General Plan

Safety Element

BACKGROUND TO THE
1993 GENERAL PLAN AS AMENDED
Amended December 13, 2016
Amended September 26, 2017

County of Sacramento
Office of Planning and Environmental Review

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SACRAMENTO COUNTY GENERAL PLAN
SAFETY ELEMENT BACKGROUND

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SACRAMENTO COUNTY GENERAL PLAN
SAFETY ELEMENT

Background Section

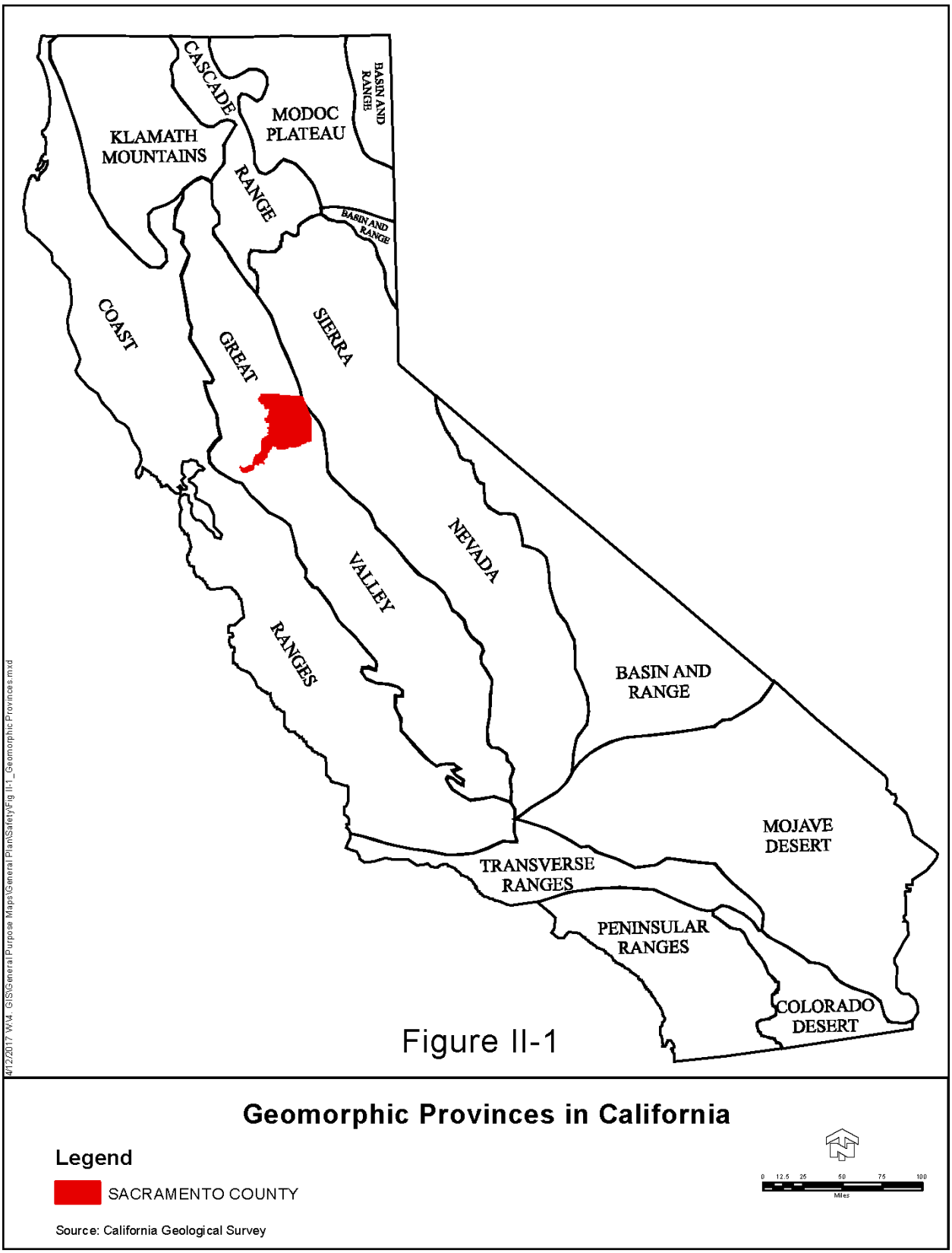
SEISMIC AND GEOLOGIC HAZARDS TECHNICAL DISCUSSION

GEOLOGIC ENVIRONMENT OF SACRAMENTO COUNTY

Sacramento County is centrally located in the Sacramento Valley between the Sierra Nevada Mountains to the east and Coast Range Mountains to the west. The Valley has a diverse and complex geologic history created by the convergence of the Pacific and North American plates. Millions of years ago, the present-day Sacramento Valley was inundated by the Pacific Ocean. Over geologic time, the Pacific shoreline moved back and forth from the eastern side to the western side of the area. Today, the shoreline has moved westward to its current position, west of the California Coast Ranges, exposing the Sacramento Valley as it looks today. The upper geologic formations of Sacramento County are made up of floodplain and alluvial fan sediments, which derive from the Sierra Nevada Mountains. Beneath this immediate level are older marine sediments, followed by the underlying bedrock of the Pacific and North American Plates.[1]

A "geomorphic province" is comprised of an area of similar geologic origin and erosional/depositional history. Sacramento County is situated in portions of two geomorphic provinces. By far the largest portion of the County lies in the Great Valley province. A small area in the northeastern part of the County is in the Sierra Nevada province (Figure II-1).

[1] Adapted from the Geology of the Northern Sacramento Valley, California, State of California, California Natural Resources Agency, California Department of Water Resources -Northern Region Office, June 2014 - Updated: September 22, 2014, Prepared by the California Department of Water Resources Northern Region Office Groundwater and Geologic Investigations Section


CASCADE
BASIN AND RANGE
MODOC PLATEAU
KLAMATH MOUNTAINS
RANGE
BASIN AND RANGE
COAST
GREAT
SIERRA
NEVADA
VALLEY
RANGES
BASIN AND RANGE
MOJAVE DESERT
TRANSVERSE RANGES
PENINSULAR RANGES
COLORADO DESERT
4/12/2017 W:\4. GIS\General Purpose Maps\General Plan\Safety\Fig II-1_Geomorphic Provinces.mxd
Figure II-1
Geomorphic Provinces in California
Legend
SACRAMENTO COUNTY
0 12.5 25 50 75 100
Miles
Source: California Geological Survey

The Great Valley province can be further divided into four geomorphic subunits, as described below and shown in Figure II-2. Please note that Figure II-2 is for general illustrative purposes and is based on staff interpretation of preliminary geologic maps and data provided by the California Geologic Survey.

The Delta - The Delta, characterized by geologically young Holocene deposits (a period defined as encompassing only the past 11,000 years), includes the low-lying lands that extend along the County's southwestern boundary. The boundary of the Delta is arbitrarily fixed at the zero-elevation contour, which coincides with the contact between the organic and inorganic soils. Prior to human intervention, this region was dominated by tidal marshes that were traversed by meandering sloughs. Over time, however, the sloughs were altered and the marshes drained. Numerous islands have been created by the construction of a system of artificial levees. Please note that this geomorphic definition of the delta should not be confused with the definition of the Legal Delta as described in the Delta Protection Element.

River Floodplain - Adjacent to the Delta subunit is the river floodplain. This subunit consists of unconsolidated inorganic soils which were formed by the deposition of sediment when flood waters overtopped the rivers' natural levees.

Alluvial Plain - Further to the east of the floodplain is an extensive area of former floodplain that has been highly dissected by subsequent stream erosion. The geologic subunit is comprised of older, Quaternary deposits (up to 2 million years old). This area is underlain by soil which is characterized by layers of hardpan or dense, impervious clay.

Low Foothills - The low foothill subunit, located east of the alluvial plain, is typified by rolling, boulder-strewn topography and is underlain by moderately consolidated silts, sands, and clays of continental origin. The small area in the northeast part of the County within the Sierra Nevada geomorphic province consists of Pliocene (up to 12 million years old) and older deposits and is characterized by steep-sided hills and narrow, rocky stream channels. Stream patterns here are well established and are controlled principally by bedrock features (Figures II-2 and II-3).

The Sierra Nevada geomorphic province is located in the extreme northwest of Sacramento County and consists of Pliocene and older deposits and is characterized by steep-sided hills and narrow, rocky stream channels. Stream patterns here are well established and are controlled principally by bedrock features.

SEISMIC HAZARDS

FAULTING

A fault is defined as a tectonic fracture or break in the earth's crust along which displacement (horizontal, vertical, or diagonal movement) has taken place[2]. For the purpose of planning, an active fault is one which has had surface displacement within Holocene time; or approximately the last 11,000 years. A potentially active fault is defined as a fault which has had surface displacement within Quaternary time (approximately the last 1.6 million years)[2]. It may be assumed that a fault which has been active in recent geologic time (Quaternary) is likely to be active again. Alquist-Priolo Earthquake Fault Zones are regulatory zones, delineated by the State Geologist, within which site-specific geologic studies are required to identify and avoid fault rupture hazards prior to subdivision of land and/or construction of most structures for human occupancy. Inactive faults are those which show no evidence of surface deformation in recent geologic time. It is important to note that groundshaking can still occur as a result of inactive faults that are considered "buried" but these faults do not result in surface deformation.

Two types of fault movement represent possible hazards to structures in the immediate vicinity of the fault: fault creep and sudden fault displacement. Fault creep, a slow movement of one side of a fault relative to the other, can cause cracking and buckling of sidewalks and foundations even without perceptible groundshaking. Sudden fault displacement occurs during an earthquake event and may result in the collapse of buildings or other structures that are found along the fault zone when fault displacement exceeds an inch or two. The only protection against damage caused directly by fault displacement is to prohibit construction in the fault zone.

The Richter scale is used to quantify the magnitude or strength of an earthquake, while the Mercalli scale is used to measure the intensity as it relates to structural and cultural features. The Modified Mercalli (MM) Intensity Scale measures the intensity of ground shaking at any particular site in response to fault movement. The MM Intensity Scale is useful in planning for seismic safety, as it translates the intensity of earthquake shaking into possible damaging effects on structures. However, this scale should be used with caution because it relates to older structures (pre-1933) rather than to those built in accordance with modern building codes (Tables II-1 and II-2).

[2] Jennings, C.W., and Bryant, W.A., 2010, Fault activity map of California: California Geological Survey Geologic Data Map No. 6, map scale 1:750,000.
http://www.conservation.ca.gov/cgs/cgs_history/Documents/FAM_phamplet.pdf

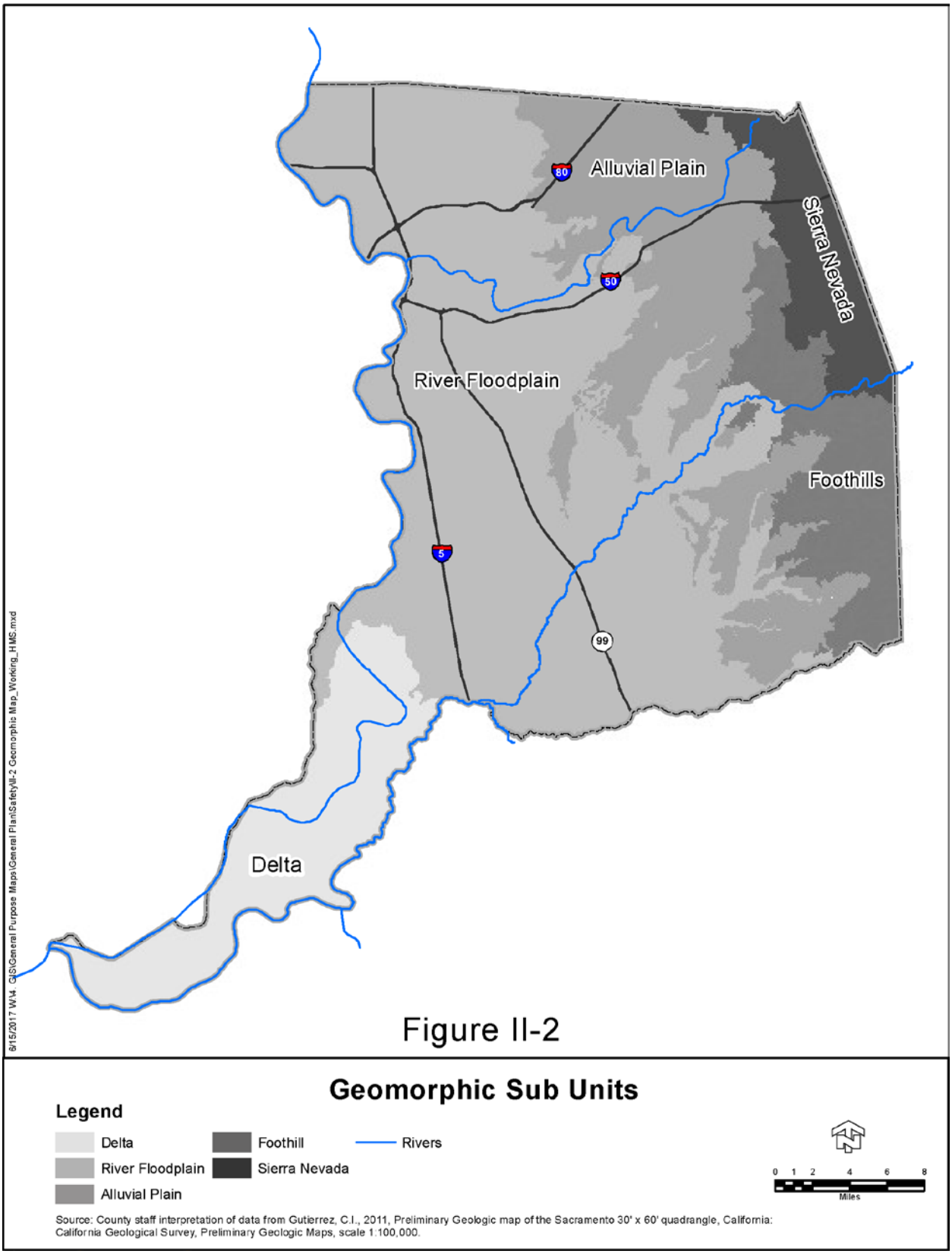

Alluvial Plain
Sierra Nevada
River Floodplain
Foothills
Delta
80
50
5
99
8/15/2017 W:\4_GIS\General Purpose Maps\General Plan\SafetyII-2 Geomorphic Map_Working_HMS.mxd
Geomorphic Sub Units
Legend
Delta
River Floodplain
Alluvial Plain
Foothill
Sierra Nevada
Rivers
0 1 2 4 6 8
Miles
Source: County staff interpretation of data from Gutierrez, C.I., 2011, Preliminary Geologic map of the Sacramento 30' x 60' quadrangle, California: California Geological Survey, Preliminary Geologic Maps, scale 1:100,000.

Figure II-2

TABLE II-1

HISTORIC EARTHQUAKES IN THE VICINITY OF SACRAMENTO COUNTY

Fault	Approximate Distance From Sacramento County Boundary	Historic Earthquake Date[3]	Magnitude (Richter)[4]
San Andreas	46	1906;1989	7.8; 7.1
Vaca	5	1892	6.6
Concord	12	1955	5.4
Greenville	17	1980	5.1
Hayward	26	1868	7
Calaveras	21	1861; 1979; 2007	5.8; 5.74; 5.44
Foothill Fault System (Cleveland Hill)	48	1975 (Oroville)	5.7
Las Positas	24	1980	5.4
Great Valley (Midland)	0	1892	5.6
West Napa Fault	22	2014	6.02

[3] California Department of Conservation, *Fault Activity Map of California*, 2010. http://maps.conservation.ca.gov/cgs/fam/

[4] California Department of Conservation, *Historic Earthquake Online Database*, 2017. http://maps.conservation.ca.gov/cgs/historicearthquakes/

TABLE II-2

MODIFIED MERCALLI SCALE OF EARTHQUAKE INTENSITY

Scale	Effects
I.	Not felt except by a very few under especially favorable conditions.
II.	Felt only by a few persons at rest, especially on upper floor of buildings.
III.	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV.	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V.	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI.	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII.	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII.	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, and walls. Heavy furniture overturned.
IX.	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X.	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI.	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII.	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Source: *The Severity of an Earthquake,* USGS General Interest Publication 1989-288-913.

