Meeting Date: **6/21/2016**

Report Type: Consent

Report ID: 2016-00610

City of SACRAMENTO 03

City Council Report
915 I Street, 1st Floor
www.CityofSacramento.org

Title: Accepting the Sacramento Area Flood Control Agency (SAFCA) Urban Level of Flood Protection Plan and Engineer's Report

Location: Citywide

Recommendation: Pass a Resolution accepting the SAFCA Urban Level of Flood Protection Plan and Adequate Progress Baseline Report and Adequate Progress Towards an Urban Level of Flood Protection Engineer's Report.

Contact: Remi Mendoza, Associate Planner, 916-808-5003; Jim McDonald, Principal Planner, (916) 808-5723, Community Development Department; Tony Bertrand, Supervising Engineer, (916) 808-1461; Connie Perkins, Senior Engineer, (916) 808-1914, Department of Utilities

Presenter: None

Department: Community Development Dept

Division: Long Range Planning

Dept ID: 21001222

Attachments:

1-Description/Analysis
2-Background
3-SAFCA ULOP Plan and Baseline Report
4-SAFCA Adequate Progress Towards an ULOP Engineer's Report
5-SPFC Covered Area
6-Areas of Non-Riverine Flooding
7-Resolution

City Attorney Review

Approved as to Form
Jeffrey Heeren
6/9/2016 3:14:38 PM

Approvals/Acknowledgements

Department Director or Designee: Ryan Devore - 6/3/2016 9:22:35 AM

Description/Analysis

Issue Detail: On March 1, 2016, the City Council adopted an Ordinance (2016-0012) implementing SB 5 (The Central Valley Flood Protection Act of 2008) and subsequent amendments, which specified that beginning on July 1, 2016, cities and counties could not enter into development agreements, approve discretionary permits, or ministerial permits that would result in the construction of a new residence, or approve tentative or parcel maps for areas located within a flood hazard zone unless the city or county made certain findings demonstrating attainment of, or adequate progress towards, an Urban Level of Flood Protection (ULOP) (Government Code §65865.5). In most cases this means protection from a 200-year flood.

In order to comply with the requirement of SB 5 to have a 200 year flood plan in place by July 1, 2016, staff recommends Council adopt a resolution accepting the SAFCA Urban Level of Flood Protection (ULOP) Plan (Attachment 3) and associated Engineer's Report (Attachment 4). The SAFCA ULOP Plan includes identification of flood improvement projects, their costs, revenues to fund them, and a schedule to complete them by 2025. The associated Engineer's Report documents the data and analysis to provide substantial evidence that structural flood control facilities protecting the urban areas of the City will be able to withstand flooding from a 1-in-200 year flood event.

Policy Considerations: The 2035 General Plan includes the following goals and policies related to flood protection:

GOAL EC 2.1
Protect life and property from flooding.

EC 2.1.4 200-Year Flood Protection. The City shall work with local, regional, state, and federal agencies to achieve at least 200-year flood protection for all areas of the City by 2025.

EC 2.1.5 Funding for 200-year Flood Protection. The City shall continue to cooperate with local, regional, State, and Federal agencies in securing funding to obtain the maximum level of flood protection that is practical, with a minimum goal of achieving at least 200-year flood protection as quickly as possible.

Economic Impacts: Not applicable.

Environmental Considerations: Policies to achieve a 200-year level of flood protection were included in the 2035 General Plan and evaluated in the certified Master Environmental Impact Report. Acceptance of the SAFCA Urban Level of Flood Protection Plan and associated Engineer's Report will enable the City to use them for future flood-related findings in compliance with State law. Acceptance of these documents constitutes an administrative action that will not result in direct or indirect physical changes in the

environment, and the action is not a project that requires environmental review under the California Environmental Quality Act (CEQA). See CEQA Guidelines section 15378(b)(5); 15060(c)(3).

Sustainability: The proposed resolution will reduce flood risk by strengthening the linkage between local land use planning decisions and flood management practices. This resolution would also support the City's efforts to promote urban infill and redevelopment.

Commission/Committee Action: None.

Rationale for Recommendation: Approval of this resolution will achieve compliance with state law (SB 5 and subsequent amendments) thereby allowing the City to make the required findings related to flood protection for approval of developments projects.

Financial Considerations: Not applicable.

Local Business Enterprise (LBE): Not applicable.

BACKGROUND

The Central Valley Flood Protection Act of 2008 (enacted by SB 5)

In light of the catastrophic flooding of New Orleans following Hurricane Katrina in 2005, there was an increased focus in flood risk management in California. The legislature recognized that the current federal flood standard (100-year flood protection) was not sufficient to protect urban and urbanizing areas within flood prone areas throughout the Central Valley. Nationally, levees have typically been constructed to a 100-year federal flood standard (level of protection that is necessary to withstand flooding that has a 1% chance of occurring in any given year). California has adopted an even tougher 200-year flood standard for levees protecting urban areas.

In 2007, the State legislature passed the Central Valley Flood Protection Act (CVFPA) of 2008 (enacted by SB 5). The CVFPA set in motion the State's plan for improvement of flood protection statewide, establishes the 200-year flood protection standard, and ensures that 200-year protection will be provided to all Central Valley urban and urbanizing areas as soon as possible but no later than 2025 by requiring amendment of local general plans and zoning to institute the requirements. As required by the State law, after July 1, 2016, new development in areas potentially exposed to 200-year flooding more than three feet deep will be prohibited unless the local land use agency certifies that 200-year flood protection has been provided, or that "adequate progress" has been made toward provision of 200-year flood protection by 2025.

The CVFPA of 2008 Created New Local Agency Requirements

The State now requires local agencies to amend their General Plans to address flood risk for affected land use decisions based on an Urban Level of Flood Protection (ULOP). The ULOP is defined by the legislation as the level of protection necessary to withstand flooding that has a 1-in-200 chance of occurring in any given year. The legislation also requires local agencies to revise their zoning codes to reflect this new standard within one year following adoption of their revised General Plans.

On March 3, 2015, the City of Sacramento 2035 General Plan was adopted by City council. It included new goals, policies, and implementation measures consistent with the Central Valley Flood Protection plan and State flood protection standards.

On March 1, 2016, Ordinance 2016-0012 was adopted by City Council and amended the zoning code to comply with SB 5. This ordinance provides that in order to enter into a development agreement or issue a permit to construct a residence, or approve parcel maps within a flood hazard zone, the city must:

1. Find existing facilities protect urban and urbanizing areas to a 1-in-200 chance of flooding, or
2. Impose conditions on the development that will provide the required level of protection, or
3. Find that the local flood management agency has made *adequate progress* on construction of the flood protection system to provide a 200-year level of flood protection, or
4. Find that the property is in an undetermined risk area, or
5. Find the property is in an area of potential flooding of 3 feet or less, or
6. Find the property is within a watershed with a contributing area of less than 10 square miles.

Although the Sacramento Area Flood Control Agency (SAFCA) is the local partner in projects improving the flood protection system, the flood legislation placed the responsibility for making flood findings on local land use agencies. Therefore, beginning July 1, 2016, the city will make findings based on an Urban Level of Flood Protection (ULOP) plan and associated Engineer's Report prepared by SAFCA. The plan will aid the City in making the finding (No.3 above) that adequate progress is being made on the State Plan of Flood Control system which will provide a 200-year level of flood protection (Attachment 3-Area Covered by SAFCA's Improvements to the State Plan of Flood Control System). The SAFCA ULOP plan highlights key planned improvements that will provide Sacramento with a 200-year level of flood protection, their costs, revenues to fund them, and a schedule to complete them by 2025.

Areas of Non-Riverine Flooding

Notwithstanding SAFCA's planned improvements to the State Plan of Flood Control System, the City also has responsibility for determining whether non-riverine sources of flooding, such as localized rainfall or overflow of creeks, would subject some areas in the City to a flood depth above 3.0 feet (Attachment 4 – Areas of Non-Riverine Flooding). For approval of new development in these areas, beginning on July 1, 2016, the City may be required to adopt findings based on imposed conditions (i.e. require elevating or flood proofing) in order to meet the new 200-year level of flood protection standard.

Sacramento Area Flood Control Agency

Final Urban Level of Flood Protection Plan

And Adequate Progress Baseline Report

Prepared for the City of Sacramento and parts of Sacramento and Sutter counties

June 10, 2016

Sacramento Area Flood Control Agency

1000 7th St, 7th Floor
Sacramento, CA 95814

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A. SAFCA ADEQUATE PROGRESS TOWARDS AN URBAN LEVEL OF FLOOD PROTECTION ENGINEER'S REPORT

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A. SUMMARY

Recent laws specify that, beginning in mid-2016, cities and counties shall not approve most new developments in specified floodplains unless they make findings that the developments have or will be provided with an Urban Level of Flood Protection (ULOP). In most cases this means protection from a 200-year flood. This document was prepared at the request of the City of Sacramento and the County of Sacramento to assist in making those findings in areas to be protected by Sacramento Area Flood Control Agency (SAFCA) projects. It may also be of use for affected parts of Sutter County and Rancho Cordova.

Recent legislation required cities and counties to incorporate flood information in general plans and zoning codes no later than July 2, 2016. After that time, for areas within flood hazard zones, a city or county must make one of four specified findings before approving new development agreements, discretionary entitlements, permits allowing building one or more new homes, or tentative maps or parcel maps.

The four possible findings are summarized as:

> (1) Existing facilities provide ULOP in urban areas or meet the Federal Emergency Management Agency (FEMA) standard in nonurbanized areas;
>
> (2) Conditions on the project will protect it to the applicable standard;
>
> (3) The local flood management agency has made adequate progress on a flood system providing the applicable level of protection. For urban and urbanizing areas protected by project levees, ULOP will be achieved by 2025; or
>
> (4) The property in an undetermined risk area has met ULOP based on substantial evidence in the record.

Flood protection features protecting most local areas from a 200-year flood on the Sacramento or American River require substantial improvements to provide the requisite ULOP and meet the State's new Urban Levee Design Criteria (ULDC). SAFCA has prepared an engineer's report for the creation of an assessment district (CCAD 2 Engineer's Report, subject to landowner protest ballot process, that would provide the funding to complete these improvements. Consistent with the State ULOP Criteria, SAFCA has also prepared an engineer's report to provide evidence that implementation of SAFCA's ULOP Plan will in fact provide an Urban Level of Flood Protection (Adequate Progress Engineer's Report). Those two documents are incorporated by reference in this plan, and the Adequate Progress Engineer's Report is in Appendix A (bound separately). The relationship between these overlapping documents is shown in Figure S-1. This ULOP Plan is based on project and scope data provided in the two engineer's reports, the technical background in the Adequate Progress Engineer's Report, and the schedule and financial information in the CCAD 2 Engineer's Report.

This ULOP Plan is intended to assist in providing substantial evidence for land use findings, in concert with local agency data regarding urbanizing areas and interior drainage. This Plan

identifies State Plan of Flood Control (SPFC) flood protection projects, their costs, revenues to fund them, and a schedule to complete them by 2025.

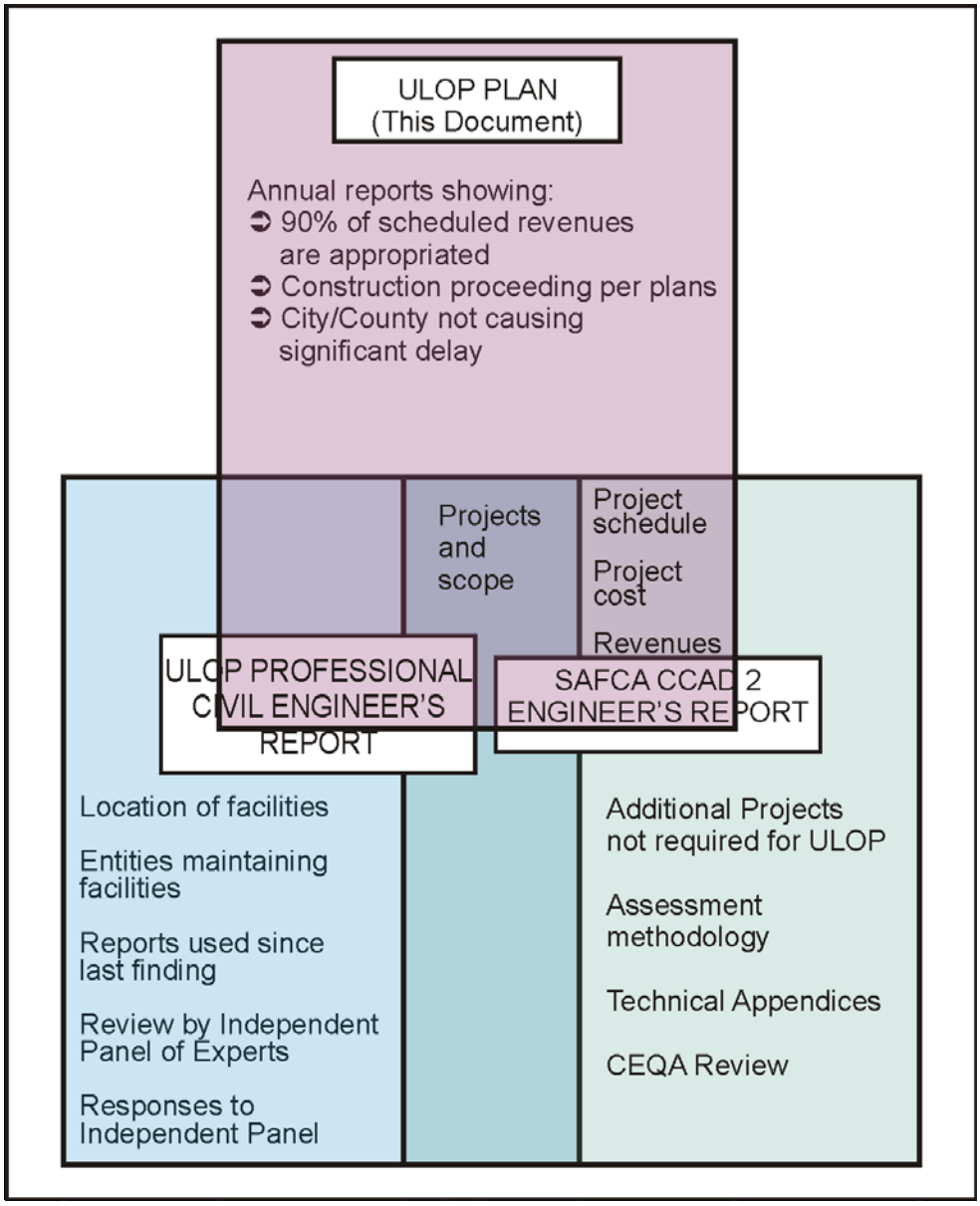

Figure S-1: Relationship of ULOP Plan to Other Documents

While SAFCA plans to upgrade the SPFC facilities in the region to provide ULOP, additional improvements may be required or implemented by other local agencies to protect against flooding from local or internal drainage. Land use agencies will need to consider those flood sources independently in making their findings.

SAFCA's levee systems are shown in Figure S-2, and Table S-1 presents a timeline by levee system.

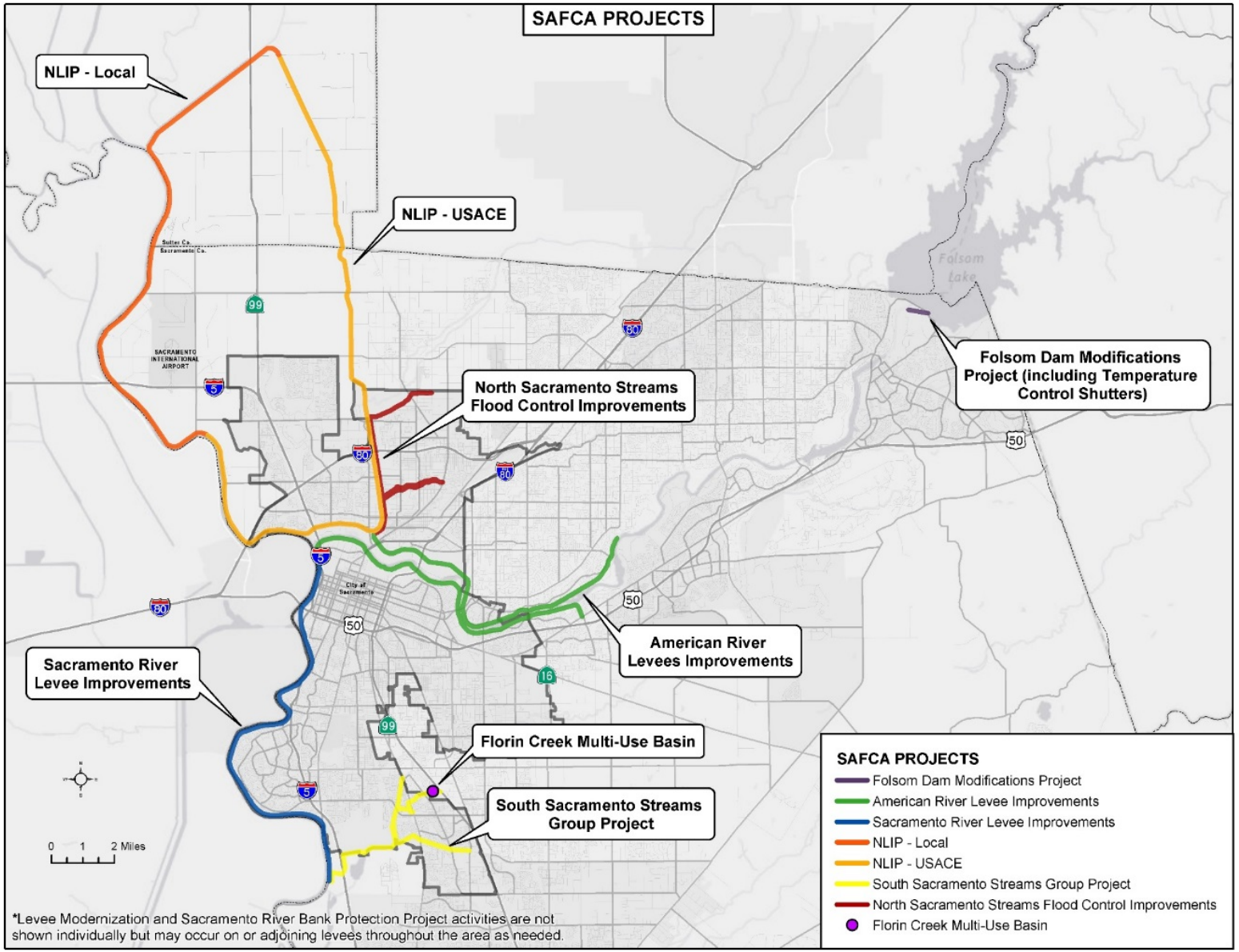

Figure S-2: SAFCA Projects

Table S-1: Timeline for Projects

Project	Levee System						Complete by
	Natomas	Dry Creek	Robla Creek – Arcade Creek	American River North Levee	American River South and Sacramento River East Levee	South Sacramento Streams	
Folsom Dam Modifications	Required for ULOP	Required for ULOP	Required for ULOP	Required for ULOP	Required for ULOP	Required for ULOP	2025
NLIP USACE Project	Required for ULOP	Not required	Not required	Not required	Not required	Not required	2025
NLIP Local Project	Required for ULOP	Not required	Not required	Not required	Not required	Not required	2016
ARCF GRR	Provides resiliency	Not required	Provides resiliency	Provides resiliency	Provides resiliency	Provides resiliency	2040
SRBPP	As needed	As needed	As needed	As needed	As needed	As needed	As needed
LAP	Not required	Not required	Required for ULOP	Required for ULOP	Required for ULOP	Required for ULOP	2023
SSSG	Not required	Not required	Not required	Not required	Not required	Site specific*	2017
Florin Basin	Not required	Not required	Not required	Not required	Not required	Site specific*	2017
Non-structural Actions	Required for ULDC	Required for ULDC	Required for ULDC	Required for ULDC	Required for ULDC	Required for ULDC	Varies
Local Government Projects	None identified	None identified	None identified	None identified	None identified	None identified	N/A
Levee Modernization	ULDC requires within 40 years	ULDC requires within 40 years	ULDC requires within 40 years	ULDC requires within 40 years	ULDC requires within 40 years	ULDC requires within 40 years	2055

*This plan provides 100- to 200-year flood protection in the South Sacramento Streams area. Conditions may be required for some projects in that area to achieve ULOP. Depending on the location and flood parameters at a specific development site, the levee system improvements in this table may aid the site in achieving ULOP without conditions or with a reduced set of conditions.

SAFCA's funding plan for the proposed projects and O&M costs through the year 2025 is developed in the CCAD 2 Engineer's Report and assumes formation of the assessment district. With carryover from previous fiscal years, SAFCA would then have a positive funding balance throughout the planning period. Planned expenditures are shown below.

Table S-2: Planned Expenditures ($millions, all sources)

Fiscal Year	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024	2024-2025
Costs	$175.3	$148.9	$122.1	$154.0	$129.6	$129.6	$167.7	$131.2	$131.2	$113.4

1. INTRODUCTION

New laws specify that, beginning in mid-2016, cities and counties shall not approve most new developments in specified floodplains unless they make findings that the developments have or will be provided with an Urban Level of Flood Protection (ULOP). In most cases this means protection from a 200-year flood. This document was prepared at the request of the City of Sacramento and the County of Sacramento to assist in making those findings in areas to be protected through the efforts of the Sacramento Area Flood Control Agency (SAFCA). It may also be of use for affected parts of Sutter County and Rancho Cordova.

In 2007, several bills were passed that amended the California Water Code and California Government Code (CGC) to strengthen flood protection and link land use planning to flood planning. Of particular importance, Senate Bill (SB) 5 (2007), as amended by SB 1278 (2012) and AB 1259 (2013), requires cities and counties within the Sacramento and San Joaquin valleys to make specified findings before allowing development in flood hazard zones (California Department of Water Resources (DWR), 2010; DWR, 2013; DWR, 2014b[1]). "Flood hazard zones" include floodplains within a FEMA designated special flood hazard area (a 100-year floodplain) or FEMA-designated moderate flood hazard area (this is FEMA's "shaded zone X," generally the remainder of the 500-year floodplain) (CGC §65007(d)).

Government Code Section 6500(h) defines the Sacramento-San Joaquin Valley in a way that may allow some flexibility in geographic interpretation. All of the area of this plan is assumed to be within the Sacramento-San Joaquin Valley and subject to the related flood legislation.

The 2007 bills and their amendments require all valley cities and counties to update their general plans with flood information by July 2, 2015, and to amend their zoning codes to be consistent with the updated general plan within 12 months thereafter but no later than July 2, 2016 (DWR, 2014a). Once the amendments are in effect, the city or county must make one of four findings before approving the following activities within flood hazard zones:

- development agreements (CGC §65865.5);
- discretionary permits or other discretionary entitlements, or ministerial permits that would result in the construction of a new residence (CGC §65962); or
- tentative maps or parcel maps for which a tentative map was not required (CGC §66474.5).

