

ABOVE AND BEYOND 200-year Flood Protection for Sacramento's Future



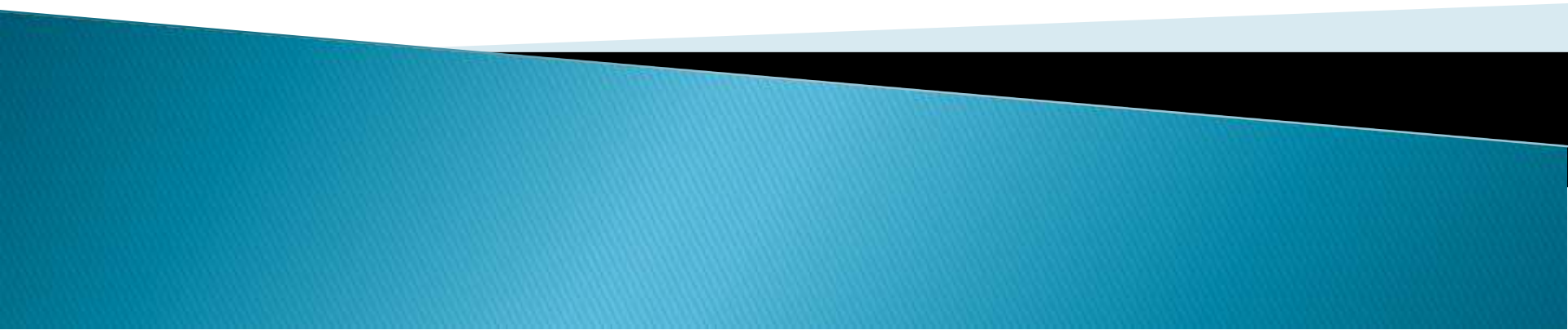
Presented by:

Jim McDonald, AICP, CFM
Connie Perkins, PE, CFM
Remi Mendoza, CFM


City of Sacramento
April, 2017

Jim McDonald

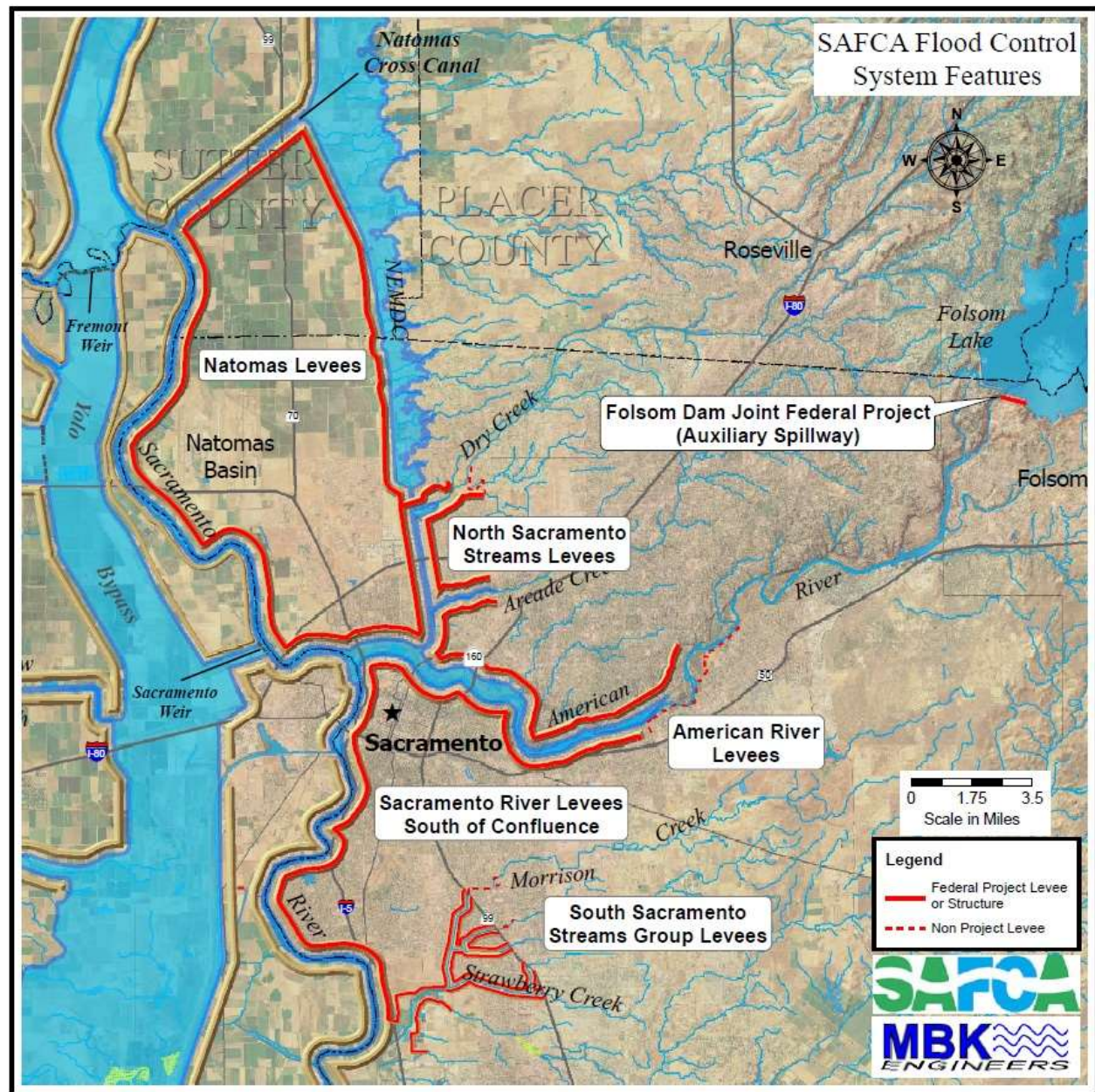
Presentation Overview



Presentation Overview

- ▶ City of Sacramento's Flood History & Levee System
 - ▶ Comprehensive Flood Management Plan (CFMP)
 - ▶ State of California's new 200-year Flood Standard
 - ▶ Next Steps
- 

Sacramento River Flood Control System

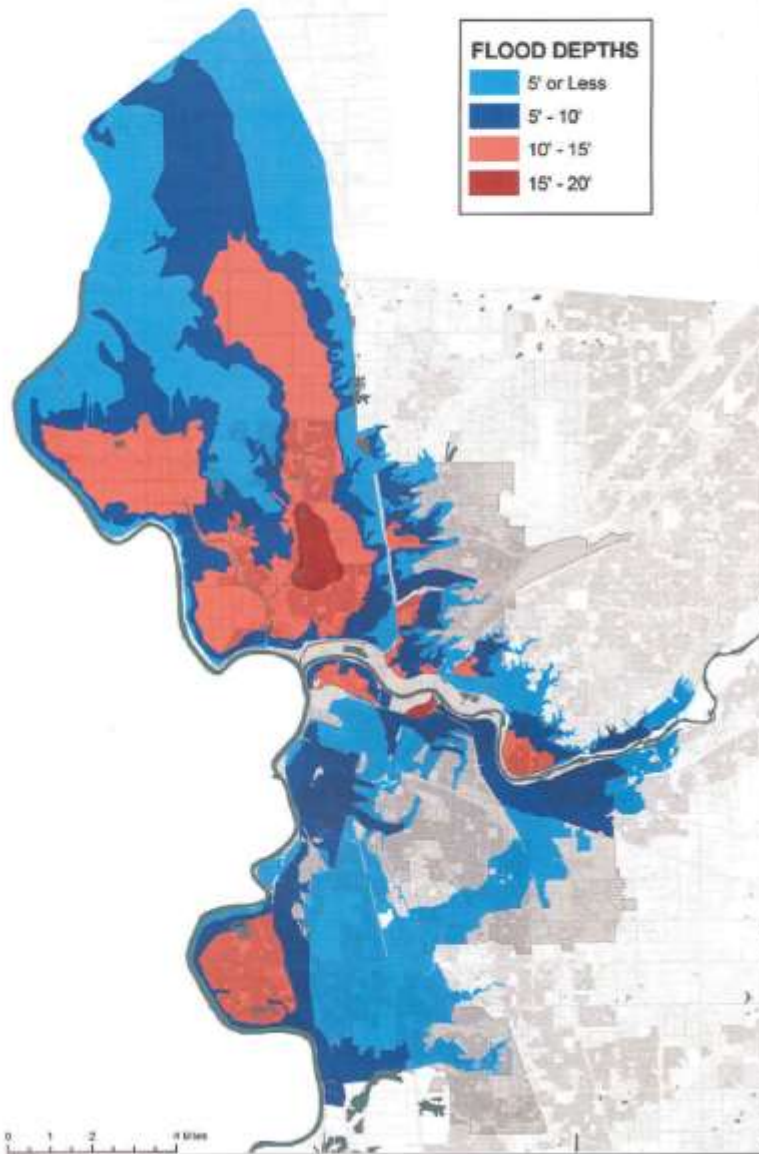


Folsom Dam upstream on American River



ULTIMATE FLOOD DEPTHS

ASSUMES NO LEVEES



Historical Perspective

- ▶ Sacramento has experienced great floods events in 1860, 1911, 1913, 1950, 1955, 1963, 1964, 1986, 1995 and 1997



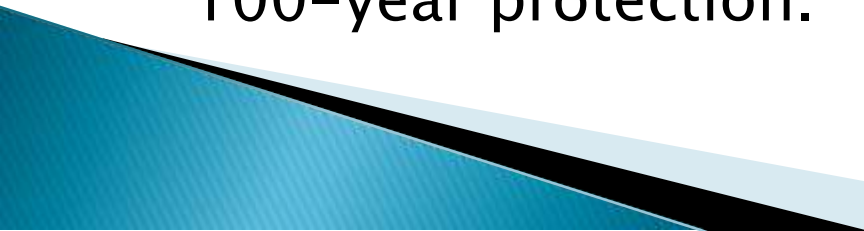
K. STREET, FROM THE LEVEE.