The geological literature indicates that no major active faults transect the County, nor are there any Alquist-Priolo Earthquake Fault Zones within the County; however, there are several subsurface faults in the Delta. The Midland fault, buried under alluvium, extends north of Bethel Island in the Delta to the east of Lake Berryessa and is considered inactive. In 1892 an earthquake was recorded with an epicenter in Solano County, in the vicinity of the Midland Fault, which measured 5.6 on the Richter Scale; however, this earthquake did not result in surface deformation. To the east, the Bear Mountain fault zone trends northwest to southeast through Amador and El Dorado Counties. Geologists believe this series of faults has not been active in historic time; or approximately the last 200 years. Figure II-3 identifies the historically active faults in close proximity to Sacramento County.

While Sacramento County has experienced relatively little seismic activity, faulting in neighboring regions, especially the San Francisco Bay area and the Sierra Nevada, suggests that the County could be affected by future ground motion originating elsewhere (Table II-3). The greatest amount of groundshaking experienced in the County occurred on April 21, 1892, when an earthquake shook Yolo County between Winters and Vacaville. While the damage in Yolo County was severe, the damage in Sacramento County was substantially less. Damage to buildings in Sacramento was limited to statuary falling from building tops and cracks in chimneys. The 1906 San Francisco earthquake generated little shaking in Sacramento County and damage locally was limited to minor cracks in a local post office and jail. Similarly, Sacramento County suffered little damage from the October 17, 1989 Loma Prieta earthquake, which was felt over an area covering 400,000 square miles from Los Angeles to the California-Oregon border. The earthquake measured 7.1 on the Richter Scale; the epicenter was located along the San Andreas fault beneath the Santa Cruz Mountains, about 60 miles southeast of San Francisco. The San Francisco Bay region suffered over $6 billion in property damage and 62 lives were lost.

The 2014 South Napa earthquake, the largest since the Loma Prieta earthquake, measured a 6.0 on the Richter scale and could be felt within Sacramento County. While the damage was localized to the southern Napa and Vallejo region, there is possibility that future quakes of a larger magnitude could damage dams and levees in the Sacramento-San Joaquin Delta.

GROUNDSHAKING

Groundshaking is motion that occurs as a result of energy released during faulting. The damage or collapse of buildings and other structures caused by groundshaking is among the most serious seismic hazards. Damage to structures from this vibration, or groundshaking, is caused by the transmission of earthquake vibrations from the ground to the structure. The intensity of shaking and its potential impact on buildings is determined by the physical characteristics of the underlying soil and rock, building materials and workmanship, earthquake magnitude and location of epicenter, and the character and duration of ground motion. Much of the County is located on alluvium which increases the amplitude of the earthquake wave. Ground motion lasts longer and waves are amplified more on loose, water-saturated materials than on solid rock. As a result, structures located on alluvium typically suffer greater damage than those located on solid rock.

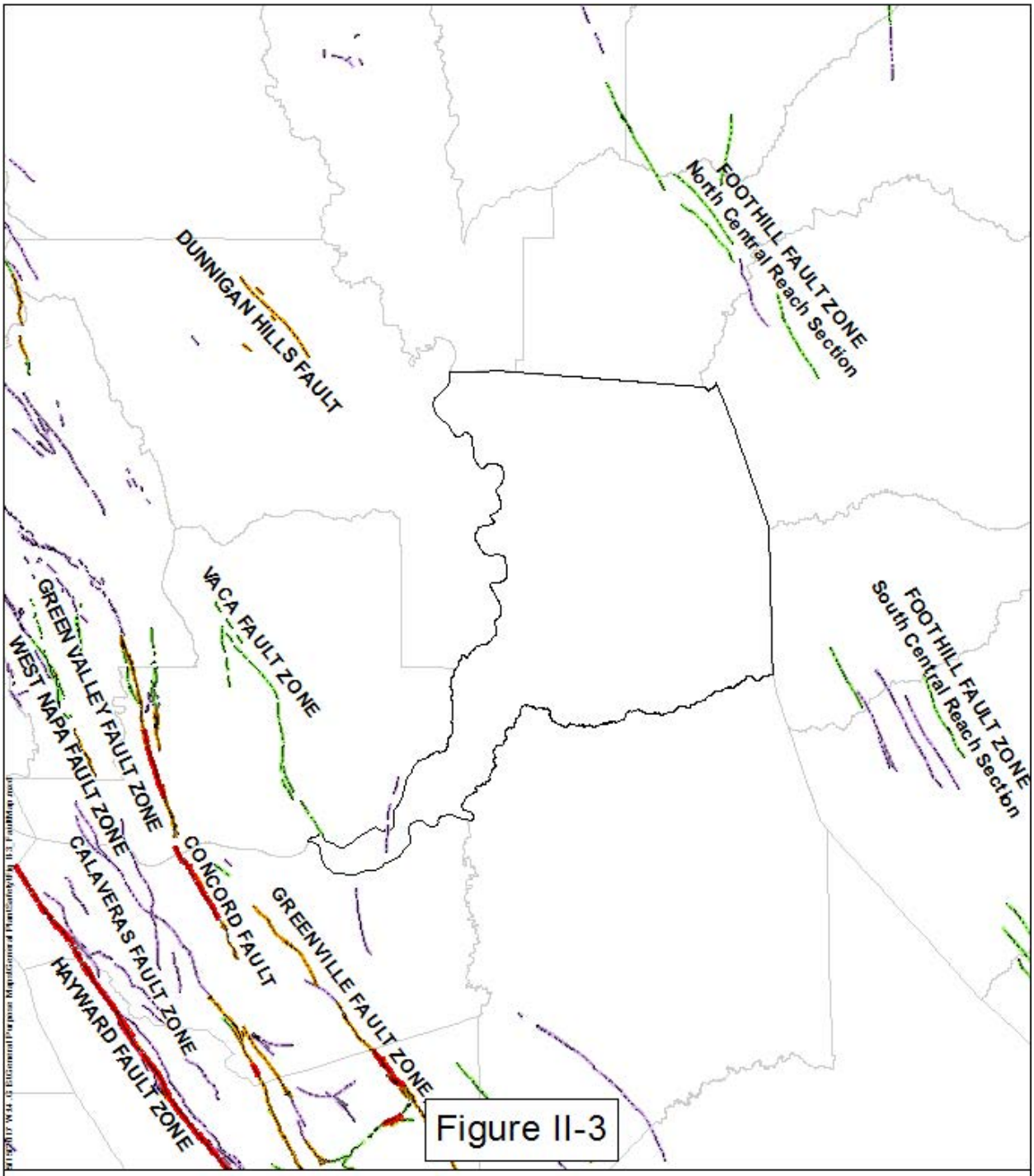

DUNNIGAN HILLS FAULT
FOOTHILL FAULT ZONE
North Central Reach Section
VACA FAULT ZONE
GREEN VALLEY FAULT ZONE
WEST NAPA FAULT ZONE
CALAVERAS FAULT ZONE
CONCORD FAULT
GREENVILLE FAULT ZONE
HAYWARD FAULT ZONE
FOOTHILL FAULT ZONE
South Central Reach Section
Figure II-3
Active Faults in the Vicinity of Sacramento County
Displacement in the last 200 years
Displacement in the last 11,700 years
Displacement in the last 700,000 years
Dispalcement undifferentiated
Source: California Department of Conservation, California Geologic Survey
Updated: 2017

TABLE II-3

APPROXIMATE RELATIONSHIPS BETWEEN EARTHQUAKE MAGNITUDE AND INTENSITY

Richter Scale Magnitude	Maximum Expected Intensity (MM)*	Distance Felt (kilometers)
2.0 - 2.9	I - II	0
3.0 - 3.9	II - III	15
4.0 - 4.9	IV - V	80
5.0 - 5.9	VI - VII	150
6.0 - 6.9	VII - VIII	220
7.0 - 7.9	IX - X	400
8.0 - 8.9	XI - XII	600

*Modified Mercalli Intensity Scale.

Source: United State Geologic Survey, Earthquake Intensity Zonation and Quaternary Deposits, Miscellaneous Field Studies Map 9093, 1977.

Maps indicating the maximum expectable intensity of groundshaking for the County are available through several sources. The California Geologic Survey has prepared a State map showing the predicted relative intensity of groundshaking and damage caused by future earthquakes. According to this map, the proximity of the Southern Delta region to major active faults subjects it more frequently to strong earthquake shaking than the rest of the County. The majority of the County is expected to experience less frequent and more mild groundshaking[5] (Figure II-4). Again, caution is advised in that the intensities shown are not applicable to modern earthquake-resistant construction. Since there are portions of the County where pre-1933 buildings exist, there is a threat to health and safety in cases where major groundshaking occurs.

Reservoirs are also sometimes subject to damage as a result of strong groundshaking. There are 21 significant dams in Sacramento County. Of these, only Folsom and Nimbus are under federal ownership and jurisdiction; the California Division of Safety of Dams takes jurisdiction over the remaining nineteen. The Division in recent years has required dam designs to be earthquake and seiche resistant and any construction or alteration must undergo a full seismic and geologic investigation. Water exceeding specified volumes may only be stored upon the issuance of a Certificate of Approval from the Division.

Several actions to minimize the damage to buildings from earthquakes and ground shaking have occurred since 1933. The construction of schools is regulated by the Field Act passed in 1933, when regulation and enforcement of construction codes became highly restrictive. Building regulations for hospitals are even more restrictive per the Alquist Hospital Seismic Safety Act of 1973 because hospitals must be fully functional after a disaster. In order to minimize danger caused by surface rupture along fault lines during an earthquake, the Alquist-Priolo Earthquake Fault Zoning Act (1972) prohibits building structures meant for human occupancy across active fault lines. It also requires the State Geologist to map "Earthquake Fault Zones" and distribute to the relevant local agencies. While there are no Earthquake Fault Zones in Sacramento County, neighboring Yolo, Solano, and Contra Costa Counties contain active faults subject to Alquist-Priolo[6].

Additionally, all structures are subject to the California Building Code (CBC) adopted by the County. The CBC requires that structures be built to withstand groundshaking in areas of high earthquake hazards and that strong motion instruments be placed in larger buildings. These instruments are activated by strong groundshaking and record the response of the structure and the site of seismic activity. Buildings constructed prior to 1951 are not subject to CBC regulations. However, the Dangerous Building Code (County Code, Title 16, Chapter 22) provides abatement procedures, on a complaint basis, for existing structures deemed unsound.

[5] California Geological Survey, Department of Conservation, *Earthquake Shaking Potential for California.* http://www.conservation.ca.gov/cgs/rghm/psha/Documents/shaking_18x23.pdf

[6] California Geological Survey, Special Publication 42, Interim Revision 2007, *Fault-Rupture Hazard Zones in California, 2007.* ftp://ftp.consrv.ca.gov/pub/dmg/pubs/sp/Sp42.pdf

LIQUEFACTION

Liquefaction is a process whereby water in unconsolidated soils is subjected to pressure, usually produced by ground motion, causing these materials to behave as quicksand. The result is that the underlying soil literally flows out from under buildings.

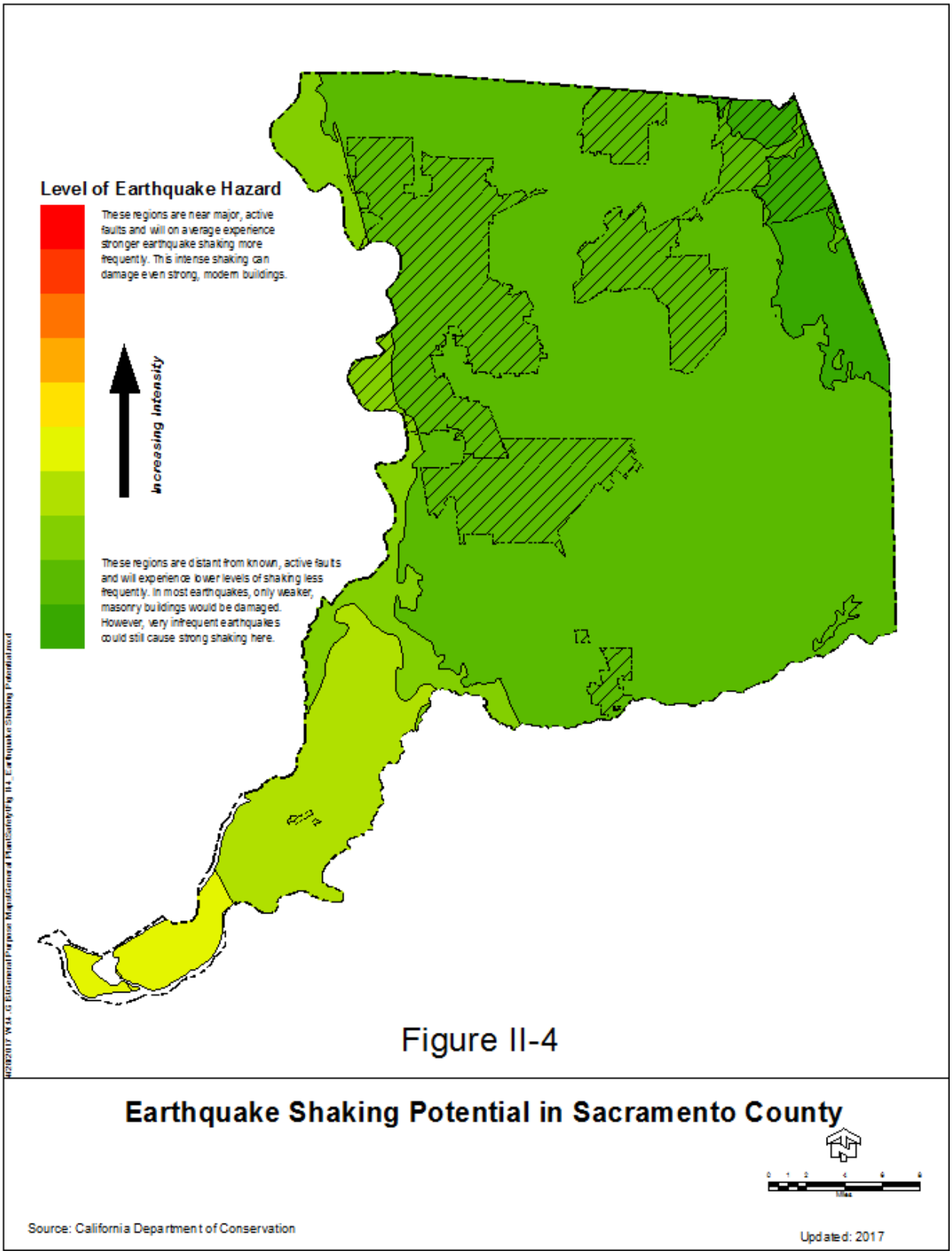
The evaluation of potential for liquefaction is complex and factors that must be considered include soil type, soil density, groundwater table, and the duration and intensity of shaking. Liquefaction is most likely to occur in deposits of water-saturated alluvium or similar deposits of artificial fill.

In 2016, Sacramento County updated the countywide Local Hazard Mitigation Plan (LHMP) in partnership with the Cities of Sacramento, Citrus Heights, Elk Grove, Folsom, Galt, Isleton, Rancho Cordova, and several special districts. The LHMP identifies and profiles hazards, assesses the vulnerability of Sacramento County and incorporated cities, and includes mitigation capabilities to combat these risks. Within the Hazards Profile section of the LHMP, there is a subsection specifically devoted to the risks posed by Liquification. The LHMP can be viewed at the following web address:

http://www.waterresources.saccounty.net/stormready/Pages/Hazard-Mitigation-Planning-Committee-2016-Plan-Update.aspx

According to the LHMP, Sacramento County has two areas that have been suggested as posing potential liquefaction problems - the downtown area and the Delta. Although the Delta's levee system has never been subject to strong groundshaking, many of the levees are considered at risk of failure due to liquefaction in the event of an earthquake. Those with the highest risk are levees which are built higher, in response to island subsidence, and in close proximity to neighboring fault systems, which are concentrated in the Central and Western portions of the Delta. Levee failure, depending on the extent, could result in salt water intrusion from the San Francisco Bay and could have disastrous effects on agriculture and fisheries.

A geological and seismological study in 1972 indicated that the Housing and Redevelopment Agency building site located downtown at the intersection of 7th and I Streets has a potential for liquefaction. This study also concluded that potential liquefaction problems may exist throughout the downtown area where loose sands and silts are present below the ground water table.


Level of Earthquake Hazard
These regions are near major, active faults and will on average experience stronger earthquake shaking more frequently. This intense shaking can damage even strong, modern buildings.
Increasing Intensity
These regions are distant from known, active faults and will experience lower levels of shaking less frequently. In most earthquakes, only weaker, masonry buildings would be damaged. However, very infrequent earthquakes could still cause strong shaking here.
Figure II-4
Earthquake Shaking Potential in Sacramento County
Source: California Department of Conservation
Updated: 2017

GEOLOGIC HAZARDS

SUBSIDENCE

Subsidence is the gradual settling or sinking of the earth's surface with little or no horizontal motion. Sacramento County is affected by five types of subsidence: liquefaction caused by earthquake shaking, compaction by heavy structures, the erosion of peat soils, peat oxidation, and fluid withdrawal. Groundwater extraction for residential, commercial and agricultural uses causes the greatest amount of subsidence in Sacramento County (Figure II-5).