The possible findings are (CGC §65865.5, §65962, and §66474.5):

> (1) The facilities of the State Plan of Flood Control or other flood management facilities protect the [project or property] to the urban level of flood protection in urban and urbanizing areas or the national Federal Emergency Management Agency standard of flood protection in nonurbanized areas;

[1] References are listed at the end of this report.

> (2) The city or county has imposed conditions … that will protect the [project or property] to the urban level of flood protection in urban and urbanizing areas or the national Federal Emergency Management Agency standard of flood protection in nonurbanized areas; .
>
> (3) The local flood management agency has made adequate progress on the construction of a flood protection system which will result in flood protection equal to or greater than the urban level of flood protection in urban or urbanizing areas or the national Federal Emergency Management Agency standard of flood protection in nonurbanized areas for property located within a flood hazard zone, intended to be protected by the system. For urban and urbanizing areas protected by project levees, the urban level of flood protection shall be achieved by 2025; or
>
> (4) The property in an undetermined risk area has met the urban level of flood protection based on substantial evidence in the record.

Although the Government Code requires each city or county to make findings for new development within the FEMA moderate hazard (500-year) floodplain, the required findings must only show protection to the 200-year level for urban and urbanizing areas (this is the "urban level of flood protection," referred to herein as the ULOP) and to the FEMA 100-year level for other areas. Of the four flood findings provided in law, it is assumed that the appropriate finding for areas within the 500-year floodplain but outside the 200-year floodplain is that existing facilities protect the property to the ULOP, even though some areas may not be dependent on facilities at all within the fringes of the 500-year floodplain. Figure 1 is a flowchart of the ULOP finding process.

DWR's 2013 *Urban Level of Flood Protection Criteria* (DWR, 2013) (referred to herein as the ULOP Criteria) lists the substantial evidence required to make a finding that a parcel or project provides ULOP based on adequate progress. In summary, this includes:

1. A report by the local flood management agency demonstrating adequate progress as defined by the Government Code.
2. A report by a Professional Civil Engineer showing that a parcel or project will have ULOP when the flood system is completed.
    a. A report by an Independent Panel of Experts (IPE) reviewing the engineer's report.
    b. The engineer's response to the IPE report.
3. The most recent annual report prepared by the local flood management agency on efforts to complete the flood protection system.
4. Any additional data that cities or counties use to make the finding.

This Plan fulfills item (1) and, until the first annual report, item (3) above. Starting in 2017, SAFCA will prepare annual reports in continued compliance with item (3). This plan relies on the engineering conclusions of the *Sacramento Area Flood Control Agency Adequate Progress Towards an Urban Level of Flood Protection Engineer's Report* (MBK Engineers, 2016), which incorporates the IPE report and response required in item (2) above, and the financial data in the *Draft Engineer's Report SAFCA's Consolidated Capital Assessment District No. 2* (WSP

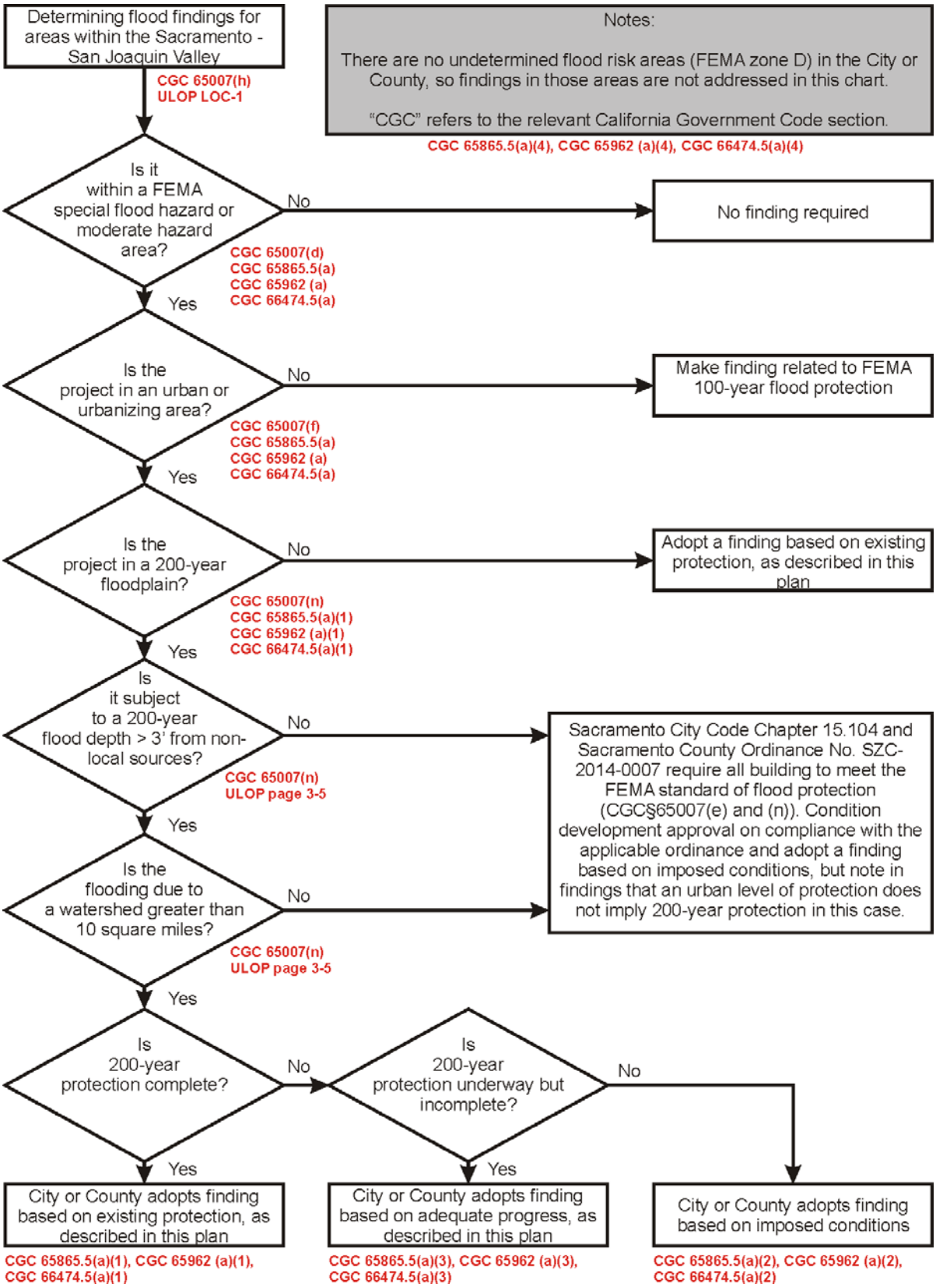

Figure 1: Flow Chart for Flood Findings

Parsons Brinckerhoff, 2016), which identifies the funding necessary to complete the projects. Those documents are incorporated by reference into this document. They can be referred to for more information, and prevail in matters of technical detail. Data that the City and County use to determine interior drainage, site elevations, and the urban or non-urban nature of each project vicinity will provide item (4) above.

The language of the law and the ULOP Criteria make it clear that the findings need to be in place for development at the individual approval or parcel level. However, the ULOP Criteria also state that "cities and counties may leverage any previous findings that cover a large geographic scope for use in subsequent approvals on a smaller scale." It is the intent of both the City of Sacramento (City) and County of Sacramento (County) to use this ULOP Plan and associated engineering analysis (MBK, 2016), in conjunction with their own data on urbanization and interior drainage, to support ULOP findings for multiple projects within their jurisdictions to minimize the need for repetitive studies for each future development. Findings may become invalid if circumstances have changed leading to a greater probability or severity of flooding, if laws or regulations have changed, or if the level of protection provided by the facilities changes. For areas where the finding indicates that adequate progress is being made on achieving an urban level of protection, the finding expires if adequate progress is not made, if the adequate progress finding is superseded, or after 10 years. Adequate progress findings may not be relied upon after 2025 for project levees.

The purpose of this plan is to provide information for the City and County to make the necessary ULOP findings for projects or properties protected by the State Plan of Flood Control. It may also be used by the County of Sutter or the City of Rancho Cordova. SAFCA's improvements to the SPFC are generally north of Freeport. The City and County will need to make land use determinations such as whether a given property within the plan area is in an "urban area" or "urbanizing area" as defined by CGC 65007(l) and (m), respectively, for purposes of ULOP findings.

The ULOP Criteria do not require flood protection from local watershed sources that are less than 10 square miles or from flooding that is less than three feet deep. The City and County, as the floodplain managers, have the data necessary to determine which parts of their jurisdictions are subject to interior drainage and have mapped those areas. The City and County will use that information in conjunction with this plan to ascertain where findings are required and what findings to make for development projects.

Other sources of data exist for the City and County to make findings related to areas that already have an urban level of flood protection. Although this plan provides that information, the plan will be most useful as an aid to the agencies when they make the finding (3) above that adequate progress is being made on a flood system that will provide an urban level of protection. As defined by the Government Code, "adequate progress" entails identification of "the total project scope, schedule, and cost" of that system. This plan is the document that identifies that scope, schedule, and cost. Other elements of adequate progress require ongoing effort after completion of this plan, including appropriating the identified funds, constructing the improvements, and reporting progress annually to the State.

1(a) Relationship Between This Plan, DWR Criteria, and SAFCA Projects

This plan complies with the DWR ULOP Criteria and underlying State law to provide substantial evidence backing flood protection findings for future land developments within the plan area. The ULOP Criteria document, in turn, incorporates by reference the State's Urban Levee Design Criteria (DWR, 2012). Whereas the ULOP Criteria document describes how land management agencies can make the findings required by law, the ULDC document describes the actual design criteria for levees. Therefore, in order to make a finding that levees provide or will provide ULOP to an area, an agency must comply with the ULDC as well.

The ULDC present a special case in that some of the criteria may not be applicable to federal certification of levees or federal mapping of floodplains. In addition, the ULDC impose extremely rigorous standards in some situations, like a requirement that hydrologic and hydraulic design assume that upstream and downstream levees do not breach even when overtopped, which requirement does not necessarily reflect past experience with regional levee performance. Therefore, a project that is described in this plan as essential for meeting ULDC may not be essential to achieving the special benefits of SAFCA's flood risk reduction programs, because those SAFCA programs may confer a greater than 200-year level of protection as demonstrated in the assessment district documentation.

In addition to design requirements, ULDC imposes requirements that are more closely tied to planning or operations and maintenance, such as requirements for security plans or treatment of animal burrows. Some of these requirements do not have specific timelines associated with them. These requirements will be met by SAFCA as described in this plan, and in most but not all cases will be completed prior to 2025.

2. BACKGROUND/HISTORY

SAFCA is a joint exercise of powers agency that encompasses Sacramento County and a portion of south Sutter County containing the Natomas Basin and part of the Natomas Cross Canal watershed directly east of Natomas. SAFCA's board of directors is made up of representatives from the County of Sacramento and the County of Sutter plus the City of Sacramento, the American River Flood Control District, and Reclamation District No. 1000. SAFCA's projects also protect parts of other cities in Sacramento County that are not members of the joint powers agency.

SAFCA was formed in 1989 to address the Sacramento area's vulnerability to catastrophic flooding. This vulnerability was exposed during the record flood of 1986 when Folsom Dam exceeded its normal flood control storage capacity and several area levees nearly collapsed under the strain of the storm. In response, local agencies created SAFCA through a Joint Exercise of Powers Agreement to provide the Sacramento region with increased flood protection along the American and Sacramento Rivers.

SAFCA had already managed a number of flood improvement projects, including construction of the North Area Local Project and re-operation of Folsom Dam, by the time of the 1997 floods in the lower Sacramento Valley. Some of these improvements, including repairs to erosion in the

American River levee system completed just prior to the storm, undoubtedly helped save Sacramento from severe flooding.

SAFCA's improvement program continued and led to FEMA certification of levees protecting Natomas and portions of North Sacramento and the Sacramento and American River floodplains. Along the way, flooding of New Orleans – a city with a nominally higher level of flood protection than Sacramento – by Hurricane Katrina in 2005 led to more stringent federal levee standards, the availability of more State flood protection money via propositions approved by California voters, and the 2007 California flood legislation prompted the preparation of this plan. By 2007, SAFCA had begun planning, design and environmental work for the Natomas Levee Improvement Program (NLIP), which broke ground in 2008, the same year that FEMA decertified the Natomas levees based on upgraded levee standards. SAFCA has since completed the locally-led portion of the NLIP project and undertaken a levee accreditation project for the Sacramento River East Levee and North Area Stream systems. SAFCA also has continuing partnerships with the US Army Corps of Engineers (USACE) and US Bureau of Reclamation (BOR) which have led to completion of levee improvements along the American River, construction of the Folsom Dam Joint Federal Project (JFP), initiation of an update to the Water Control Manual governing flood operations at Folsom Dam, and the start of design for the Folsom Dam Raise Project and the federal portion of the NLIP.

SAFCA's projects will be described in greater detail in Chapter 3 of this report. More information on the history of flooding in the Sacramento region is available online at http://www.safca.org/history.html (SAFCA, 2015a), and information on the nature of the flood threat in the region is available online at http://www.safca.org/floodhistory/floodthreat.html (SAFCA, 2015b).

3. SAFCA'S PROTECTED AREAS

As noted previously, SAFCA's jurisdiction covers Sacramento County and the Natomas Basin portion of south Sutter County. This plan covers the 500-year floodplain for the SPFC north of and including Freeport and most of the Morrison Creek watershed within SAFCA's Operation and Maintenance Assessment District No. 1. It excludes the Laguna Creek and Cosumnes watersheds and areas south. This plan describes six major geographic areas within the area influenced by flows on the American River and contributing tributaries within SAFCA's jurisdiction. The geographic areas are the Natomas Levee System, the Dry Creek North Levee System, the Robla Creek to Arcade Creek Levee System, the American River North Levee System, the American River South and Sacramento River East Levee System, and the South Sacramento Streams System (Figure 2).

3(a) Natomas

i. Area Protected

The Natomas Basin is located north and east of the confluence of the American and Sacramento Rivers (Figure 3). The basin encompasses approximately 53,000 acres (about 83 square miles). It includes portions of the City of Sacramento, the County of Sacramento, and the County of Sutter.

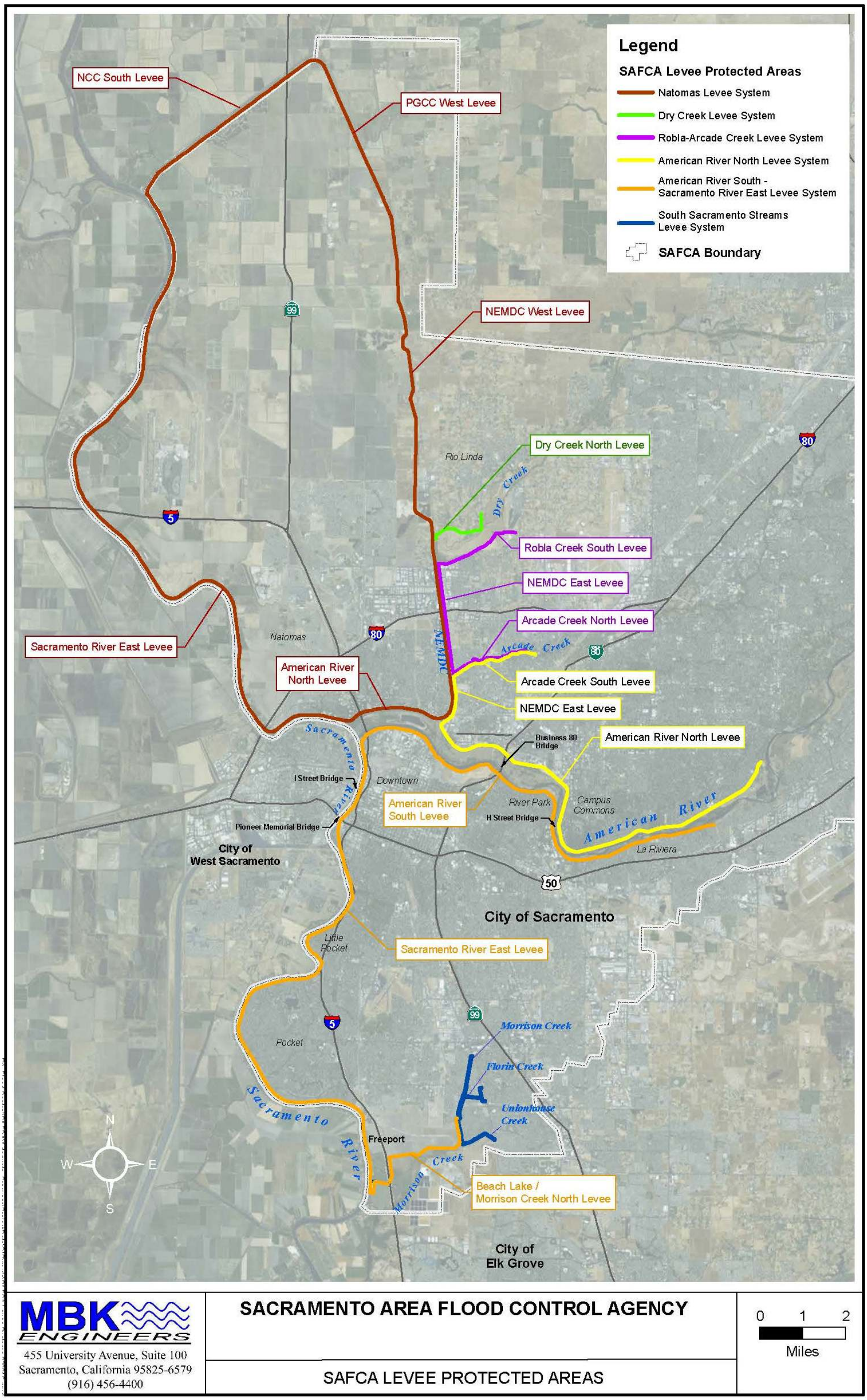

Figure 2: SAFCA Levee Protected Areas

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In addition to the American and Sacramento Rivers, the Natomas Basin is bordered on the north by the Natomas Cross Canal (NCC) and on the east by the Pleasant Grove Creek Canal (PGCC) and the Natomas East Main Drainage Canal (NEMDC), also known as Steelhead Creek. The design capacities cited below for these channels are from a map published by DWR (DWR, 2006).

The Natomas Basin extends from approximately Sacramento River Mile 77 at the north (the river mile is measured from the Sacramento River's junction with the San Joaquin River at the top of the Suisun Bay) to just above Sacramento River mile 60 at the confluence with the American River in the south. Three miles upstream of the Natomas Basin, the Sutter Bypass joins the river from the north.

The NCC is a 5.3-mile long engineered channel that conveys up to a capacity of 22,000 cubic feet per second (cfs) to the Sacramento River from two tributary canals: the 16,000 cfs East Side Canal north of Natomas and the 6,000 cfs Pleasant Grove Creek Canal (PGCC) running north from about Sankey Road along the northeast edge of the Natomas Basin. These canals drain a large watershed in south Sutter County and western Placer County. The East Side Canal collects drainage from Coon Creek, Markham Ravine, Auburn Ravine, and King Slough. Tributaries to PGCC include Pleasant Grove Creek, Curry Creek, and unnamed drainages. The water surface in the NCC is influenced both by upstream drainage and by backwater effects from the Sacramento River at its downstream end. The NCC South Levee has recently been substantially improved as part of SAFCA's NLIP phases 1 and 2. These improvements included raising the levee as needed to provide three feet of freeboard above the 200-year water surface elevation, flattening the landside levee slopes to meet current standards, and installing cutoff walls typically about 70 feet deep through the levee and underlying strata (EDAW|AECOM, 2007).

The NEMDC is an engineered channel along the eastern flank of the Natomas Basin south of approximately Sankey Road. The NEMDC has a capacity of 1,500 cfs near its head and 16,000 cfs near its junction with the American River. The NEMDC discharges directly to the Sacramento River during periods of low to moderate flow. However, for about 2.8 miles above this confluence, the creek is parallel to the American River and between the levees that form the American River floodway. During high flows when the water spans levee to levee, the American River and NEMDC flows are commingled in this reach.

For more on the American and Sacramento rivers, please refer to the later sections on the American River North Levee System and the American River South and Sacramento River East Levee System.

The interconnected levee system surrounding the Natomas Basin was originally created to promote agricultural development within the basin. Today, however, the Natomas Basin contains the Sacramento International Airport; portions of Interstate 5, Interstate 80, and State Route 99/70; and extensive recent urban development occupying the lower third of the basin.

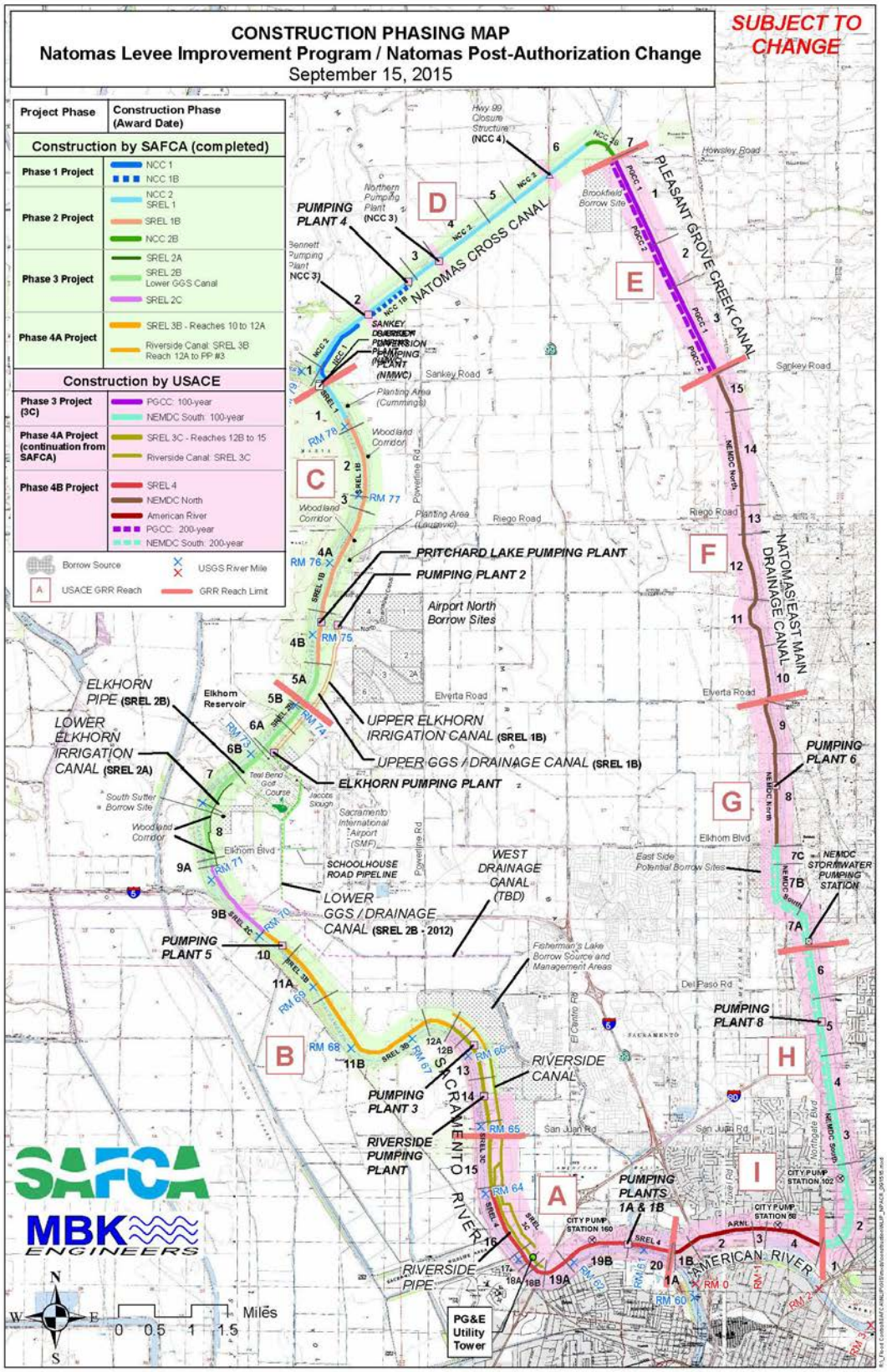

Figure 3: Natomas Levee Improvement Program

The NCC South Levee and portions of the Sacramento River East Levee have been recently improved by SAFCA as part of phases 2 through 4a of the NLIP. Improvements along the NCC included levee raises of between 2 and 3 feet to provide 3 feet of freeboard over the 200-year flood water surface elevation and installation of cutoff walls of varying depths to address identified underseepage vulnerabilities. Along the Sacramento River East Levee between the mouth of the NCC and Powerline Road the improvements included construction of a "raised adjacent setback levee" extending landward from the landward shoulder of the existing levee to provide the requisite levee functional cross-section and freeboard for the 200-year flood without disturbing the many waterside encroachments in this reach (EDAW|AECOM, 2009a). A combination of cutoff walls and seepage berms was constructed in this reach to address levee underseepage.