**INUNDATION OF THE STATE CAPITOL,
City of Sacramento, 1862.**

Published by ADOLPH FIELD & CO. San Francisco



Sacramento Flood History

- ▶ **1956 Record Flood:** Though engineers had been predicting it would take a year to fill the nearly completed upstream Folsom Dam, the second record storm filled the dam in a week and Sacramento is saved from flooding.
 - ▶ **1964 Record Flood:** The 3rd record flood in less than 15 years. Engineers concluded that Folsom Dam was only designed to handle is a 120-yr storm, not a 500-yr storm.
 - ▶ **1986 Record Flood:** 10 in. of rain in 11 days. Folsom Dam downgraded to about a 60-year storm. Corps determines that a majority of the city does not have 100-year protection.
- 

Historical FIRMs

SACRAMENTO
Department of Utilities

CITY OF SACRAMENTO FLOODPLAIN HISTORY



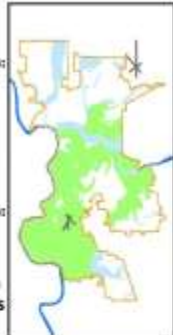
PRE-1986
Zone X

- 1986 - 1989**
- 1986 STORMS
 - ARMY CORPS DETERMINES SACRAMENTO FLOOD CONTROL SYSTEM DOES NOT PROVIDE 100-YEAR PROTECTION
 - CONGRESS AUTHORIZES A99 ZONE FOR CITY (1989)
 - SACRAMENTO AREA FLOOD CONTROL AGENCY (SAFCA) FORMED (1989)



1989
Zone A99

- 1990 - 1998**
- CONGRESS AUTHORIZES (1992):
 - NATOMAS LEVEE FEATURES PROJECT (NLFP) AND REIMBURSEMENT
 - FOLSOM DAM REOPERATION
 - CORPS REPORTS ON AMERICAN RIVER WATERSHED STUDIES (1992 & 1996)
 - CONGRESS AUTHORIZES (1996):
 - \$56.9M FOR AMERICAN RIVER COMMON FEATURES PROJECT
 - SAFCA COMPLETES NLFP (1998)
 - FEMA REMAPS NORTH NATOMAS AND NORTH SACRAMENTO TO SHADED X ZONE (1998)
 - FEMA REMAPS SACRAMENTO TO AR ZONE (1998)



1998
Zone AR

- 1999 - 2000**
- CORPS INITIATES COMMON FEATURES PROJECT (1998)
 - CORPS COMPLETES 50. SAC. CO. STREAM GROUP (SSSG) STUDY (1998)
 - CONGRESS AUTHORIZES (1999):
 - INCREASE TO \$91.9M FOR COMMON FEATURES PROJECT
 - \$65.5M FOR SSSG
 - \$150M FOR FOLSOM DAM MODIFICATIONS
 - CITY COMPLETES NATOMAS COMPREHENSIVE DRAINAGE PLAN; FEMA REMAPS NATOMAS INTERNAL DRAINAGE AREA TO ZONE X (1999)
 - FEMA DETERMINES ADEQUATE PROGRESS ON SACRAMENTO FLOOD CONTROL SYSTEM; REMAPS MOST OF SACRAMENTO TO A99 ZONE (2000)



2000
Zone A99

- 2001 - 2005**
- CONGRESS AUTHORIZES (2003):
 - INCREASE TO \$209M FOR COMMON FEATURES PROJECT
 - \$257.3M FOR FOLSOM DAM MINT RAISE
 - CORPS CERTIFIES AMERICAN RIVER LEVEES (2004)
 - FEMA REMAPS REMAINDER OF AMERICAN RIVER FLOODPLAIN TO SHADED X ZONE
 - SSSG CONSTRUCTION STARTS (2005)



2004/2005
Zone X

- 2006 - 2007**
- WORK COMPLETED ON:
 - COMMON FEATURES PROJECT (2004)
 - SACRAMENTO RIVER
 - MORRISON CREEK
 - NORTH BEACH LAKE LEVEE PROJECT (SSSG)
 - FOLSOM DAM MODIFICATION
 - REMAP PARTS OF SSSG AND POCKET AREA FLOODPLAIN TO ZONE X (2007)



2007
Zone A99

- 2007 - 2008**
- CORPS DETERMINES NATOMAS LEVEES PROVIDE <33-YEAR PROTECTION
 - FEMA REMAPS NATOMAS TO AN AE ZONE (2008)



2009
Zone AE

- 2009 - 2015**
- FEMA REMAPS SSSG 'WEST SIDE OF MORRISON CREEK' (2010)
 - FEMA REMOVES MAJORITY OF SSSG FROM A99 ZONE; REMAINING AH ZONE AROUND FLORIN CREEK (2014)
 - ARMY CORPS EXPIRES LEVEE CERTIFICATION (2012 & 2013)
 - WRDRA BILL AUTHORIZED BY CONGRESS TO IMPROVE NATOMAS LEVEES (2014)
 - NATOMAS REMAPPED TO A99 ZONE (2015)



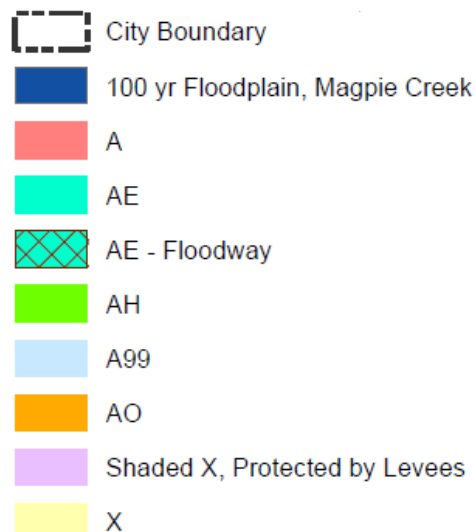
2016
Zone A99

- 2016 - CURRENT**
- WORK TO CONTINUE:
 - FLORIN CREEK WIDENING AND DETENTION BASINS
 - FOLSOM DAM RAISE AND JOINT FEDERAL PROJECT
 - COMMON FEATURES PROJECT
 - SAFCA LEVEE ACCREDITATION
 - MODERNIZATION PROGRAM
 - STATE OF CALIFORNIA 200-YR FLOOD PROTECTION REQUIREMENT EFFECTIVE (JULY 2016)

Legend

- OUTSIDE SPECIAL FLOOD HAZARD ZONE
- A, AE, AH, AD ZONES
- A99 ZONE
- AR ZONE

Current Flood Insurance Rate Map



Flood Zone Definitions

Zone A: No base flood elevations determined.

Zone AE: Base flood elevations determined.

