Plan Benefits)

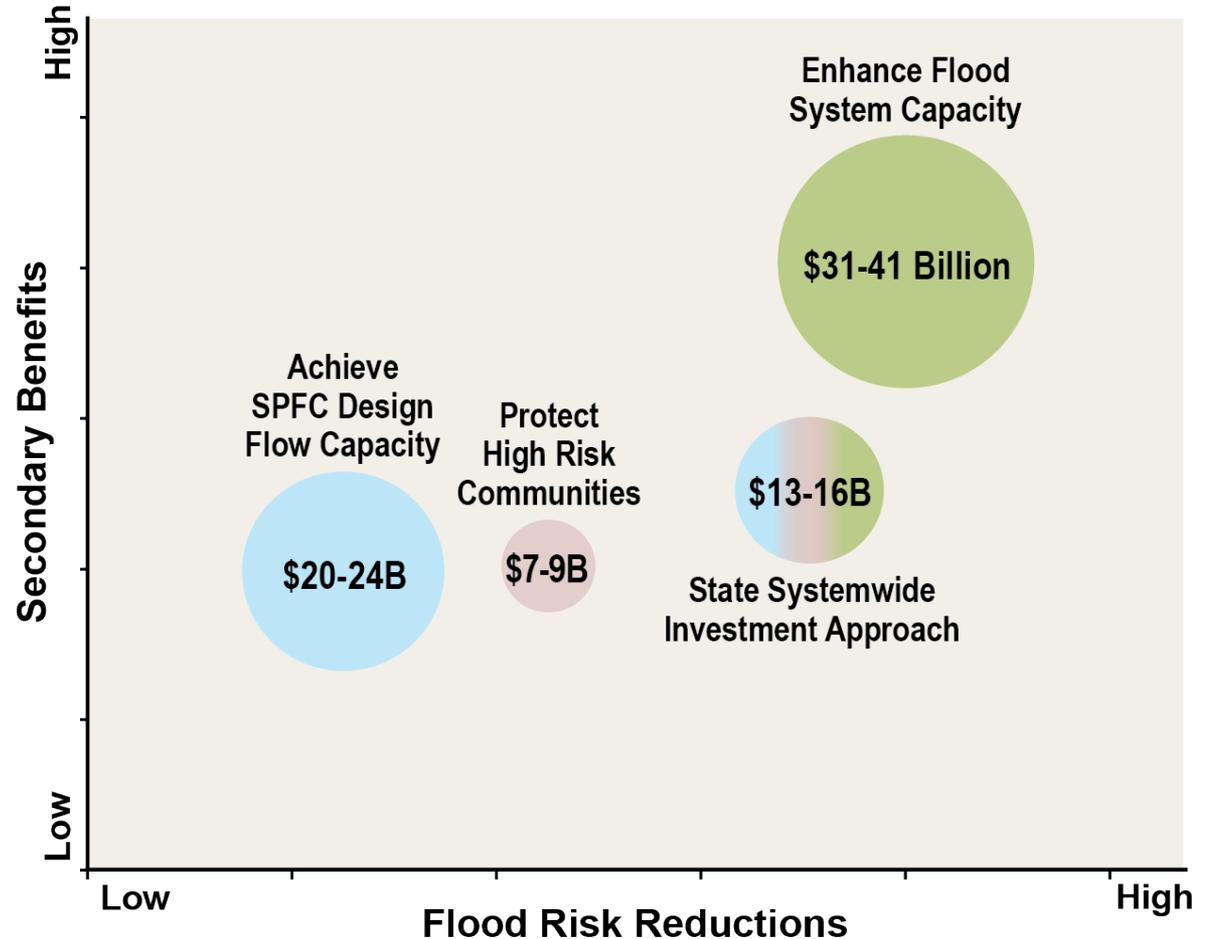
**PUBLIC SAFETY**

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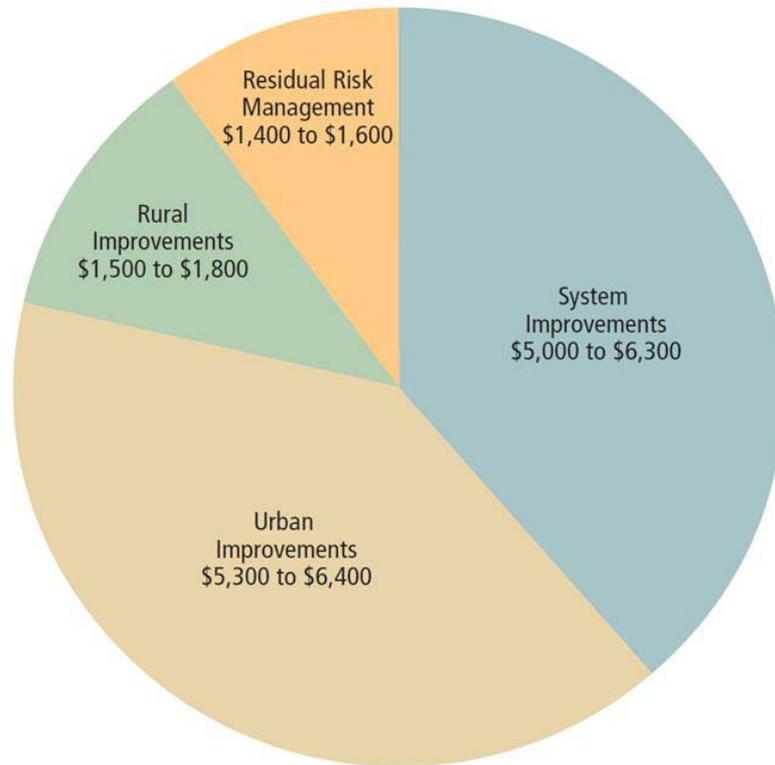
# CVFPP Relative Cost and Performance

Relative Cost and Performance of the Three Preliminary Approaches with SSIA



# Element Type of CVFPP Investments

SSIA Investments by SSIA Elements  