The local maintaining agency for the Natomas Basin levees is Reclamation District No. 1000 (RD 1000). RD 1000 also maintains about 30 miles of internal drainage canals within the Natomas Basin, principally the West Drainage Canal and the East Drainage Canal, which join at Interstate 80 in the southern end of the basin to form the Main Drainage Canal, which discharges to the Sacramento River via RD 1000 pumping plants 1A and 1B (RD 1000, 2015a). There are an additional 150 miles of drainage ditches and additional pumps discharging to the Sacramento River, NCC, and NEMDC/Steelhead Creek (RD 1000, 2015b). In addition, the City of Sacramento and the County of Sacramento operate street drainage facilities, and the City maintains detention basins within the Natomas Basin.

ii. Status of Levees Relative to State Standards

The status of levee certifications in the Natomas Basin below includes information summarized from recent SAFCA environmental impact reports (EDAW|AECOM, 2006; EDAW|AECOM. 2007) in addition to the reports cited individually below.

Prior to 1986, FEMA had considered the Natomas Basin to have 100-year flood protection from the American and Sacramento rivers. Following the 1986 floods, the flood probability in the basin was reevaluated, and in 1989 FEMA mapped the basin as a 100-year floodplain. The same year, SAFCA was formed and began work with USACE and DWR to improve Sacramento's flood protection. The completion of USACE's Sacramento Urban Levee Reconstruction Project in 1992 and SAFCA's North Area Local Project (NALP) in 1996 led USACE to certify the levees to meet FEMA's 100-year standards in 1998, allowing Natomas to be mapped out of the 100-year floodplain again. However, by this time the 1997 flood had revealed potential underseepage problems with the Sacramento River East Levee, and USACE, DWR and SAFCA worked together to assess the nature and extent of this potential. The report by the USACE and a separate evaluation by SAFCA led USACE to determine in 2006 that Natomas did not in fact have a 100-year level of flood protection, and led FEMA to remap the basin back into the 100-year floodplain in 2008 (City of Sacramento, 2015).

SAFCA meanwhile obtained an Early Implementation Program (EIP) grant from the California Department of Water Resources and began levee improvements through the NLIP. This work has allowed the area to be remapped into FEMA interim flood zone A99, which indicates that adequate progress has been made toward completion of a federal project providing 100-year

flood protection. The A99 designation became effective in June 2015 (City of Sacramento, 2015) and will have the effect of allowing development, which has been on hold, to proceed. The interim designation shows that the NLIP improvements completed to date include at least half of the critical features needed to provide 100-year flood protection and involve at least half of the total cost of the improvements needed to provide 100-year protection (Johnson, 2014).

The levee improvements completed to date have included levee raises to provide freeboard meeting the Urban Levee Design Criteria (ULDC) (DWR, 2012). However, as described in more detail in the Planned Improvements section below, existing seepage, stability, and height issues in the levee reaches not yet improved, as well as non-structural ULDC criteria, have kept the basin as a whole from meeting the ULOP. In addition, encroachments have been identified around the basin that over time may require modification in order to meet ULDC. Levee modernization needs and plans are described separately in Section 4 rather than being described individually by area below.

iii. Planned Improvements

Figure 4 shows the areas of SAFCA's planned improvements.

1. Federally-Led Projects

Folsom Dam Modifications – Folsom Dam Modifications include three related projects: the Folsom Joint Federal Project (JFP), the Folsom Dam Raise, and the Folsom Dam Water Control Manual Update.

The JFP is a joint project of BOR, USACE, DWR, and SAFCA authorized by Congress in 2007 and currently under construction. The JFP addresses dam safety and flood control needs by creating a new auxiliary spillway with closure gates on the east abutment of the dam. The new structure will enable higher flows to be released from the dam at lower reservoir levels, enabling the dam to be operated in a way that will safely accommodate a 200-year flood with discharges no greater than 160,000 cfs. The JFP is planned for completion in 2017 (LWA, 2015), and is essential to provide ULOP to the Sacramento region.

The Folsom Dam Raise was approved in 2003. Congress authorized USACE to raise the height of the structures comprising Folsom Dam, including the main dam, wing dams, and dikes that contain Folsom Reservoir. The current height of the main dam is 484.0 feet above Mean Sea Level (msl) and the height of the wing dams and dikes is 480.5 feet msl. The 2003 authorization allowed the height of each of these facilities to be increased to 487.5 feet. In 2007, as recommended by USACE, Congress reduced the scope of the project and directed that the wing dams and dikes be raised by 3.5 feet to equal the existing height of the main dam. This increased height will allow flood operators to store more flood water behind Folsom Dam when forecasted inflows are decreasing (resulting in no imminent threat to the safety of the dam) and the additional storage is required to maintain releases from the dam at a level that can be safely contained by the downstream levee system (LWA, 2015). The dam raise is essential to provide ULOP to the Sacramento region.

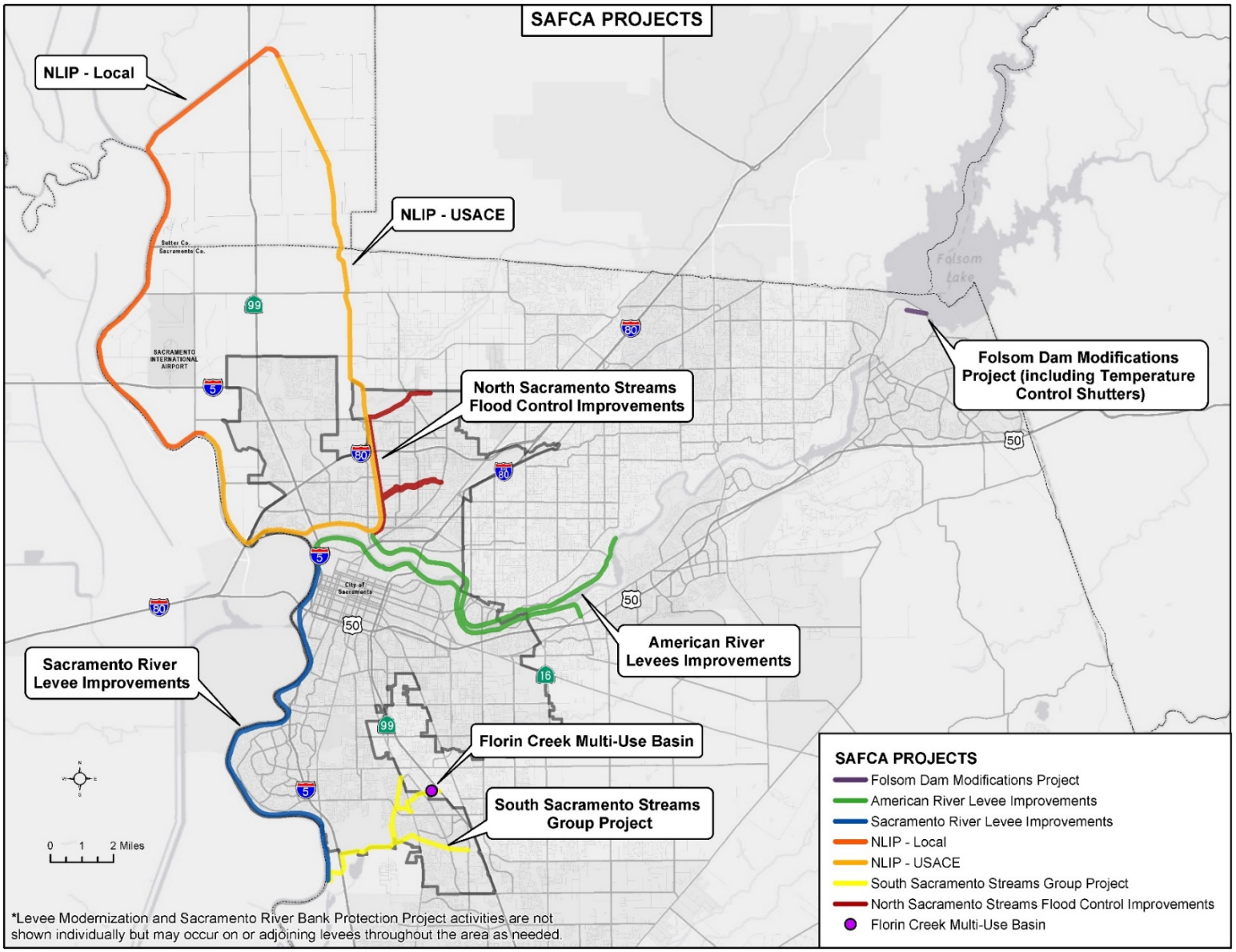

Figure 4: SAFCA Projects

The Folsom Dam Water Control Manual Update will optimize operations at the dam with the new physical improvements. Since 1995, BOR has operated Folsom Dam to provide variable flood storage based on how much empty space is available in three large non-Federal reservoirs located in the upstream watershed. Current operations require a minimum flood storage reservation (i.e. available capacity) in Folsom Dam's reservoir during flood season of 400,000 cfs, with the flood reservation increased to 670,000 cfs when the upstream reservoirs are full.

In 1999, Congress directed USACE to implement a new water control manual for Folsom Dam once the modifications to the dam's outlet works have been completed. USACE is to perpetuate the variable storage operation initiated by BOR with a slightly reduced flood storage envelope (the envelope will be from a minimum 400,000 acre-feet to a maximum 600,000 acre-feet). The actual storage reservation will be determined not only by the availability of creditable upstream storage space but also by forecasted inflows to Folsom Dam. USACE and BOR along with the State and SAFCA are currently developing the new water control manual with the aim of having it ready when the Folsom JFP project is completed at the end of 2017. A key objective of the new manual is to ensure that Folsom Dam can safely contain a 200-year flood in the American River watershed without releasing more than 160,000 cfs into the American River channel (LWA, 2015).

Once the Folsom Dam Raise Project is completed, the new water control manual will be adjusted to reflect the increased reservoir storage capacity created by that project. With this new storage capacity in place, modeling studies by SAFCA (2015) indicate that in a 200-year flood, maximum discharges into the American River would not exceed 115,000 cfs.

Natomas Levee Improvement Project (NLIP) USACE Project – The Natomas levees are being improved in two phases. The NLIP Local Project, led by SAFCA, is complete and comprised eighteen miles of improvements to the Natomas Cross Canal and the Sacramento River East Levee as shown in Figure 3. The NLIP USACE Project (also known as the American River Common Features Natomas Federal Project or ARCF Natomas Project) proposes levee improvements around the remainder of the 42-mile Natomas Basin perimeter. The following project elements remain for completion by USACE (USACE, 2015):

- American River adjacent to Natomas Basin – widen 2 miles of levee in place and install a seepage cutoff wall through the levee and foundation on the Lower American River.
- Sacramento River adjacent to Natomas Basin – construct 5 miles of adjacent levee, 3.3 miles of deep seepage cutoff walls, and 4.3 miles of seepage berms.
- Pleasant Grove Creek Canal adjacent to Natomas Basin - Widen 3.3 miles of levee in place and install a soil bentonite cutoff wall on the Pleasant Grove Creek Canal.
- NEMDC/Steelhead Creek West Levee – widen 12.8 miles of existing levee and install 10.7 miles of cutoff wall.
- Natomas Cross Canal (NCC) – complete gaps left by SAFCA NLIP at Bennett and Northern pumping plants and at the State Route 99 closure structure.

Completion of these elements is essential to providing a ULOP within the Natomas basin.

American River Common Features General Reevaluation Report (ARCF GRR) – The ARCF Natomas Project described above was authorized prior to the ARCF GRR and will be completed

with or without the ARCF GRR changes. Those features are essential to providing ULOP within the Natomas Basin. Other ARCF features new or changed in the GRR that are relevant to Natomas include more bank protection along the American and Sacramento rivers and changes to the Sacramento Weir and Bypass. These ARCF GRR features are described later in this document in the section on the American River North Levee System. These changes help provide protection in excess of the ULDC and add resiliency to the system, but they are not essential to provide ULOP in the Sacramento region assuming the completion of State and SAFCA projects and based on modeling that shows that Folsom Dam releases can be held to 115,000 cfs in a 200-year event.

Sacramento River Bank Protection Project (SRBPP) – The SRBPP is an ongoing project to provide bank protection along critically eroding reaches of the Sacramento River flood control system, including tributaries like the American River. The SRBPP may accomplish a portion of the bank protection described in the ARCF GRR. The implementation of the SRBPP on an as-needed basis in the Sacramento region is assumed to continue and to support ULOP. Any critical erosion risks that arise in the region and are not expeditiously addressed by the SRBPP or other means may need to be addressed in future "adequate progress" reports on this plan.

2. State/SAFCA Led Projects

NLIP Local Project – The SAFCA-led NLIP has consisted of improvements on 18 of the 42 miles of levees surrounding the Natomas Basin. Because this work is complete, it is described in Section 3(a) of this report. This work is essential for achieving a ULOP for Natomas.

Non-Structural Actions – The ULDC, which are incorporated by reference in the ULOP Criteria, require a number of actions that do not necessarily change the physical level of flood protection in the region, but that are good practices for the effective operation and maintenance of levee systems over time to sustain system performance. These actions include such measures as engineering evaluation and documentation, development of security and safety plans, and other items. The non-structural actions and their necessity are described in greater detail in the Adequate Progress Engineer's Report (MBK, 2016) attached hereto as an Appendix A. Levee modernization actions including plans for acquiring rights-of-way at the landside toe of levees are described in Section 4 of this report. SAFCA will work with its partners, including the City and County and Local Maintaining Agencies (LMAs), to implement these non-structural actions over time. Ongoing operation, maintenance, repair, and rehabilitation may be considered ongoing non-structural actions that to the extent required are funded by SAFCA under this plan.

3. Local Government

This plan addresses the improvements that must be made to the SPFC to provide an urban level of flood protection within the protected basins. SAFCA is the lead local agency for these SPFC projects.

The ULOP Criteria do not require flood protection from local watershed sources that are less than 10 square miles or from flooding that is less than three feet deep. In addition, the requirement for providing ULOP only applies to urban and urbanizing areas (the FEMA standard

still applies in non-urbanized areas). The cities and counties, as the floodplain managers and the land use agencies, have the data necessary to determine which parts of their jurisdictions are subject to interior drainage and/or are urban or urbanizing within the meaning of the law and must use that information in conjunction with this plan to ascertain where findings are required and what findings to make for development projects.

No improvements to the Natomas flood control system are currently proposed by the City of Sacramento or the County of Sacramento as part of this plan.

The City of Sacramento, Sacramento County, and Sutter County (Communities) identified areas within the 500-year floodplain, located within a watershed with a contributing area of more than 10 square miles, and with flood depths greater than 3.0 feet, that do not have 200-year planned improvements within Natomas area. The identified areas that met these criteria were further analyzed and mapped to the 200-year standard. After mapping the 200-year floodplain, any areas that have less than 3 feet of flooding from both local and SPFC sources can be found to have an urban level of protection under Government Code Section 65007(n) and ULOP Criterion LOC-1. When the Communities receive applications for land-use decisions, the flood maps will be utilized by the Communities to impose conditions, as necessary.

3(b) Dry Creek North Levee System

i. Area Protected

Dry Creek drains approximately 100 square miles of west Placer County and northern Sacramento County before joining the NEMDC. The lower reach of the creek in Sacramento County is paralleled by SPFC levees, and the lower reach of Robla Creek is within this levee system too. The northern levee, which extends west from Rio Linda Boulevard to the NEMDC, is referred to as the Dry Creek North Levee and is discussed here, and the southern levee is referred to as the Robla Creek South Levee and is described as part of the Robla Creek to Arcade Creek Levee System.

The Dry Creek North Levee protects rural residential areas to the north of the creek and southwest of Rio Linda. The levee ties in to the West Levee of the NEMDC at SAFCA's NEMDC stormwater pumping station; there is no NEMDC East Levee north of Dry Creek. The NEMDC stormwater pumping station pumps flows from the NEMDC and its northern tributaries as well as high-water spills from the Pleasant Grove Creek Canal into the southern reach of the NEMDC while preventing the northern reach from flooding from backflows from the Dry Creek watershed or the American River.

ii. Status of Levees Relative to State Standards

The Dry Creek North Levee System currently meets ULDC structural standards, and no structural deficiencies were identified during assessments made for the ARCF GRR. However, non-structural actions may be required for ULDC, and associated evaluations may point to a need for the Folsom Dam Modifications, which will lower the water surface elevation in Dry

Creek and the NEMDC by moderating flows in the American River. Adequate access and visibility is provided along this levee reach.

iii. Planned Improvements

1. Federally-Led Projects

Folsom Dam Modifications – These projects, described earlier in Section 3(a) under the discussion of the Natomas area, are essential to provide ULOP in this area because they moderate discharges into the American River and thus influence stages and velocities in the NEMDC and Dry Creek as well.

2. State/SAFCA Led Projects

Non-Structural Actions, described earlier under the discussion of the Natomas area planned improvements Section 3(a), will be implemented by SAFCA and its partners, including the City and County and LMAs, over time to meet long-term ULDC objectives.

3. Local Government

This plan addresses improvements to the SPFC necessary to provide a ULOP. In addition, the City has mapped floodplains subject to 200-year flood depths of greater than 3 feet and affected by local source watersheds greater than 10 square miles and found none affecting the City within the area protected Dry Creek North Levee System. The County has also mapped its ULOP applicability area and will determine ULOP applicability in the Dry Creek North area on a project by project basis using that data in conjunction with this plan.

3(c) Robla Creek to Arcade Creek

i. Area Protected

The Robla Creek to Arcade Creek area includes the 200-year floodplain within Sacramento County east of the NEMDC East Levee, south of the Robla Creek South Levee, and north of the Arcade Creek North Levee. Flood flows in this area may originate from the NEMDC, Dry Creek, Robla Creek, Magpie Creek, and Arcade Creek.

As noted previously, the NEMDC is an engineered channel along the southeastern flank of the Natomas Basin, with a capacity of 1,500 cfs near its head and 16,000 cfs near its junction with the American River. The NEMDC has a watershed of approximately 180 square miles (AECOM, 2015).

DWR rates the channel capacity of Dry and Robla creeks together at 15,000 cfs. This also includes the headwaters of Magpie Creek, which are diverted to Robla Creek by way of the Magpie Creek Diversion Channel (MCDC). Lower Magpie Creek discharges into NEMDC by way of a pump station.

The ARFCD maintains levees along the Sacramento County portion of Dry Creek, Robla Creek, the MCDC, NEMDC East Levee, and Arcade Creek downstream of Marysville Boulevard.

ii. Status of Levees Relative to State Standards

In 1993, Congress authorized a program of levee and other facility improvements to provide flood protection in the Natomas and North Sacramento areas. Under this authorization, SAFCA completed substantial improvements as part of the North Area Local Project (NALP). These improvements included levee raising and strengthening along the north and south levees of Arcade Creek, the east and west NEMDC levees, and the south levee of Dry/Robla Creek. They also included construction of a new levee along the north side of Dry/Robla Creek and construction of a new pumping station in Dry/Robla Creek North Levee. As a result of this work, USACE certified in 1998 that these elements of the improved levee system met FEMA requirements for safe containment of a 100-year flood. This certification has since expired.

The NALP did not fully address the risk of flooding to the floodplain along old Magpie Creek in the City. Extending eastward from the NEMDC East Levee, this floodplain is influenced by local drainage and by potential floodwaters overtopping the MCDC left bank levee. The MCDC was constructed by USACE and the State Reclamation Board (now the Central Valley Flood Protection Board or CVFPB) in the 1950s to divert high flows in the upper portion of Magpie Creek to Dry/Robla Creeks so that these flows could enter the NEMDC by gravity in lieu of being pumped over the NEMDC East Levee as lower Magpie Creek flows now are (AECOM, 2015).

The USACE ARCF GRR (USACE, 2015) has determined that high flows in the Magpie Creek area outflank or overtop the levee along the left bank of the MCDC and flow west along the historic channel of Magpie Creek. Floodwaters can overtop this levee at approximately the 14-year event. Outflanking of the MCDC levee upstream at Raley Boulevard currently occurs at a two-year event.

SAFCA has been evaluating flood threats to this levee system as part of its Levee Accreditation Project. The accreditation evaluation has determined that (AECOM, 2015):

- Approximately 4 miles of the levees along the NEMDC East Levee and Arcade Creek North and South Levees require substantial work to mitigate seepage and meet embankment and foundation stability requirements. This need is also identified in the GRR.
- High-hazard encroachments and levee vegetation must be removed from portions of all of the levee segments in the project area.
- Channel conveyance in NEMDC/Steelhead Creek must be restored to address apparent height deficiencies on Arcade Creek.

SAFCA's evaluation of SPFC levees for their ability to meet access and visibility requirements of the ULDC found that portions of the Arcade Creek North Levee may not meet those requirements. In addition, SAFCA has identified levee encroachments on Arcade Creek North

Levee that have been categorized as high-risk, either posing a threat to levee integrity or to operation, maintenance, and inspection. Many low-risk encroachments have also been identified on levees throughout the area. To meet the ULDC, the high-risk encroachments must be monitored and a removal or modification plan needs to be approved by the maintaining agency. Low-risk encroachments must be addressed over time. Other non-structural actions, including further evaluations to meet ULDC standards, may be required. Levee modernization needs and plans are described separately in Section 4.

iii. Planned Improvements

1. Federally-Led Projects

Folsom Dam Modifications – These projects, described earlier under the discussion of the Natomas area in Section 3(a)., are essential to provide ULOP in this area because they moderate discharges into the American River and thus influence stages and velocities in the NEMDC.