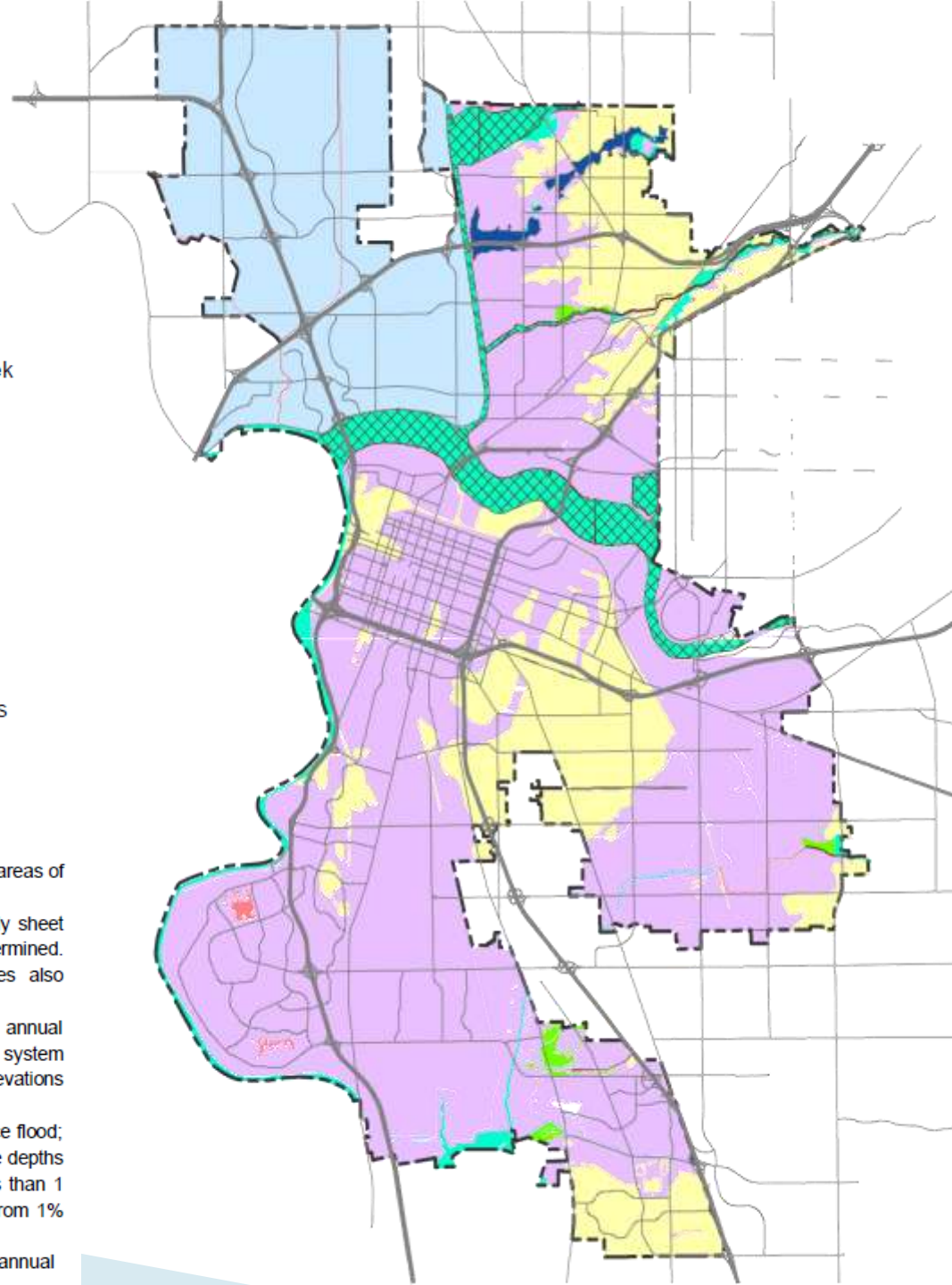
Zone AH: Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.

Zone AO: Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding; velocities also determined.

Zone A99: Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no base flood elevations determined.

Shaded Zone X: Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with rainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

Zone X: Areas determined to be outside 0.2% annual



News Headlines

— Entertainment "Death Spiral" Begins in California

End Of Days – Only 3 Weeks To Go! —

California Extreme Super Flood

Posted on 28 November 2012

Can It Happen Again?

And what **was** it anyway?

I figured I'd get a jump on the inevitable stories to come about how this is extreme weather and therefor caused by Global Warming!!!

(We really need a sound effect whenever AGW is mentioned, like [in Young Frankenstein](#) [when the horses would always sound off at Frau Blucher](#) being mentioned. Perhaps thunder or a 'dun duun Dun DUUNNN' on the piano...)

At any rate, we're going to get rain. LOTS of rain. I'm on the lower edge of it, so hopefully will just get modest rain. Crosspatch in T8 deserves a h/t for the pointer.

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Sacramento: The Nation's Next Urban Flood Disaster?

West Coast winter storms may lack the "star power" of East Coast hurricanes. They aren't named at birth or routinely tracked by the media. But the impact of these western cyclones, spawned over Earth's largest ocean and nourished by long ribbons of moisture from the tropics, can be even more devastating than their famous cousins back East. Huge, soggy systems slam the coast with torrents of rain, powerful winds, and — at higher elevations — deep snows. Widespread power outages, flooding, and debris flows can follow, rivaling the destruction of major hurricanes.

In the path of these storms lies the city of Sacramento, deep in the flood-vulnerable basin of the American River and downstream from the massive Folsom Reservoir. A second large river, the Sacramento, flows along the western edge of the city.



A system of levees protects the city from inundation by the rain-swelled rivers. One or more levees giving way could drown parts of Sacramento under 20-plus feet of water. One big miss on a major storm forecast may be all it takes to catch water managers off guard and turn a background risk into nightmarish reality.

To prevent such a disaster, NOAA's Earth System Research Laboratory (ESRL) is funneling years of West Coast storm

By JIS-0000, nearly eight feet of snow had fallen on this U.S. Forest Service's summer visitor center in Tahoe National Forest northeast of Sacramento.
[High resolution](#) (Credit: NOAA)



 The Wildest Weather

 Confused About Seafood?

 Spies of the Sky

 Tornadoes 101

 The Destructive Power of Water

[Archive](#)

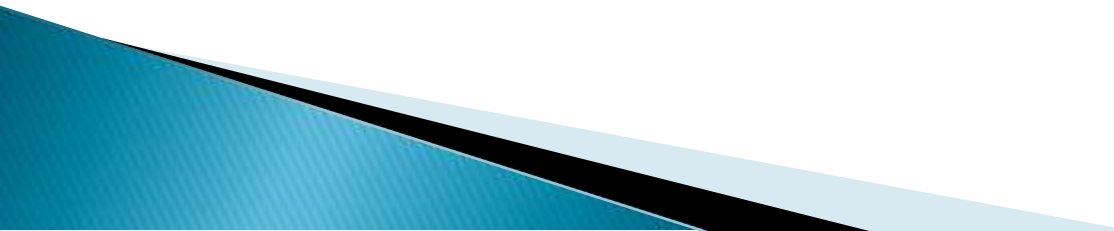
Climate Change...It's Getting Real!



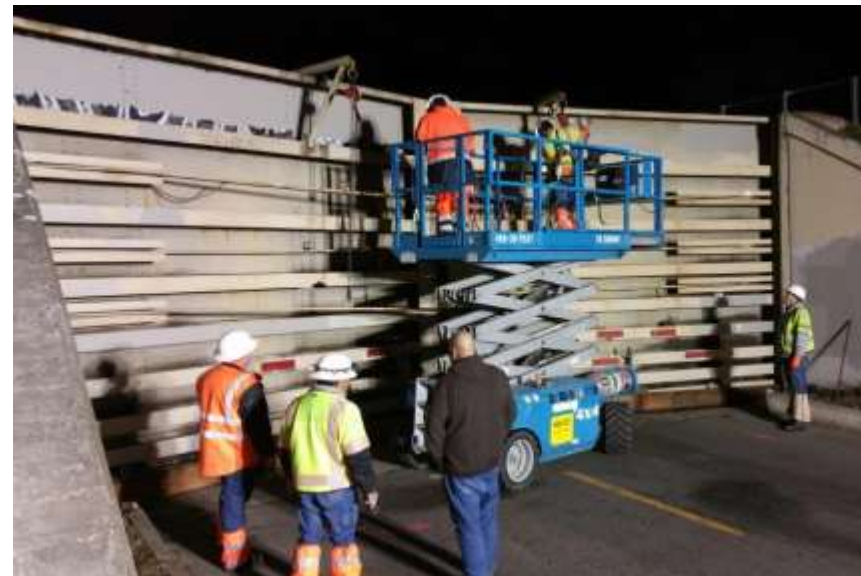
Climate Change

- ▶ From The City's Climate Actions Plan:
 - Extreme weather is expected to become more common in the Sacramento region
 - Shifts in seasonal timing of raining and snowpack runoff
 - Causing increase water runoff to streams and rivers during the winter months

Climate Change

- ▶ City of Sacramento is protected by a system of pipelines, pump stations, levees/floodwalls and dams that may be strained by climate change
 - ▶ The City and partner agencies will prepare for adverse climate change impacts by improving the resiliency of the infrastructure systems
 - ▶ State of California requires
- 