Subsidence has created major problems for flood control, particularly in the Delta. As levees sink under their own weight and are weakened by the erosive force of water, expensive periodic rebuilding is necessary. According to the California Department of Water Resources, the Sacramento-San Joaquin Delta's peat soils are subsiding at an estimated 0.4 to 0.6 inches per year[7]. However, according to USGS estimates, developed islands in the Central and Western Delta are subsiding at 1-3 inches per year on average[8]. Many islands in the Delta that, at one time, were at or above sea level are now between 10 and 25 feet below sea level.

[7] California Department of Water Resources, *Subsidence in the Sacramento-San Joaquin Delta*, July 2012. http://www.water.ca.gov/floodsafe/fessro/subsidence.cfm#rates

[8] United States Geologic Survey, *Delta Subsidence in California*, April 2000. https://pubs.usgs.gov/fs/2000/fs00500/pdf/fs00500.pdf

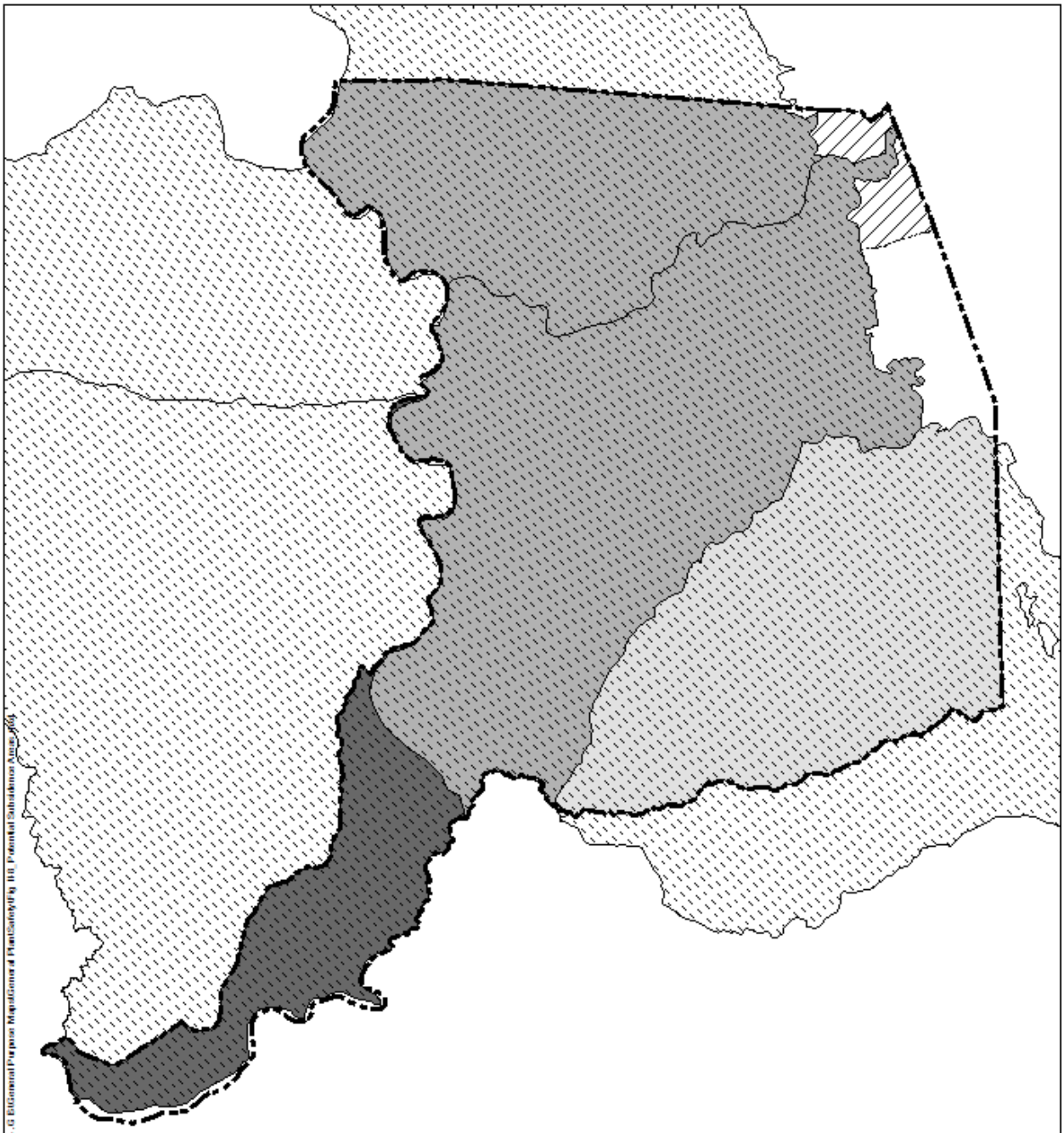


Figure II-5

Potential Subsidence Areas in Sacramento County

Areas of Potential Subsidence

- High
- Medium to High
- Low to Medium
- Groundwater Basins

Source: California Department of Water Resources

Updated: 2017

EXPANSIVE SOILS

Expansive soils represent approximately one third of all soil types in Sacramento County. They are largely comprised of clays, which greatly increase in volume when water is absorbed and shrink when dried. Expansive soils are of concern because building foundations may rise during the rainy season and fall during the dry season in response to the clay's action. If movement varies under different parts of the building, the result is that foundations creak, structural portions of the building are distorted, and doors and windows are warped so that they do not function properly.

In accordance with the State Subdivision Map Act, the County Grading Ordinance, and Chapter 22 of the Sacramento County Code, soil reports are required prior to issuance of building permits in areas where the potential for expansive soils is present.

LANDSLIDES

Landslide is a general term used for a falling mass of soil and rock. In Sacramento County, only a narrow strip along the eastern boundary, from the Placer County line to the Cosumnes River, is considered to have landslide potential. However, future slides on these slopes are expected to be minor in nature and do not pose a large scale threat to life or property. The American River Bluffs downstream from Folsom and in Fair Oaks and Carmichael are considered stable and are generally not subject to fracture or landslides.

EROSION

Erosion is a natural geological process by which landforms are worn down or reshaped by wind and water and the eroded material is deposited elsewhere. While erosion occurs in Sacramento County, it does not appear to pose a significant hazard to property.

Erosion from agriculture seems to pose little problem in most of the County. The Central and Western portions of the County are fairly level and very little erosion takes place in these areas unless poor farming practices leave large areas of soil exposed and dry and subject to wind erosion.

There is a greater potential for erosion in the Eastern foothills of the County, but extensive grass cover protects most of the vulnerable soils. Also, there is little agricultural activity in this area because the soils are generally of poor quality. The grasses, therefore, remain undisturbed unless a fire or some other event exposes the soil.

Although construction activity does present a potential for erosion – specifically in instances where soils are continuously exposed – Sacramento County provides measures to limit or restrict such practices through Grading and Drainage Ordinances and any permit issued under such ordinances would not be granted for a project which might generate potentially significant erosion hazards.

CONCLUSION

Sacramento County is affected by seismic and geologic activity that could be disastrous to the economy and detrimental to the health and wellbeing of the community. The general lack of dramatic geologic activity in and around the County is misleading. The potential for destructive geologic and seismic hazards is a serious consideration when reviewing development plans for commercial and residential expansion. To protect life and property it is incumbent upon policy makers, developers, and planners to be knowledgeable of the earth hazards facing this County, and to remain diligent in developing a community that protects, to the best of our ability, people and property from the dangers of seismic and geologic hazards.

SACRAMENTO COUNTY GENERAL PLAN
SAFETY ELEMENT

FLOODING
TECHNICAL DISCUSSION

INTRODUCTION

Flooding is the rising and overflowing of a body of water onto normally dry land. The initial force of flood waters can shatter structures and uplift vehicles. Floodwaters can transport large objects downstream which, in turn, can damage or remove stationary structures. Saturation can result in instability, collapse, or other damage. Objects can be buried or destroyed through sediment deposition. Floodwaters can break utility lines, interrupt services and potentially affect health and safety, particularly in the case of a broken sewer, domestic water, or gas lines. Standing water may cause septic tank failure, well contamination, and loss of crops. Roads, foundations and electrical circuits may also become damaged by standing water.

Flooding can occur due to surface flow of stormwater, ponding, overbank flood flow from ditches and creeks, or failure of flood control systems. In modern times, Sacramento County has been fortunate to not have experienced catastrophic flooding in urban areas due to levee or dam failure. However, the American and Sacramento River could pose a threat to public safety. The statistically unlikely flood event that would overwhelm dams and levees would have enormous consequences.

Sacramento County is vulnerable to riverine flooding. Riverine flooding generally occurs as a result of prolonged rainfall, or rainfall combined with snowmelt and/or already saturated soils from previous rain events. Factors that directly affect the amount of flood runoff include precipitation amount, intensity and distribution, the amount of soil moisture, seasonal variation in vegetation, snow depth, and impermeability of the surface due to urbanization. Placement and integrity of existing levees and reservoir operation for flood control are also important factors. Riverine flooding can occur anytime from November through April, and is largely caused by heavy and continued rains. Intense storms may overwhelm local waterways, as well as threaten the integrity of flood control structures.

Due to the County's relatively flat, generally low-lying terrain and numerous waterways, flooding has historically constituted the most frequent natural hazard. Several rivers flow through the County including the Sacramento, American, and Cosumnes Rivers. The Sacramento and American Rivers, and several tributaries to the east, north, and west, flow toward the City of Sacramento. The watersheds of these two main rivers drain most of Northern California and part of Oregon for a total of approximately 20,000 square miles. The Shasta and Folsom Dams, under the jurisdiction of the US Bureau of Reclamation, manage the Sacramento and American River flows with flood control as an important feature of their operational rules.

The Cosumnes River, which is not influenced by a flood-control reservoir, flows southwesterly through the southern portion of the County into the Sacramento-San Joaquin Delta region.

When the Sacramento River reaches its peak capacity, the American River and other tributaries that flow into the Sacramento River cannot discharge at a normal rate. These conditions result in "backflows," which can cause tributaries to overflow and flood local areas. The reach of Sacramento River closest to the Sacramento-San Joaquin Delta is also affected by ocean tides. High tides that occur simultaneously with high river flows could increase chances of flooding. To combat the natural tendencies for flooding in the Sacramento region, the American River and Sacramento River flood control systems have been established with dams, bypasses, and levees to control high flows and potential inundation. The construction of these control systems have greatly reduced the risks of flooding on the Sacramento River, with 20 floods accounting for State and federal disaster declarations since 1950.

There are other characteristics specific to the Sacramento, American, and Cosumnes Rivers which also contribute to the potential for Delta flooding to occur. Agricultural interests continue to farm land which contributes to subsidence in the Sacramento San Joaquin Delta, where the watersheds of these three rivers converge, weakening levees and leaving them vulnerable to breaching. As this land continues to subside, coupled with the potential impacts of sea-level rise, additional strain may be placed on the Delta levee system, which already experiences erosion and sloughing due to river velocity and wind-driven, wave wash. In addition, catastrophic Delta flooding from levee failure may occur as result of a seismic event.

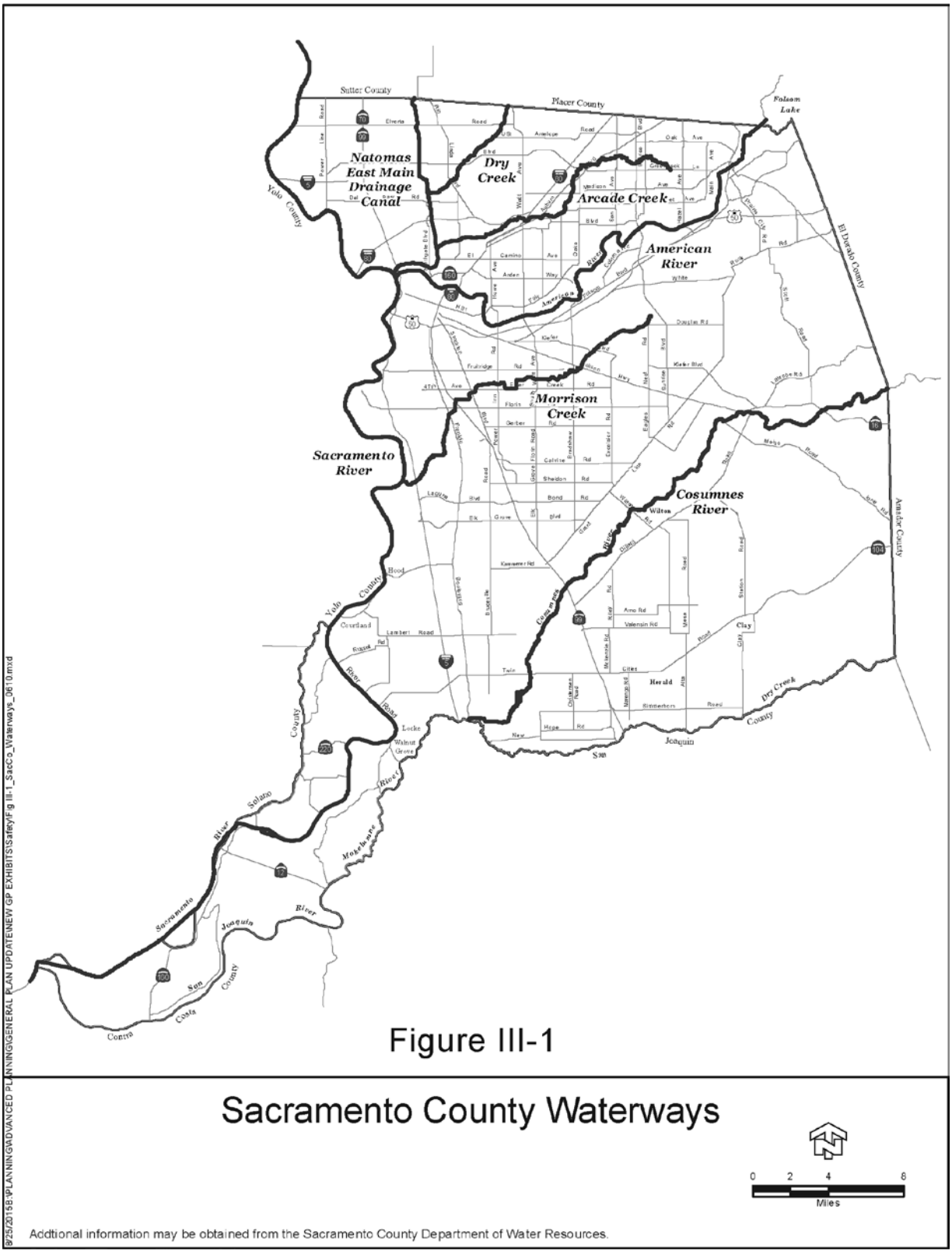
While it is uncertain precisely how and to what extent climate change will affect flooding events in Sacramento County, it is reasonable to expect that an increase in flooding could have serious ramifications, because the area is already considerably vulnerable. More rapid and earlier snowmelt, or increased potential for high-intensity storm events, compared to historical trends, could potentially place additional strain on the components of flood control systems (e.g., levees, dams), and increase the likelihood of flooding in Sacramento County.

Sacramento County does enjoy much area of high ground and is not susceptible to flooding due to such a flood control failure.

As of 2004, nearly 30% of the County's population lives within the 100-year floodplain, over 5,000 residences have previously been damaged by floods and the federal share of past damage to public facilities exposed to flood hazard has cost $15 million. Considering the increasing rate of development and the condition of the current flood control system, greater protection from flood hazards is needed. Prudence in planning and locational analysis in the development process is warranted. **(Updated 2011)**

Historically, Sacramento County was much more vulnerable to flooding before the dams and levees were constructed. Early residents of downtown Sacramento were forced to build on top of the original town level to avoid floods. Flood zones in Sacramento County are still extensive. Several areas of the County are subject to flooding by the overtopping of rivers and creeks, levee failures, and the failure of urban drainage systems that cannot accommodate large volumes of water during severe rainstorms.

In Sacramento County, there are two main rivers and several tributaries to the east, north, and west that all flow towards the City of Sacramento (Figure III-1). The Sacramento River delineates the western borders of the City and most of the County of Sacramento. The American River flows west through the County and City and meets the Sacramento River just north of downtown Sacramento. During winter storms, the creeks and streams swell from runoff emptying into rivers already impacted by floodwaters. The volumes of water increase and the flood control system is tested as the rivers approach the County.