American River Common Features General Reevaluation Report–
The ARCF GRR proposes height improvements along the NEMDC East Levee from about Main Avenue south to about El Camino Avenue, in addition to seepage and stability improvements north and south of Interstate 80. The ARCF GRR also proposes levee height increases along Arcade Creek from Marysville Boulevard west to the confluence with NEMDC/Steelhead Creek, as well as seepage and stability improvements in this reach that correspond to those in SAFCA's Levee Accreditation Project (USACE, 2015).

Since the early 1990s, SAFCA has been working with USACE and CVFPB to improve the MCDC and levee to reduce the risk of overflow into the old Magpie Creek floodplain downstream of the diversion channel. This effort has focused on a combination of floodplain storage and levee rehabilitation improvements that would be carried out as part of the ARCF GRR. The GRR proposes raising approximately 2,100 feet of the MCDC left bank levee and extending the levee south along the west side of Raley Boulevard to Santa Ana Avenue, with floodgates at two driveways (USACE, 2015). An additional culvert and channel would be constructed at the Sacramento Northern Railway Bike Trail.

Although SAFCA is a local partner in the implementation of the ARCF GRR, the GRR provides protection in excess of the ULDC. Therefore, it is not essential to provide ULOP for most of the Robla Creek to Arcade Creek plan area. In the absence of the GRR, however, not all of the Magpie Creek floodplain downstream of the MCDC may meet the ULOP, or portions may meet ULOP only because the 200-year flood elevations are no higher than three feet. Any future development in areas with flood depths greater than three feet prior to completion of the ARCF GRR must have conditions imposed to ensure that ULOP is achieved.

Sacramento River Bank Protection Project (SRBPP) – See description under the discussion of Natomas above in Section 3(a). The SRBPP may be used to accomplish some of the rock bank protection proposed in the ARCF GRR. The implementation of the SRBPP on an as-needed basis in the Sacramento region is assumed to continue and to support ULOP. Any critical erosion risks

that arise in the region that are not expeditiously addressed by the SRBPP or other means may need to be addressed in future annual reports on this plan.

2. State/SAFCA Led Projects

Levee Accreditation Project – The Levee Accreditation Project will construct slurry cutoff walls along about 8,500 feet of the Arcade Creek North Levee (AECOM, 2015). It will address NEMDC and Arcade Creek levee height deficiencies identified in the ARCF GRR not by raising levees, but by implementing a NEMDC/Steelhead Creek Corridor Management Plan (CMP). This plan will remove beaver dams and vegetative undergrowth, including non-native species such as red sesbania, to restore the NEMDC/Steelhead Creek channel capacity (AECOM, 2015). Modeling done for SAFCA has shown that by implementing the CMP, the stage will be reduced enough in the NEMDC channel and in tributaries such as Arcade Creek to attain ULOP without levee height increases. Completion of the LAP improvements is essential to provide ULOP.

Non-Structural Actions, described earlier under the discussion of the Natomas area planned improvements, will be implemented by SAFCA and its partners, including the City and County and LMAs, over time to meet long-term ULDC objectives.

3. Local Government

No improvements to the Robla Creek to Arcade Creek flood control system, including the MCDC, are currently proposed by the City or County.

This plan addresses improvements to the SPFC necessary to provide a ULOP. The City identified areas within the 500-year floodplain, located within a watershed with a contributing area of more than 10 square miles, and with flood depths greater than 3.0 feet, that do not have planned improvements within the Robla Creek to Arcade Creek area. The areas that met these criteria were further analyzed and mapped to the 200-year standard. These areas included Arcade Creek (non-leveed areas), Magpie Creek Diversion Channel (MCDC), and Dry/Robla Creek. Upon receiving applications for land-use decisions, those maps will be utilized in conjunction with this plan to impose conditions, as necessary. The County has also mapped its ULOP applicability area and will use that data and this plan to determine ULOP applicability in the area on a project by project basis.

3(d) American River North Levee

i. Area Protected

As defined for this project, the American River North Levee system includes the Arcade Creek South Levee and NEMDC East Levee south to the American River, plus the American River North Levee east of the NEMDC. Protected areas include all of the areas within the 200-year American River floodplain north of the river and downstream of Folsom Dam upstream of Natomas such as North Sacramento, Campus Commons and Cal Expo.

The American River drains a 2,100-square-mile watershed. Most of that is upstream of Folsom Dam. By managing upper watershed flows, Folsom Dam is the dominant flood management feature protecting Sacramento from American River floods. The right (north) bank of the Lower American River is leveed for approximately 10 miles from Carmichael west to the confluence with the Sacramento River (DWR, 2010b). USACE improvements to the American River levees completed in 2015 will enable the levees to meet applicable federal and state urban levee design requirements for embankment and foundation stability.

Folsom Dam was constructed in 1956 and holds back a 977,000-acre-foot multi-purpose reservoir with a designated 400,000 acre-foot flood pool (DWR, 2010b). It is currently operated by the US BOR with variable flood storage of up to 670,000 acre-feet depending on the available storage capacity of upstream reservoirs (DWR, 2010b). The Folsom Dam JFP includes an auxiliary spillway now under construction which will modify the dam's low level discharge capacity so that flood releases during a 200-year storm can be kept at or below 160,000 cfs. As part of the JFP, the Folsom Dam Water Control Manual is being updated to reflect the dam's increased low level discharge capacity expected to come on line in 2017. Thereafter, the new Water Control Manual will be adjusted to reflect the increased reservoir storage capacity that will be created by the Folsom Dam Raise Project which is expected to be completed between 2020 and 2022.

Levees along the Lower American River are maintained by the American River Flood Control District.

ii. Status of Levees Relative to State Standards

The American River levees have been the subject of substantial improvement over the past two decades, including the construction of over 20 miles of slurry walls, and a one-foot levee raise along the north bank upstream of Howe Avenue. As a result, the levees have the capacity to convey 200-year flood flows with adequate freeboard (USACE, 2015). However, the ARCF GRR indicates that approximately 4 miles of the north bank of the Lower American River have erosion risks that may warrant treatment in order to pass 200-year flows. The extent of such treatment will depend on the magnitude of these flows and the results of an ongoing evaluation of the susceptibility of the channel to erosion. The new water control manual being developed as part of the Folsom JFP is expected to take effect in 2017. Thereafter the new manual will be adjusted to reflect the accomplishments of the Folsom Dam Raise Project. Modeling studies by SAFCA indicate that once the Folsom Dam Raise Project is in place, projected 200-year flood flows in the American River channel would not exceed 115,000 cfs. The extent of erosion control work needed to safely contain these flows would be substantially less than 4 miles along the North Levee.

SAFCA's evaluation of American River levees for their ability to meet access and visibility requirements of the ULDC show that some portions of the North Levee may not meet those requirements. These areas mostly comprise publicly-owned or commercial properties where visibility requirements may be achieved through pruning of vegetation. In the long term this may be addressed by Memoranda of Understanding (MOUs), easements, or ordinances. SAFCA has also identified levee encroachments that have been categorized as high-risk, either posing a

threat to levee integrity or to operation, maintenance, and inspection. In addition, there are many low-risk encroachments on levees throughout the region. SAFCA's plan to meet the ULDC encroachment standards is detailed in the levee modernization, Section 4 later in this report. Low-risk encroachments must be addressed over time and are also discussed in the levee modernization section. Additional non-structural actions and evaluations may be required to meet ULDC.

iii. Planned Improvements

1. Federally-Led Projects

Folsom Dam Modifications – These projects, described earlier under the discussion of the Natomas Levee System in Section 3(a), are essential to provide ULOP in the American River plan area because they moderate discharges into the American River.

American River Common Features General Reevaluation Report – The American River Common Features Project was authorized in 1996 to construct flood control elements that would be necessary in the Sacramento area in conjunction with reservoir alternatives being considered for the region. These elements, called "common features" because they were common to all reservoir alternatives, are mostly complete. The USACE has subsequently undertaken the JFP and prepared a general reevaluation report (GRR), currently in draft form, to accommodate 160,000 cfs flows downstream of Folsom (USACE, 2015). The GRR entails improvements throughout the region. On the lower American River it proposes rock bank protection and launchable rock trenches to combat erosion from such high flows. Projects would span approximately 4 miles of the right (north) bank and 7 miles of the left (south) bank (USACE, 2015).

Bank protection would consist of filling the eroded portion of the bank as necessary and installing revetment along the waterside levee slope and stream bank from the streambed to a height determined by site-specific analysis. After the erosion protection work has been completed, a small planting berm would be constructed in the rock when feasible to allow for some revegetation of the site (USACE, 2015).

Launchable rock filled trenches are designed to deploy rock to cover lower banks once erosion has removed the underlying bank material. Launchable rock trenches would be constructed outside of the natural river channel. Disturbed areas would be reseeded with native grasses and small shrubs where appropriate (USACE, 2015). Small trees could be permitted on the berm if planted outside the USACE's specified vegetation free zone.

ARCF GRR elements that would be required on the Sacramento River and Sacramento Weir and Bypass to accommodate American River discharges of 160,000 cfs are described in Section 3(e) American River South and Sacramento River East Levee.

As discussed above, modeling studies by SAFCA indicate that Folsom Dam releases can be held to 115,000 cfs in a 200-year event once authorized improvements to the dam are in place. Accordingly, by ensuring that the levee system along the American River can safely contain

sustained releases up to 160,000 cfs, the ARCF GRR will provide protection in excess of the ULOP.

Sacramento River Bank Protection Project (SRBPP) – The SRBPP is an ongoing project to provide bank protection along critically eroding reaches of the Sacramento River flood control system, including tributaries like the American River. The SRBPP may accomplish a portion of the bank protection described in the ARCF GRR. The implementation of the SRBPP on an as-needed basis in the Sacramento region is assumed to continue and to support ULOP. Any critical erosion risks that arise in the region and are not expeditiously addressed by the SRBPP or other means may need to be addressed in future "adequate progress" reports on this plan.

2. State/SAFCA Led Projects

Levee Accreditation Project (LAP) – Because of the recent history of improvements on the American River levees, SAFCA has determined that no physical improvements to the American River levee system are required at this time to achieve ULOP standards for geometry, seepage and stability. However, additional measures are required to meet ULDC standards which are incorporated into the ULOP Criteria by reference (DWR 2012; DWR 2014). Structures and vegetation encroaching on the levees will be removed as part of the Levee Accreditation Project if necessary to meet NFIP standards and the State's ULDC. These standards and criteria require removal or modification of encroachments that pose an unacceptably high risk to the performance and safety of a levee by undermining its structural integrity prior to accreditation. Those encroachments impeding inspection, operation, and maintenance of the levee will be removed within 3 years of levee accreditation (AECOM, 2015).

The Levee Accreditation Project will construct slurry cutoff walls along about 1,700 feet of the NEMDC East Levee from the Arcade Creek confluence south. The project will also construct approximately 9,200 feet of cutoff walls along the Arcade Creek South Levee (AECOM, 2015).

The Levee Accreditation Project will address NEMDC and Arcade Creek height deficiencies identified in the ARCF GRR not by raising levees, but by implementing a NEMDC/Steelhead Creek CMP. This plan will remove beaver dams and vegetative undergrowth, including non-native species such as red sesbania, to restore the NEMDC/ Steelhead Creek channel capacity (AECOM, 2015). Modeling done for SAFCA has shown that by implementing the CMP, the stage will be reduced in both in the channel and in tributaries such as Arcade Creek enough to attain ULOP without levee height increases.

Vegetation management would consist of removal of "high-hazard trees" and other vegetation from the levees. The ULDC reflect the underlying risk management objectives of the NFIP. Under these criteria, vegetation on levees must be modified or removed if it presents an unacceptable risk to levee structural integrity or if it impedes levee operation and maintenance.

The Levee Accreditation Project is essential to provide ULOP to the Sacramento region.

Non-Structural Actions, described earlier under the discussion of the Natomas area planned improvements in Section 3(a), will be implemented by SAFCA and its partners, including the City and County and LMAs, over time to meet long-term ULDC objectives.

3. Local Government

No improvements to the American River flood control system are currently proposed by the City or County.

This plan addresses improvements to the SPFC necessary to provide a ULOP. The City also identified areas within the 500-year floodplain, located within a watershed with a contributing area of more than 10 square miles and flood depths greater than 3.0 feet. The tributaries within the American River area that met these criteria were further analyzed and mapped to the 200-year standard. If the City receives applications for land use decisions affecting these areas, the City's data will be used with this plan to make findings and impose conditions if required. The County has also mapped its ULOP applicability area and will use that data in conjunction with this plan to determine ULOP applicability in the American River North area on a project by project basis.

3(e) American River South and Sacramento River East Levee

i. Area Protected

This levee system protects urban areas within the 200-year floodplain downstream of Folsom Dam, south of the American River, east of the Sacramento River East Levee, and north of the Beach Lake North Levee. Protected areas include Rancho Cordova, downtown Sacramento, Land Park, south Sacramento, and the Pocket and Little Pocket areas. The South Sacramento Streams floodplain described later in this report in Section 3(f) overlaps the American River Basin. The American River watershed was described previously. The left (south) bank of the American River is leveed for approximately 13 miles from Mayhew west to the confluence (DWR, 2010b). The Sacramento River is described below.

The Sacramento River drains the largest watershed in California, comprising over 21,000 square miles (Palmer, 2012). Flood protection in the valley portion of the Sacramento River watershed is provided by a combination of headwater dams, notably Shasta Dam and Oroville Dam, by levees, and by weirs that divert high waters into flood bypasses running in parallel to the river and at times conveying volumes much greater than those left in the main river.

North of Sacramento, high river flows are diverted into the Sutter Bypass, which rejoins the Sacramento River north of Natomas. High flows in the Sutter Bypass effectively cross the Sacramento River to exit south over the Fremont Weir and into the Yolo Bypass. Just north of the American River, the Sacramento Weir and Sacramento Bypass divert more flows from the Sacramento River into the Yolo Bypass and away from Sacramento. The Sacramento River channel capacity is 107,000 cfs along the Natomas Basin and 110,000 downstream of the American River, compared to a Yolo Bypass capacity of 377,000 cfs at Fremont Weir and 579,000 cfs near Rio Vista (DWR, 2010b). The Sacramento Bypass capacity is 112,000 cfs.

The Sacramento River East Levee protects much of Sacramento south of the American River and west of the Union Pacific Railroad (former Western Pacific Railroad) from flooding in high flows. This levee system has been well described in SAFCA's accreditation EIR (AECOM, 2015), and much of the following discussion is taken directly from there.

The Sacramento River East Levee system within the plan area extends approximately 14.6 miles southward from the American River to the community of Freeport. Some areas within the American River South and Sacramento River East floodplain are also subject to flooding from the South Sacramento Streams, which are addressed separately. The Sacramento River East Levee protects the heavily urbanized areas of Downtown Sacramento and environs, the Little Pocket neighborhood, and Greenhaven/Pocket (referred to as the "Pocket") area neighborhoods and community. This levee has experienced numerous seepage and erosion issues over the years. Reports of past performance issues are more frequent within the southern portion of the Sacramento River East Levee area in the Little Pocket and Pocket neighborhoods. During the last three decades, SAFCA and USACE have designed and constructed various improvements along several portions of the levee system in response to observed deficiencies in flood protection. Improvements have included shallow and deep seepage cutoff walls, relief wells, berms, and erosion protection.

During the 1986 flood, seepage and boils were noted throughout the southern portion of the Sacramento River East Levee improvements area, triggering construction of the USACE Phase I and Phase II cutoff walls from 1991 to 1993. During the 1995, 1996, 1997, 1998, and 2005 floods, seepage, wave wash/erosion, and boils were noted within the area. The deeper cutoff walls constructed by SAFCA and USACE in 2003, 2005, and 2006 were installed to address some of the more significant seepage- and boil-related performance issues observed from these floods; however, areas where protection from seepage and erosion is deficient still exist along this alignment based on evaluation of current conditions and reports of past performance during recent high-water events.

The Sacramento River East Levee is maintained by three different entities. The northern portion, from the American River confluence south approximately 0.4 miles to the City of Sacramento drinking water intake, is maintained by the American River Flood Control District (ARFCD). From that point south to Sutterville Road (approximately 3.6 miles) is maintained by the City. From Sutterville Road south to Freeport (about 10.5 miles) is within state Maintenance Area 9 (MA 9) and is maintained by DWR. The Sacramento Weir and Bypass is also maintained by MA 9.

The Beach Lake levee extends from the Sacramento River East Levee on the south side of Cavanaugh Golf Course eastward along the north side of Morrison Creek to where Morrison Creek is crossed by the Cosumnes River Boulevard extension.

ii. Status of Levees Relative to State Standards

The American River levees have been the subject of substantial improvement over the past two decades, including the construction of slurry walls. As a result, the levees have the capacity to

convey 200-year flood flows with adequate freeboard (USACE, 2015). However, the ARCF GRR indicates that approximately 7 miles of the south bank of the Lower American River have erosion risks that may warrant treatment. Modeling studies by SAFCA indicate that once Folsom Dam Modifications are in place, the projected 200-year flood flows in the American River channel would not exceed 115,000 cfs. The extent of erosion control work needed to safely contain these flows would be substantially less than the 7 miles required for higher flows.

In 2012-2013 on the Sacramento River East Levee, SAFCA identified about 6.5 miles of the total 14.6 miles of levee that meet FEMA and ULDC geotechnical criteria, while approximately 8.1 miles of levee were judged as being potentially deficient with respect to embankment and/or foundation seepage and stability requirements and in need of additional investigations. Subsequent analysis of the potentially deficient levee, located south of R Street and north of the Freeport Regional Water Authority Water Intake Facility, has shown that some portions of the levee are adequate, but seepage and stability remediation are still recommended for 5.1 miles of this levee (AECOM, 2015). In addition, additional evaluations may be necessary to meet ULDC non-structural criteria.

Erosion also threatens the Sacramento River East Levee at several sites. Approximately 2,500 linear feet of erosion repair is required to certify these levees (MBK, 2016).

SAFCA's evaluation of American River levees for their ability to meet access and visibility requirements of the ULDC estimates that approximately 4.25 miles of the American River South Levee do not meet those requirements. On publicly-owned or commercial properties, visibility requirements may be achieved through pruning of vegetation. In the long term this may be addressed by MOUs, easements, or City and/or County ordinances. SAFCA has also identified levee encroachments that have been categorized as high-risk, either posing a threat to levee integrity or to operation, maintenance, and inspection. In addition, there are many low-risk encroachments on levees throughout the region.

SAFCA's evaluation of Sacramento River levees for their ability to meet access and visibility requirements of the ULDC estimates that approximately 4 miles of the Sacramento River East Levee do not meet those requirements. SAFCA has also identified levee encroachments that have been categorized as high-risk, either posing a threat to levee integrity or to operation, maintenance, and inspection. In addition, there are many low-risk encroachments on levees throughout the region. To meet the ULDC, the high-risk encroachments must be monitored and a removal or modification plan needs to be approved by the maintaining agency. Low-risk encroachments must be addressed over time. Levee modernization needs and plans are described separately in Section 4. High-hazard trees along the Morrison Creek/Beach Lake levee, which runs on the north side of the creek for approximately 2.5 miles between Interstate 5 and the Union Pacific Railroad, will be removed or remediated within 3 years of levee certification.

iii. Planned Improvements

1. Federally-Led Projects

Folsom Dam Modifications – These projects, described earlier under the discussion of the Natomas Levee System, are essential to provide ULOP in the American River South and Sacramento River East Levee System because they moderate discharges into the American River and thus influence stages and velocities in the Sacramento River as well.

American River Common Features General Reevaluation Report – The ARCF GRR prescribes construction of the following system improvements downstream of the American River confluence (USACE, 2015):

- About 9 miles of slurry cutoff walls to address levee seepage and stability problems
- About 10 miles of rock bank protection to address erosion problems
- About 2.5 miles of geotextile stabilized slope to address levee stability
- About 2 miles of slope flattening to address levee stability
- Less than a mile of levee raise to address freeboard

In addition, the ARCF GRR proposes widening the Sacramento Weir and Bypass. The bypass would be widened by 1,500 feet to the north for its entire length. The weir, which is currently 1,920 feet long, would be widened to match the widened bypass.

The extent of bank protection required on the American River and Sacramento River and the need for the Sacramento Weir and Bypass widening to provide an Urban Level of Flood Protection in Sacramento depends in part on the operational parameters for Folsom Dam. Those parameters are the subject of the Folsom Dam Water Control Manual Update currently underway. The manual may prescribe a maximum 200-year release into the Lower American River from 115,000 to 160,000 cfs. At the upper end of this range, all of the bank protection described in the ARCF GRR plus the Sacramento Bypass widening may be necessary, whereas at the lower end, the bypass widening and most of the bank protection would not be essential to provide an urban level of flood protection.

Although SAFCA is a local partner in the implementation of the ARCF GRR, the ARCF GRR provides protection in excess of the ULOP in the Sacramento region assuming the completion of State and SAFCA projects and Folsom Dam releases at or below 115,000 cfs in a 200-year event.

Sacramento River Bank Protection Project (SRBPP) – See earlier description. The SRBPP may be used to accomplish some of the rock bank protection proposed in the ARCF GRR. The implementation of the SRBPP on an as-needed basis in the Sacramento region is assumed to continue and to support ULOP. Any critical erosion risks that may arise in the region that are not expeditiously addressed by the SRBPP or other means may need to be addressed in future annual reports on this plan.

2. State/SAFCA Led Projects

Levee Accreditation Project – A combination of measures is proposed to address existing seepage and stability conditions along the Sacramento River East Levee. Previous enhancements have left a patchwork of reaches where conditions are acceptable and where they are not. Within the 5.1 miles where conditions warrant repair, SAFCA's Levee Accreditation Project will install, depending on the reach, stability berms, relief wells, relief well improvements, cutoff walls, or toe drains.

The Levee Accreditation Project will also include approximately 2,500 feet of erosion repairs as well as encroachment removal and vegetation management at nine sites along the Sacramento River East Levee (AECOM, 2015).

Encroachment removal would entail removal of structures and vegetation encroaching on the levees. Removal would meet NFIP standards for levee accreditation and the State's ULDC, which require removal or modification of encroachments that pose an unacceptably high risk to the performance and safety of a levee by undermining its structural integrity or by interfering with inspection, operation, and maintenance.

Vegetation management would consist of removal or remediation of "high-hazard trees" and other vegetation from the levees. The ULDC reflect the underlying risk management objectives of the NFIP. Under these criteria, vegetation on levees must be modified or removed if it presents an unacceptable risk to levee structural integrity or if it impedes levee operation and maintenance.

Non-Structural Actions, described earlier under the discussion of the Natomas area planned improvements Section 3(a), will be implemented by SAFCA and its partners, including the City and County and LMAs, over time to meet long-term ULDC objectives. A portion of the Sacramento River East Levee is the responsibility of DWR MA 9. Although SAFCA has no authority over MA 9, it is the assumption of this plan that as a state entity, MA 9 will work to meet ULDC non-structural actions as required.