January 7-10, 2017 Storm



January 7-10, 2017 Storm



January 7–10, 2017 Storm

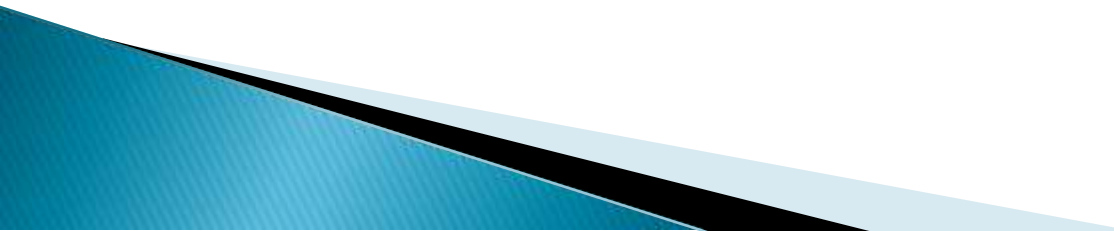
Oroville Dam



Connie Perkins

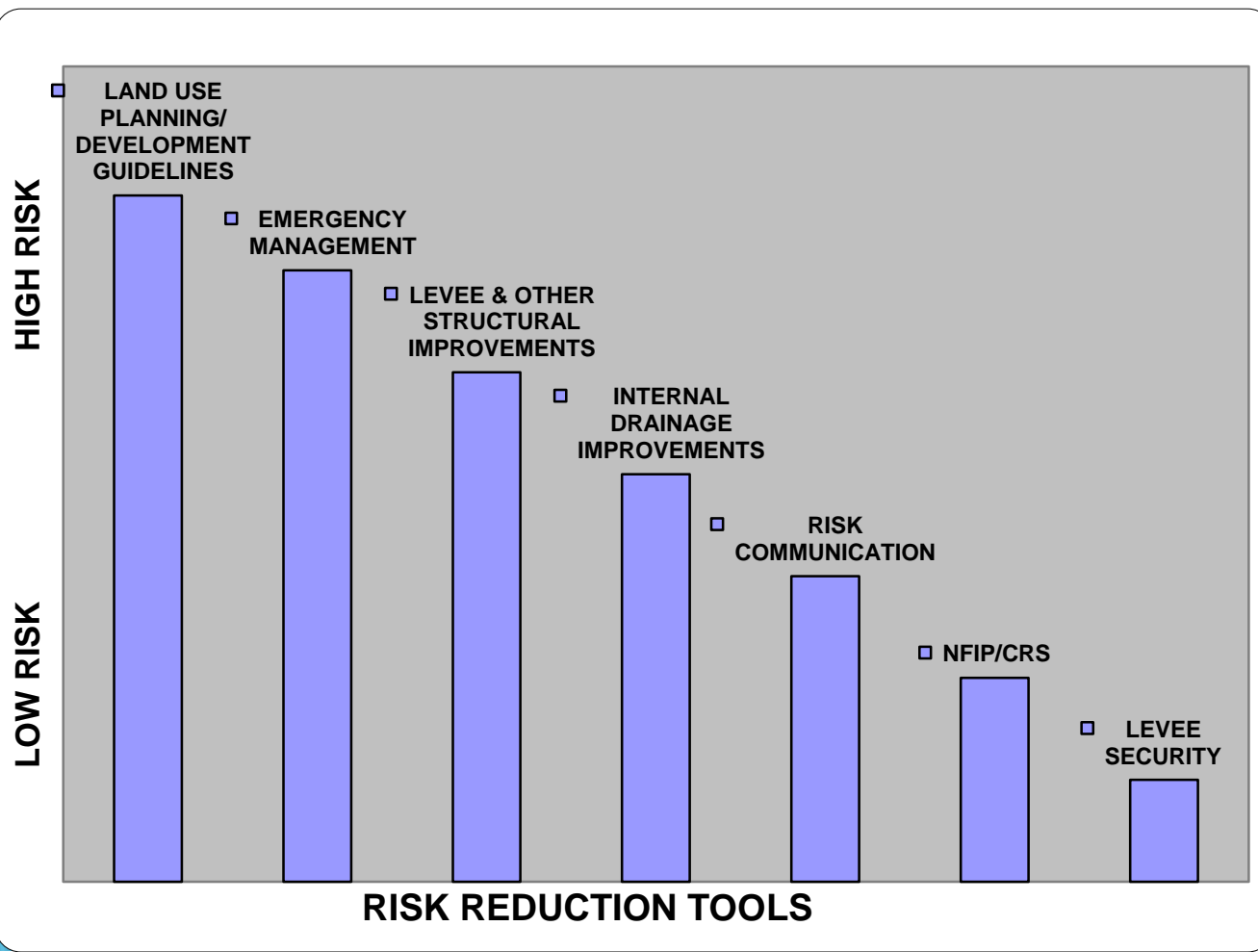
Higher Regulatory Standards in the City's
Comprehensive Flood Management Plan

Need for a Comprehensive Flood Management Plan

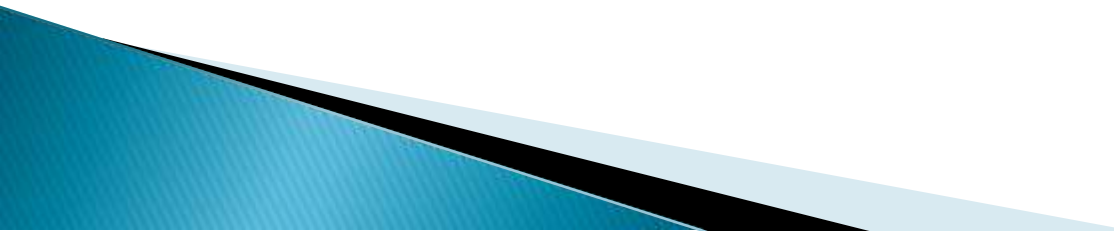
- ▶ City's strategic plan to reduce flood risk over the next 5 years with implementation goals
 - ▶ A comprehensive management document that will guide the City's flood risk reduction and mitigation efforts.
 - ▶ Help increase the City's Community Rating System (CRS) Class
 - ▶ Sacramento Countywide Local Hazard Mitigation Plan
- 

Risk Reduction Tools

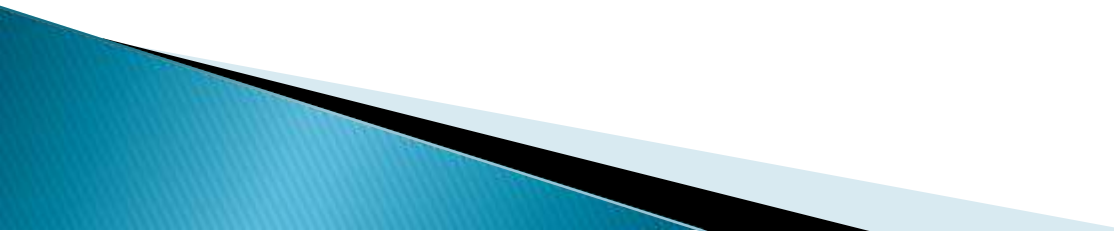
Flood risk reduction is best achieved by employing a suite of structural and non-structural risk reduction tools.



Comprehensive Flood Management Plan Overview

- ▶ Purpose
 - ▶ Historical Perspective
 - ▶ Land Use Planning and Development Guidelines
 - ▶ Emergency Preparation
 - ▶ Levee and Other Structural Improvements
 - ▶ Internal Drainage
 - ▶ Risk Communication
 - ▶ National Flood Insurance Program/Community Rating System Program
 - ▶ Levee Security
- 

Land Use & Development Guidelines

- ▶ Relation to City's 2035 General Plan
 - ▶ Floodplain Management Ordinance & Enforcement
 - ▶ Limited development in Natomas floodplain
 - ▶ Special Restrictions in Areas Next to Levees
- 

Rescue and Evacuation Maps

Rescue Zone: An area of the City that would flood to a depth of 1 foot in 2 hours.

Evacuation Zone: An area protected by levees that would flood slowly, allowing for adequate time to evacuate.




Land Use & Development Guidelines

Rescue Zones

- ▶ Evacuation Plans for **special needs facilities** (schools, hospitals etc.);
- ▶ Identification of **refuge or evacuation locations** for special needs facilities, new residential developments, large commercial and public buildings

Rescue and Evacuation Zones

- ▶ Identification of **emergency vehicle access** to subdivisions
 - ▶ Provision of infrastructure to **protect on-site fuel storage.**
- 

Additional Land Use & Development Standards

- ▶ SB5 / Central Valley Flood Protection Plan (CVFPP) Requirements
 - 200-year flood protection
 - Levee clearance and maintenance requirements