(Modified 2016)

Brief History of Sacramento Area Flood Events[9] -

December 1861: Possibly the largest storm to hit Northern California. A levee along the American River, east of 30th Street, failed, flooding what is now known as River Park. To relieve the rising water levels, the levee at 5th and R Streets was cut to drain the "lake" but houses were swept away in the current created during the process.

1880, First Comprehensive Flood Control Plan: In response to the 1878 flood, State Engineer William Hammond Hall developed an integrated, comprehensive flood control plan for the Sacramento Valley. The plan subsequently came to include a system of levees, weirs, and bypass channels to protect existing population centers.

1917, Congress authorizes Sacramento Flood Control System: After a series of violent floods between 1902 and 1909, the Comprehensive flood control project envisioned by Hall gained federal financial authorization in 1917.

1944, Folsom Dam Authorized: The Flood Control Act of 1944 authorized the U.S. Army Corps of Engineers (Corps) to build a dam on the lower American River. Completed in 1956, Folsom Dam was originally designed to provide in excess of a 500-year level of flood protection.

1951, Record Flood: Just after ground was broken on Folsom Dam, the American River watershed experienced the first of five record storms.

1956, Record Flood: Though engineers had been predicting it would take a year to fill the nearly completed Folsom Lake, the second record storm filled the lake in a week and Sacramento was saved from flooding.

1964, Record Flood: The third record flood in less than 15 years caused engineers to re-evaluate storm frequency. They concluded the storm Folsom is designed to handle is a 120-year storm not a 500-year storm.

1986, Record Flood: A storm in February 1986 produced a 10 inches of rainfall in 11 days, causing the American River to dump more water into Folsom than it was designed to handle. After two days of releases at the design level, (115,000 cubic feet per second (cfs)), officials boost releases to 134,000 cfs. Folsom performance is downgraded to about a 60-year storm.

1994, Folsom Dam Operation Improved: Sacramento Area Flood Control Agency and the Bureau of Reclamation execute an agreement to operate Folsom Dam and Reservoir to take advantage of incidental flood control provided by upstream water and power reservoirs at French Meadows, Hellhole, and Union Valley.

January 10, 1995, Record Rainfall: This storm broke records in some parts of the County for its intensity, causing widespread flooding due to overtopped creeks and overwhelmed storm drain systems.

[9] Sacramento History Journal of the Sacramento County Historical Society Volume VI No. 1,2,3 & 4 dated 2006 "Water Our History & Our Future".

January 2, 1997: The heavy rains brought the Cosumnes River to record flows above designed limits for the protective levees. Twenty breaks occurred, with the largest near the town of Wilton in the southern end of the County. The surging floodwaters inundated thousands of acres of cropland and damaged at least 84 homes.

January 22, 1997: Localized heavy rain brought Chicken Ranch Slough out of its banks, flooding the Arden-Arcade area of the city. At least 1,000 homes and apartment buildings were flooded.

January 26, 1997: Heavy showers and thunderstorms moved over the metro area, re-flooding the neighborhoods surrounding Chicken Ranch Slough, which had just experienced flooding on the 22nd. The flooding was higher in this instance and caused additional damage to 500 more homes.

Summer 1997: The Cosumnes River levees were repaired by the County using funding from the Natural Resources Conservation Service.

1999: Congress Approves Significant Sacramento Flood Control Projects: Projects include enlarging outlets at Folsom Dam, raising the lowest levees on the American River, and raising levees along Morrison creek and its tributaries in South Sacramento. Construction of seepage cutoff walls and other levee improvements along Lower American River also began.

January 23, 2000: Persistent rains for 34 hours swelled Dry Creek over its banks in Rio Linda. Cherry Lane, 6th Street, as well as Curved Bridge Road were flooded.

January 1, 2006: A series of warm winter storms brought heavy rain, mudslides, flooding, and high winds to Northern California. Levee overtopping, breaching, and river flooding occurred along the Feather and Sacramento main-stem Rivers as well as along numerous smaller rivers, creeks, and streams. Several urban areas had significant street flooding. The Sacramento weir opened twenty gates, the first opening since 1997. Transportation throughout the area was difficult during the course of the storms as airports were closed due to the high winds and major road closures resulted from flooding and mudslides. Interstate 80, the main artery between Sacramento and the San Francisco Bay area, was closed near Fairfield in Solano County for several hours due to severe flooding. Additionally, Interstate 80 eastbound between Sacramento and Reno, NV, was closed for more than a day due to a massive mudslide, as were both directions of U.S. Highway 50 between Sacramento and South Lake Tahoe.

2008: Construction begins on Folsom Dam Joint Federal Project, with the main feature being a gated auxiliary spillway designed to allow Folsom Dam to safely control a 200-year flood.

December 3, 2014: Heavy rain showers and thunderstorms brought record rainfall and flooding issues to portions of the Central Valley and foothills. There were 2 berm levees which failed in Tehama County, flooding over 200 homes and damaging farms and orchards. Significant traffic delays were caused by road flooding across interior Northern California. Snow levels remained

above 7,500 feet, so snowfall was limited to higher Sierra peaks and Lassen Peak. Watt Avenue and Roseville Rd. number 1 lane flooded with 2 feet of water due to clogged drain.

2017: Was one of the wettest winters on record. Storms in January and February caused flood damage and multiple levee breaches along the Cosumnes River. Flooding occurred in the communities of Wilton and Point Pleasant. Additional levee breaches occurred on Lost Slough and the Mokelumne River resulting in the flooding of large tracts of agricultural land.

When the Sacramento River reaches its peak capacity, the American River and other tributaries that flow into the Sacramento River cannot flow into the Sacramento River at a normal rate. Under these conditions, "backflows" can occur, causing tributaries to overflow and flood local areas. The Sacramento River is also affected by ocean tides that periodically raise and lower the water level. High tides that occur simultaneously with flooding conditions could increase the rate of flooding.

To control flooding in Sacramento County, there is an extensive system of dams, levees, overflow weirs, drainage pumping plants, and flood control bypass channels strategically located on the Sacramento and American Rivers and various creeks. These facilities can control floodwaters by regulating the amount of water passing through a particular reach of the river. The amount of water flowing through the levee bound system can be controlled by the Folsom Dam on the American River and the reserve overflow area of the Yolo Bypass on the Sacramento River. Regular inspection and repair of the levees are undertaken by various maintaining agencies. Figure III-7 depicts the Countywide system of levees and Figure III-8 shows which levees are accredited by the Federal Emergency Management Agency (FEMA) as providing 1-percent-annual-chance (1:100 year) flood protection. Figure III-8 will be updated as needed and posted on the County Department of Water Resources website. The riverine flood control system is quite extensive and effective. There are many other areas of creek flooding. Figure III-2 illustrates the areas within the urban portions of Sacramento County that have been prone to flooding in the past, and Figure III-9 depicts existing and future urban development that lies within the 100 year floodplain. **(Updated 2011)** Flooding also occurs in the agricultural south County area. County Water Resources has flood hazard information available to the public on their website.

Local drainage is managed by Sacramento County, Folsom Dam is operated by the Bureau of Reclamation, and there are twenty-three levee maintenance agencies. Clearly, a variety of entities have responsibility for flood protection affecting the County. Each role is well defined. The County operates a real time stream and rain gauge system, known as ALERT. Levee patrols take action when regular monitoring of weather conditions and flow releases in the American and Sacramento Rivers indicates that severe rainfall and other weather conditions have the likelihood to result in rising water levels. Prior to severe storms, the County Emergency Operations Office will open up the Regional Emergency Operations Center and begin staffing the center in preparation for a large scale emergency. The Emergency Operations Center acts as a central point of coordination and communication of activities and conditions in the field, such as road closures, and is staffed with representatives of law enforcement, fire, health care, transportation, flood control and other local, State and federal agencies involved in responding to emergencies. **(Added 2011)**

The California Department of Water Resources (DWR) and the Central Valley Flood Protection Board (formerly State Reclamation Board) are required to prepare and adopt a Central Valley Flood Protection Plan by 2012. The American River Flood Control District, the Sacramento Area Flood Control Agency (SAFCA), and the California-Nevada River Forecast Center (CNRFC) also provide flood protection for Sacramento County. Formed by the State Legislature in 1927, the American River Flood Control District maintains the 40 miles of levees along the American River and portions of Steelhead, Arcade, Dry and Magpie Creeks[10]. SAFCA was created by the City of Sacramento, the County of Sacramento, the County of Sutter, the American River Flood Control District and Reclamation District 1000 through a Joint Exercise of Powers Agreement to provide the Sacramento region with increased flood protection along the American and Sacramento Rivers[11]. **(Added 2011)**

CNRFC, a field office of the National Weather Service (NWS), is located in Sacramento. The NWS is an agency of the National Oceanic and Atmospheric Administration (NOAA) under the United States Department of Commerce. CNRFC assimilates hydrometeorological data, and provides river basin modeling and hydrologic forecast preparation for the California/Nevada region.[12] Additionally, there are twenty reclamation/ levee districts in Sacramento County (see list in Appendix to Safety Element). **(Added 2011)**

THE 1986 FLOOD

In February of 1986, the flood control system was taxed when storms produced record flows in both the Sacramento and the American River watersheds. During the storm, the American River was over 16 percent higher than its design capacity. The Sacramento River was at its highest stages ever recorded. Recordings taken at the I Street Bridge near downtown Sacramento showed the river to have only two feet of freeboard (the distance between the water level and the top of the levee), although the system was designed to have at least three feet of freeboard.

During the 1986 flood, fortunately, the flood control systems protecting the urban areas stood up to the flood and protected the community from a catastrophe. Nevertheless, the successive storms damaged 1,730 private homes and businesses. The storms caused close to $50 million in public and private property damage, excluding damage to roads and other infrastructure. In the northern Delta, 1,600 people were evacuated and $20 million in property damage occurred. Interstate 5, Interstate 80, State Highway 99, and numerous local roads were flooded.

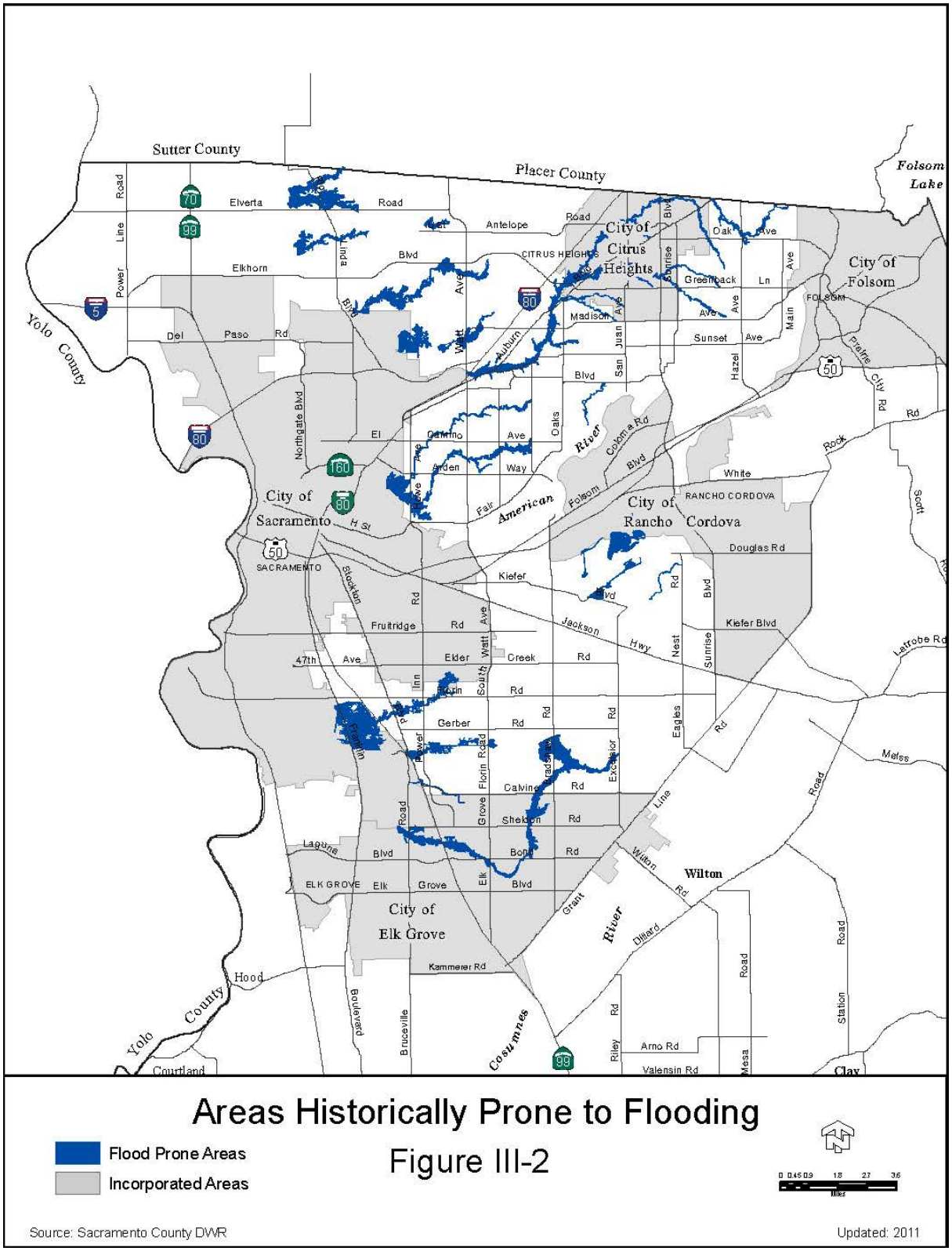
Before 1986, it was believed that Sacramento's 110-mile levee system was sufficient to withstand at least a 100-year flood (a flood having a one percent chance of being equaled or exceeded in any given year). The flood of February 1986 was, however, calculated to be about a 70-year flood (1.4 percent chance of occurrence in any given year).

[10] American River Flood Control District, website: http://www.arfcd.org/who_we_are.php, accessed on May 3, 2010
[11] SAFCA, website: http://www.safca.org/, accessed on May 3, 2010
[12] National Weather Service California and Nevada River Forecast Center, website: http://www.cnrfc.noaa.gov/about_us.php, accessed on May 3, 2010

Significant federal, State, and local resources have been applied to improving the American River flood control system. The American River currently enjoys 1 in 100 year flood protection. There is a plan to further improve the flood protection to the 1 in 200 year level, required by State law, by 2025.

The Sacramento River and Natomas levee systems have a plan in place to achieve 1 in 200 year flood protection by 2025.

Studies are underway to determine how to improve flood risk reduction for the Delta legacy communities of Hood, Courtland, Locke, Walnut Grove, and Ryde.



(Modified 2016)

FLOOD POLICY

Federal Flood Policy

The Federal Emergency Management Agency (FEMA) is responsible for maintaining flood insurance rate maps; the local floodplain manager is responsible for the accuracy of those maps. FEMA is also responsible for distributing the Federal Insurance Rate Map (FIRM) which is used in the National Flood Insurance Program (NFIP).

The 1 in 100 year flood protection standard was set by the National Flood Insurance Program as a 'bright line;' that is, those in the floodplain are to obtain flood insurance and those outside of the FEMA floodplain are not required to do so. California law requires 1 in 200 year flood protection for new development in urban areas, when there is a watershed of more than ten square miles affecting that development. The Sacramento Area Flood Control Agency is making strides to achieve this level of flood protection in coming years.

Flood hazard information is available by calling or visiting the County Water Resources Department.

The National Flood Insurance Program is responsible for flood hazard mapping. Flood hazard zones are geographic areas that the FEMA has defined according to varying levels of flood risk. These zones are depicted on a community's Flood Insurance Rate Map (FIRM) or Flood Hazard Boundary Map. Each zone reflects the severity or type of flooding in the area. The following are the FEMA Flood Zone Designations for the Flood Insurance Rate Maps[13]. Sacramento County participates in the FEMA Community Rating System, and as such, flood insurance is significantly discounted. (**Updated 2011)**

Zone A

The flood insurance rate zone that corresponds to the 1% annual chance floodplain for requiring federal backed mortgages to purchase flood insurance; no depths or base flood elevations are shown within this zone. **(Added 2011)** The County has information to assist in determining the base flood elevation.