3. Local Government

No improvements to the American River South and Sacramento River East Levee flood control system are currently proposed by the City or County.

This plan addresses improvements to the SPFC necessary to provide a ULOP. The City identified areas within the 500-year floodplain, located within a watershed with a contributing area of more than 10 square miles and flood depths greater than 3.0 feet. The tributaries within the Sacramento River area that met these criteria were further analyzed and mapped to the 200-year standard. The City will use its data in conjunction with this plan to make findings and impose conditions as required. The County has also mapped its ULOP applicability area and will determine ULOP applicability in the area on a project by project basis using its data with this plan.

3(f) South Sacramento Streams

i. Area Protected

The South Sacramento Streams protected area is the 200-year floodplain generally west of State Route 99 and south of Florin Road, where it overlaps the southwestern portion of the American River floodplain and the southern portion of the Sacramento River floodplain within the project area and described earlier in this document. Creeks in the South Sacramento Streams Group, from north to south, are Florin Creek, Elder Creek, and Unionhouse Creek. These creeks flow into Morrison Creek (Florin Creek joins Elder Creek first), which drains to Beach Lake. The Morrison Creek watershed spans approximately 125 square miles on the Sacramento Valley floor and lower Sierra Nevada foothills, including the central Sacramento County area between U.S. Highway 50 and the Cosumnes River. The area protected is mostly within the City, including the Pocket and Meadowview areas, and also includes adjoining parts of unincorporated County in the Parkway and Florin areas. South and west of the Cosumnes River Boulevard extension, the Beach Lake North Levee confines Morrison Creek. This levee is described in the American River South and Sacramento River East Levee section earlier in this document.

Stream channels and levee features in this area are maintained by the political jurisdiction in which they fall, either the City or County. Levee modernization needs and plans are described separately in Section 4.

ii. Status of Levees Relative to State Standards

A history of flooding in the South Sacramento Streams Group floodplain led the state and local agencies to request federal assistance with flood improvements in the mid-1990s. A USACE feasibility study recommended the construction of new floodwalls and levees, raising existing levees, installing cutoff walls, and retrofitting bridges to provide at least a 100-year level of flood protection in the area. That work, with some state and local enhancements, is now largely complete. The final improvements are planned for the next two years and consist of increasing the flood capacity of Florin Creek downstream of State Route 99 and building an off-stream detention basin at Florin Creek Park. Upon completion of these improvements, the 100-year flows within these local streams will be contained within the channel. Since flood depths in much of this area are below 3 feet, much of the area will meet the ULOP by achieving 100-year rather than 200-year protection (DWR, 2013). Additional evaluations and non-structural actions may be necessary to meet ULDC.

iii. Planned Improvements

1. Federally-Led Projects

South Sacramento County Streams Project – USACE has been the lead agency on this project, which consists of improvements to levees and channels along Morrison Creek and its tributaries in South Sacramento, including Florin Creek, Elder Creek, and Unionhouse Creek. Most of this work is now complete, although the USACE is finishing channel capacity improvements on Florin Creek upstream as far as State Route 99. The South Sacramento County Streams Project

goal is to achieve at least 100-year flood protection. The 200-yr flood risk will be analyzed as part of the land use decisions in the area as appropriate under ULOP.

2. State/SAFCA Led Projects

Florin Creek Multi-Use Basin Project – In moderate and larger flood events, the Florin Creek Multi-Use Basin Project will store up to 32 acre-feet of Florin Creek flows at Florin Creek Park on the north bank of Florin Creek (ESA, 2014). It will provide at least 100-year flood protection within its floodplain in conjunction with the Florin Creek capacity improvements being constructed by USACE as part of the South Sacramento County Streams Project. Although the basin project may assist in achieving ULOP for this area, especially in areas where flooding is less than three feet deep in the 200-year event, it is not intended to provide 200-year protection; and future development in the largely built-out floodplain may depend on findings requiring conditions of the development to achieve ULOP.

Non-Structural Actions, described earlier under the discussion of the Natomas area planned improvements in Section 3(a), will be implemented by SAFCA and its partners, including the City and County, over time as needed to meet long-term ULDC objectives.

3. Local Government

No improvements to the South Sacramento Streams Group flood control system are currently proposed by the City or County.

The City identified areas within the 500-year floodplain, located within a watershed with a contributing area of more than 10 square miles, and flood depths greater than 3.0 feet that do not have 200-year planned improvements within the South Sacramento Streams Group area. The areas that met these criteria were further analyzed and mapped to the 200-year standard. These areas included Morrison Creek, Unionhouse Creek, Florin Creek (with planned improvements), Elder Creek, and Laguna Creek. Upon application for land-use decisions, the City's maps will be utilized in conjunction with this plan to impose conditions as necessary. Any of these creeks that have watersheds less than 10 square miles or less than 3 feet of flooding will be excluded from imposing conditions under ULOP but still must comply with the City's floodplain management ordinance. The County has also mapped its ULOP applicability area and will determine ULOP applicability in the area on a project by project basis using its mapping data with this plan.

4. LEVEE MODERNIZATION

Whereas the ULOP Criteria are oriented towards findings that a 200-year flood event can be contained by the levee system, the ULDC includes levee criteria that are not necessarily uniformly quantifiable in terms of their effect on floodway capacity or levee reliability. Instead, some criteria promote practices that will help maintain the desired level of protection over time. These include criteria to:

- Maintain adequate access and visibility
- Assess and manage encroachments

- Assess and manage penetrations
- Manage levee vegetation
- Provide levee security

Although these topics are not explicitly required to be addressed in the ULOP adequate progress report or annual updates, the ULDC document is incorporated by reference in the ULOP Criteria. Therefore, these practices are described here to the extent appropriate for a planning document for use by land use agencies.

Property Rights or Restrictions

The ULDC requires property rights or restrictions within 20' of the landside levee toe to provide access except where the rights have not yet been acquired and major challenges to acquisition are present, in which case a minimum 10'-wide clear zone for access <u>or</u> a 20' visibility zone are acceptable in developed areas. The following elements are proposed in the plan area.

1. The land use agency, possibly in concert with the Levee Maintaining Agency or local flood management agency, if different, will survey and monument landside property line and/or easement boundaries. Where access is adequate, no further action will be required.
2. In areas where property rights do not encompass a minimum 10'-wide clear zone or a 20' visibility zone at the landside levee toe:
    a. The land use agency with assistance from SAFCA will establish a timeline to acquire needed access rights or visibility. This timeline will seek to acquire access or visibility rights to at least 25% of the remaining parcels or linear footage of property each decade until all necessary rights are acquired. All necessary property rights should be acquired within 40 years from the publication of this plan. Preliminary estimates are that there are approximately 10-11 miles of levee in the region along which access or visibility rights will need to be obtained over the 40-year period.
    b. Private property acquisitions should be on a voluntary, willing-seller basis for at least the first decade or as long as willing sellers are available.
    c. In lieu of acquisitions, the land use agency may implement zoning restrictions or other means of enforcing 20' of visibility at the toe of a levee for commercial and government properties, which will count as progress towards the 25%/decade goal.
    d. Property rights acquisition may be waived at such time as an alternative technology can be deployed that allows inspection objectives to be met in a manner that is satisfactory to the state and/or maintaining agencies. This may include a narrower patrol road or remote sensing.
    e. At such time as it becomes apparent that the combination of willing-seller acquisitions, commercial and governmental zoning codes, and technology will not be able to achieve the 25%/decade goal, the land use agencies will implement additional measures to achieve the goal. These measures may include adopting ordinances to require transfer of the access or visibility rights at the time of sale of affected properties. Eminent domain acquisitions will be a last resort.

f. The land use agencies will consider acquiring additional right of way or imposing development or excavation restrictions for long-term flood protection as desired and available.

Encroachments

Where constructed features encroach on public flood control structures, those encroachments need to be managed to meet ULDC. The following elements are proposed to manage encroachments over the plan life.

1. Outside Natomas, SAFCA's Levee Accreditation Program (LAP) is SAFCA's plan to address high-hazard encroachments. SAFCA will work with the LMAs to remove or remediate high-hazard encroachments posing an immediate threat to levees prior to accrediting levees, whereas high-hazard encroachments that obstruct operations and maintenance will be removed or remediated within three years following accreditation. Permits, including CVFPB encroachment permits, for LAP implementation will be obtained in four sets: those for the Sacramento River, those for North Sacramento Streams, those for the American River, and those for the Beach Lake levee. Encroachments have been addressed on the locally-implemented NLIP segments, and they will be addressed by USACE in partnership with CVFPB on the federally-led NLIP segments.
2. The land use agencies' encroachment remediation plan for low-hazard encroachments is that LMAs should use the California Code of Regulations Title 23 Article 8 to determine whether encroachments are acceptable (do not pose a threat to the levee) or unacceptable (may pose a threat). Acceptable, permitted encroachments will be allowed to remain.
3. For acceptable, unpermitted encroachments the LMA should request that the affected landowner obtain a proper permit.
4. For unacceptable, permitted encroachments the LMA should report on the encroachment to the CVFPB and request that it revoke the permit.
5. Unacceptable, unpermitted encroachments within public lands or easement areas should be removed by the land or easement owner or operator (e.g. the LMA) or by the owner of the encroachment in coordination with the land or easement owner or operator.
6. For unacceptable, unpermitted encroachments within the access/visibility zone but on private property with no easement the LMA should report on the encroachment to the local land use agency for removal. Removal can be enforced through the exercise of property rights as they are acquired, and unacceptable improvements may be used as a criterion for accelerating the acquisition of rights on select parcels.

Penetrations

Penetrations are typically pipes, roads, or other utility features that penetrate the levee and foundation cross-section. They must be managed under the ULDC to ensure they do not create a preferential seepage path or conveyance for floodwater. The following are elements of this plan.

1. SAFCA will work with the LMAs to remediate or remove high-hazard penetrations identified through the LAP. High-hazard penetrations posing an immediate threat to

levees will be removed or remediated prior to accrediting levees, whereas high-hazard penetrations that obstruct operations and maintenance will be removed or remediated within three years of the accreditation. Acceptable, permitted penetrations will be allowed to remain.

2. Acceptable, unpermitted penetrations should be addressed by the LMA by requesting the improvement owner to obtain a CVFPB permit.
3. Unacceptable, permitted penetrations serving a public purpose will be referred to the LMA and CVFPB to work with the owner to bring them into compliance with Title 23.
4. Unacceptable, unpermitted penetrations will be referred to the LMA and CVFPB to work with the owner to remove them or bring them into compliance with Title 23, including obtaining the necessary permit.

Vegetation

The ULDC document expresses DWR's commitment to flood risk reduction solutions that integrate environmental stewardship. Vegetation on levees may affect visibility or access, or in the case of a toppled tree, threaten the levee prism. Vegetation also may reduce erosion and provide environmental benefits. The following vegetation management elements are included in this plan.

1. Under the LAP, SAFCA and the LMAs will work together to meet ULDC for vegetation on or near the levee. SAFCA has identified high-hazard trees through its LAP, and will remove those trees as part of the levee accreditation process. Additional, non-high-hazard trees may be removed during construction of other levee improvements such as cutoff walls as part of the LAP.
2. Under the LAP, SAFCA and the LMAs will remove shrubs and herbaceous ground covers that prevent routine inspection of levee slopes, trim tree branches to 8-10 feet above ground level, prune tree canopies if needed to balance asymmetrical trees, and top some trees to reduce windthrow.
3. Upon completion of the LAP, affected levees will achieve ULDC and ULOP vegetation management standards. Ongoing maintenance of vegetation to these standards will be the responsibility of the LMAs and will be conducted in accordance with State standards applicable to SPFC facilities.
4. The purpose of this plan is to meet ULDC and ULOP standards. If LMAs choose to pursue greater vegetation removal for a USACE or other standard, it is not a part of this plan or SAFCA's funding mechanism.

Miscellaneous Levee Modernization Actions

The ULDC document also requires a variety of miscellaneous levee modernization actions that the land use agencies will support through this plan as follows.

1. Erosion that has the potential to intersect the levee prism should be addressed by LMAs through regular erosion surveys and repair based on the severity of the erosion and inclusion in either the SRBPP or ARCF GRR.

2. Animal burrows should be addressed by LMAs pursuant to accepted practices for the levees and environment in which they are found, and measures may include rodent control and backfilling or grouting of burrows.
3. Security plans should be prepared and implemented by LMAs and land use agencies to protect flood control systems from acts of terrorism and other malicious acts.
4. System design should accommodate sea level rise or climatic changes in hydrology during the period for which any levee findings are in effect, which may be up to 20 years. Sea level rise may influence stage in the Sacramento River at Freeport by up to 0.06" in the next 20-year period (Tustison, 2015), which will not materially affect system function.
5. LMAs and land use agencies should implement emergency actions such as flood-fighting, closure of closure structures, and operation of flood relief structures as needed during flood events.
6. LMAs and land use agencies should prepare, maintain and implement flood safety plans to protect their residents.

Levee modernization throughout the region will emphasize resolving high-hazard issues first.

5. FUNDING CAPABILITY

SAFCA has prepared an Engineer's Report for its Consolidated Capital Assessment District No. 2 (CCAD 2) (WSP Parsons Brinckerhoff, 2016). As part of the analysis for the formation of the district, SAFCA has prepared a cash flow analysis that appears in Table 1. More detail on the financing is available in the CCAD 2 Engineer's Report if desired for further reference. Table 1 provides SAFCA's funding plan, including identifying the schedule and cost of the completed flood protection system for Sacramento. Annual reports will be made to the CVFPB regarding the efforts in working toward completion of the identified system as required by CGC) Section 65007(a)(5).

The CGC Section 65007(a)(2)(A) specifies that adequate progress depends on appropriation and expenditure of 90% of the revenues shown in each year of the schedule. However, a large portion (about 85%) of the revenues planned for SAFCA projects is issued by State and Federal agencies over which SAFCA has no control. Therefore, SAFCA may amend this report at the time of the annual report preparation each year based on outside funding appropriation. Provided that any amended funding projections still show that the ULOP improvements to a given levee system will be completed by 2025, the amended report may still be relied upon for a finding of adequate progress.

Table 1: CCAD 2 Cash Flow

(in millions of dollars)

Project	Agency	2006-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26
Folsom Dam Mod Modifications	Fed	$460.2	$58.2	$51.1	$21.3	$21.3	$21.3	$21.3	$21.3	$0.0	$0.0	$0.0	$0.0
	State	$167.4	$21.1	$19.9	$9.2	$9.2	$9.2	$9.2	$9.2	$0.0	$0.0	$0.0	$0.0
	SAFCA	$68.8	$9.0	$12.2	$3.9	$3.9	$3.9	$3.9	$3.9	$0.0	$0.0	$0.0	$0.0
	Total	**$696.4**	**$88.3**	**$83.2**	**$34.4**	**$34.4**	**$34.4**	**$34.4**	**$34.4**	**$0.0**	**$0.0**	**$0.0**	**$0.0**
Folsom Bridge	Fed	$66.8	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
	State	$7.5	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
	SAFCA	$3.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
	Local (City of Folsom)	$44.5	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
	Total	**$122.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**
American River Levee Improvements	Fed	$173.9	$28.0	$0.0	$0.0	$0.0	$0.0	$0.0	$13.3	$13.3	$13.3	$13.3	$13.3
	State	$40.6	$6.7	$0.0	$0.0	$0.0	$0.0	$0.0	$7.3	$7.3	$7.3	$7.3	$7.3
	SAFCA	$17.4	$2.9	$0.0	$0.0	$0.0	$0.0	$0.0	$3.1	$3.1	$3.1	$3.1	$3.1
	Total	**$231.9**	**$37.5**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$23.8**	**$23.8**	**$23.8**	**$23.8**	**$23.8**
Sacramento River Levee Improvements	Fed	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$10.7	$10.7	$10.7	$10.7	$10.7
	State	$0.0	$0.0	$21.0	$21.0	$21.0	$6.3	$5.5	$12.9	$5.9	$5.9	$5.9	$5.9
	SAFCA	$9.9	$1.9	$3.0	$5.0	$10.7	$1.0	$1.1	$8.1	$2.5	$2.5	$2.5	$2.5
	Total	**$9.9**	**$1.9**	**$24.0**	**$26.0**	**$31.7**	**$7.3**	**$6.6**	**$31.7**	**$19.0**	**$19.0**	**$19.0**	**$19.0**
Natomas Levees	Fed	$4.0	$5.1	$11.0	$21.2	$54.9	$54.9	$54.9	$54.9	$54.9	$54.9	$54.9	$0.0
	State	$242.7	$12.5	$11.0	$25.4	$12.6	$12.6	$12.6	$12.6	$12.6	$12.6	$0.0	$0.0
	SAFCA	$152.1	($1.2)	($5.4)	($6.7)	$5.3	$5.3	$5.3	$5.3	$5.3	$5.3	$0.0	$0.0
	Total	**$398.7**	**$16.4**	**$16.6**	**$39.9**	**$72.7**	**$72.7**	**$72.7**	**$72.7**	**$72.7**	**$72.8**	**$54.9**	**$0.0**
South Sacramento Streams Group	Fed	$66.0	$16.5	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
	State	$23.8	$6.2	$2.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
	Local (City of Sac)	$2.0	$0.3	$0.7	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
	SAFCA	$4.8	$3.1	$0.6	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
	Total	**$96.5**	**$26.1**	**$3.3**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**
North Sacramento Streams	Fed	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$10.0	$0.0	$0.0	$0.0	$0.0	$0.0
	State	$0.0	$0.0	$10.2	$10.0	$7.5	$7.0	$0.5	$0.0	$0.0	$0.0	$0.0	$0.0
	SAFCA	$5.9	$1.3	$3.7	$0.0	$2.5	$3.0	$0.2	$0.0	$0.0	$0.0	$0.0	$0.0
	Total	**$5.9**	**$1.3**	**$13.9**	**$10.0**	**$10.0**	**$10.0**	**$10.7**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**
Environmental Enhancements	Fed	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$5.0	$5.0	$5.0	$5.0
	State	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$2.5	$2.5	$2.5	$2.5
	SAFCA	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$2.5	$2.5	$2.5	$2.5
	Total	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$10.0**	**$10.0**	**$10.0**	**$10.0**
Total Capital Projects	Fed	$770.9	$107.9	$62.1	$42.4	$76.2	$76.2	$86.2	$100.2	$83.9	$83.9	$83.9	$29.0
	State	$482.0	$46.5	$64.1	$65.6	$50.3	$35.1	$27.8	$42.0	$28.3	$28.3	$15.7	$15.7
	Local	$46.5	$0.3	$0.7	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
	SAFCA	$262.0	$16.9	$14.1	$2.3	$22.4	$13.2	$10.5	$20.5	$13.4	$13.4	$8.2	$8.2
	Total	**$1,561.4**	**$171.6**	**$141.0**	**$110.3**	**$148.9**	**$124.5**	**$124.5**	**$162.6**	**$125.6**	**$125.6**	**$107.8**	**$52.9**
		2006-15	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22**	**2022-23**	**2023-24**	**2024-25**	**2025-26**
Levee Modernization	SAFCA	**$0.0**	$0.0	$0.0	$1.0	$1.0	$1.0	$1.0	$1.0	$1.0	$1.0	$1.0	$1.0
System O&M	SAFCA	$20.0	$2.5	$2.5	$4.1	$4.1	$4.1	$4.1	$4.1	$4.6	$4.6	$4.6	$4.6
SAFCA Funding	2007 Bond	*$56.5*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*
	2008 Bond	*$80.3*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*
	2012 Bond	*$37.7*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*
	2014 Bond NBLAD	*$39.2*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*
	2015 Bond	*$0.0*	$17.2	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*
	2017 Bond	*$0.0*	*$0.0*	*$0.0*	*$64.4*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*	*$0.0*
	Bond Sub-Total	***$213.69***	***$17.2***	***$0.0***	***$64.4***	***$0.0***	***$0.0***	***$0.0***	***$0.0***	***$0.0***	***$0.0***	***$0.0***	***$0.0***
	NALP Reimburses	$26.9	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
	AR/SSG	$1.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
	Net Revenue	$57.0	$3.9	$3.7	$9.1	$9.2	$9.3	$9.4	$9.5	$9.6	$9.7	$9.8	$9.9
	Interest/Taxable Sales	$1.5	$0.1	$0.1	$0.1	$0.5	$0.4	$0.3	$0.3	$0.2	$0.2	$0.1	$0.1
	DIF	$4.0	$0.0	$0.0	$1.0	$1.0	$1.0	$1.0	$1.0	$1.0	$1.0	$1.0	$0.0
	Total	**$304.2**	**$21.2**	**$3.8**	**$74.6**	**$10.7**	**$10.7**	**$10.7**	**$10.8**	**$10.8**	**$10.9**	**$10.9**	**$10.0**
	End Bal.	**$22.1**	**$24.0**	**$11.2**	**$78.4**	**$61.6**	**$54.0**	**$49.2**	**$34.4**	**$26.2**	**$18.1**	**$15.3**	**$11.6**
Assessment Revenues & Bond Debt Service	CCAD	$144.7	$18.1	$18.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
	NBLAD	$5.4	$2.7	$2.7	$2.7	$2.7	$2.7	$2.7	$2.7	$2.7	$2.7	$2.7	$2.7
	CCAD 2	$0.0	$0.0	$0.0	$25.9	$26.0	$26.1	$26.2	$26.3	$26.4	$26.5	$26.6	$26.7
	2007 Bond	($42.36)	($5.59)	($5.58)	($4.29)	($4.29)	($4.29)	($4.29)	($4.29)	($4.29)	($4.29)	($4.29)	($4.29)
	2008 Bond	($36.96)	($5.82)	($5.82)	($4.87)	($4.87)	($4.87)	($4.87)	($4.87)	($4.87)	($4.87)	($4.87)	($4.87)
	2012 Bond	($6.18)	($2.67)	($2.67)	($2.23)	($2.23)	($2.23)	($2.23)	($2.23)	($2.23)	($2.23)	($2.23)	($2.23)
	2014 Bond NBLAD	($0.53)	($2.30)	($2.30)	($2.30)	($2.30)	($2.30)	($2.30)	($2.30)	($2.30)	($2.30)	($2.30)	($2.30)
	2015 Bond	$0.00	$0.00	($0.85)	($1.09)	($1.09)	($1.09)	($1.09)	($1.09)	($1.09)	($1.09)	($1.09)	($1.09)
	2017 NBLAD Coverage	$0.00	$0.00	$0.00	($0.40)	($0.40)	($0.40)	($0.40)	($0.40)	($0.40)	($0.40)	($0.40)	($0.40)
	2017 Bond	$0.00	$0.00	$0.00	($4.32)	($4.32)	($4.32)	($4.32)	($4.32)	($4.32)	($4.32)	($4.32)	($4.32)
	Bond Reserve	($7.0)	($0.5)	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
	Net Revenue	**$57.0**	**$3.9**	**$3.7**	**$9.1**	**$9.2**	**$9.3**	**$9.4**	**$9.5**	**$9.6**	**$9.7**	**$9.8**	**$9.9**

Notes:

Assessments assume growth in Natomas and Delta Shores based on 20-year build out under existing City and County General Plans (Greenbrier, Sutter Pointe, and Joint Vision area excluded)

CCAD 2007, 2008, 2012 and 2015 bonds refinanced and 2017 CCAD 2 bond issued.