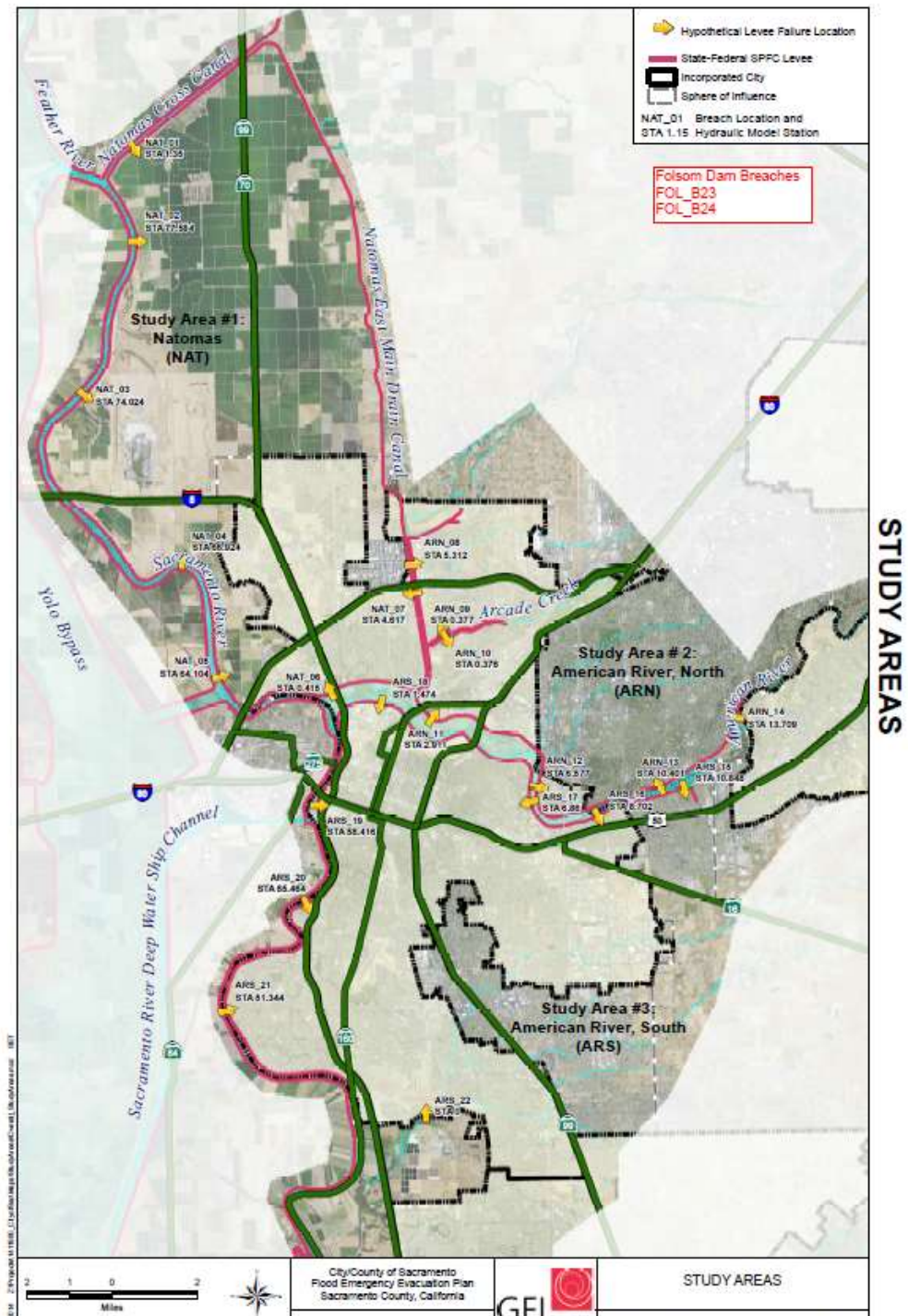
Emergency Preparation

- ▶ Reviewing and summarizing all emergency response documents
- ▶ List of flood maps available
- ▶ City's Exercises & Training Schedule
- ▶ Recording High Water Marks
- ▶ Recovery Plan
 - Damage Assessment
 - Recovery Ordinance
 - Sample Emergency Broadcasts / Press Releases



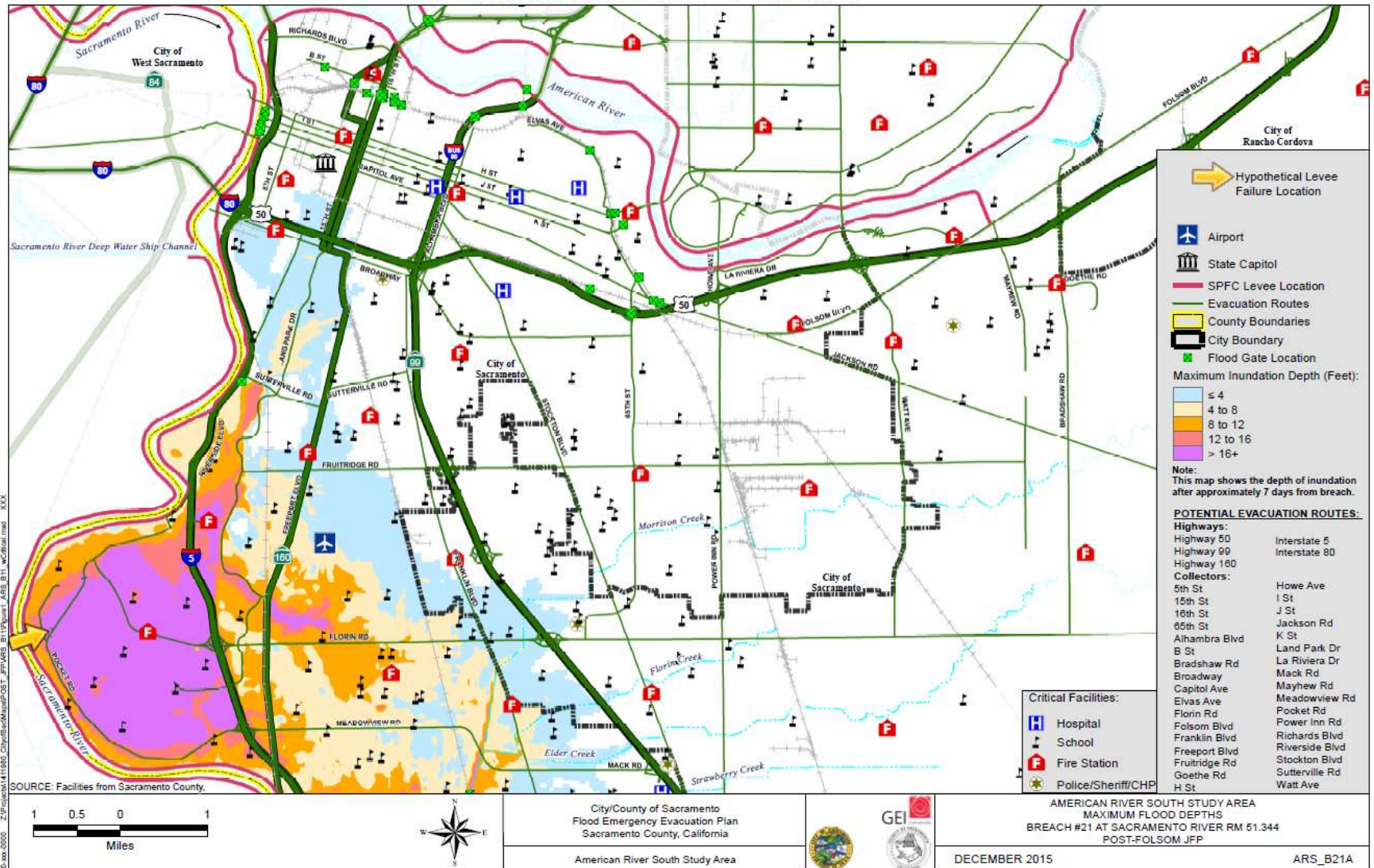
2016 Rescue & Evacuation Maps

- ▶ 22 Levee Break Scenarios
- ▶ Based on new 200-year flood State requirement
- ▶ Animated levee break scenarios (FERIX)