Zone AE

The flood insurance rate zone that corresponds to the 1% annual chance floodplain for requiring federal backed mortgages to purchase flood insurance. Base Flood Elevations (BFEs) are shown at selected intervals within this zone. New buildings constructed in this zone must be elevated above the base flood elevation (i.e., the 1% annual chance flood level). **(Added 2011)** The County has additional information on many of the floodplain areas, requiring higher flood elevations for new construction and substantial improvement.

[13] USACE: USACE Sacramento District-- FEMA Flood Zone Designations, website: http://www.spk.usace.army.mil/projects/civil/natomascertification/FEMAzones.htm, accessed on January 29, 2009

Zone AH

Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are between one and three feet. Base flood elevations (BFEs) derived from detailed hydraulic analyses are shown in this zone. Mandatory flood insurance purchase requirements and floodplain management standards apply.[14] **(Added 2011)**

[14] FEMA: http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/zone_ah.shtm, accessed on June 28, 2010

Zone A99

The flood insurance rate zone that corresponds to the 1% annual chance floodplain that will be protected by a federal flood protection system where construction has reached specified statutory milestones. No BFE or depths are shown in this zone. Mandatory flood insurance purchase requirements apply; however, no minimum building standards are required for this zone. **(Added 2011)** The County must report to FEMA annually on the progress toward finishing the flood control improvements resulting ultimately in Zone X mapping.

Zone AR

The flood insurance rate zone used to depict areas protected from flood hazards by flood control structures such as a levee that are being restored. FEMA will consider using the AR designation for a community if the flood protection system has been deemed restorable by a federal agency in consultation with the local project sponsor; a minimum 3% annual chance level of flood protection is still provided to the community by the system and restoration of the flood protection system is scheduled to begin within a designated time period. Mandatory purchase requirements for flood insurance apply as do minimum building standards. **(Added 2011)**

Zone X

The flood insurance rate zone that corresponds to areas outside the 1% annual chance floodplain; mandatory purchase requirements for flood insurance and minimum building standards do not apply to this zone. **(Added 2011)** There are vast areas of the County that are mapped shaded Zone X indicating that while protected from the 1 in 100 year flood, they are susceptible to flooding in larger, less frequent storms.

The information above is an outline, the County Floodplain Management Ordinance, Building Code, and Improvement Standards take precedence.

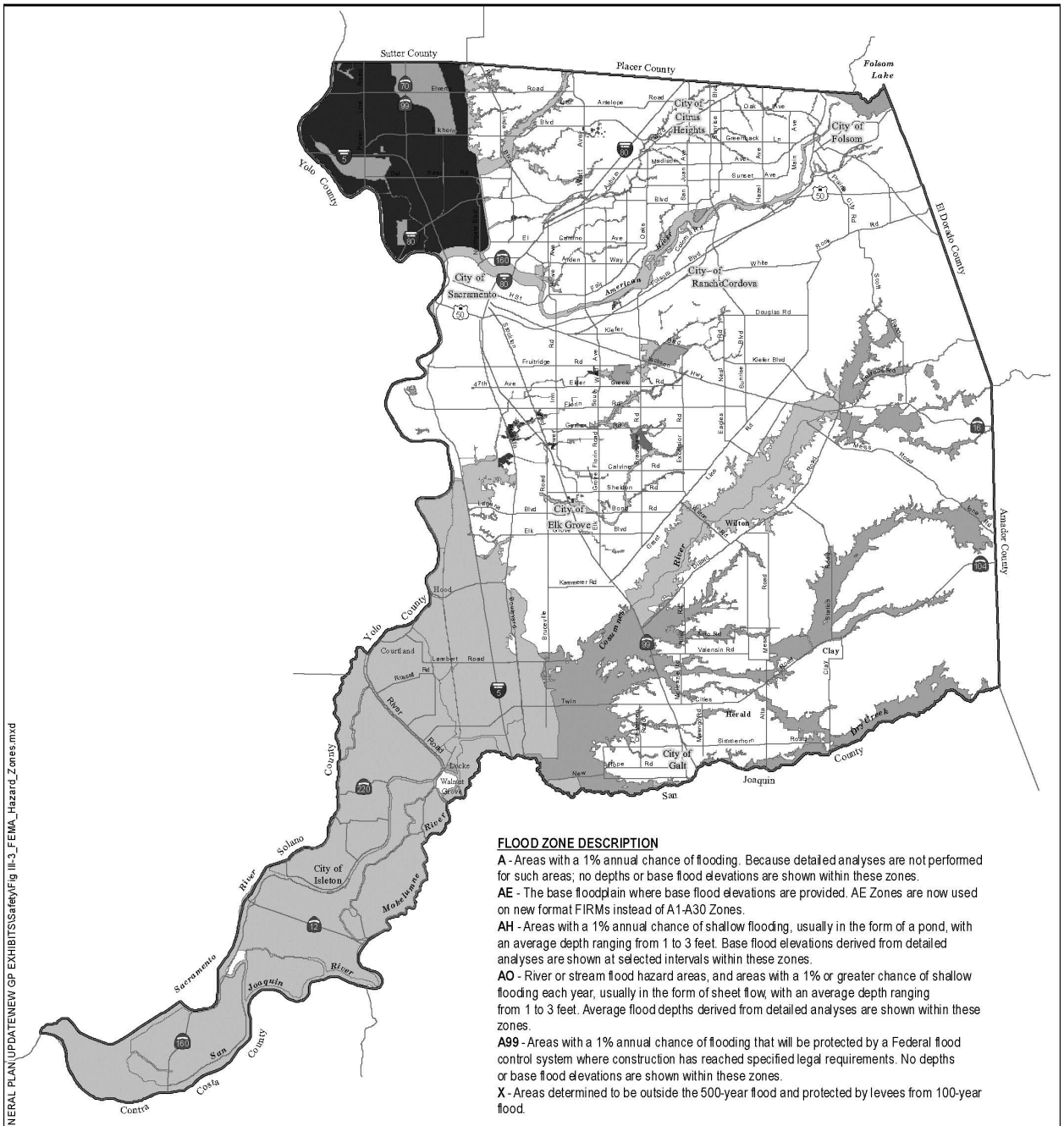


Figure III-3

(Modified 2016)

State Department of Water Resources (DWR) Floodplain Mapping

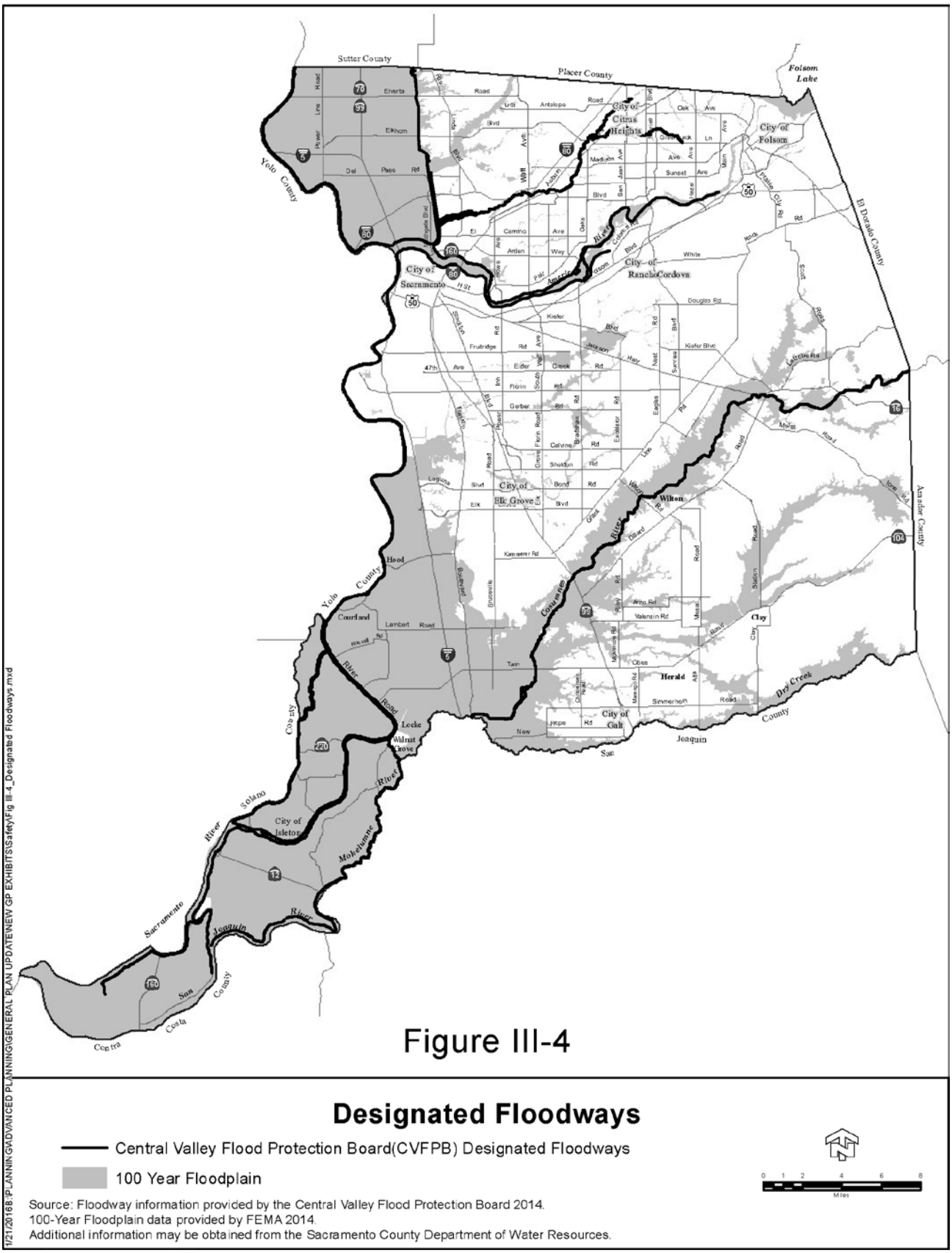
In an effort to provide information essential to community planning needs, DWR has initiated the Awareness Floodplain Mapping Project. The intent of the Awareness Floodplain Mapping project is to identify all pertinent flood hazard areas by 2015 for areas that are not mapped under the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program (NFIP) and to provide the community and residents an additional tool in understanding potential flood hazards currently not mapped as a regulated floodplain. The awareness maps identify the 100-year flood hazard areas using approximate assessment procedures. These floodplains will be shown simply as flood prone areas without specific depths and other flood hazard data. These maps are not FEMA regulatory floodplain maps; however, at the request of the community FEMA would include this data on their maps[15]. **(Added 2011)**

2007 Flood Legislation Package

Pursuant to SB 5 (Machado, 2007) and AB 162 (Wolk, 2007), the California Department of Water Resources (DWR) and Central Valley Flood Protection Board (formerly State Reclamation Board) are required to prepare and adopt a Central Valley Flood Protection Plan (CVFPP) by 2012. As a basis for the CVFPP, DWR is required to prepare new 100 and 200 year floodplain maps. Upon the adoption of the CVFPP, the standard for flood protection for the Sacramento-San Joaquin Valley area will increase to a 200-year level (ability to withstand a 1 in 200 chance of flooding in any given year) in urban areas. **(Added 2011)**

Upon adoption of the CVFPP, jurisdictions will have 24 months to incorporate the measures of the plan into their General Plans, and 36 months to incorporate measures into their zoning ordinances. Upon DWR's finalization of the updated 100 and 200 year floodplain maps, they will be incorporated into the Safety Element of the General Plan. **(Added 2011)**

[15] CA DWR: Flood Management—Awareness Floodplain Maps, website: http://www.water.ca.gov/floodmgmt/lrafmo/fmb/fes/awareness_floodplain_maps/, accessed on February 2, 2009



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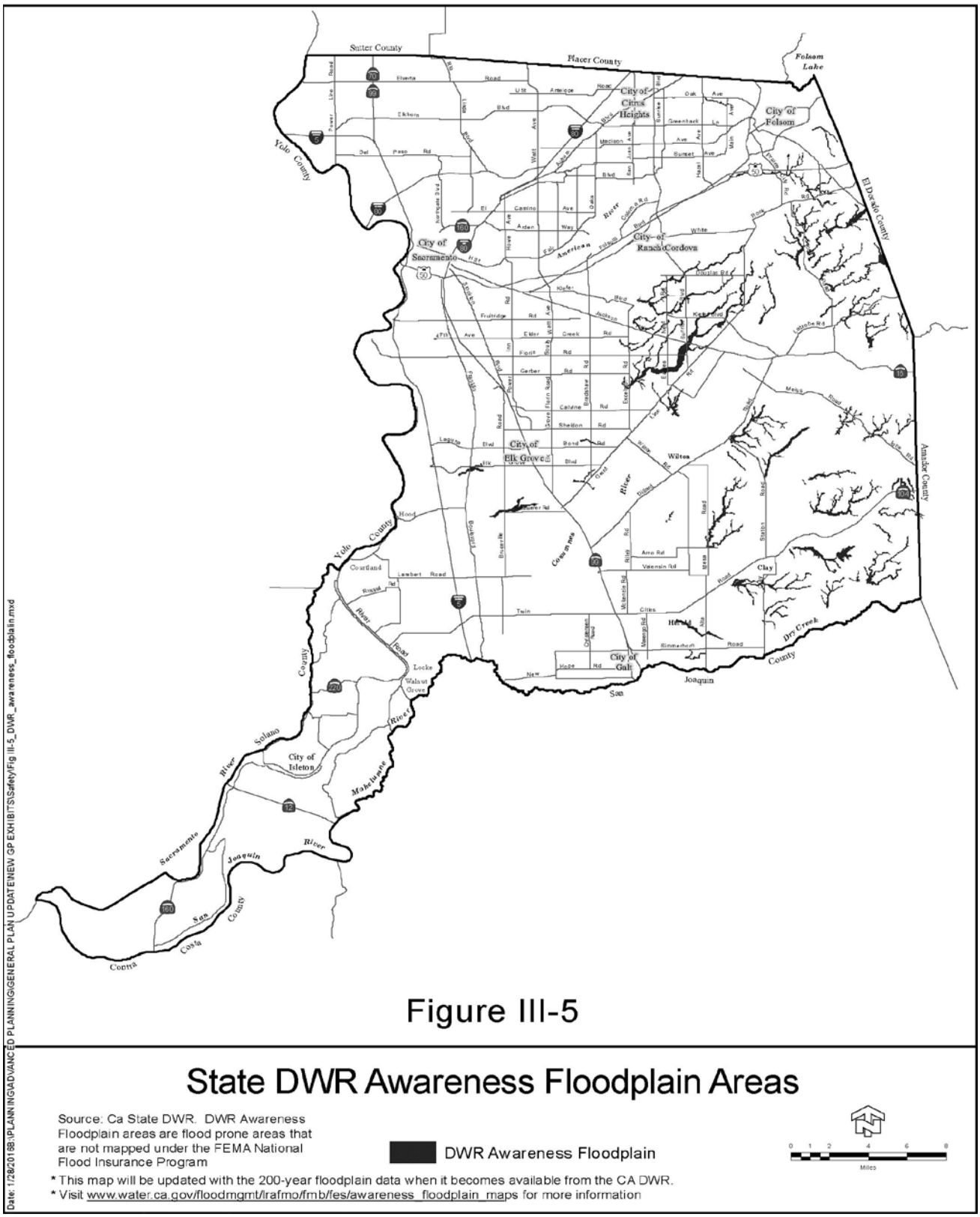


Figure III-5

State DWR Awareness Floodplain Areas

Source: Ca State DWR. DWR Awareness Floodplain areas are flood prone areas that are not mapped under the FEMA National Flood Insurance Program

DWR Awareness Floodplain

0 1 2 4 6 8
Miles

* This map will be updated with the 200-year floodplain data when it becomes available from the CA DWR.
* Visit www.water.ca.gov/floodmgmt/lrafmo/fmb/fes/awareness_floodplain_maps for more information

(Modified 2016)