Table Source: WSP Parsons Brinckerhoff, 2016

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6. TIMELINE FOR 200-YEAR PROGRAM

The Urban Level of Flood Protection must be achieved by the year 2025 in order for land use agencies, in approving new development, to make a finding that adequate progress is being made on the construction of a flood protection system (CGC §65865.5, §65962, and §66474.5). All regional flood control improvements necessary to achieve this level of protection within the covered areas will be complete by 2025, as shown in Table 2.

Table 2: Timeline for Projects

Project	Levee System						
	Natomas	**Dry Creek**	**Robla Creek – Arcade Creek**	**American River North Levee**	**American River South and Sacramento River East Levee**	**South Sacramento Streams**	**Complete by**
Folsom Dam Modifications	Required for ULOP	Required for ULOP	Required for ULOP	Required for ULOP	Required for ULOP	Required for ULOP	2025
NLIP USACE Project	Required for ULOP	Not required	Not required	Not required	Not required	Not required	2025
NLIP Local Project	Required for ULOP	Not required	Not required	Not required	Not required	Not required	2016
ARCF GRR	Provides resiliency	Not required	Provides resiliency	Provides resiliency	Provides resiliency	Provides resiliency	2040
SRBPP	As needed	As needed	As needed	As needed	As needed	As needed	As needed
LAP	Not required	Not required	Required for ULOP	Required for ULOP	Required for ULOP	Required for ULOP	2023
SSSG	Not required	Not required	Not required	Not required	Not required	Site specific*	2017
Florin Basin	Not required	Not required	Not required	Not required	Not required	Site specific*	2017
Non-structural Actions	Required for ULDC	Required for ULDC	Required for ULDC	Required for ULDC	Required for ULDC	Required for ULDC	Varies
Local Government Projects	None identified	None identified	None identified	None identified	None identified	None identified	N/A
Levee Modernization	ULDC requires within 40 years	ULDC requires within 40 years	ULDC requires within 40 years	ULDC requires within 40 years	ULDC requires within 40 years	ULDC requires within 40 years	2055
*This plan provides 100- to 200-year flood protection in the South Sacramento Streams area. Conditions may be required for some projects in that area to achieve ULOP. Depending on the location and flood parameters at a specific development site, the levee system improvements in this table may aid the site in achieving ULOP without conditions or with a reduced set of conditions.							

7. USE OF THIS DOCUMENT

This document is intended to demonstrate SAFCA's plan to achieve ULOP requirements for SPFC facilities within the City and County by 2025 in compliance with SB-5 and related legislation. This plan can be referenced by covered land use agencies in making findings related to approval of development projects that rely on reasonable progress towards ULOP. Those findings, as summarized below, include:

- Findings Based on Existing Flood Management Facilities
- Adequate Progress Findings
- Imposed Conditions Findings

This document does not address land use decisions such as whether any given property within the plan area is in an "urban area" or "urbanizing area" as defined by CGC 65007(l) and (m), respectively, and thus subject to the requirement for ULOP findings. This is a decision for the land use agency. In addition, this plan only addresses SPFC facilities. The local land use agencies, acting as floodplain managers, must consider this plan with their own data to determine whether interior drainage and sources not contained by SPFC facilities affect development projects to a degree that the projects would be subject to flood protection findings under state law. Figure 5 shows areas where SAFCA projects will improve the SPFC and affect the potential flood findings, subject to the local agency data review.

7(a) Findings Based on Existing Flood Management Facilities

The SPFC facilities protecting the region have been shown to have deficiencies that may affect their ability to provide 200-year flood protection. Therefore, it is expected that a finding that ULOP is provided "based on flood management facilities providing the required level of flood protection," will be little used at least for the early years of this plan. An existing flood management facilities finding for urban development would rely on:

1. A report by a professional civil engineer (PE) documenting the data and analysis for demonstrating the property, development project, or subdivision will meet ULOP Criteria when the system is complete
2. A report by an independent panel of experts (IPE) reviewing the PE report.
3. A response by the PE to the IPE report.
4. Any additional data and information used to make the finding.

The first three of the above items are being prepared for SAFCA separately from this report. This plan is not a necessary part of the substantial evidence in the record needed to justify a finding based on existing flood management facilities. In later years of this plan, upon completion of projects identified herein, local land use agencies may be able to make existing flood management facilities findings for urban development in areas newly protected by these flood projects.

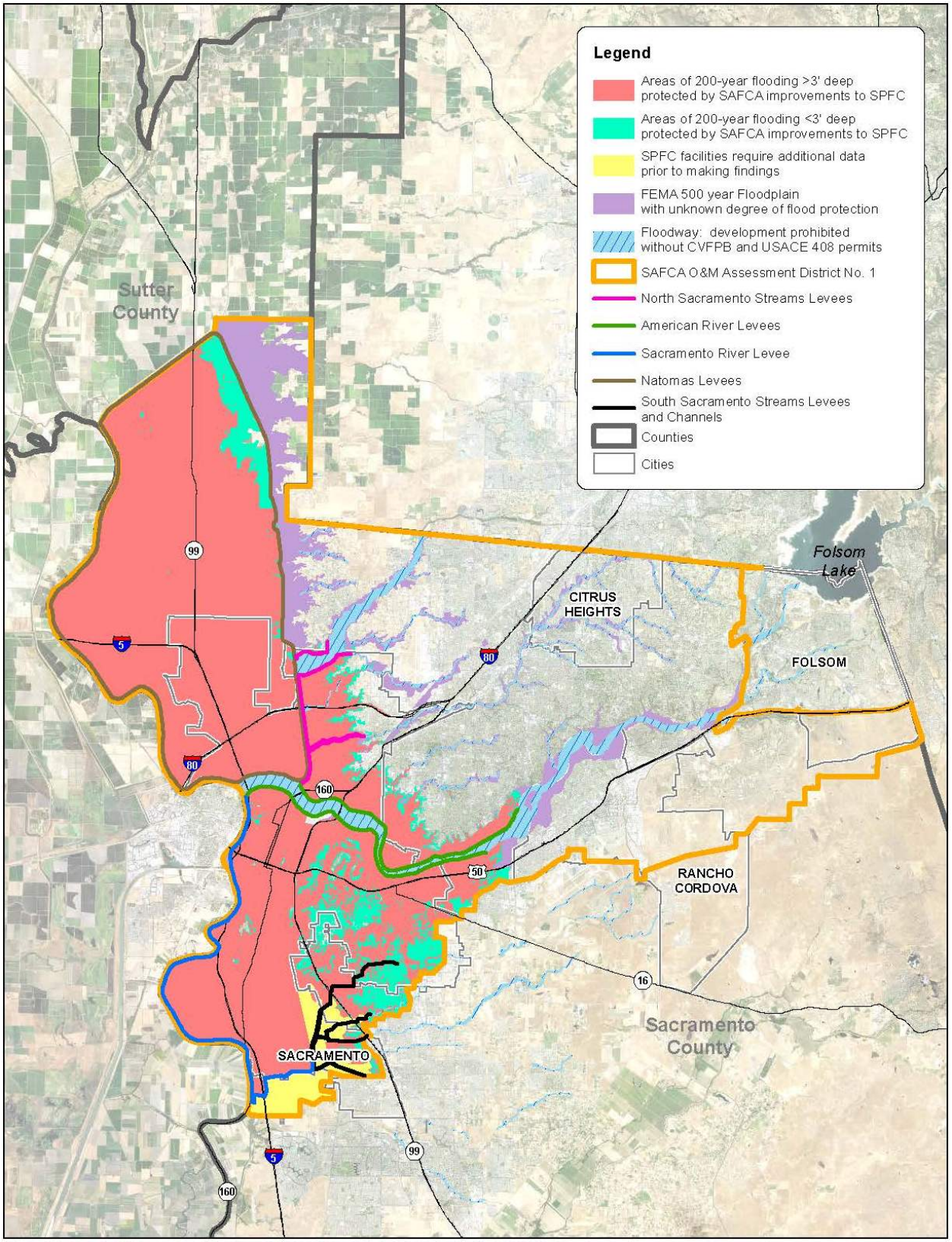

Figure 5: Areas of Flooding Affected by SPFC Improvements in SAFCA Work Area

7(b) Adequate Progress Findings

In most cases, due to levee deficiencies identified by MBK (2016) and summarized in this report, land use agencies in the region will need to make urban development findings relying on adequate progress on the construction of a flood protection system. These will require the following in addition to items 1-4 above:

5. A report by the local flood management agency demonstrating adequate progress as defined in CGC §65007(a).
6. The most recent annual adequate progress report prepared by the local flood management agency and submitted to the CVFPB.

This plan serves as item 5 above, and as item 6 until the first annual report is prepared in 2017.

7(c) Imposed Conditions Findings

Local land use agencies have the flexibility to approve development at any time based on conditions imposed on that new development to provide ULOP. It is assumed that these approvals may be in areas for which non-system facilities, improvements, or conditions may allow development earlier than would otherwise be possible. An "imposed conditions" finding requires information on the conditions that the jurisdiction will impose on the development, as well as a report by a PE documenting the data and analyses demonstrating that the conditions will provide ULOP for the development. Finally, evidence for such a finding must include a written statement that the developer, subdivider, permittee, or their agent must satisfy the conditions prior to final inspection or issuance of a Certificate of Occupancy for any building to which the conditions apply. A finding based on imposed conditions does not require an IPE report or rely on this plan.

7(d) Effective Period for Findings

Once findings have been made, in some cases the findings can be used for subsequent land use approvals until the findings expire or are superseded, as described in the ULOP Criteria. Expiration factors are summarized below.

- Findings Based on Existing Flood Management Facilities
  - The initial finding lasts for no more than 20 years.
  - If the initial finding is more than five years old, it can be used only if a periodic review has been done in the last five years that shows that ULOP is achieved or that a remediation plan will achieve ULOP in less than five years.
- Adequate Progress Findings
  - The initial finding lasts for no more than 10 years, and in no case after 2025
  - To rely on the initial finding, the most recent annual report must demonstrate adequate progress.
- Imposed Conditions Findings
  - A finding based on imposed conditions cannot be used to support other findings.

7(e) Annual Adequate Progress Report

SAFCA will prepare the annual progress reports required by CGC §65007(a)(5). SAFCA proposes to complete the first annual report by August 15, 2017 for the fiscal year July 1, 2016 – June 30, 2017 and then annually thereafter until the affected projects are complete or as long as the requirement applies. As noted in Section 5, amendments to this plan may be appropriate if the review shows that the availability of funding from federal or state partners has changed.

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CERTIFICATION

This certification is provided to the Sacramento Area Flood Control Agency (SAFCA), the City of Sacramento, the County of Sacramento, and the County of Sutter for the sole purpose of supporting an Adequate Progress Finding (APF). This certification is made in accordance with the requirements, definitions, and descriptions in the State of California Department of Water Resources' (DWR) *Urban Level of Flood Protection Criteria* (November 2013), Section 2, Subsection *EVD-3* and *Urban Levee Design Criteria* (ULDC) (May 2012), Section 7.0 *Urban Levee Design Criteria*.

All information, calculations, definitions, descriptions, restrictions, limitations, or other pertinent data contained or referenced in this document form the basis of this certification. This certification does not constitute a warranty or guarantee of performance, expressed or implied.
This certification is made with respect to the following levee systems, as described in the *Sacramento Area Flood Control Agency, Adequate Progress Towards an Urban Level of Flood Protection Engineer's Report* (Engineer's Report):

- Natomas Levee System comprised of Natomas Cross Canal south levee; Sacramento River east levee, Natomas Cross Canal to Powerline Road; Sacramento River east levee, Powerline Road to American River; American River north levee; Natomas East Main Drainage Canal west levee; and Pleasant Grove Creek Canal west levee.

- Dry Creek Levee System comprised of the Dry Creek north levee.

- Robla-Arcade Levee System comprised of Robla Creek south levee; Natomas East Main Drainage Canal east levee from Robla (Dry) Creek to Arcade Creek; and Arcade Creek north levee.

- American River North Levee System comprised of Arcade Creek south levee; Natomas East Main Drainage Canal east levee from Arcade Creek to American River; and American River north levee from NEMDC east levee to Arden Way (at William B. Pond Recreation Area).

- American River South and Sacramento River East Levee System comprised of American River south levee; from Sacramento River to Mayhew Drain; Sacramento River east levee from American River to Beach Lake north levee; and Beach Lake north levee from Sacramento River to UPRR.

- South Sacramento Streams Levee System comprised of the Morrison Creek right and left bank levees and floodwalls, Florin Creek right and left bank levees and floodwalls, Elder Creek right and left bank levees and floodwalls, and Unionhouse right bank levee and floodwall.

Limits and Conditions of this Certification

This certification shall expire or become invalid at the earliest time any of the following conditions are met for any particular levee system:

- A certification of an urban level of flood protection for the facilities.
- Integrity of the levee systems have degraded to the point that the identified improvements will not be adequate to provide an urban level of flood protection, as determined by me, or a duly qualified designated successor.
- Discovery of any substantive defect in the condition of any component of the levee systems that was not known at the time this certification was made, and which materially affects the systems' ability to provide protection relative to the 0.5 percent annual flood, as determined by me, or a duly qualified designated successor.

Certification Statement

At the request of SAFCA, as supported by the information contained and referenced within this report, this is to certify the following:

- *Certification of Data and Information* – The data and information presented in this report are accurate to the best of my knowledge.
- *Certification of Analysis* – To the best of my knowledge, the analyses conducted were performed in accordance with DWR's ULDC and/or sound engineering practices, in a manner consistent with the degree of skill and care ordinarily exercised by members of the civil engineering profession currently practicing in the same locality under similar conditions.

I, Richard Reinhardt, PE, a professional registered civil engineer in the State of California, certify that the aforementioned levee systems, as described in the *Sacramento Area Flood Control Agency, Adequate Progress Towards an Urban Level of Flood Protection Engineer's Report,* will provide an urban level of flood protection upon completion of the improvements identified in the Engineer's Report.

June 1, 2016
date

SACRAMENTO AREA FLOOD CONTROL AGENCY

ADEQUATE PROGRESS TOWARDS AN URBAN LEVEL OF FLOOD PROTECTION

ENGINEER'S REPORT

JUNE 2016

FINAL

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APPENDICES

Appendix A Review by an Independent Panel of Experts (IPE)

ACRONYMS AND ABBREVIATIONS

ARCF	American River Common Features
cfs/ft	cubic feet per second per foot
CPT	Cone Penetration Test
CVFPB	Central Valley Flood Protection Board
DWR	California Department of Water Resources
DWSE	Design Water Surface Elevation
EC	Engineering Curriculum
EM	Engineering Manual
ETL	Engineering Technical Letter
FEMA	Federal Emergency Management Agency
H:V	horizontal-to-vertical ratio
HTOL	Hydraulic Top of Levee
JFP	Joint Federal Project
LF	linear feet
LM	Levee Mile
LMA	Local Maintaining Agency
MBK	MBK Engineers
MTOL	Minimum Top of Levee
NALP	North Area Local Project
NIMS	National Incident Management System
NLD	National Levee Database
NLIP	Natomas Levee Improvement Project
O&M	operation and maintenance
pcf	pounds per cubic foot
PIR	Problem Identification Report
RD	Reclamation District
RM	River Mile
SB	Senate Bill
SOP	Standard Operating Procedure
SPFC	State Plan of Flood Control
SPK	Sacramento District (USACE)
ULDC	Urban Levee Design Criteria
ULOP	Urban Level of Flood Protection
UPRR	Union Pacific Railroad
USACE	U.S. Army Corps of Engineers
USACE RIP	USACE Rehabilitation and Inspection Program
WSE	water surface elevation

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INTRODUCTION

In 2007, the California Legislature passed Senate Bill (SB) 5, which requires all cities and counties within the Sacramento-San Joaquin Valley to make findings related to an urban level of flood protection for urban and urbanizing lands within a flood hazard zone. The bill defined "urban level of flood protection" as the level of flood protection necessary to withstand flooding that has a 1-in-200 chance of occurring in any given year using criteria consistent with, or developed by, the California Department of Water Resources (DWR). The Urban Level of Flood Protection Criteria (ULOP Criteria) implementation guidance, issued by the State in November 2013, requires that these findings be based on substantial evidence in the record.

The City of Sacramento (City), County of Sacramento and County of Sutter (herein after referred jointly as "County"), intend to make an Adequate Progress Finding (APF) in July 2016 for the levee systems protecting the Sacramento metropolitan area within their jurisdictions. The Sacramento Area Flood Control Agency (SAFCA) has prepared this Engineer's Report to provide substantial evidence that, once the planned improvements have been completed, the structural flood control facilities protecting the urban areas of the City and County from flooding from the Sacramento and American Rivers and their tributaries will be able to withstand flooding from a 1-in-200-year flood event in accordance with the State of California's Urban Levee Design Criteria (ULDC), issued in May 2012.

This Engineer's Report evaluates the structural flood control facilities, and their associated non-structural components (e.g., security plan, encroachment remediation plan) protecting Sacramento's urban areas. As such, this report does not evaluate levees or other flood control facilities south of the town Freeport, or beyond the levee protected floodplain in the urban areas. Additionally, this document does not evaluate protection from the 1-in-100-year flood event for non-urban areas.

In formulating an APF, ULOP Criteria (EVD-3) requires that the substantial evidence include "a report prepared by a Professional Civil Engineer registered in California to document the data and analyses for demonstrating the property, development project, or subdivision will have an urban level of flood protection at the time when the flood protection system is completed." Furthermore, the ULOP Criteria indicates that the Engineer's Report should include the following:

- A list of the flood management facilities, including, but not limited to, State Plan of Flood Control (SPFC) facilities;
- The location of the flood management facilities;
- The entities that operate and maintain the flood management facilities; and
- A list of, and consideration of, reports, evaluations, inspections, and performance history of the flood management facilities.

SAFCA has prepared a separate report, titled SAFCA *Urban Level of Flood Protection Plan and Adequate Progress Baseline Report* (SAFCA, 2016), that demonstrates adequate progress and the identified scope, schedule, and cost of the construction of a flood protection system which will result in flood protection equal to or greater than the urban level of flood protection in urban or urbanizing areas. For urban and urbanizing areas protected by project levees, the urban level of flood protection shall be achieved by 2025.

REPORT PURPOSE AND ORGANIZATION

This report discusses six (6) levee systems (see Plate 1):

1. Natomas Levee System;
2. Dry Creek Levee System;
3. Robla – Arcade Levee System;
4. American River North Levee System;
5. American River South – Sacramento River East Levee System; and
6. South Sacramento Stream Levee System.

The purpose of this report is to present the minimum information listed above, and describe the current status of each levee system's compliance with the ULDC. To this end, for each of the six levee systems discussed, there is a description of the status for compliance with each criterion for each levee within the levee system.

The report is organized by levee system, with each levee system comprising its own chapter. Each chapter includes a description of the flood management facilities in that system, evaluation of those facilities against ULDC, and finally, identification of the planned efforts that will bring the levee system into compliance with ULDC. This report relies on dozens of other documents, reports, analyses, and evaluations which are listed in the references chapter at the end of this report.

REVIEW BY AN INDEPENDENT PANEL OF EXPERTS

The ULOP Criteria (Section 2, Subsection EVD-5), requires a report by an Independent Panel of Experts (IPE) on the review of this Engineer's Report. The IPE's report and SAFCA's responses to the IPE's comments are included in Appendix A of this report.

1.0 NATOMAS LEVEE SYSTEM

DESCRIPTION OF NATOMAS LEVEE SYSTEM

The Natomas Basin is unique among the areas covered by this report, in that it is protected by a ring levee approximately 42 miles in length. Five levees, described below (Plate 2), comprise this system. The levee system is rated as Minimally Acceptable by the U.S. Army Corps of Engineers (USACE) and is Active in the USACE Rehabilitation and Inspection Program (RIP). All of the levees in this system are operated and maintained by Reclamation District (RD) 1000.

NATOMAS CROSS CANAL SOUTH LEVEE

The NCC is a 5.4-mile-long leveed channel that carries water from several tributary watersheds in western Placer County and southern Sutter County to the Sacramento River. The NCC south levee begins at the PGCC west levee and East Side Canal and extends southwest to its confluence with the Sacramento River near the Sankey Road/Garden Highway intersection. Stationing is from 0+00 (Sacramento River) to 287+50 (PGCC west levee at Howsley Road).

Although some portions of this levee were improved following the 1986 Flood, and in the 1990s as part of the NALP, this levee was substantially improved as part of the NLIP from 2007 through 2010. Improvements, from the confluence of the Sacramento River to Howsley Road, included levee degrade and reconstruction for installation of a seepage cutoff wall and a levee raise. As-built drawings and construction completion reports for the NLIP improvements constructed for this levee are contained in the following references: Kleinfelder, 2010b, 2010c, 2011a, 2011b; URS, 2015b. There remains three windows along the levee, up to 500 feet long, where levee improvements were not implemented at locations where two active pumping plants and one highway crossing had to be temporarily avoided. These windows will be addressed as part of the USACE ARCF Project. Since reconstruction as part of the NLIP, this levee has not experienced an extreme event.

Highway 99 crosses the levee near the upstream limit. Most of the land along the south levee consists of privately owned farmland and habitat conservation lands owned and managed by The Natomas Basin Conservancy. A few rural residences and ranch buildings associated with a horse training facility are located at the eastern end of the NCC south levee.

SACRAMENTO RIVER EAST LEVEE - NCC TO POWERLINE ROAD

An approximately 18.5 mile long section of the east levee of the Sacramento River protects the west side of the Natomas Basin between the NCC and the American River. For the purposes of this report, the SREL protecting the Natomas Basin is divided into two segments: NCC to Powerline Road, and Powerline Road to the American River. This distinction is being made because significant improvements to the upstream segment have been accomplished in recent years thus affecting its current condition.

The SREL from the NCC (Station 0+00) to just slightly east (downstream) of Powerline Road (Station 654+50) is approximately 12 miles in length. This section of the levee was originally constructed in the 1800s and was substantially improved in the early and mid-1900s. This levee was substantially improved as part of the NLIP from 2009 through 2012. Improvements included removal of the existing landside stability berm, and construction of a new adjacent levee embankment, seepage berm, and seepage cutoff wall. As-built drawings and construction completion reports for the NLIP improvements constructed for this levee are contained in the following references: Kleinfelder, 2013a, 2013b, 2015; URS, 2015b. Since reconstruction as part of the NLIP this levee has not experienced an extreme event.

Garden Highway remains present along the old levee crown. Along the landside, the levee is bordered mainly by private agricultural lands. Several residences exist along the waterside of the levee. Many fences, gates, and other appurtenances associated with these properties are located on the levee itself.