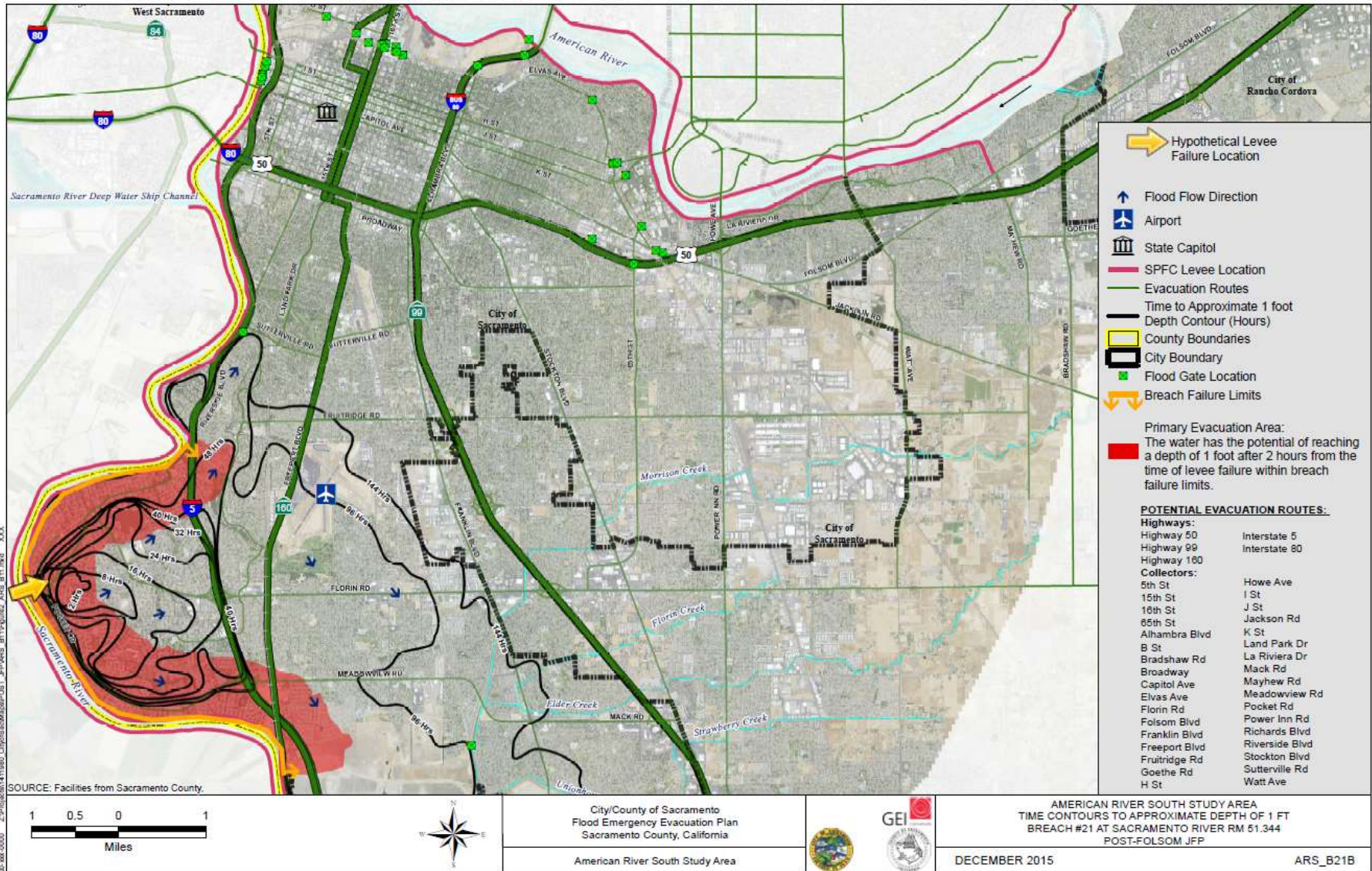
Rescue & Evacuation Maps

MAXIMUM FLOOD DEPTH MAP



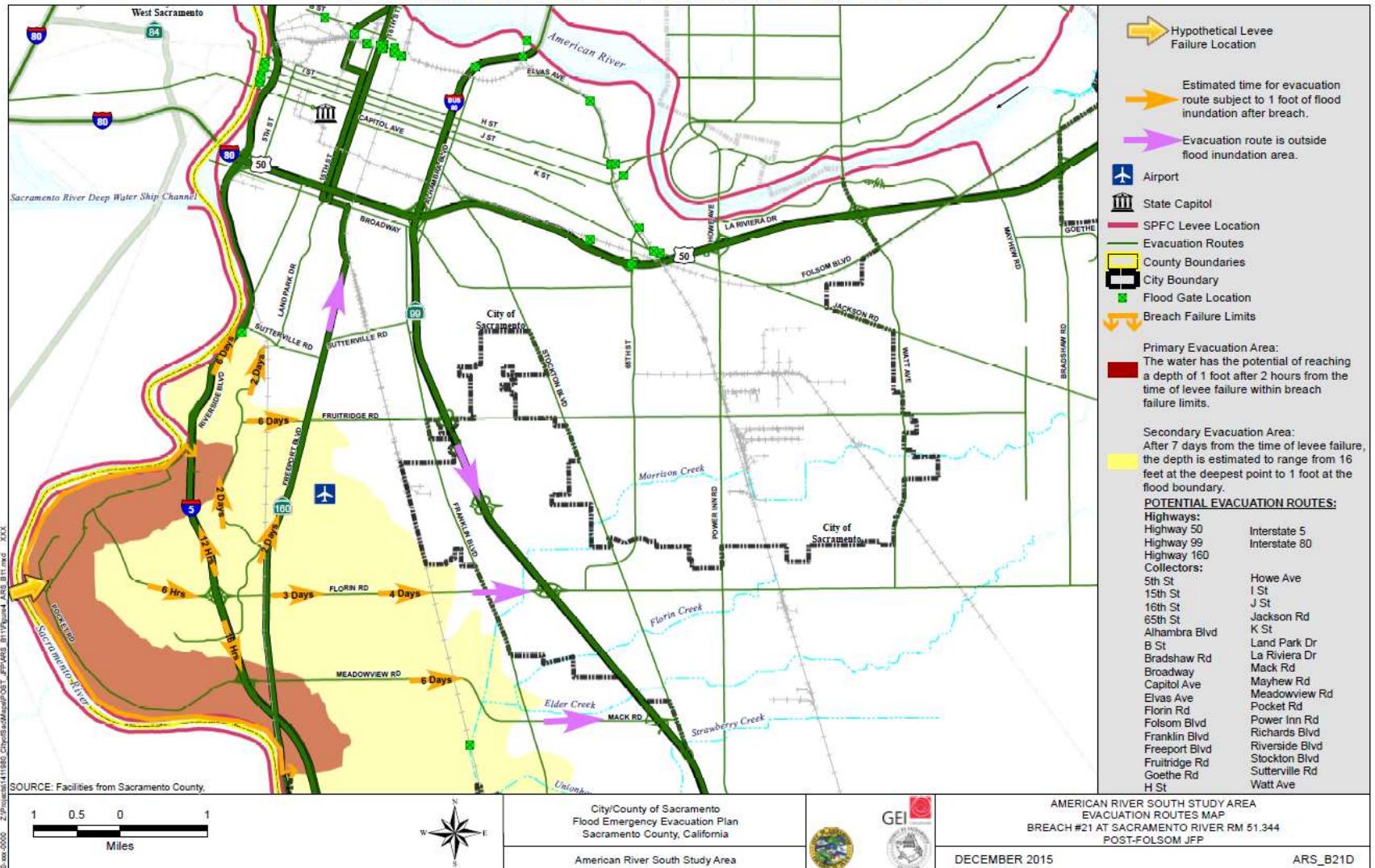
Rescue & Evacuation Maps

TIME CONTOURS IN HOURS TO APPROXIMATE DEPTH OF ONE FOOT



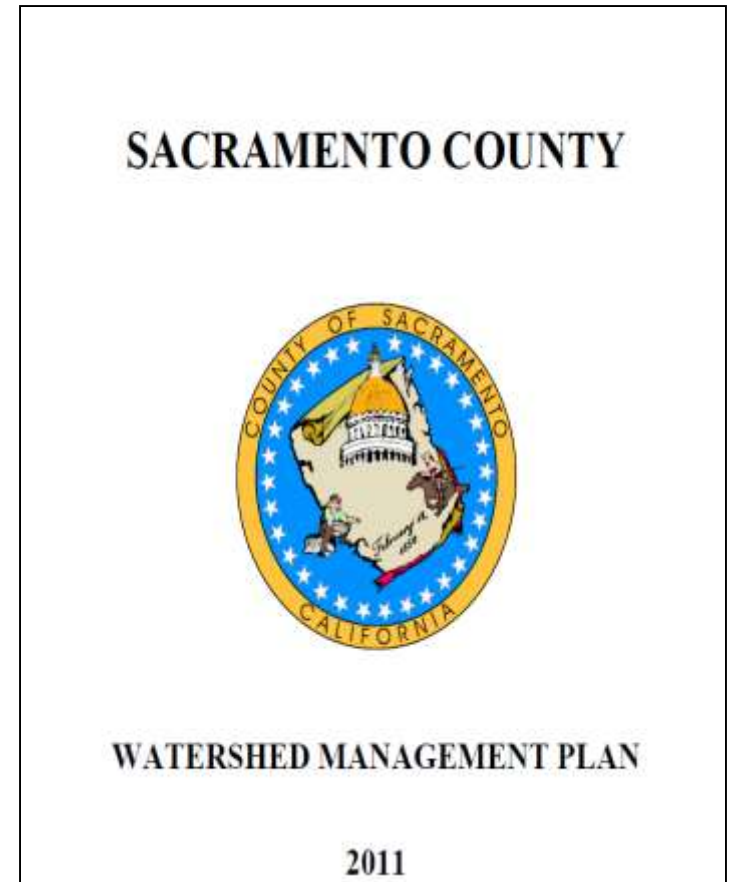
Rescue & Evacuation Maps

RECOMMENDED EVACUATION ROUTES



Internal Drainage

- ▶ City/County Watershed Management Plan (WMP)
- ▶ CRS Activity 450
- ▶ Reducing the increased flooding from development on watershed-wide basis



Risk Communication

- ▶ Brochure in City's Utility Bill annually
- ▶ Mailing to Repetitive Loss properties
- ▶ State of CA's Flood Risk Notice to SFHA properties
- ▶ Billboards, advertisements on buses, community meetings and events
- ▶ High Water Mark Signs



Risk Communication

- ▶ Program For Public Information
 - Flood Response Plan
 - Flood Insurance Coverage Improvement Plan
 - Repetitive Loss Area Analysis
- ▶ CRS Credit