AMERICAN RIVER FLOOD CONTROL SYSTEM

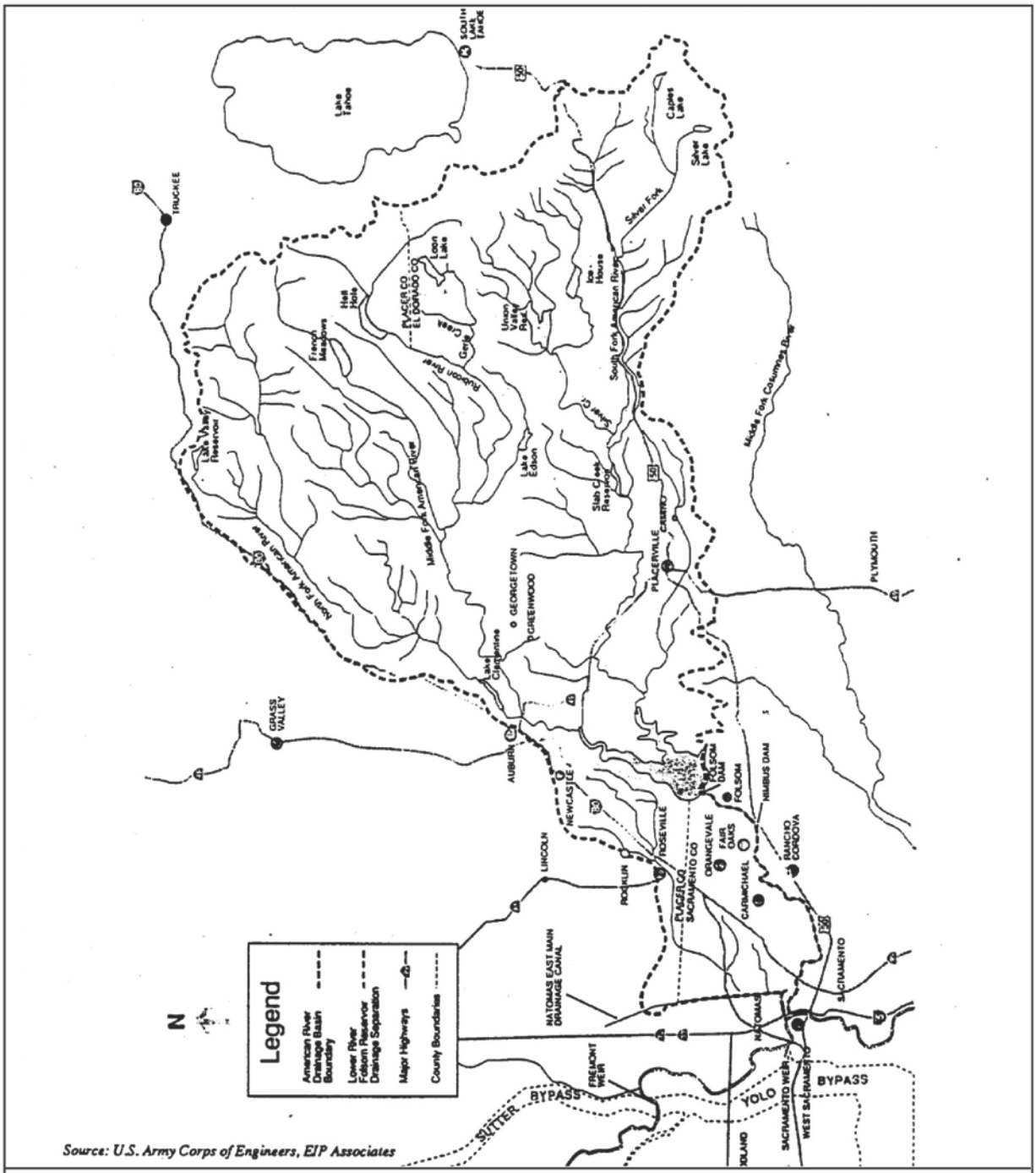
The American River Flood Control System consists of the Folsom Dam, an auxiliary Folsom Lake dam at Mormon Island, eight earth-filled dikes, and miles of levees on the north and south banks of the American River. The System receives runoff from the American River watershed which extends east into the Sierra Nevada Mountain Range to about elevation 7,000 feet (Figure III-6). The watershed area above Folsom Dam is about 1,900 square miles[16]. Immediately downstream of Folsom Dam in line in the American River, is the Nimbus Dam and Lake Natoma.

Folsom Lake is about 1 million acre-feet and Lake Natoma is only about 8,760 acre-feet. Flood control with these facilities is challenging. The Lower American River has limited capacity within the freeboard of the levee system. In 1986, about 133,000 cubic feet per second flowed from Folsom Lake causing grave concern; fortunately, the potential flood disaster was thwarted. Again, there were grave concerns in 1997, but the levees held. The U.S. Army Corps of Engineers completed construction in 2016 of a new spillway for Folsom Lake, which, if managed in concert with weather forecasts, will control flow releases to the lower American River.

The Natomas area, not to be confused with Lake Natoma, is at the confluence of the American River and the Sacramento River and is home to tens of thousands residents, City of Sacramento limits housing the majority of those, as well as various business and industries, and the Sacramento International Airport.

The flood control plan for the American River has long included a dam at Foresthill, known as the Auburn Dam. Construction began in 1977 and was halted in 1979 due to concerns that the design might not have adequately accounted for seismic forces. Additionally, there has been, and continues to be, strong environmental opposition to further upstream storage. No further decision has been made for completion of the Auburn Dam.

[16] Coloma-Lotus Chamber of Commerce, *American River Watershed*, 2017. https://www.theamericanriver.com/rivers/american-river-watershed/



American River Watershed

Figure III-6

THE SACRAMENTO RIVER FLOOD CONTROL SYSTEM

The Sacramento River Flood Control System consists of the Fremont Weir, Tisdale Weir, Sacramento Weir, Yolo Bypass Channel, and levees along the Sacramento River, Lower American River, Natomas East Main Drain (NEMD), Arcade Creek, Natomas Cross Channel and the Sacramento Bypass Channels. The Corps report "Sacramento River System Evaluation, June 1988" revealed that levees on both the Sacramento and American Rivers have inadequate freeboard and/or stability problems. Much work has been accomplished and more is planned in accordance with the goal to achieve 1 in 200 year flood protection for urban areas by 2025. The Delta area is also being studied to develop strategies to reduce flood risk.

THE NATOMAS AREA

Natomas is a desirable area for development because of its proximity to freeways and short commute to downtown Sacramento. There is a plan to achieve 1 in 200 year flood protection by 2025 in accordance with the Central Valley Flood Protection Plan. A levee breach during high river flows could be catastrophic in Natomas. There are many residences and businesses in the area so it is very important to the County that efforts to reduce flood risk in Natomas continue. Natomas will enjoy much improved flood protection, in the future, when the levees are improved, Folsom Dam is operated with its new spillway, and the weirs on the Sacramento River are widened. The Sacramento Area Flood Control Agency with Reclamation District 1000 are diligently pursuing efforts to achieve 1 in 200 year flood protection. In the unlikely event of a catastrophic levee breach in Natomas, the Department of Water Resources has prepared flood time and depth inundation maps as well as evacuation route maps which are available at http://www.waterresources.saccounty.net/stormready/Pages/Flood-Depth-and-Evacuation.aspx.

THE DELTA REGION

The Delta Region lies within a floodplain and is faced with a major flooding potential because of levees that have not been maintained to federal standards (Code of Federal Regulation 44CFR65.10).

The Delta islands were created in the late 1800s for farming activities. After many years of farming, the rich organic soils have experienced subsidence, causing many of the islands to be much lower than when first reclaimed. Consequently, the levees have more pressure on them as they work to repress the floodwater. Flood hazards are not limited to the winter storm season; indeed, many of the sloughs have high water all year and tidal influences at the lower delta add hydrostatic pressures daily. Levee stability problems and the potential for seismic-caused levee failure is a continuous concern. Additionally, the vulnerability assessment prepared for the County's Climate Action plan indicates that sea level rise will place additional hydrostatic pressures on delta levees.

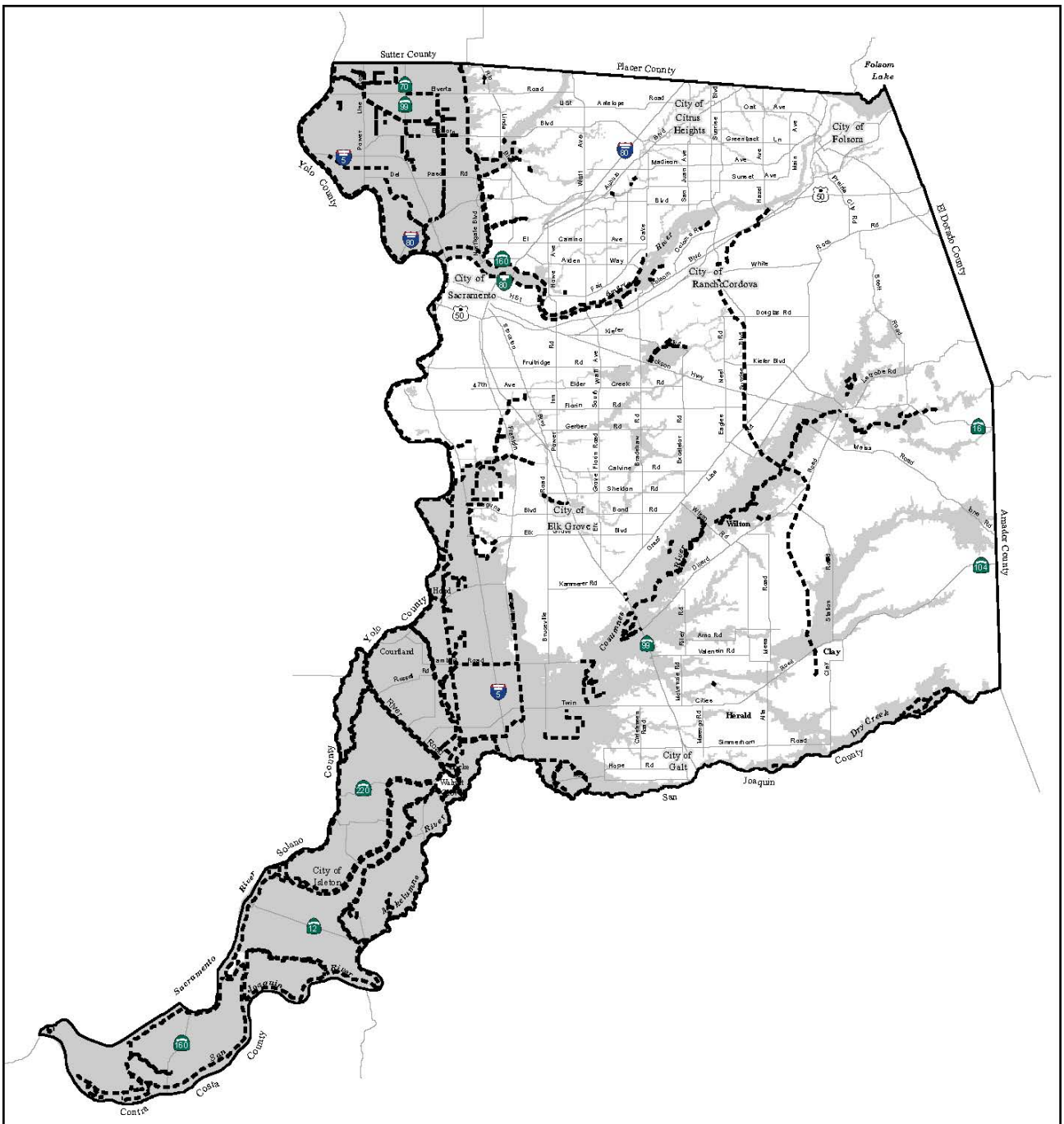


Figure III-7

Sacramento County Levee System

Sacramento County Levee System

100 Year Floodplain/Levee Protection Areas

Source: FEMA, State DWR and Sacramento County DWR

(Modified 2016)

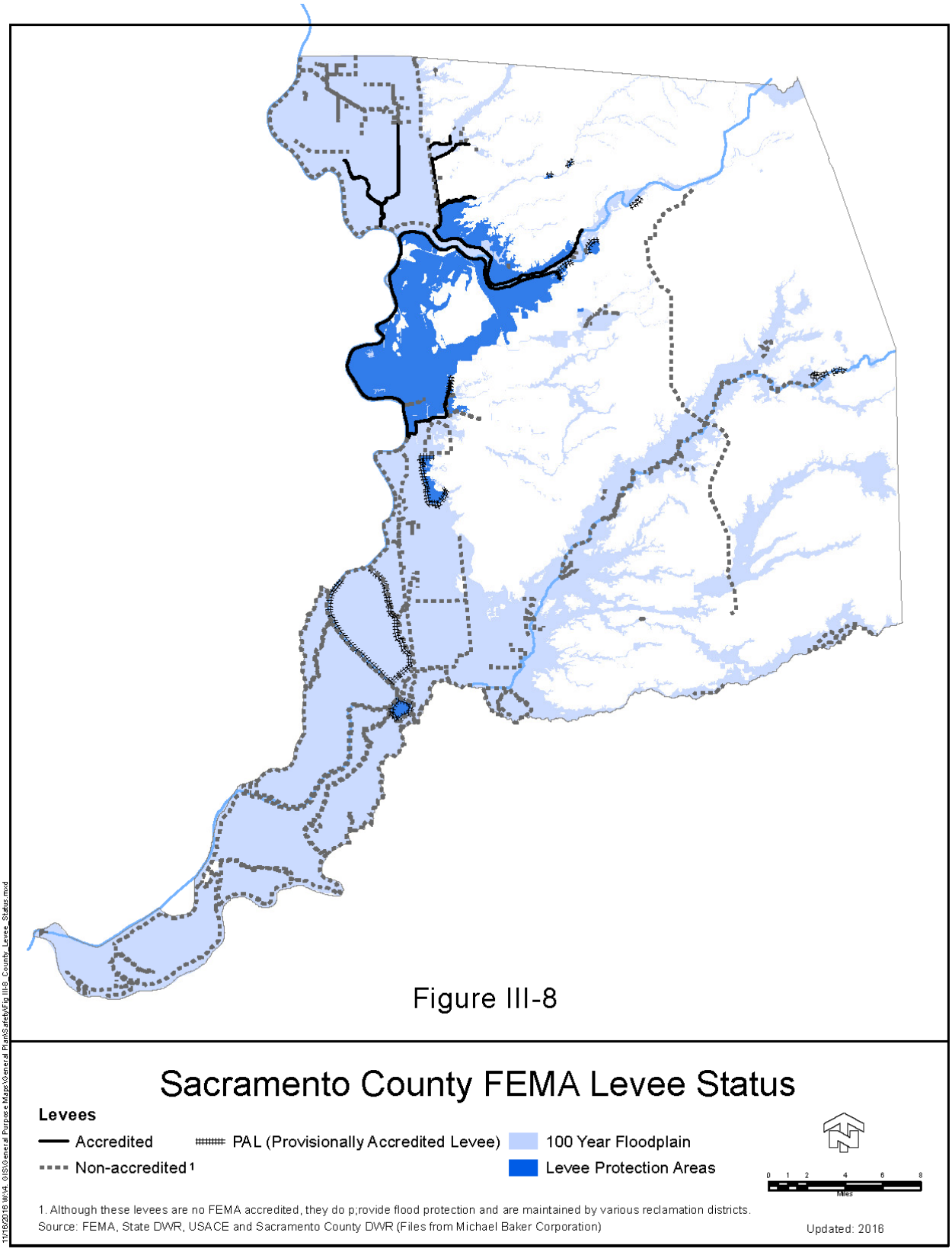
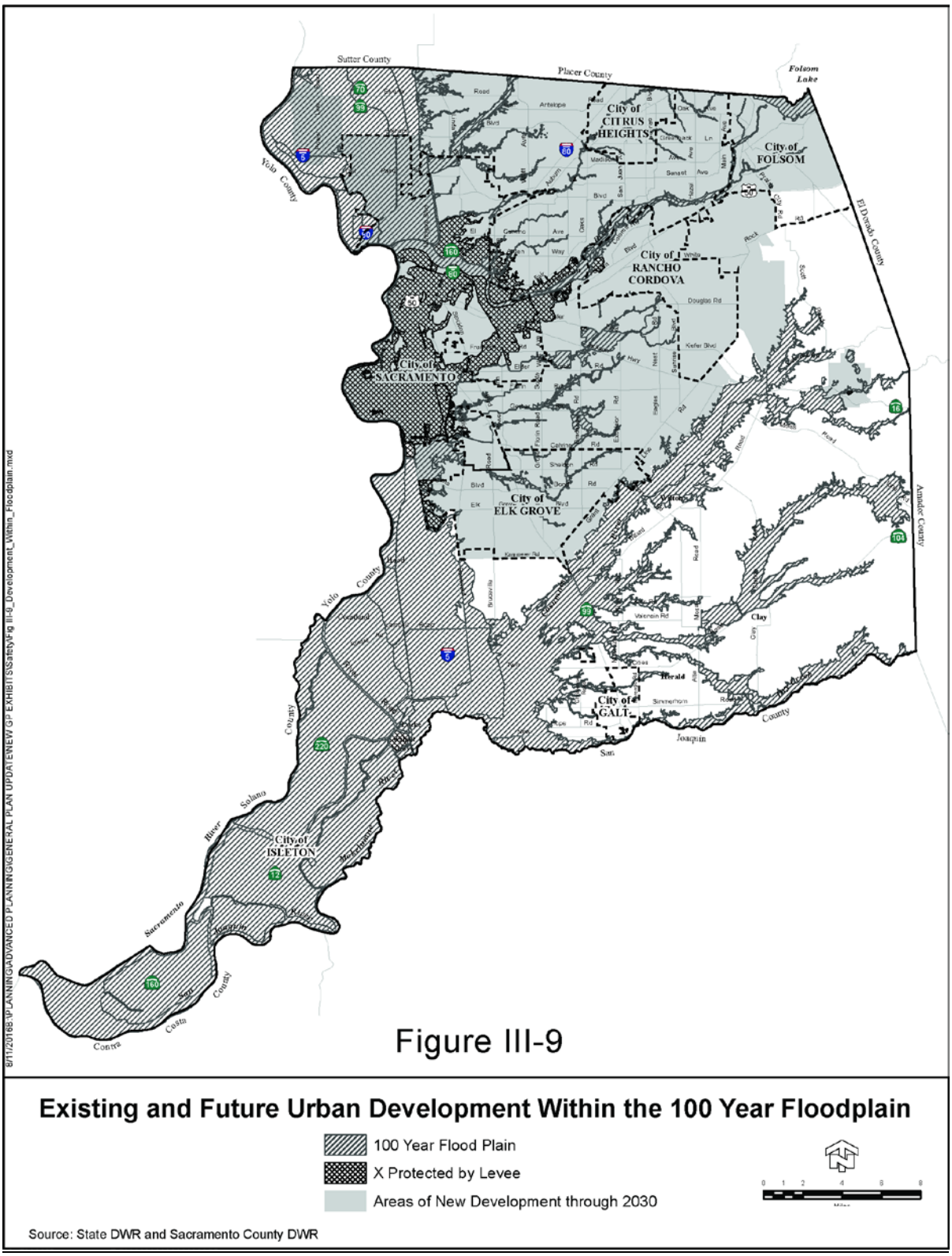