(in \$million)



4 Types of Elements Covered in CVFPP:

- ✓ System Improvements
- ✓ Urban Improvements
- ✓ Rural Improvements
- ✓ Residual Risk Management Actions

# Chapter 4:

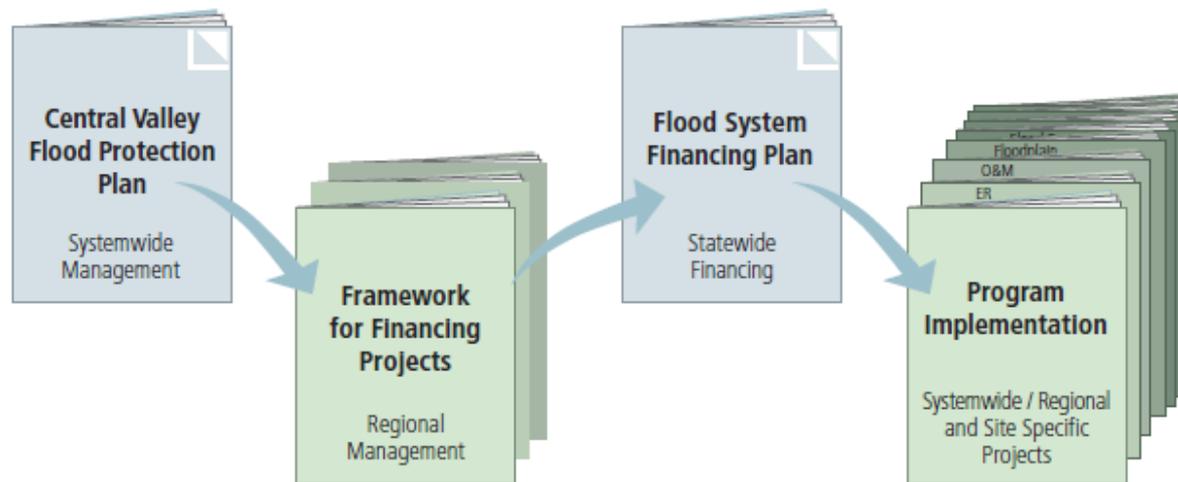
## Central Valley Flood Protection Plan Implementation (i.e., Paying for the Plan)