Remi Mendoza

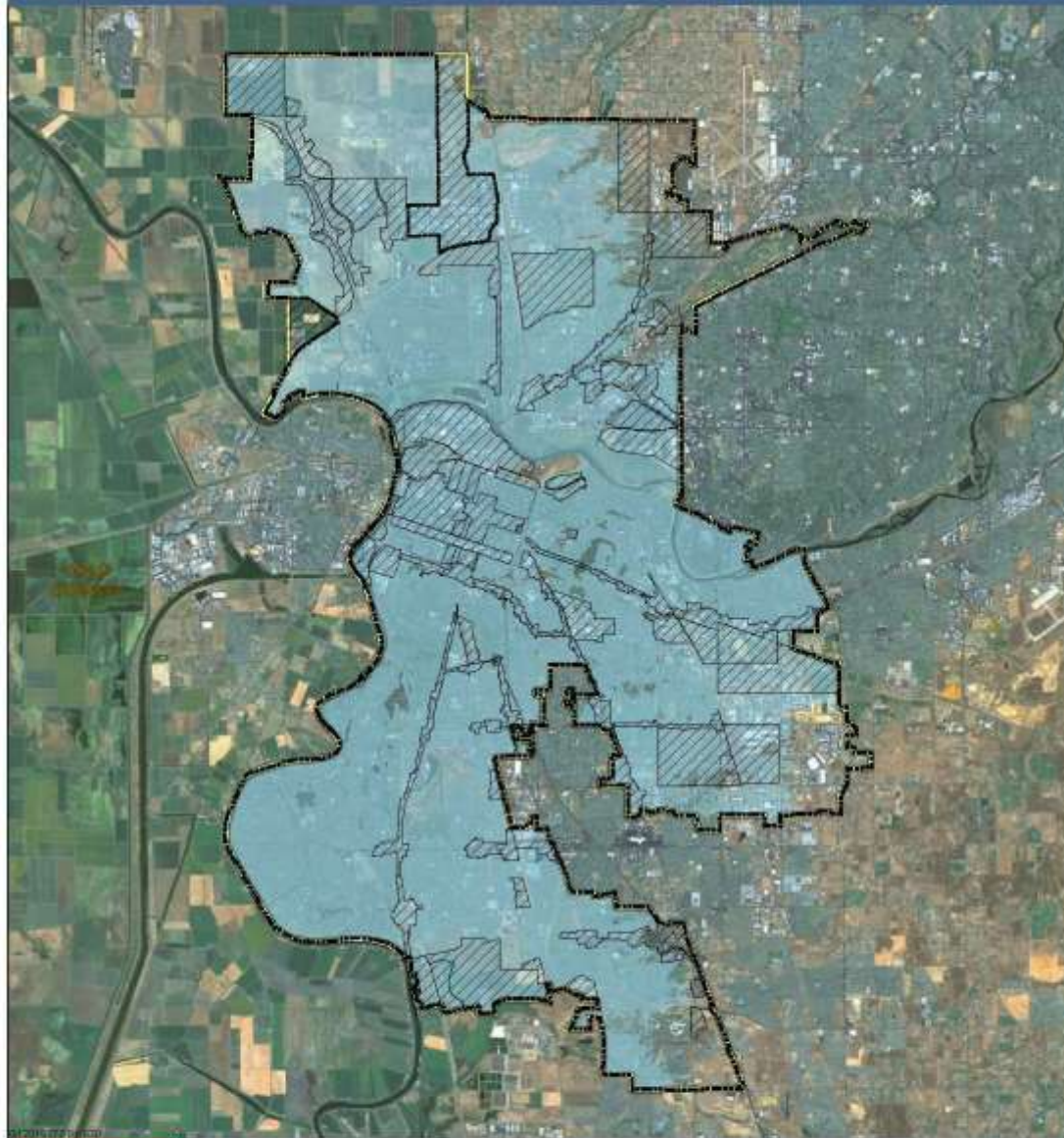
200 Year Flood Standard

General Plans, Zoning Ordinances, and the Central Valley Flood Protection Plan – HELP!

General Plan update
Zoning Code Update

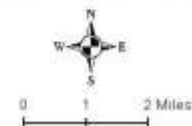


Figure 7.3
200 Year Floodplain



Legend

-  200-year Floodplain
-  2030 General Plan Opportunity Areas
-  City Limits
-  Policy Area



CVFPB General Plan Safety Element Crosswalk

Jurisdiction to Fill Out			CVFPB Use Only		
Safety elements must identify information regarding flood hazards per GC 65302(g)(2)(A)	Jurisdiction's Notes for CVFPB Reviewer	Location in the Safety Element/ Page #	Board Reviewer's Comments	Score	
				✓ MET	✓ NOT MET
ii. Does the new or updated safety element include National Flood Insurance Program (NFIP) maps, published by FEMA?	Yes. Figure 7-2 (p. 7-15) shows the FIRM hazard area zones.	Background Report, Section 7 Page <u>7-15</u>		<input type="checkbox"/>	<input type="checkbox"/>
iii. Does the new or updated safety element contain information about flood hazards available from the U.S. Army Corps of Engineers including the Corps Sacramento and San Joaquin River Basins Comprehensive Study?	Yes. The 200-year floodplain is based, in large part, on information provided to DWR from USACE. See Figure 7-3 (p. 7-23) in the Background Report.	Background Report, Section 7 Page <u>7-23</u>		<input type="checkbox"/>	<input type="checkbox"/>
iv. Does the new or updated safety element include dam failure inundation maps, available from CalEMA (prepared pursuant to GC Section 8589.5)?	Yes. Page 7-18, 7-19, and 7-22 provide a discussion of potential dam failure and link to the Sacramento County Local Hazard Mitigation Plan, which shows inundation areas within the City.	Background Report, Section 7 Pages <u>7-18 and 21</u>		<input type="checkbox"/>	<input type="checkbox"/>

2035 General Plan

New flood protection goals, policies, and implementation measures in the 2035 General Plan ensure that:

- New developments in flood hazard zones will be evaluated to ensure they are safe from flooding, and
- Prohibits approval of new development unless the adequacy of flood protection specific to the area in which the development is proposed has been demonstrated.

www.sacgp.org



City Code Update (March 2016)

ULOP Findings required for:

1. Development Agreements
2. Discretionary permits, entitlements, or ministerial permits resulting in construction of a new residence.
3. Approving a tentative map or parcel map