Sacramento County FEMA Levee Status
Levees
Accredited
PAL (Provisionally Accredited Levee)
100 Year Floodplain
Non-accredited 1
Levee Protection Areas
0 1 2 4 6 8
Miles
1. Although these levees are no FEMA accredited, they do p;rovide flood protection and are maintained by various reclamation districts.
Source: FEMA, State DWR, USACE and Sacramento County DWR (Files from Michael Baker Corporation)
Updated: 2016
11/16/2016 W:\4. GIS\General Purpose Maps\General Plan\Safety\Fig III-8_County_Levee_Status.mxd

Figure III-8



(Modified 2016)

DAM FAILURES

Since the 1850's, hundreds of dams and reservoirs have been built in California to supply water for agriculture and domestic use, to allow for flood control, as a source of hydroelectric power, and to serve as a recreational facility. The storage capacity of these reservoirs range from a few thousand acre-feet to five million acre-feet. The water from these reservoirs eventually makes its way to the Pacific Ocean by way of several river systems. The river systems which flow through or near Sacramento County, and which may affect the population when flooding, are the Sacramento, Feather, American, Cosumnes, and the Mokelumne. There are four major and two minor dams which, if they fail, may impact the people and resources of this jurisdiction. The major dams are comprised of Shasta on the Sacramento, Oroville on the Feather, Comanche on the Mokelumne and Folsom on the American. The minor dams include Nimbus and Rancho Seco.

The State Office of Emergency Services (OES) provides local jurisdictions with hazard information based on data from the U.S. Bureau of Reclamation and the Department of Water Resources. Included in this information is a series of dam inundation maps for Sacramento County. Detailed inundation maps from the OES and County mapping projects are available at the Sacramento County Department of Water Resources.

Dam failure is statistically improbable, as any dam operator would do all they could to release flow via the spillway rather than uncontrollably losing the dam. Most dams have a far greater capacity to release flows than the design flow for the receiving river. Thus, a downstream levee breach from high spillway releases, while also being unlikely, is more probable than dam failure.

Folsom Dam (including the Mormon Island auxiliary dam and the lengthy earth embankment) would have the greatest impact on the population of Sacramento County should it fail. The flood waters from this system would affect the cities of Sacramento, Folsom, Rancho Cordova and Elk Grove and the surrounding unincorporated area. Figure III-10 depicts the flood area. **(Updated 2011)** In a case where the dam operator releases controlled flood flows far in excess of the design capacity of the lower American River, the County has levee breach flood emergency evacuation plans.

Nimbus Dam is a small forebay/afterbay below Folsom Dam, with a nominal volume of 8,760 acre-feet (a picturesque lake known as Lake Natoma). The Flood Operations Branch, Department of Water Resources, State of California, believes that the American River Channel will not flood unless the levees fail or there is a catastrophic release.
The Sacramento Municipal Utility District (SMUD) inundation map indicates that a failure of the Rancho Seco Dam would flow to the Laguna Creek Basin and stop approximately at Highway 99 near Galt.

Failure of Shasta Dam would affect populations south along the Sacramento River basin to about Knights Landing where it would lose momentum.

An Oroville Dam failure would impact populations southwest along the Feather River basin to the Natomas Basin.

A failure at Comanche Dam would affect the Delta and possibly slow the flow of other rivers through the Delta.

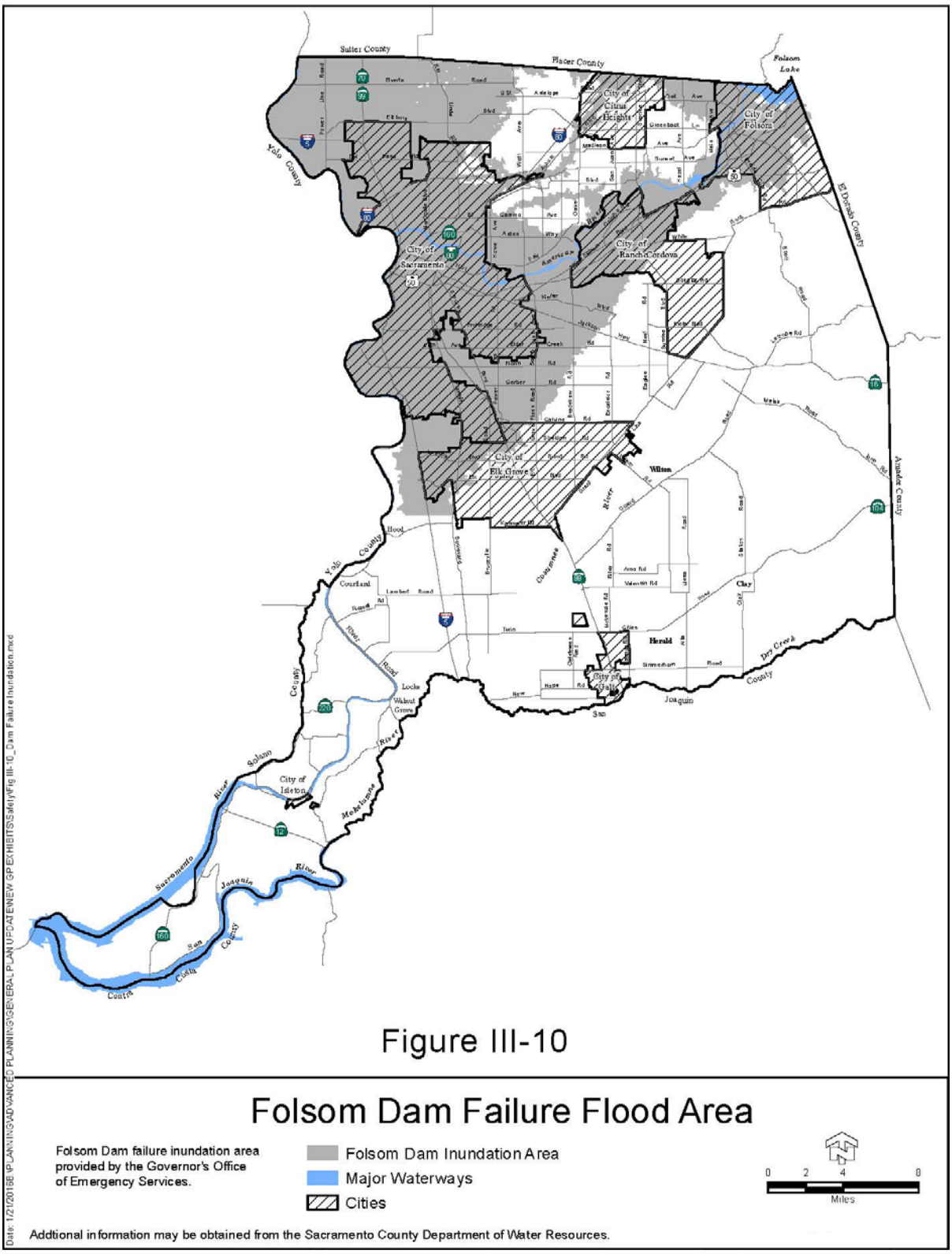


Figure III-10

(Modified 2016)

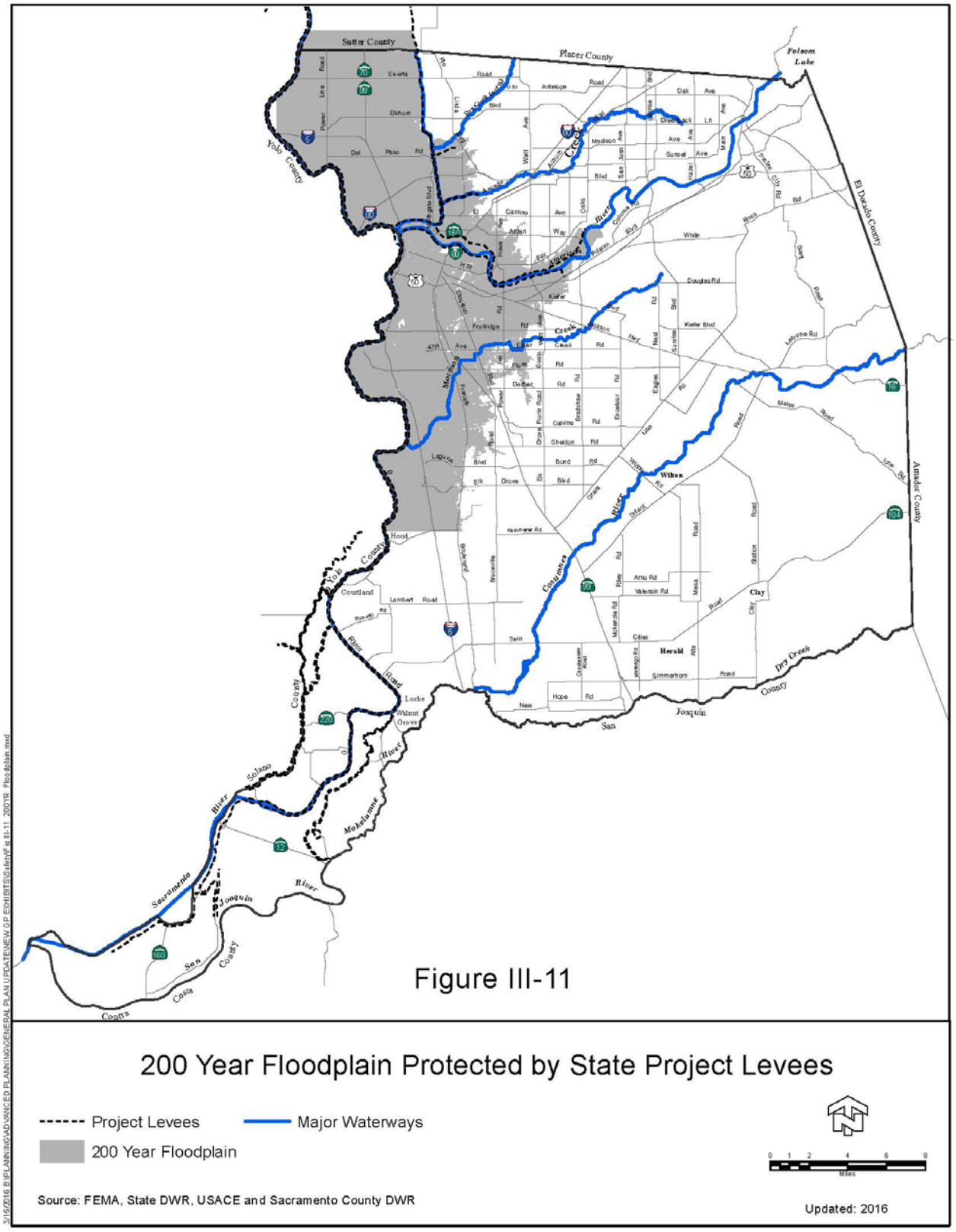


Figure III-11
200 Year Floodplain Protected by State Project Levees
Project Levees
Major Waterways
200 Year Floodplain
Source: FEMA, State DWR, USACE and Sacramento County DWR
Updated: 2016
Sutter County
Placer County
Yolo County
El Dorado County
Amador County
Sacramento River
San Joaquin River
Folsom Lake
Dry Creek
Arcade Creek
Morrison Creek
Laguna Creek
Elk Grove
Wilton
Courtland
Locke
Walnut Grove
Herald
Clay

(Added 2016)

SACRAMENTO COUNTY GENERAL PLAN
SAFETY ELEMENT

FIRE HAZARDS
TECHNICAL DISCUSSIONS

Sacramento County is served by 13 fire protection districts (Figure IV-1). These districts range in population size from the River Delta Fire District, which serves a 2017 population of approximately 1,700persons, to the City of Sacramento, which serves approximately 480,000 persons. These districts also vary in the physical size of the area served, the type of area served (urban, rural, or a combination of both), the amount of fire equipment available, the overall operation and management capability of district personnel, and the condition of the existing water system (water supply and pressure).

The level of service provided to the area served by each fire protection district is rated by the insurance industry according to Insurance Services Office (ISO) ratings. Approximately 40 percent of the rating is based on the water system and the remaining 60 percent of the rating is based on other characteristics of the particular fire protection district. While ISO ratings focus upon the level of service afforded to commercial structures, the level of service to both commercial and residential structures are combined to establish a rating that serves as a guide for determining the fire insurance premiums for property owners within the district's boundaries. The higher the ISO rating, the lower the level of service that can be provided. Many fire protection districts covering both an urban and rural area have two ISO ratings, since many properties in the rural areas may be located over 1,000 feet away from a fire hydrant and are located over five miles from a fire station--two criteria by which ISO ratings are based.

State law requires cities and counties to address fire hazards and divides these hazards into two categories; urban and wildland fires. In Sacramento County, urban fires are those that pose a threat to urban facilities and structures including the following:

- Lumber yards;
- Petroleum tanks;
- Industrial and commercial buildings;
- Residential dwelling units; and
- Communities of a historical nature, such as Locke, where wood-frame buildings were constructed before fire codes existed or standards were imposed on buildings that about one another.