**PUBLIC SAFETY**

**ENVIRONMENTAL STEWARDSHIP**

**ECONOMIC STABILITY**

# Moving from Plans to Implementation



- Flood System Deficiencies
- Capital Improvements
- Managing State-federal Flood System
- Financing Strategy

- Local/State Interest and Funding
- Federal Interest and Funding
- Implementation Issues

- History/Accomplishments
- Five-year Bond Expenditure Plan
- CVFPP Capital Improvements
- Delta Capital Improvements
- Statewide Flood Management Plan Capital Improvements

- 2017 CVFPP
- Two Systemwide Feasibility Studies
- CVFPP Systemwide Improvements
- Urban Improvements
- Rural and Small Community Improvements
- Residual Risk Management

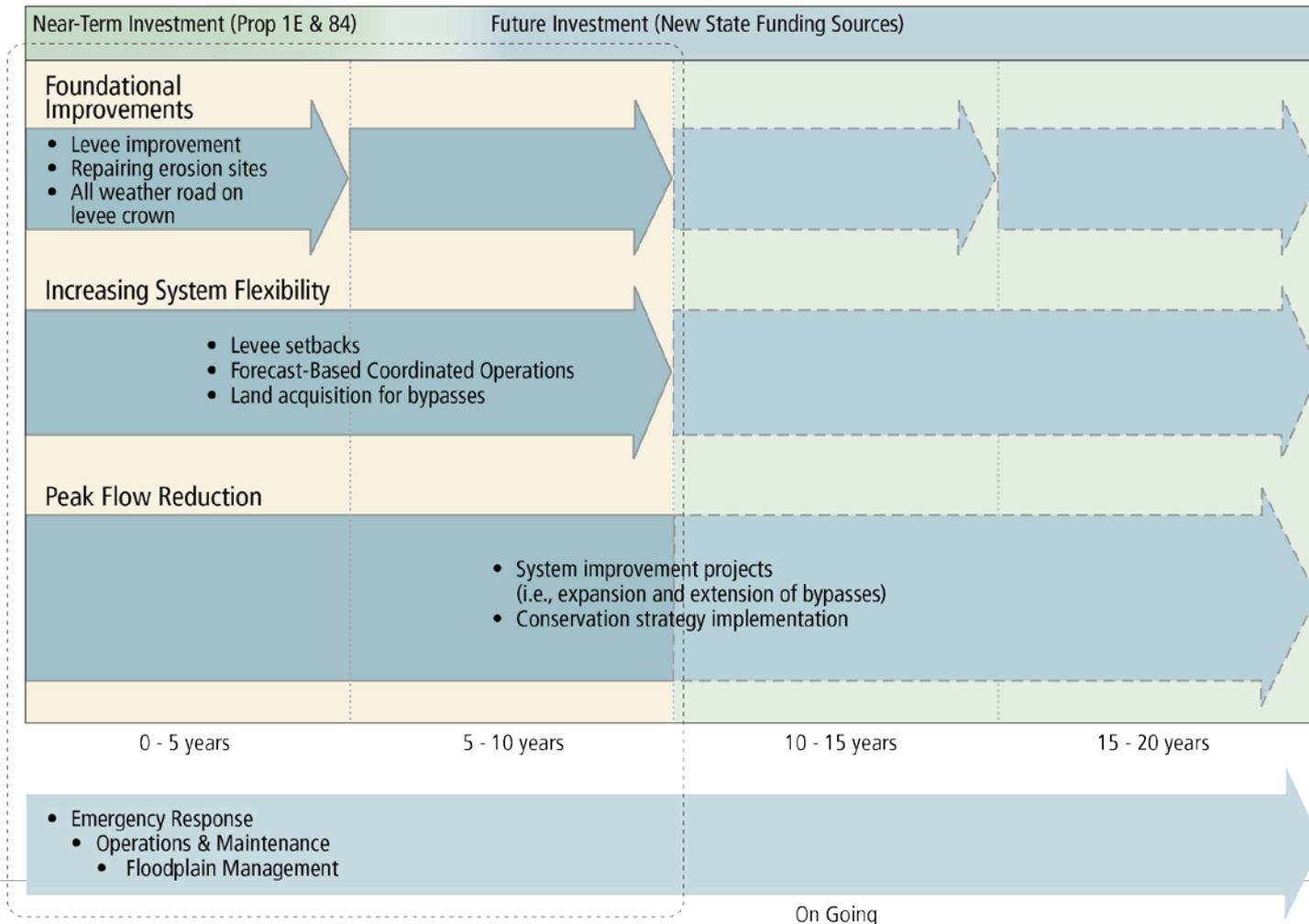


PUBLIC SAFETY