Sacramento River East Levee - Powerline Road to American River

The SREL from just slightly east (downstream) of Powerline Road (station 654+50) to the American River (Station 956+90) is approximately 6 miles in length. Originally constructed in the 1800s, this levee was substantially improved in the early and mid-1900s, and improved in the 1990s as part of the Sacramento Urban Levee Reconstruction Project, and again improved in the early 2000s as part of the ARCF Project. This reach of the SREL was not improved as part of the NLIP, although it is planned for improvement in the near future as part of the USACE Natomas Project described later in this report.

The levee south of Powerline Road is comprised of a typical levee embankment and relatively shallow cutoff wall; Garden Highway remains present along the levee crown.

The landside of the levee is bordered by private residences, several rural estates, and conservation lands and becomes more densely developed by both residential and commercial structures nearer the downstream end. Numerous residences exist along the waterside of the levee. Many fences, gates, and other appurtenances associated with these properties are located on the embankment, although most are located outside of the levee prism.

Past performance issues include erosion, which has been largely mitigated through waterside bank protection placed over time, overtopping potential, through levee seepage, and instability which is now largely mitigated through cutoff walls. Significant seepage and instability occurred during the 1986 and 1997 flood events. River bank erosion, caused by frequent boat wake, is common.

American River North Levee

The portion of the American River north levee comprising the Natomas Levee System extends for about 2.2 miles from its connection with the SREL at the mouth of the American River (Station 0+00) to its connection with the NEMDC west levee (Station 115+63). Originally constructed in the 1800s, before the construction of Folsom Dam (early 1950s), this levee is set back over 1,000 feet north of the American River main channel. The levee was subject to repeated improvement efforts in the early and mid-1900s and again in the 1990s as part of a local project by SAFCA and RD 1000. This levee was not improved as part of the NLIP, although it is planned for improvement in the near future as part of the USACE Natomas Project described later in this report.

The American River north levee is comprised of a typical levee embankment. A seepage blanket and drain system are present for a portion of the levee. The Garden Highway runs along the levee crown for most of the levee and ranges from two to four lanes. Landside of the levee is dense urbanization.

Past performance issues include erosion, which is now largely mitigated through waterside bank protection placed over time, overtopping potential, and through levee seepage. Significant seepage occurred during the 1986 and 1997 flood events.

Natomas East Main Drainage Canal West Levee

The NEMDC west levee extends approximately 12.8 miles from high ground near Sankey Road (Station 675+00) to the American River north levee at Northgate Boulevard (Station 0+00) and, along with the PGCC west levee, comprises the easterly boundary of the Natomas Basin. Originally constructed in the 1800s, this levee was subject to repeated improvement efforts in the early and mid-1900s. Additional improvements were made in the 1990s as part of the NALP including a levee raise, floodwall, chimney drain and cutoff trench. This levee was not improved as part of the NLIP, although it is planned for improvement in the near future as part of the USACE Natomas Project described later in this report.

The NEMDC west levee is contiguous with the PGCC west levee; however, flows in this portion of the channel generally travel south to the American River and therefore, the NEMDC west levee is a right bank levee, unlike the PGCC west levee where flows travel north, thus forming a left bank levee.

A stormwater pumping station connects the lower portion of the NEMDC west levee and the Dry Creek north levee. An associated embankment across the canal prevents elevated flood waters in Dry Creek and the southern reach of the NEMDC from entering the northern reach of the NEMDC. The pumping facility collects local runoff from tributaries east of the Natomas Basin, and from spills (PGCC floodwaters) over the high ground near Sankey Road, and discharges this stormwater into the southern reach of the NEMDC. A gated low-level culvert bypasses lower flows through the station when Dry Creek backwater is low.

From the American River to Interstate 80, the landside of the levee is comprised of dense urbanization. North of Interstate 80 to Dry Creek, there is commercial development on the landside of the levee. North from Dry Creek, landside use is primarily agricultural and rural residences.

Past performance issues are primarily related to seepage, with minor areas of bank erosion.

Pleasant Grove Creek Canal West Levee

The PGCC west levee extends approximately 3.3 miles from the upstream limit of the NCC south levee (Station 287+50) to the north end of the NEMDC levee near Sankey Road (Station 461+00) and, along with the NEMDC west levee, comprises the easterly boundary of the Natomas Basin. Originally constructed in the 1800s, this levee was subject to repeated improvement efforts in the early and mid-1900s. Portions of the levee were improved in the 1990s as part of the NALP. This levee was not improved as part of the NLIP, although it is planned for improvement in the near future as part of the USACE Natomas Project described later in this report.

The PGCC west levee is contiguous with the NEMDC west levee; however, flows in this portion of the channel generally travel north to the NCC and therefore, the PGCC west levee is a left bank levee.

Natomas Road is located on top of the levee crown. Several drainage culverts cross under the PGCC west levee to drain areas to the east into the RD 1000 drainage system. A private canal extends parallel to the PGCC west levee for about 1,500 feet at the landside levee toe. The land uses along the landside of the PGCC west levee are primarily agricultural along with minimal industrial manufacturing and rural residential uses. There is no waterside development.

Past performance issues are primarily related to seepage and the entering of floodwaters into the basin at Sankey Gap which, as part of the NALP, is designed to withstand overflow. The interior floodplain associated with the overflow at the Sankey Gap during a 200-year event will be mapped by the City and County as part of the ULOP finding.

EVALUATION OF NATOMAS LEVEE SYSTEM

To support an APF, an evaluation of the levee system was performed to determine if it meets ULDC. The evaluation of each levee for each criterion is provided below.

ULDC 7.1: DESIGN WATER SURFACE ELEVATION

The DWSE is the 200-year WSE used to design and evaluate levees and floodwalls for the purposes of providing an urban level of flood protection. The ULDC offers two options for determination of the DWSE: the FEMA approach and the USACE approach. The median 200-year WSE is the unadjusted DWSE. With consideration and adjustments for debris loading, superelevation, climate change, updated hydrology, updated hydraulic models, and sea level rise, the median 200-year WSE becomes the DWSE.

Using the FEMA approach, the ULDC DWSE for all of the levee systems was computed in February 2016, using the MBK version of Release 4 of the USACE Sacramento River HEC-RAS model, hydrology developed by the USACE for the Sacramento and San Joaquin River Basins Comprehensive Study (Comp Study) for the Sacramento River, and a flow of 115,000 cfs[1] released from Folsom Dam (MBK, 2016a). The ULDC DWSE includes adjustments for debris loading, superelevation, climate change, updated hydraulic models, and sea level rise. The analysis to determine the DWSE used for the NLIP was conducted prior to issuance of the ULDC and did not include adjustments for debris loading or sea level rise, although did include consideration of superelevation. The ULDC DWSE is consistently lower than the NLIP DWSE in all locations. A comparison of the NLIP DWSE to the ULDC DWSE will be completed and documented as part of the ULDC certification[2]. The ULDC DWSE memorandum (MBK, 2016a) has not undergone review by the IPE and the Folsom JFP and Folsom Dam Raise Projects need to be completed to achieve the ULDC DWSE,

[1] MBK determined that the 200-year release from Folsom Dam will be 115,000 cfs once the Folsom JFP and Folsom Raise projects are completed. The expected time of completion for the Folsom JFP is 2017 and for the Folsom Raise project is 2025, at which time ULDC certification will be made.
[2] The term "ULDC certification" means an engineer's certification that a levee and/or evaluation meets the requirements of ULDC.

therefore the Natomas Levee System does not meet ULDC 7.1 because it does not have an adopted ULDC DWSE.

A detailed description of the methodology and results for the determination of the NLIP DWSE is found in *Supplemental Report for the Design Water Surface Profile for the Natomas Levee Improvement Program* (MBK, 2008).

Natomas Cross Canal South Levee

The computed ULDC DWSE for the NCC south levee is provided in Table 1. As described above, MBK, 2016a has not undergone review by the IPE and the Folsom JFP and Folsom Dam Raise Projects need to be completed to achieve the ULDC DWSE, therefore the NCC south levee does not meet ULDC 7.1.

Table 1. DWSE for NCC South Levee

Hydraulic Model River Station*	Levee Station (feet)	ULDC DWSE (feet NAVD88)
5.242	272+00	44.6
4.518	234+00	44.6
3.789	195+50	44.6
2.596	132+50	44.6
1.252	61+50	44.6
0.057	0+00	44.6

* Comp Study RM

Sacramento River East Levee - NCC to Powerline Road

The computed ULDC DWSE for the SREL - NCC to Powerline Road is provided in Table 2. As described above, MBK, 2016a has not undergone review by the IPE and the Folsom JFP and Folsom Dam Raise Projects need to be completed to achieve the ULDC DWSE, therefore the SREL - NCC to Powerline Road, does not meet ULDC 7.1.

Table 2. DWSE for SREL - NCC to Powerline Road

Hydraulic Model River Station*	Levee Station (feet)	ULDC DWSE (feet NAVD88)
79.21	2+00	44.6
76.75	137+50	43.1
74.25	269+50	41.6
71.75	397+00	40.0
69.25	527+00	38.6
67.00	639+50	37.1

* Comp Study RM

Sacramento River East Levee - Powerline Road to American River

The computed ULDC DWSE for the SREL - Powerline Road to the American River is provided in Table 3. As described above, MBK, 2016a has not undergone review by the IPE and the Folsom JFP and Folsom Dam Raise Projects need to be completed to achieve the ULDC DWSE, therefore the SREL - Powerline Road to American River, does not meet ULDC 7.1.

Table 3. DWSE for SREL - Powerline Road to American River

Hydraulic Model River Station	Levee Station (feet)	ULDC DWSE (feet NAVD88)
67.00	639+50	37.1
66.00	699+00	35.9
65.00	752+50	35.3
64.00	803+50	34.6
63.00	853+50	35.1
61.00	948+50	35.1

* Comp Study RM

American River North Levee - Natomas

The computed ULDC DWSE for the American River north levee is provided in Table 4. As described above, MBK, 2016a has not undergone review by the IPE and the Folsom JFP and Folsom Dam Raise Projects need to be completed to achieve the ULDC DWSE, therefore the American River north levee in Natomas does not meet ULDC 7.1.

Table 4. DWSE for American River North Levee

Hydraulic Model River Station*	Levee Station (feet)	ULDC DWSE (feet NAVD88)
1.75	0+50 (NEMDC)	36.3
1.5	106+50	36.2
0.75	52+00	35.7
0.27	20+50	35.3
0.115	5+00	35.2

* Different from Comp Study RM

Natomas East Main Drainage Canal West Levee

The computed ULDC DWSE for the NEMDC west levee is provided in Table 5. As described above, MBK, 2016a has not undergone review by the IPE and the Folsom JFP and Folsom Dam Raise Projects need to be completed to achieve the ULDC DWSE. Therefore, the NEMDC west levee does not meet ULDC 7.1.

Table 5. DWSE for NEMDC West Levee

Hydraulic Model River Station*	Levee Station (feet)	ULDC DWSE (feet NAVD88)
15.10	675+00	44.6
12.63	565+50	39.2
9.98	426+00	37.7
7.93	318+50	37.7
6.19**	226+00	41.0
4.63	143+00	40.1
3.78	103+00	39.3
2.5	37+00	37.6
1.75	0+50	36.3

* Different from Comp Study RM
** NEMDC Stormwater Pumping Plant in operation

Pleasant Grove Creek Canal West Levee

The computed ULDC DWSE for the PGCC west levee is provided in Table 6. As described above, MBK, 2016a has not undergone review by the IPE and the Folsom JFP and Folsom Dam Raise Projects need to be completed to achieve the ULDC DWSE. Therefore, the PGCC west levee does not meet ULDC 7.1.

Table 6. DWSE for PGCC

Hydraulic Model River Station*	Levee Station (feet)	ULDC DWSE (feet NAVD88)
0.56	287+50	44.6
1.64	345+00	44.6
3.15	424+00	44.6
3.83	461+00	44.6

* Different from Comp Study RM

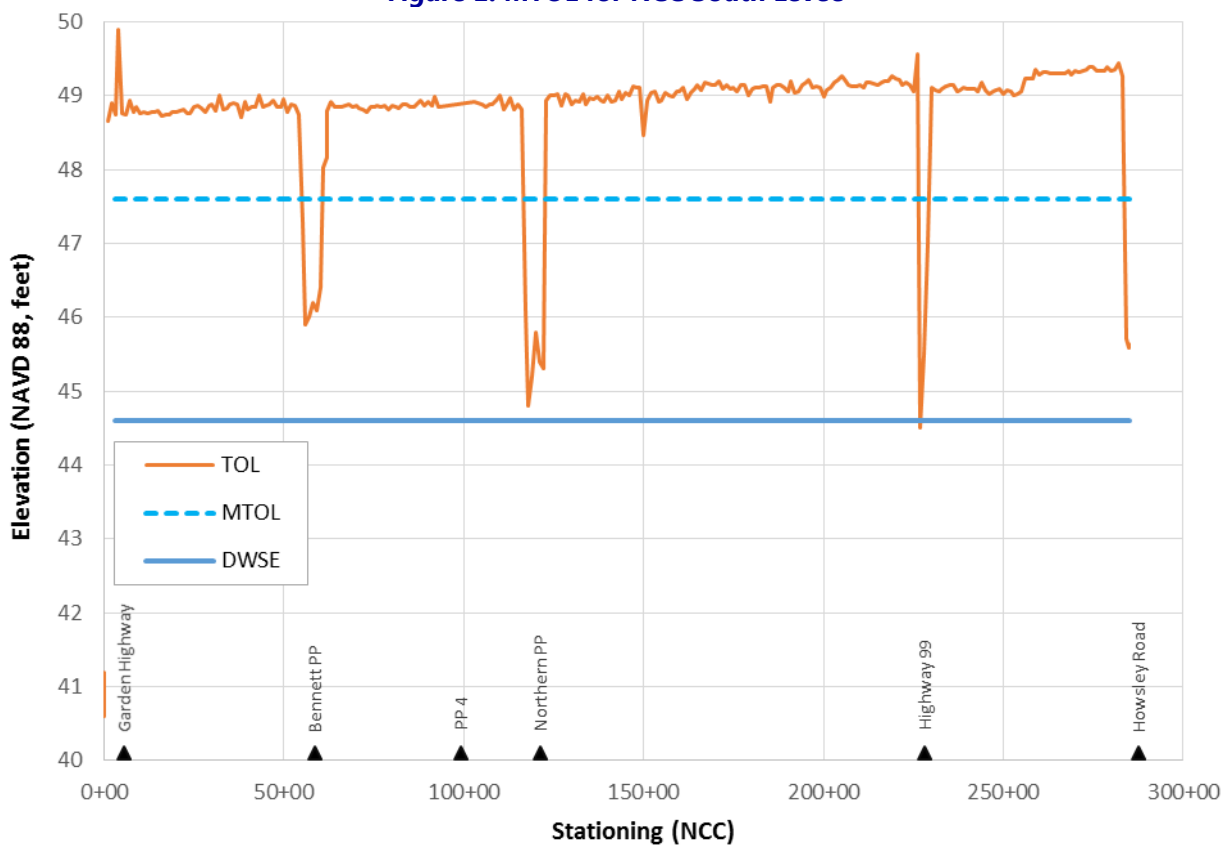
ULDC 7.2: Minimum Top of Levee

The MTOL is the required minimum elevation for the physical top of levee to provide reasonable assurance of containing the DWSE, and is defined as the higher of the DWSE plus 3 feet, or the DWSE plus wind setup and wave runup. Wind setup and wave runup were computed by Mead & Hunt (Mead & Hunt, 2008) and are discussed below in ULDC 7.17.

Natomas Cross Canal South Levee

For the NCC south levee, wind and wave runup is less than 3 feet and therefore, the MTOL is the DWSE plus 3 feet. Figure 1 shows the computed MTOL and actual top of levee profiles. Most of the NCC south levee appears to meet ULDC 7.2 for MTOL; however, there are locations where levee improvements will be addressed as part of the USACE Natomas Project (i.e., Bennett Pumping Plant, Northern Main Pumping Plant, Highway 99 crossing, and the 400 feet of levee upstream of Howsley Road at the PGCC west levee), that presently do not meet ULDC 7.2 for MTOL. The NCC south levee will be reevaluated for MTOL upon completion of USACE Natomas Project. Because portions of the levee do not meet criteria, and because, as described in ULDC 7.1, the ULDC DWSE (MBK, 2016a) has not undergone review by the IPE and thus the MTOL evaluation has not undergone review by the IPE, the NCC south levee does not meet ULDC 7.2.

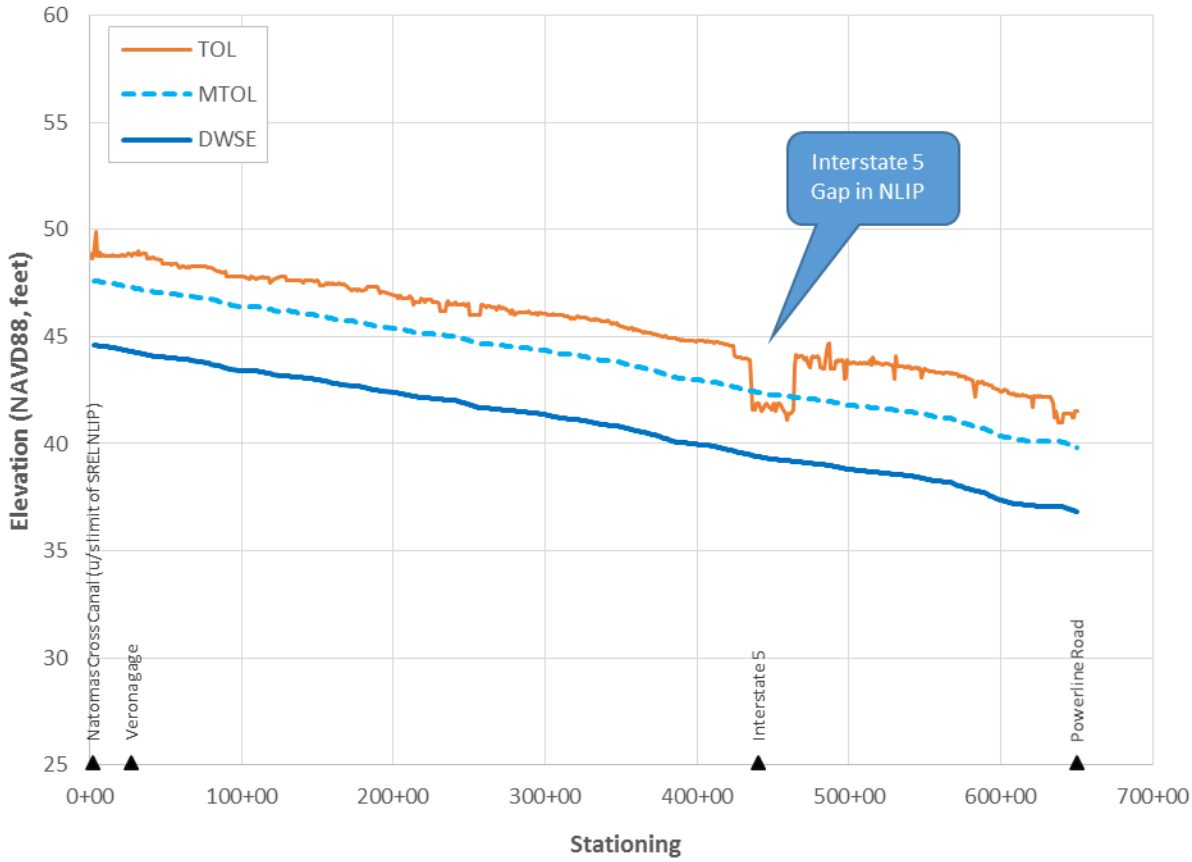
Figure 1. MTOL for NCC South Levee



Sacramento River East Levee - NCC to Powerline Road

For the SREL - NCC to Powerline Road, wind and wave runup is less than 3 feet and therefore, the MTOL is the DWSE plus 3 feet. Figure 2 shows the computed MTOL and actual top of levee profiles. The SREL - NCC to Powerline Road, appears to meet ULDC 7.2 for MTOL except for the portion of levee (2800 feet in length) under the Interstate 5 bridges crossing the Sacramento River, where levee improvements will be addressed as part of the USACE Natomas Project). The SREL - NCC to Powerline Road will be reevaluated for MTOL upon completion of USACE Natomas Project. Because portions of the levee do not meet criteria, and because, as described in ULDC 7.1, the ULDC DWSE (MBK, 2016a) has not undergone review by the IPE and thus the MTOL evaluation has not undergone review by the IPE, the SREL- NCC to Powerline Road does not meet ULDC 7.2.

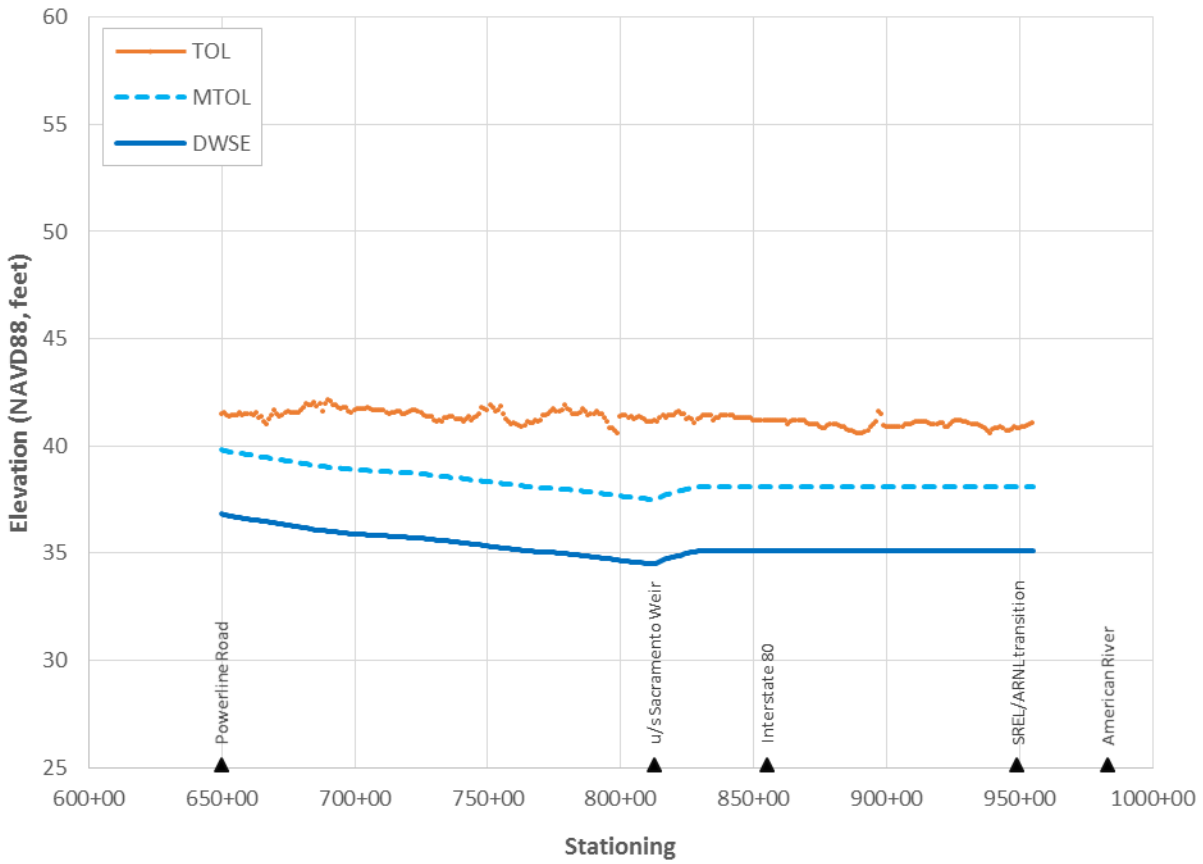
Figure 2. MTOL for SREL – NCC to Powerline Road



Sacramento River East Levee - Powerline Road to American River

For the SREL - Powerline Road to American River, wind and wave runup is less than 3 feet and therefore, the MTOL is the DWSE plus 3 feet. Figure 3 shows the computed MTOL and actual top of levee profiles. The SREL - Powerline Road to American River, appears to meet ULDC 7.2 for MTOL. However, as described in ULDC 7.1, the ULDC DWSE (MBK, 2016a) has not undergone review by the IPE and thus the MTOL evaluation has not undergone review by the IPE; therefore, the SREL - Powerline Road to American River does not meet ULDC 7.2.