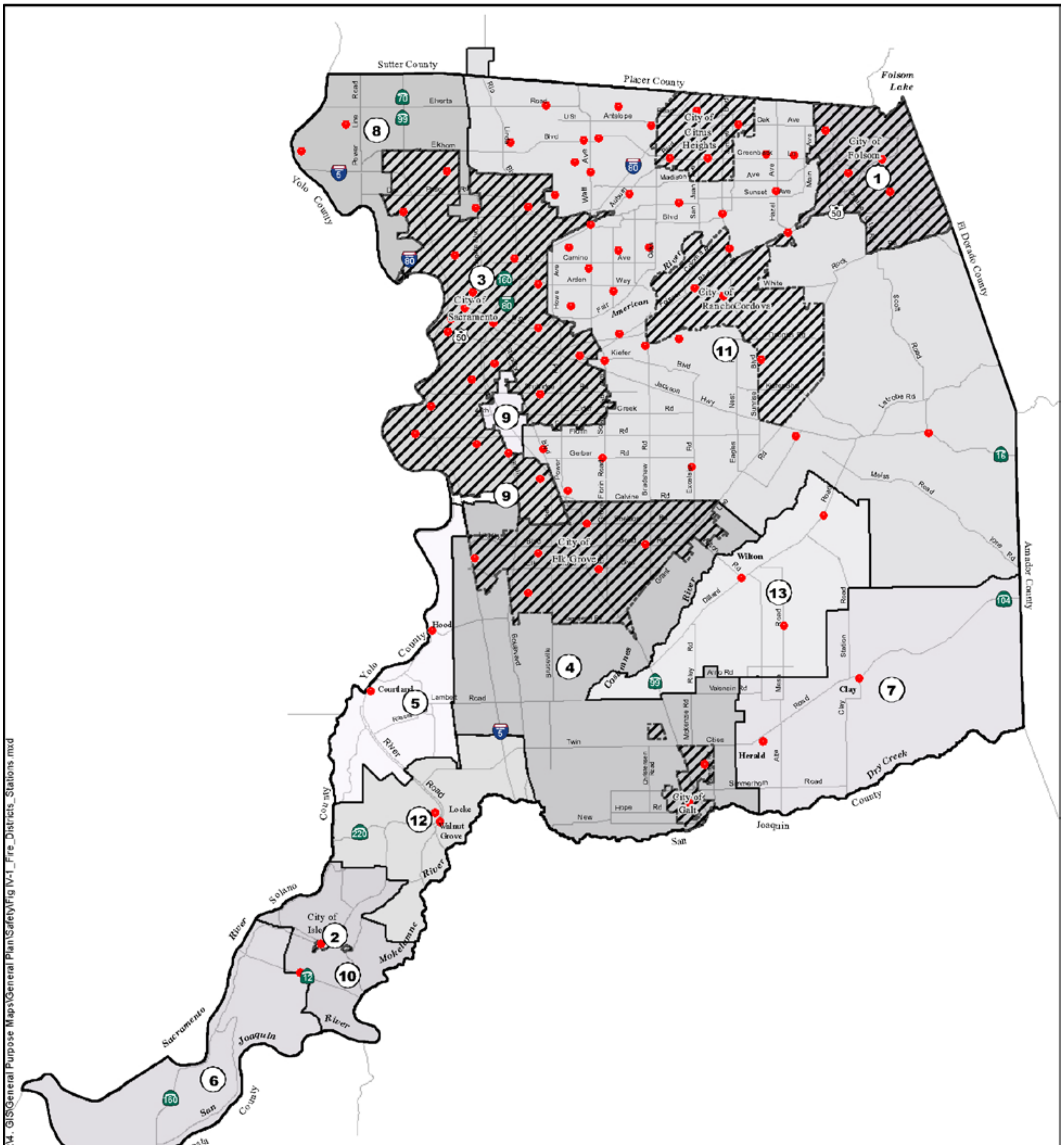


Figure IV-1

Fire Districts and Fire Stations

1 - CITY OF FOLSOM
2 - CITY OF ISLETON
3 - CITY OF SACRAMENTO
4 - COSUMNES CSD
5 - COURTLAND
6 - DELTA
7 - HERALD
8 - NATOMAS
9 - PACIFIC FRUITRIDGE FIRE PROTECTION
10 - RIVER DELTA
11 - SAC METRO
12 - WALNUT GROVE
13 - WILTON

● FIRE STATIONS

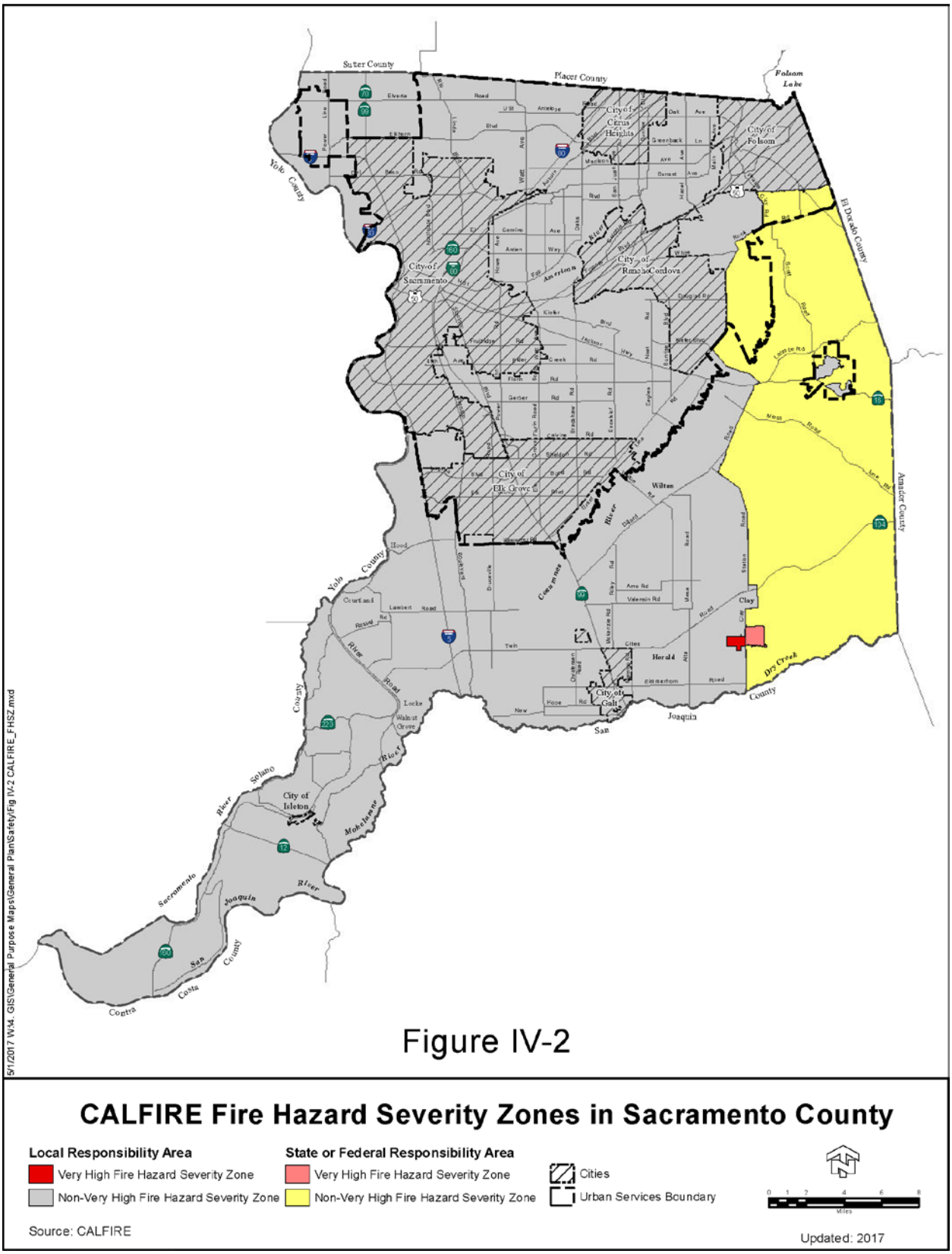
Updated: 2017

Wildland fires are fires that pose a threat to the more rural areas of the County. Grass fires and peat fires are the two main types of wildland fires of concern in Sacramento County. Grass fires are an annual threat in the unincorporated area of the County, especially recreational areas such as the American River Parkway. Peat fires are unique to the Delta where peat is subject to spontaneous combustion. Once started, these fires become very difficult to control. Peat can still burn some distance underground even when the upper layers of peat are saturated with water over an extended period of time. Once the ground has dried out, a peat fire may return to the surface. Sacramento County has a Fire Prevention Ordinance (Sacramento County Code Title 17, Fire Prevention) which details firebreak requirements, hazardous weed removal, and enforcement. The Fire Prevention Ordinance requires a firebreak area of at least thirty feet from all structures, combustible fences, vehicles, and combustible storage. Local fire districts are given the authority to require firebreak areas exceeding thirty feet based on the existing conditions of an area. In addition, CAL FIRE maintains a webpage with guidance for homeowners regarding creating and maintaining defensible space, hardening or preparing your home, using fire-safe landscaping, and evacuation planning. The CAL FIRE defensible space webpage can be found at the following web address:
http://www.readyforwildfire.org/

While the urbanized areas do not have fire hazards associated with high levels of vegetation, the intensity and type of development play a major role in the incidence of structural fires. The California Building Code is designed to address safety measures that minimize fires and the loss of life. High quality industrial and commercial structures pose significantly less of a fire hazard than other types of structures because they are usually supplied with fire detection systems and extinguishing devices. Petroleum tanks are now required to be built with dikes surrounding the tanks to minimize the fire hazard outside the storage area.

California State law also requires that cities and counties address the risk of fire for land classified as State Responsibility Area (SRA) and land classified as Very High Fire Hazard Severity Zone within their safety elements (Government Code § 65302(g)(3)). The SRA is the area in which the State is financially responsible for the prevention and suppression of wildfires; it does not include lands within city boundaries or in federal ownership. Alternatively, the Local Responsibility Area is the area in which local governments or fire districts, rather than the State, are responsible for fire prevention and suppression. The Department of Forestry and Fire Protection creates Fire Hazard Severity Zone maps for areas within the SRA and prepares recommended Fire Hazard Severity Zone maps for areas within the LRA for local agencies. Hazard ratings range from Moderate to Very High and are based on the physical conditions that create the likelihood that an area will burn over a 30 to 50-year period. A portion of the SRA is located within the Vineyard and Southeast communities of Sacramento County, roughly east of Grant Line Road and Clay Station Road and is served by Metro Fire, Herald Fire Protection District, and the Wilton Fire Protection District. A majority of this area is outside of the Urban Services Boundary (USB) and is designated in the Land Use Diagram as General Agricultural. The USB is a permanent growth boundary which concentrates growth and protects natural resources. Areas outside of the USB are subject to protection from development by many policies within the Land Use Element of the General Plan including but not limited to the following: LU-2, LU-76, LU-77, LU-84, and LU-127. The majority of this portion of the SRA in Sacramento County is defined as a Moderate Fire Hazard Severity Zone. Similarly, a majority

of the LRA within the County is either defined as Unzoned or as a Moderate Fire Hazard Severity Zone. However, a small portion of both the SRA and LRA within the Southeast community of the County contains a Very High Fire Hazard Severity Zone due to the presence of a dense eucalyptus grove. The Very High Fire Hazard Severity Zone is within an existing Agricultural Residential community outside of the USB and; therefore, very limited future residential development will occur there. This area is served by the Herald Fire Protection District which reviews all planning applications for compliance with current fire standards. Figure IV-2 is provided for illustrative purposes; the most up-to-date maps of the SRA, LRA, and Fire Hazard Severity Zones are maintained by CAL FIRE and can be viewed at the following web address.
http://www.fire.ca.gov/fireprevention fee/sraviewer


Sutter County
Placer County
Folsom Lake
City of Citrus Heights
City of Folsom
El Dorado County
Yolo County
City of Sacramento
City of Rancho Cordova
City of Elk Grove
Wilton
Amador County
Clay
Herald
City of Galt
Dry Creek
Locke
Walnut Grove
City of Isleton
Sacramento River
Mokelumne River
San Joaquin County
Contra Costa County
5/1/2017 W:\4. GIS\General Purpose Maps\General Plan\Safety\Fig IV-2 CALFIRE_FHSZ.mxd
Figure IV-2
CALFIRE Fire Hazard Severity Zones in Sacramento County
Local Responsibility Area
Very High Fire Hazard Severity Zone
Non-Very High Fire Hazard Severity Zone
State or Federal Responsibility Area
Very High Fire Hazard Severity Zone
Non-Very High Fire Hazard Severity Zone
Cities
Urban Services Boundary
0 1 2 4 6 8
Miles
Source: CALFIRE
Updated: 2017

The Sacramento Metropolitan Fire District (Metro Fire) prepared a Community Wildfire Protection Plan (CWPP), dated June 2014, to identify wildfire risks, delineate a Wildland Urban Interface (WUI), prescribe vegetation best management practices, and educate the public on Home Ignition Zones. In conjunction with the CWPP, Metro Fire developed a Residential Wildfire Risk Assessment tool for community members to receive site-specific information on how to improve wildfire resistance. Metro Fire has received approval of the CWPP from their Board of Directors. Eventually, following community outreach, the CWPP will go before the Board of Supervisors for official adoption. The CWPP and the Residential Wildfire Risk Assessment tool can be viewed at the following web addresses:
https://metrofire.ca.gov/phocadownloadpap/CWPP/appacwpp.pdf
https://metrofire.ca.gov/index.php/cwpp-crrd

The Amador-El Dorado Unit of CAL FIRE prepares a Unit Strategic Fire Plan annually. The Unit Strategic Fire Plan (Unit Plan) includes an overview of the Amador-El Dorado Unit, a list of communities at risk, and information on pre-fire management strategies. According to the Unit Plan, Sacramento County contains 119,248 acres of land that CAL FIRE is responsible for; this area is divided into CAL FIRE Battalion 1 and Battalion 4. The Unit Plan can be viewed at the following web address:
http://cdfdata.fire.ca.gov/fire_er/fpp_planning_plans_details?plan_id=249

The LHMP identifies and profiles hazards, assesses the vulnerability of Sacramento County (including the incorporated cities) to these hazards, and includes mitigation capabilities to combat these risks. The Hazard Profile section of the LHMP contains a Wildfire subsection which details historical data on wildfire events in the County dating back to 1950. The Vulnerability Assessment section of the LHMP contains a Wildfire Vulnerability Assessment subsection which discusses the communities, assets, population, critical facilities, and future development which are at risk from wildfires. According to the updated LHMP, there has been an increase in vulnerability to wildfires due to drought conditions, increased tree mortality, increased development in WUI areas, and an overall increase in wildfire conditions since adoption of the previous LHMP. The LHMP outlines the current mitigation capability of County policies and programs and includes additional mitigation actions that will be taken to mitigate the risk of wildfire faced by the County. The LHMP can be viewed at the following web address:
http://www.waterresources.saccounty.net/stormready/Pages/Hazard-Mitigation-Planning-Committee-2016-Plan-Update.aspx

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EMERGENCY PREPAREDNESS
TECHNICAL DISCUSSION

The Sacramento County Office of Emergency Services (SAC OES) is responsible for emergency preparedness within Sacramento County including both the unincorporated area and its incorporated cities – known as the Sacramento Operational Area. In a state of war or emergency, the Sacramento Operational Area serves as a link between the State's emergency operating centers and those of the political subdivisions that make up the Sacramento Operational Area.

SAC OES coordinates with local, State, federal, private and non-profit entities, as well as community groups to minimize the impact of all potential hazards facing the County of Sacramento. SAC OES is responsible for comprehensive disaster planning, hazard identification & risk assessment, hazard mitigation, protection of critical infrastructure, and enhancement of community preparedness. SAC OES manages the response and recovery efforts of the County and the region at the County's Emergency Operations Center (EOC). The primary role of the EOC is the facilitation of interagency coordination and information sharing, management of resources and resource requests, and provision of emergency public information and warnings.

In addition to the role of coordination in the event of an emergency, SAC OES is responsible for collecting and maintaining several emergency response and planning documents including the Sacramento County Emergency Operations Plan, Sacramento County Evacuation Plan, and the Multi-Year Training and Exercise Plans. These documents can be found at the following address:
http://www.sacramentoready.org/Respond/Pages/Evacuation-Plans.aspx

Flood, drought, earthquake, and severe weather are just a few of the hazards to Sacramento communities. While natural hazards such as these cannot be prevented, a Hazard Mitigation Plan forms the foundation for a community's long-term strategy to reduce disaster losses by breaking the repeated cycle of disaster damage and reconstruction. The County, in partnership with its incorporated cities and several special districts maintains a Local Hazard Mitigation Plan (LHMP). Communities with a FEMA-approved LHMP are eligible for FEMA pre- and post-disaster grant funding and for lower costs of flood insurance to residents through the National Flood Insurance Program's (NFIP) Community Rating System (CRS).

A recent rise in the generation, use, storage, and transportation of hazardous materials by local businesses has prompted increased attention to the potential effects on the public's health and safety. Hazardous material emergencies may be the result of threatened releases, highway accidents, clandestine drug laboratories, train derailments, pipeline transportation accidents, fire and/or spills at fixed facilities, or the result of a weapons of mass destruction (WMD) incident. The Sacramento County Environmental Management Department (EMD), maintains the Area Plan for Emergency Response to Hazardous Materials Incidents in Sacramento County. The

Area Plan describes the responsibilities of local, State, and federal agencies during incidents involving the release and/or threatened release of hazardous materials.

Land use decisions can greatly affect the implementation of emergency response and evacuation plans in a major disaster. Road networks which have been poorly planned, do not have regular maintenance, or are not designed to accommodate population densities and growth, can severely hinder the ability of emergency response personnel from delivering supplies into an area or move people out in a timely manner. Additionally, evacuation difficulties and loss of life and property are increased when high density developments or other sensitive land uses are allowed near facilities where major disasters are more likely to occur, such as tank farms, airports, deep floodplains, or railyards. An adequate circulation network and careful land use planning, which balances the potential for disaster with economic development equally, are key to saving lives and minimizing property damage.