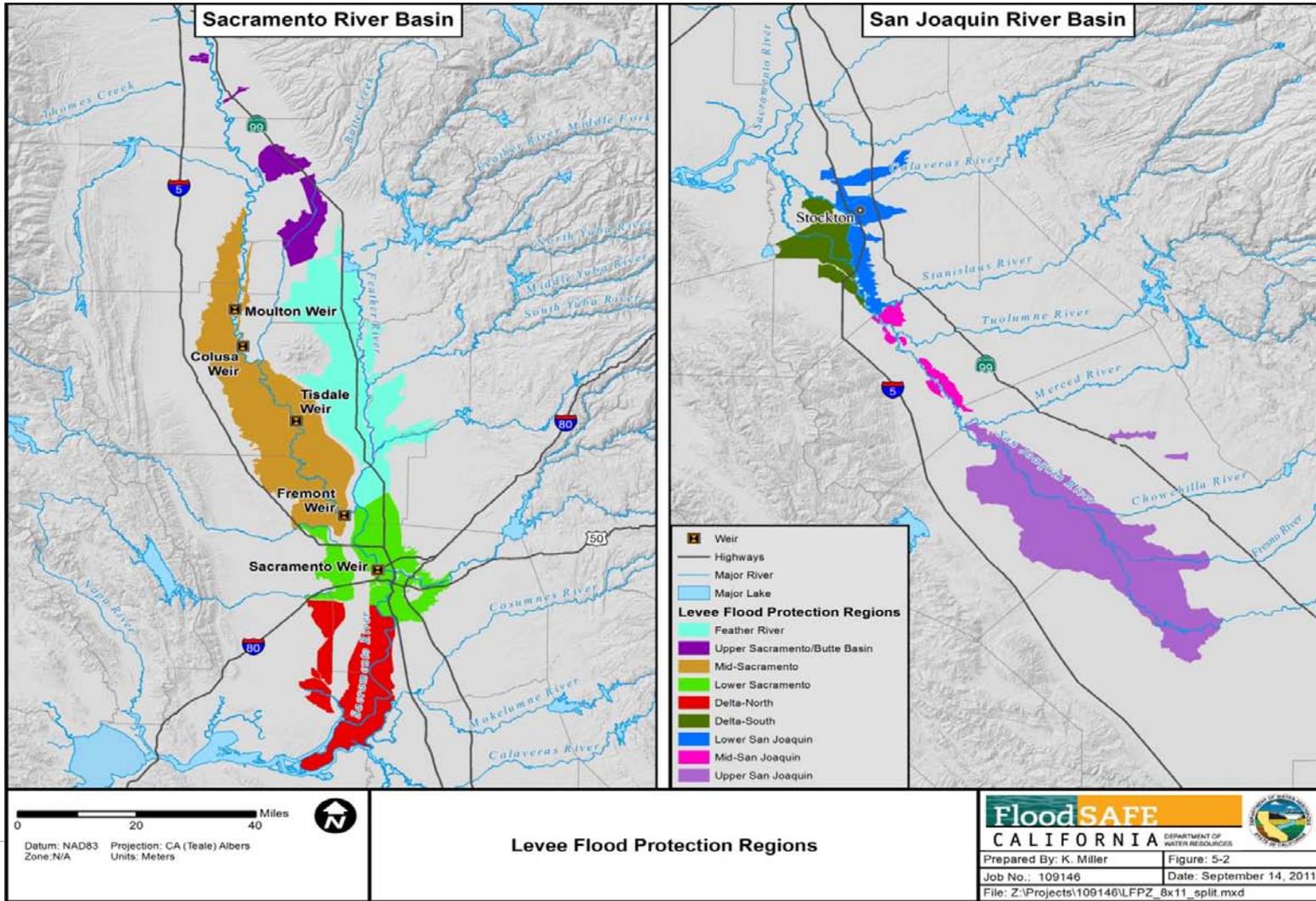
ENVIRONMENTAL STEWARDSHIP

ECONOMIC STABILITY

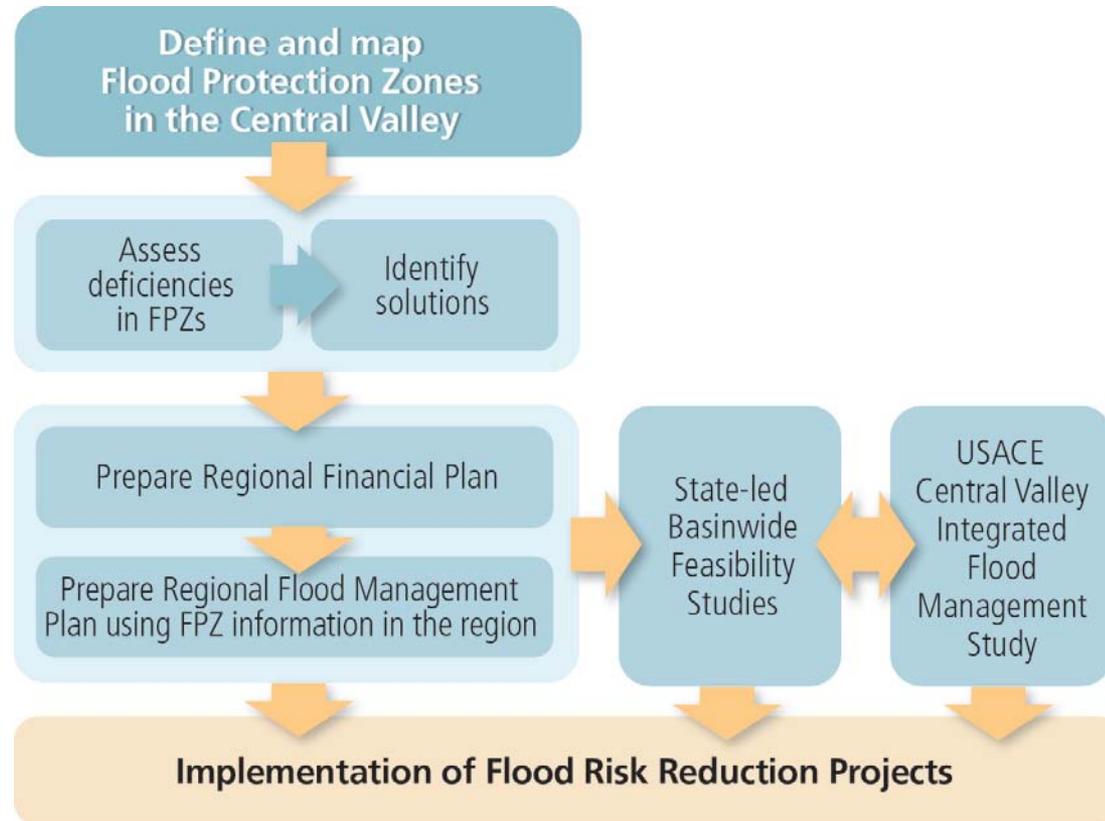
# Timing of CVFPP Implementation



# Investment Regions within CVFPP



# Process for Identifying Specific Projects

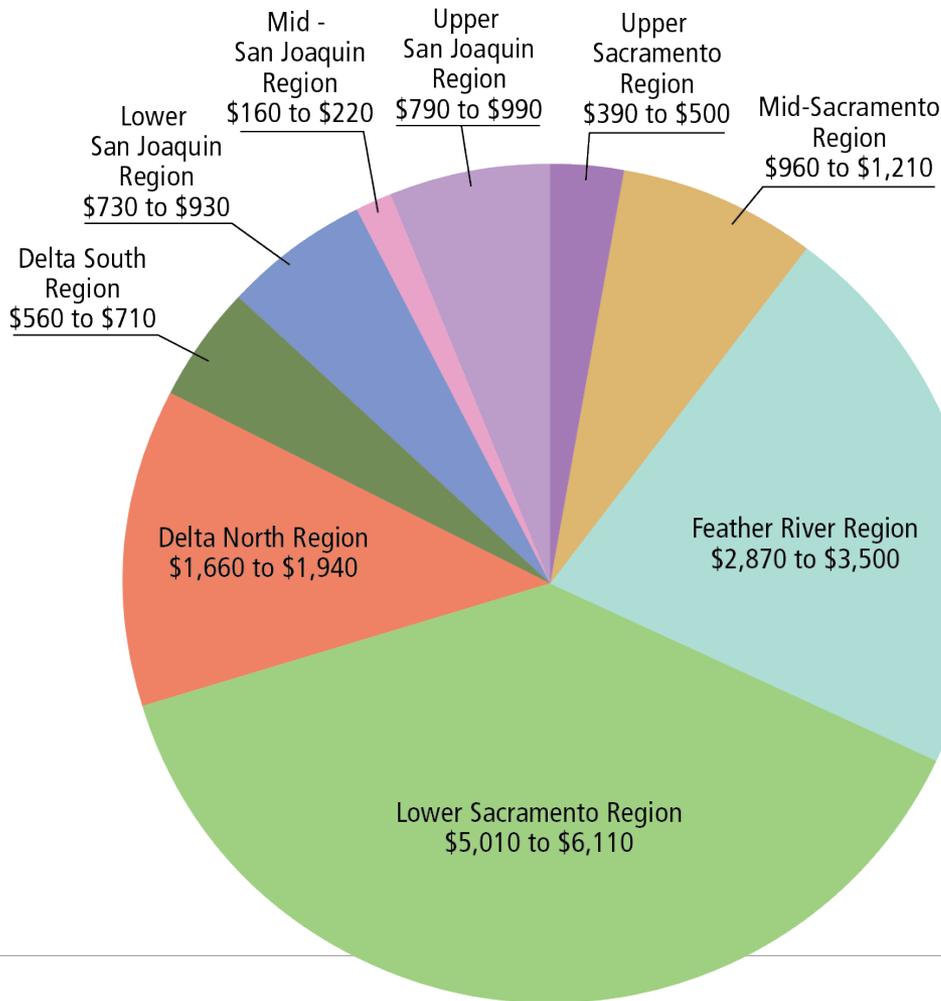


## KEY

FPZ – Flood Protection Zone

USACE – U.S. Army Corps of Engineers

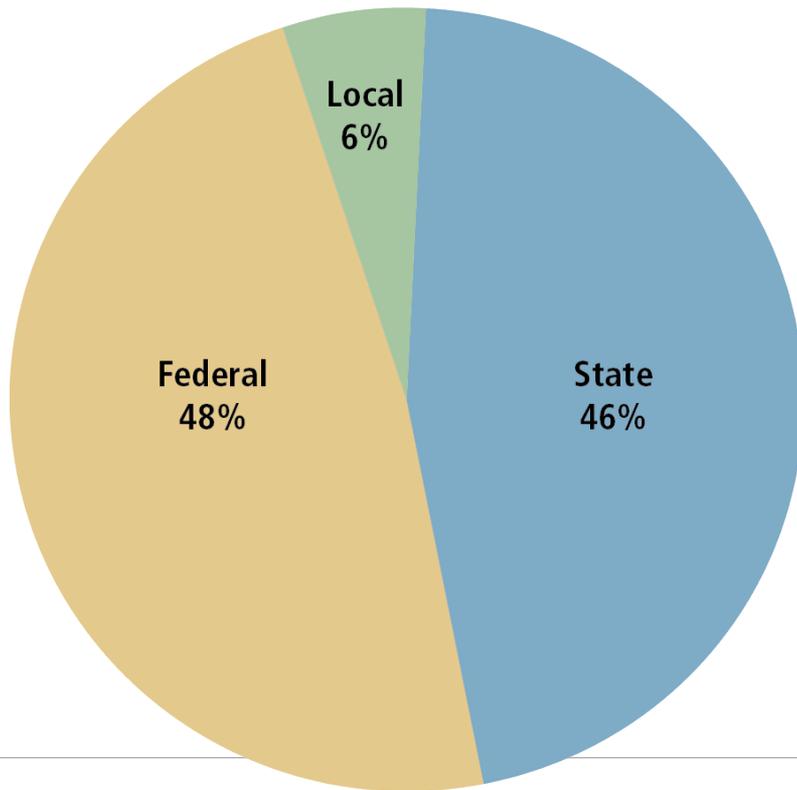
# CVFPP Investment Totals by Region



- ✓ Regional Investments based on costs associated with projects included in State Systemwide Investment Approach (SSIA)
- ✓ Specific regional costs will change based on Regional Flood Management Plans
- ✓ Actual costs will likely be higher due to future price increases & incremental nature of implementation