Planning & Development Code



Flood Control Infrastructure

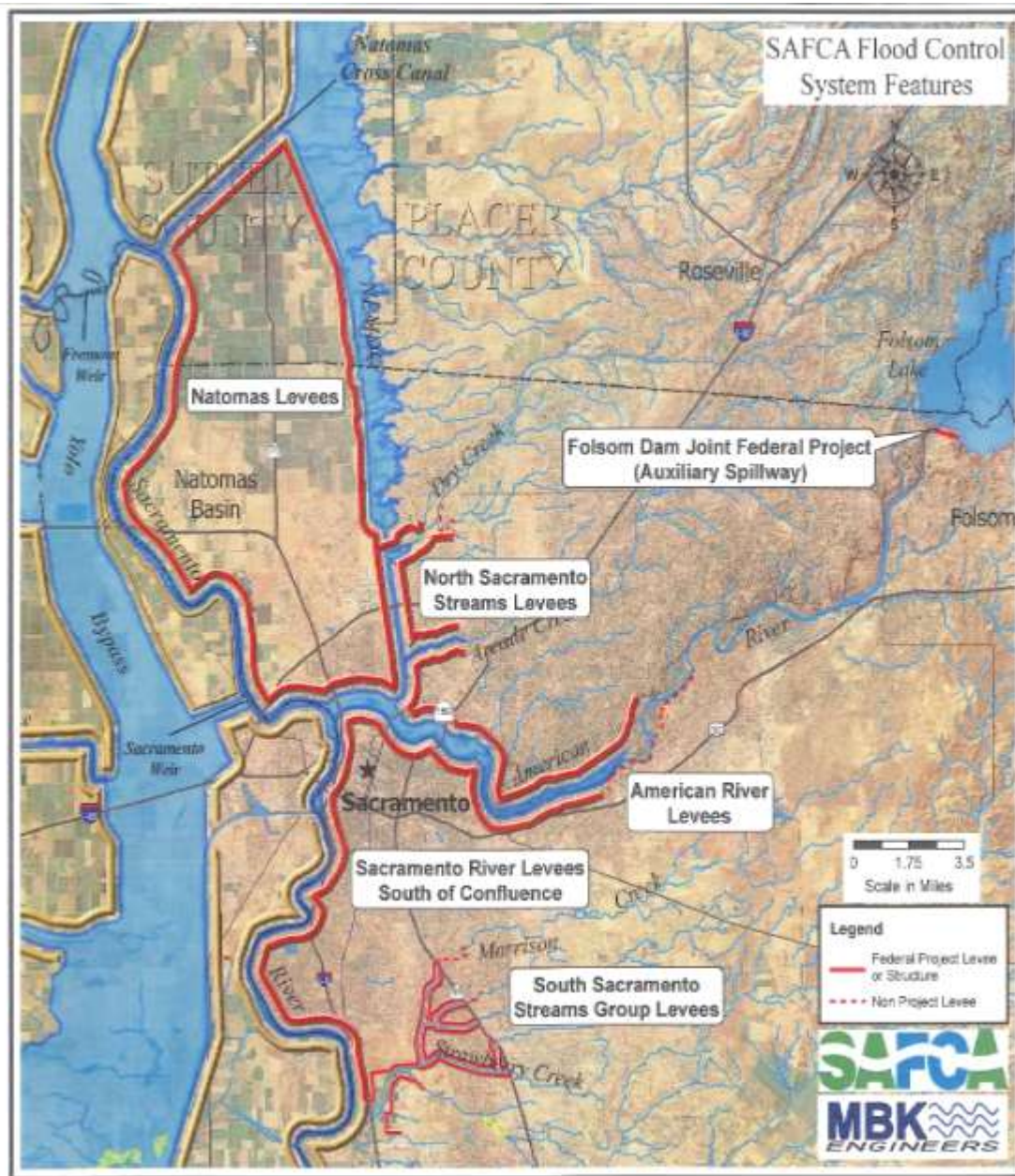
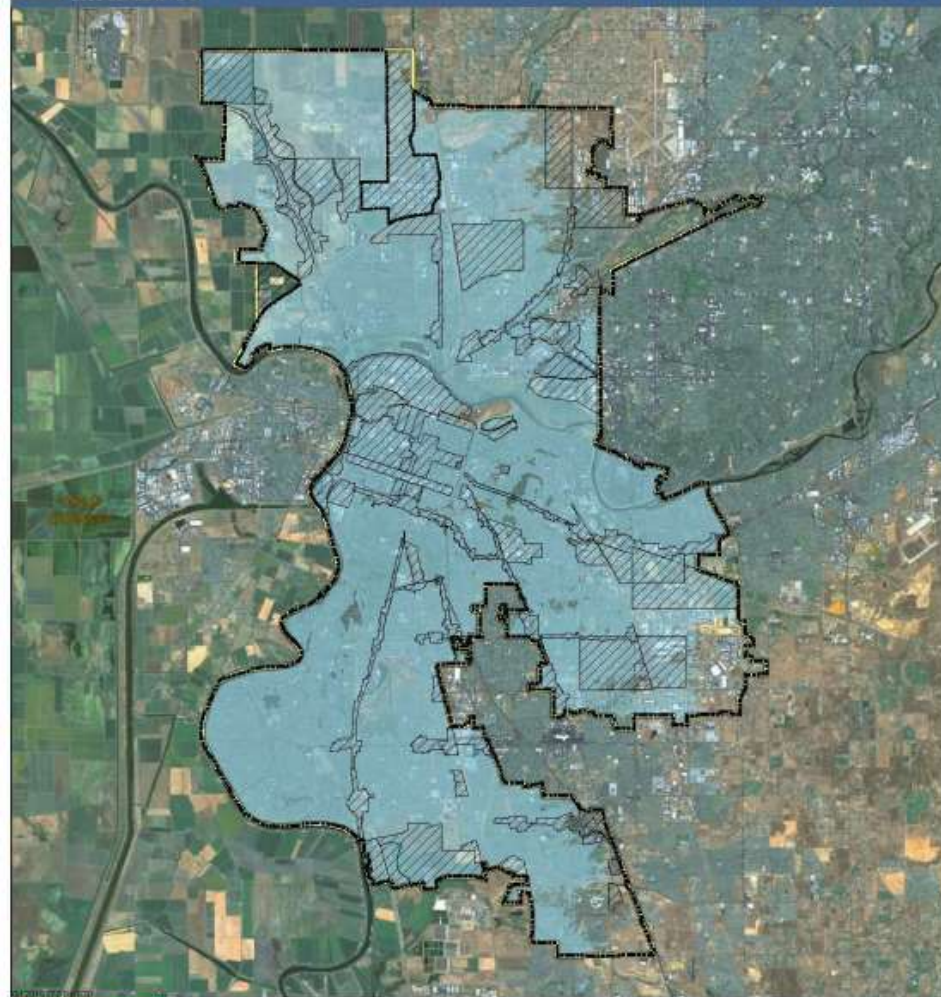
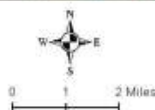


Figure 7.3
200 Year Floodplain

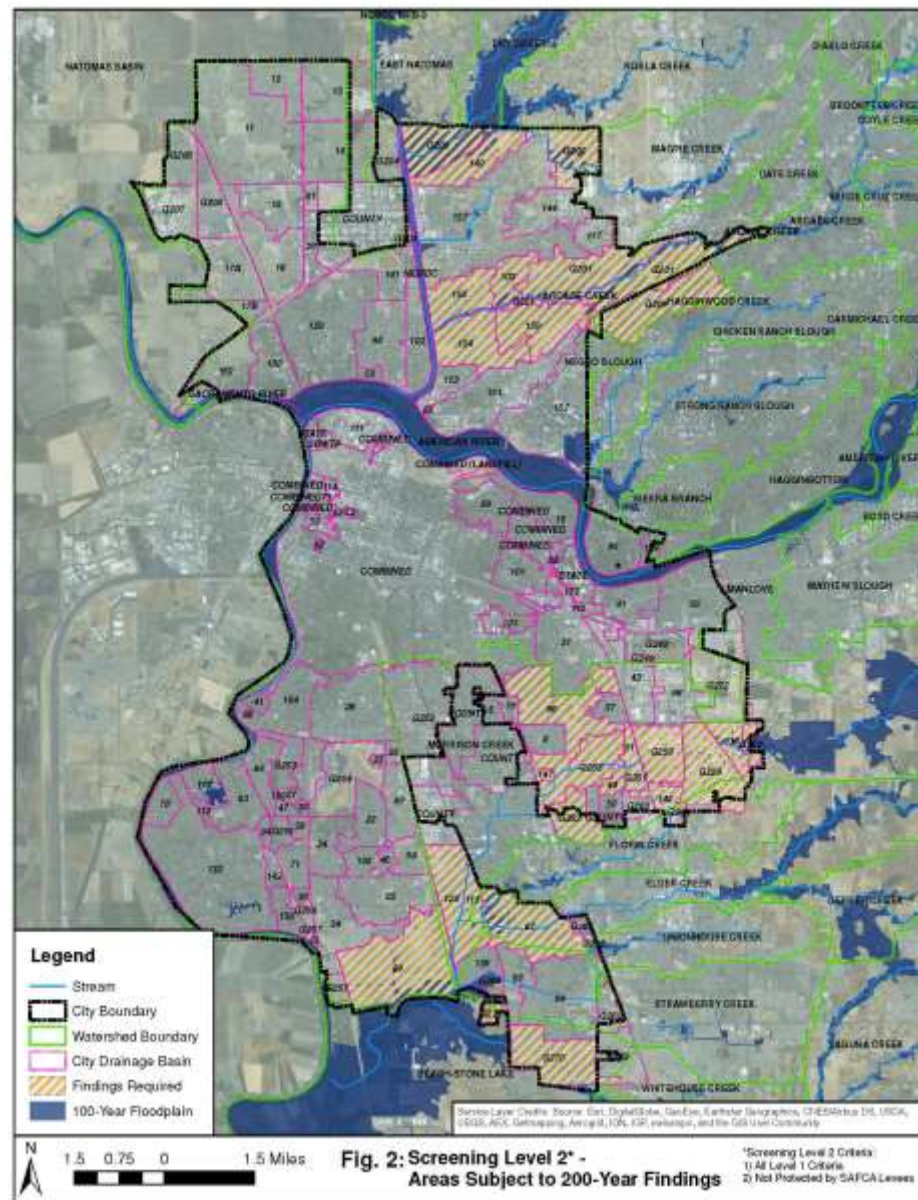


Legend

- 200-year Floodplain
- City Limits
- 2030 General Plan Opportunity Areas
- Policy Area



Only Source: City of Sacramento, 2012 and 2013; 2013 (20 June)



Legend

- Stream
- City Boundary
- Watershed Boundary
- City Drainage Basin
- Findings Required
- 100-Year Floodplain




Fig. 2: Screening Level 2* - Areas Subject to 200-Year Findings

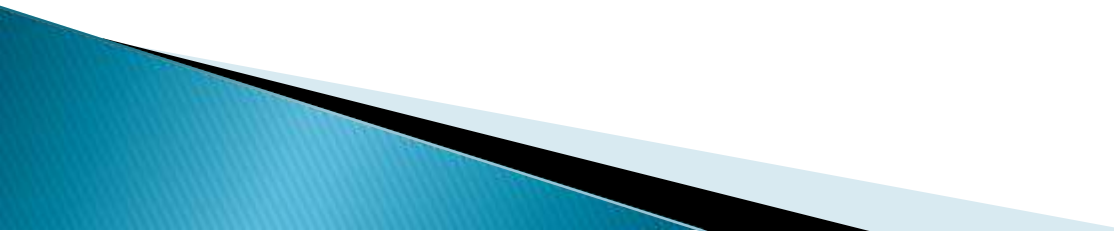
*Screening Level 2 Criteria:
1) All Level 1 Criteria
2) Not Protected by SAFCAL Levees

Findings

There is substantial evidence that the project has met one of the following conditions:

- ▶ Currently have 200–year flood protection;
 - ▶ Imposed conditions (flood proofing or elevated structures);
 - ▶ Making adequate progress (the urban level of flood protection shall be achieved by 2025);
or
 - ▶ Within an undetermined risk area.
- 

Next Steps

- ▶ Coordination
 - ▶ Education
 - ▶ Zoning Code Implementation
 - ▶ Annual Reports
- 

Questions?

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