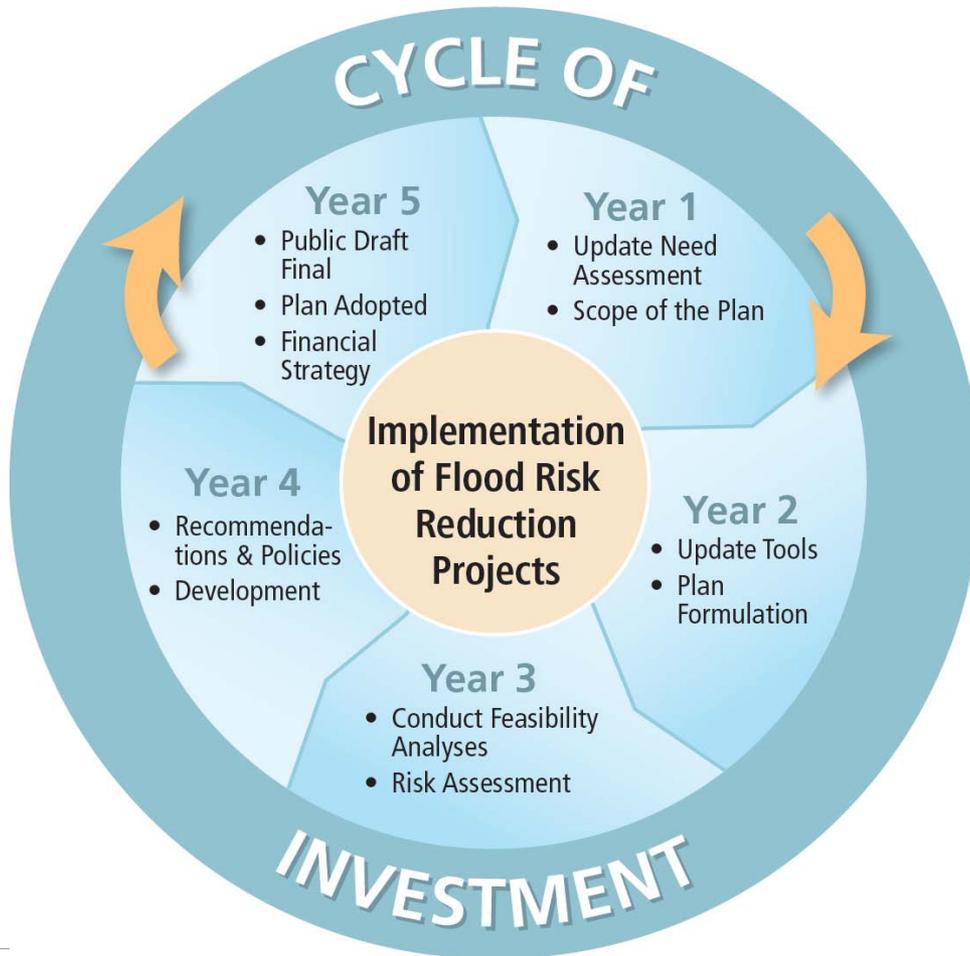
# Estimated Local, State, & Federal Contributions

SSIA Investments by Agency Level  
(in \$million)



Partner	Low	to	High
Local	790	to	945
State	6,065	to	7,475
Federal	6,350	to	7,700
<b>TOTALS</b>	<b>13,205</b>	<b>to</b>	<b>16,120</b>

# Meeting Changing Needs



CVFPP updated every 5 years:

- Technical Information Updated Based on Project & Program Activities
- Investment Recommendations Used to Support Long-Term Financing

Next CVFPP in 2017

# Questions

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