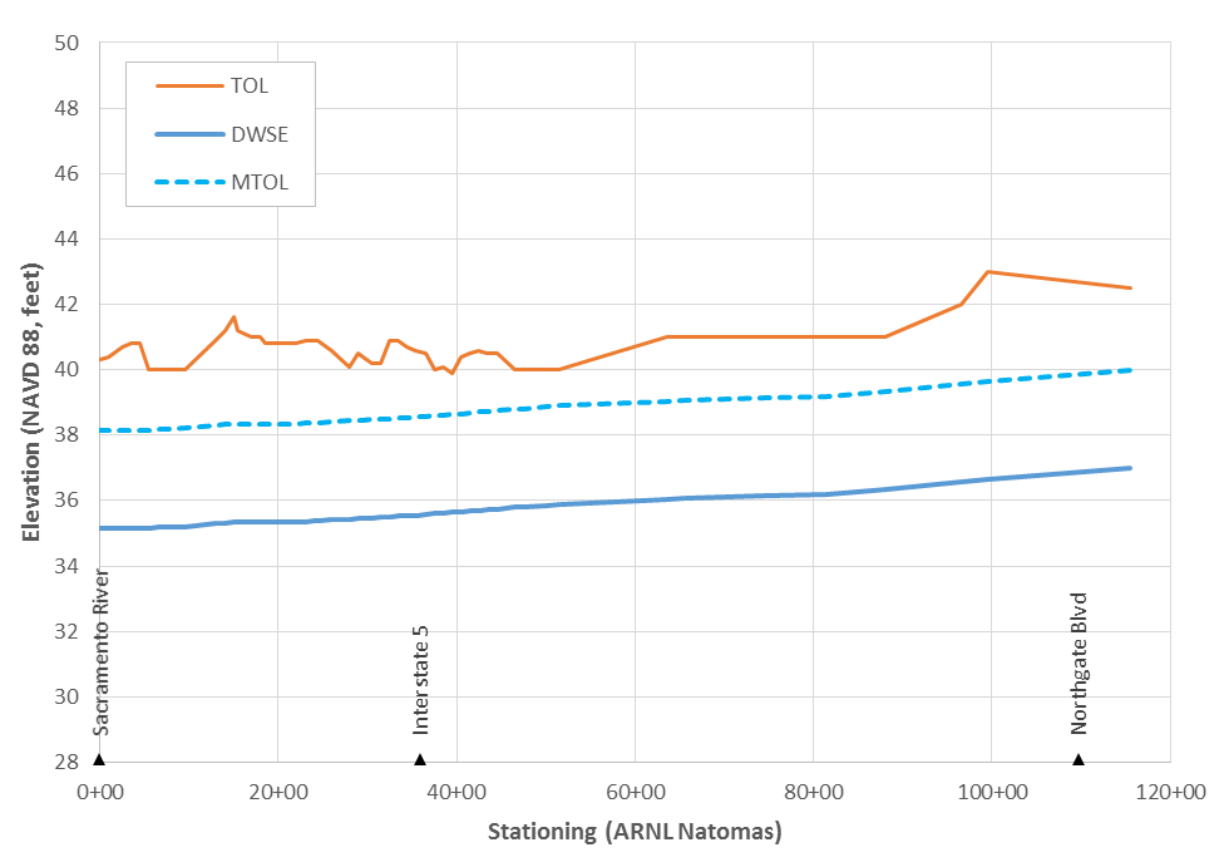
Figure 3. MTOL for SREL - Powerline Road to American River



American River North Levee

For the American River north levee, wind and wave runup is less than 3 feet and therefore, the MTOL is the DWSE plus 3 feet. Figure 4 shows the computed MTOL and actual top of levee profiles. The American River north levee, appears to meet ULDC 7.2 for MTOL. However, as described in ULDC 7.1, the ULDC DWSE (MBK, 2016a) has not undergone review by the IPE and thus the MTOL evaluation has not undergone review by the IPE; therefore, the American River north levee does not meet ULDC 7.2.

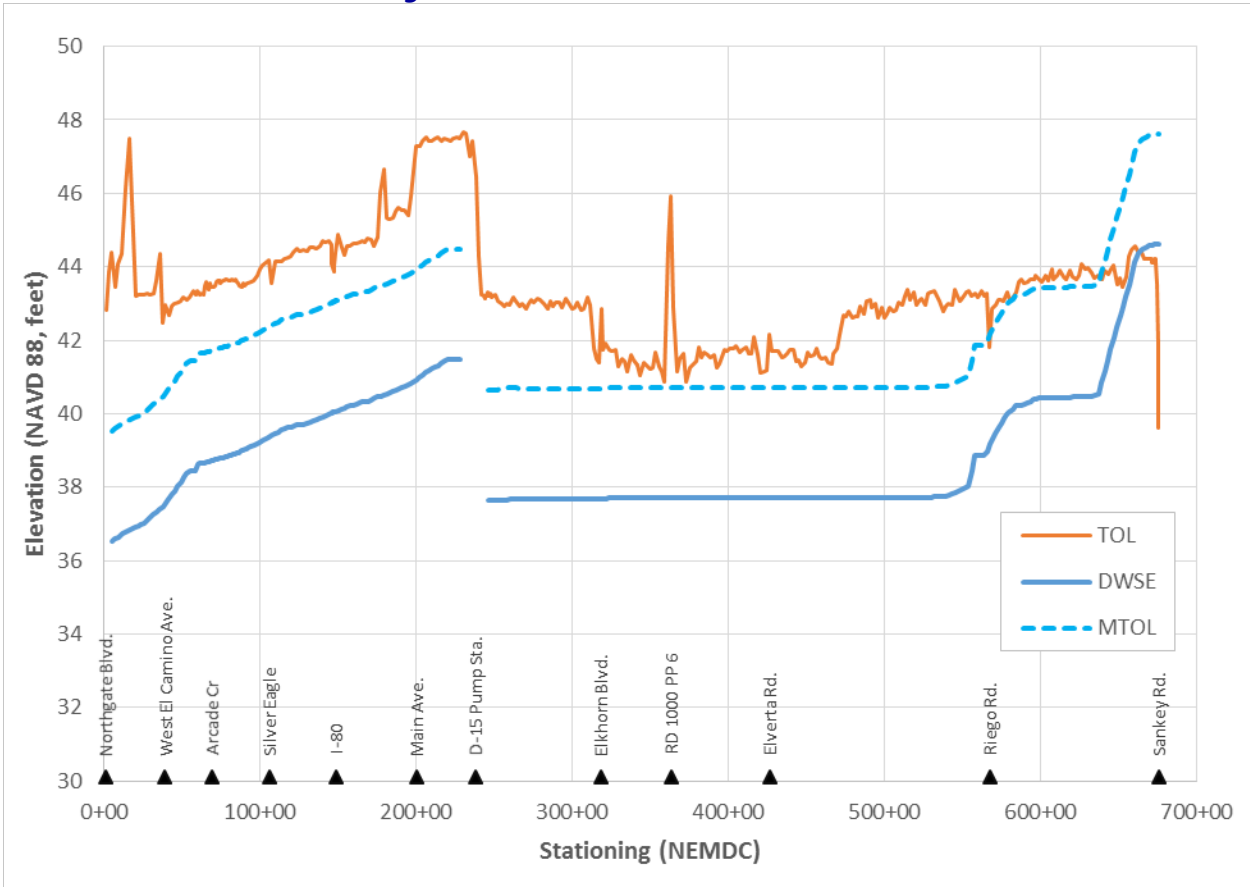
Figure 4. MTOL for American River North Levee



Natomas East Main Drainage Canal West Levee

For the NEMDC west levee, the maximum wind and wave runup is 3.05 feet. Therefore, the MTOL is the DWSE plus 3 feet or plus wind and wave in portions where wind and wave exceeds 3 feet (i.e., just upstream of the NEMDC Stormwater Pumping Station). Figure 5 shows the computed MTOL and actual top of levee profiles. The upstream portion of the NEMDC west levee at Sankey Road is deficient in levee height and does not meet ULDC 7.2 for MTOL. The remaining portion of NEMDC appears to meet ULDC 7.2 for MTOL. The NEMDC west levee will be reevaluated for MTOL upon completion of USACE Natomas Project. Because portions of the levee do not meet criteria, and because, as described in ULDC 7.1, the ULDC DWSE (MBK, 2016a) has not undergone review by the IPE and thus the MTOL evaluation has not undergone review by the IPE, the NEMDC west levee does not meet ULDC 7.2.

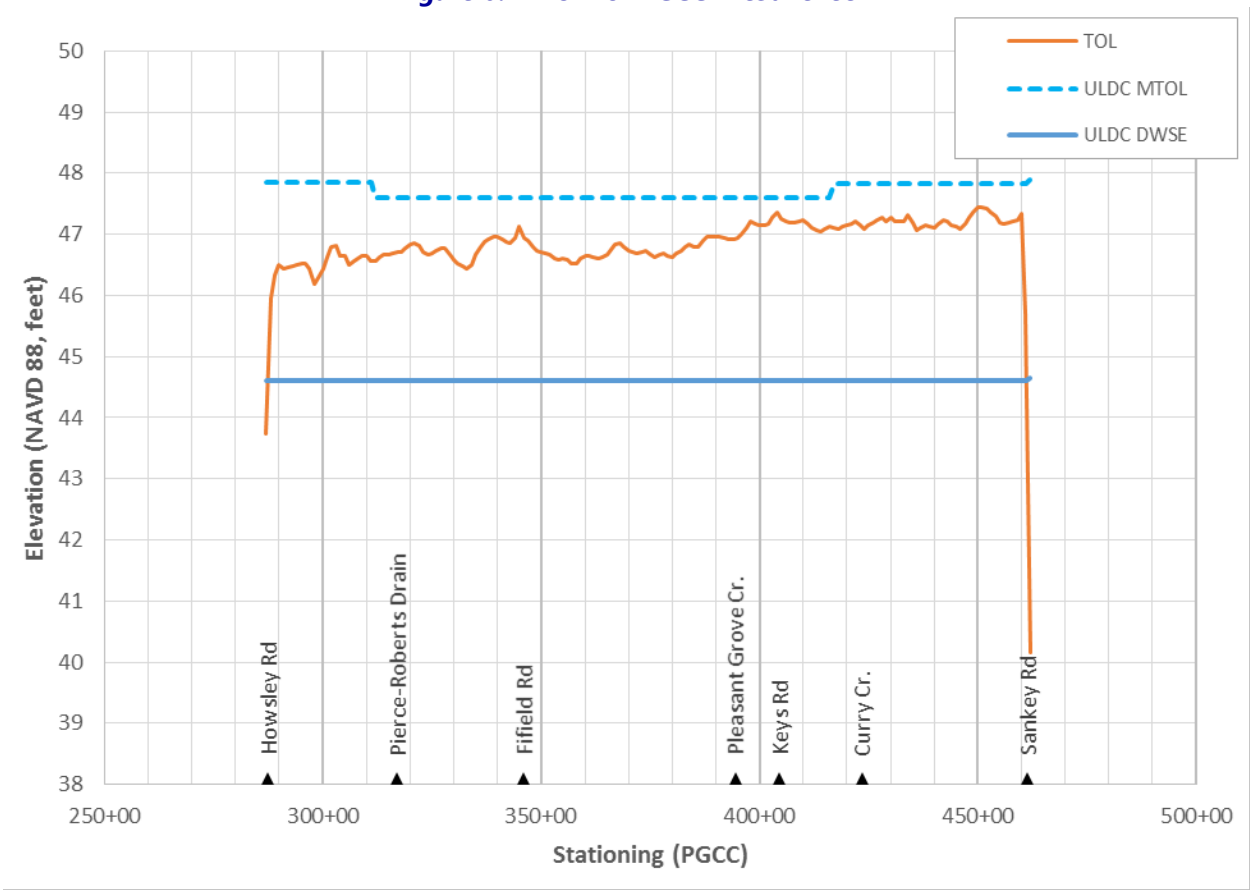
Figure 5. MTOL for NEMDC West Levee



Pleasant Grove Creek Canal West Levee

For the PGCC west levee, the maximum wind and wave runup is 3.26. Therefore, the MTOL is the DWSE plus 3 feet except where wind and wave exceeds 3 feet. Figure 6 shows the computed MTOL and actual top of levee profiles. The entire length of PGCC west levee from the downstream end at Howsley Road to Sankey Road is deficient in levee height and does not meet ULDC 7.2 for MTOL. The PGCC west levee will be reevaluated for MTOL upon completion of USACE Natomas Project

Figure 6. MTOL for PGCC West Levee



ULDC 7.3: Soil Sampling, Testing, and Logging

ULDC 7.3 requires soil sampling, testing, and logging per standard procedures prescribed in guidance documents, including the USACE Sacramento District's *Geotechnical Levee Practice Standard Operating*

Procedures (SPK SOP-03) and DWR's Division of Flood Management *Soil and Rock Logging, Classification, Description and Presentation Manual* (2009). This includes an evaluation of soil exploration quantity and location as outlined in the SPK SOP-03. Based on this document, explorations for levee evaluation should be obtained at the waterside toe, levee crown, landside toe, and landside field areas performed at a spacing of 1,000 to 2,000 feet for feasibility studies and at a spacing of 500 to 1,000 feet for design and preconstruction engineering studies. For this APF, explorations that did not meet the requirements outlined in these documents (e.g. explorations that were not drilled deep enough) above were not included.

The SPK SOP-03 also recommends a thorough evaluation of existing information as part of a levee evaluation program. This includes a review of original construction (if available), improvements, performance history, existing subsurface information, and regional and local geomorphology. The standard also recommends the use of cone penetrometers (CPTs) and geophysics to supplement borings, where appropriate.

In addition to these recommendations, where available, the as-built plans, conformance laboratory tests, and in-place compaction tests for the construction and improvements of each levee, were retained as part of the ULDC evaluation. This information was used to evaluate the levee geometry and material properties within the newly constructed and improved levee sections.

Natomas Cross Canal South Levee

Soil exploration information is contained in the data reports prepared by Kleinfelder for the NLIP and the DWR ULE project (Kleinfelder, 2009a; URS, 2012). The recommended exploration spacing described above was generally met for this levee with the exception of borings at the waterside toe due to the presence of heavy vegetation at the waterside toe, and the proximity of the levee to the waterside channel. Soil sampling, testing, and logging were generally performed following the guidance outlined above. The soil explorations that were obtained were used in combination with geology and geomorphology, geophysical resistivity surveys, past performance information, historical records, and construction records to provide an adequate assessment of the subsurface conditions as outlined in the SPK SOP-03 for design of levee improvements. Because the soil sampling, testing, and logging do not strictly meet ULDC 7.3, most notably the waterside to explorations, an exception will be required. This exception will be prepared as part of the Non-Structural Actions in support of the ULDC certification.

Sacramento River East Levee - NCC to Powerline Road

Soil exploration information is contained in the data reports prepared by Kleinfelder for the NLIP and the DWR ULE project (Kleinfelder, 2009b, 2010a, 2010d, 2010e; URS, 2012). The exploration spacing described above was generally met for this levee with the exception of borings at the waterside toe due to the existing residential development along the waterside toe, heavy vegetation at the waterside toe, and the proximity of the levee to the river channel. Soil sampling, testing, and logging were generally performed following the guidance outlined above. The soil explorations that were obtained were used in combination with geology and geomorphology, geophysical resistivity surveys, past performance information, historical records, and construction records to provide an adequate assessment of the subsurface conditions as outlined in the SPK SOP-03 for design of levee improvements. Because the soil sampling, testing, and logging do not strictly meet ULDC 7.3, most notably the waterside toe explorations an exception will be required. This exception will be prepared as part of the Non-Structural Actions in support of the ULDC certification.

Sacramento River East Levee - Powerline Road to American River

Soil exploration information is contained in the data reports prepared by the DWR ULE project (URS, 2012). The exploration spacing described above was generally met for this levee with the exception of borings at the waterside toe due to the presence of existing development along the waterside toe, heavy vegetation at the waterside toe, and the proximity of the levee to the river channel. Soil sampling, testing, and logging were generally performed following the guidance outlined above. However, the soil explorations that were obtained were used in combination with geology and geomorphology, geophysical resistivity surveys, past performance information, historical records, and construction records to provide an adequate assessment of the subsurface conditions as outlined in the SPK SOP-03 for analysis and preliminary design of levee improvements. Additional borings will be obtained by USACE as part of its design efforts. Because the soil sampling, testing, and logging do not strictly meet ULDC 7.3, an exception may be required. This exception would be prepared as part of the Non-Structural Actions in support of the ULDC certification.

American River North Levee

Soil exploration information is contained in the data reports prepared by DWR ULE project (URS, 2012) and the USACE American Common Features (Kleinfelder Geomatrix JV, 2012). The exploration spacing described above was generally met for this levee with the exception of borings at the waterside toe due to the presence of heavy vegetation at the waterside toe and the proximity of the levee to the stream channel. Soil sampling, testing, and logging were generally performed following the guidance outlined above. The soil explorations that were obtained were used in combination with geology and geomorphology, geophysical resistivity surveys, past performance information, historical records, and construction records to provide an adequate assessment of the subsurface conditions as outlined in the SPK SOP-03 for design of levee improvements. Because the soil sampling, testing, and logging do not strictly meet ULDC 7.3, most notably the waterside toe explorations, an exception may be required. This exception would be prepared as part of the Non-Structural Actions in support of the ULDC certification.

Natomas East Main Drainage Canal West Levee

Soil exploration information is contained in the data reports prepared by the DWR ULE project (URS, 2008b, 2010). The exploration spacing described above was generally met for this levee with the exception of borings at the waterside toe due to vegetation at the waterside toe and the proximity of the levee to the water channel. Soil sampling, testing, and logging were generally performed following the guidance outlined above. However, the soil explorations that were obtained were used in combination with geology and geomorphology, geophysical resistivity surveys, past performance information, historical records, and construction records to provide an adequate assessment of the subsurface conditions as outlined in the SPK SOP-03 for levee evaluations. Additional borings will be obtained by USACE as part of its design efforts. Because the soil sampling, testing, and logging do not strictly meet ULDC 7.3, an exception will be prepared as part of the Non-Structural Actions in support of the ULDC certification. Therefore, geotechnical investigations were generally performed following the guidance outlined above, and meet ULDC 7.3 for soil sampling, testing, and logging through exception.

Pleasant Grove Creek Canal West Levee

Soil exploration information is contained in the data reports prepared by the DWR ULE project (URS, 2008b, 2010). The exploration spacing described above was generally met for this levee with the

exception of borings at the waterside toe due to heavy vegetation at the waterside toe and the proximity of the levee to the stream channel. Soil sampling, testing, and logging were generally performed following the guidance outlined above. The soil explorations that were obtained were used in combination with geology and geomorphology, geophysical resistivity surveys, past performance information, historical records, and construction records to provide an adequate assessment of the subsurface conditions as outlined in the SPK SOP-03 for levee evaluations. Additional borings will be obtained by USACE as part of its design efforts. Because the soil sampling, testing, and logging do not strictly meet ULDC 7.3, an exception may be required. This exception would be prepared as part of the Non-Structural Actions in support of the ULOP Finding.

ULDC 7.4: Slope Stability For Intermittently Loaded Levees

ULDC 7.4.1 requires a minimum factor of safety of 1.4 for steady state seepage conditions, based on the DWSE, for failure surfaces that intersect the levee crown and are greater than a few feet deep in the levee slope. It also requires a minimum factor of safety of 1.2, based on the Hydraulic Top of Levee (HTOL), for failure surfaces that intersect the levee crown and are greater than a few feet deep in the levee slope. ULDC 7.4.2 requires a minimum factor of safety of 1.0 to 1.2 for waterside slope stability during rapid drawdown conditions for the DWSE depending on how long the embankment is saturated, with the higher factor of safety used for longer duration events. A factor of safety of 1.2 was used for rapid drawdown for the Sacramento River, American River, NCC, NEMDC downstream of Dry Creek, and PGCC due to the long duration events in the Sacramento and American Rivers and backwater effects of these rivers in the NEMDC, PGCC, and NCC. A factor of safety of 1.0 was used for the NEMDC between Dry Creek north levee and the PGCC. The referenced DWR ULE reports used a safety factor of 1.1 for waterside slope stability. When these models were referenced, the calculated factor of safety was compared to the factor of safety stated above for each levee (e.g. 1.0 or 1.2) to determine if the levee met criteria. The HTOLs for the Natomas Levees were calculated by MBK, and are documented (MBK, 2016a). DWR has determined that these levees are intermittently loaded as described in Section 7.6. Verification of the loading condition will be made and documented by SAFCA as part of the Non-Structural Actions to support ULDC certification.

The slope stability evaluations performed for the Natomas Levee System are documented as indicated below in the individual levee discussions. Strength parameters were interpreted from field explorations and laboratory testing. Pore water pressure values used during steady-state seepage were based on the DWSE or HTOL, respective to the analysis conducted, in use at the time of the referenced analyses. The locations of the cross sections analyzed were selected based on critical locations with respect to underseepage or stability issues within their representative reach. Reaches where the phreatic seepage surface exited on a levee slope (i.e. through seepage) that is composed of erodible material were generally considered to not meet criteria.

Natomas Cross Canal South Levee

The NCC south levee between Stations 0+00 and 287+37 has been evaluated for ULDC 7.4 landside slope stability (Kleinfelder, 2009a; URS, 2015b). Improvements, specifically a seepage cutoff wall that included levee degrading and reconstruction, constructed as part of the NLIP, remediated slope stability issues identified during the problem identification phase of the program from Station 0+00 to 283+00.

The levee appears to meet ULDC 7.4 for slope stability for intermittently loaded levees for the DWSE and the HTOL, except where windows in the cutoff wall were left at the pump stations (between Stations 56+00 to 61+00 and Stations 118+50 and 122+90), and for the Highway 99 crossing (between Stations 225+70 and 231+10) where they do not meet. Closure of these windows is currently being designed as part of the USACE Natomas Project. Additionally, the remaining upstream 437 feet of the NCC south levee, from the ending station of the cutoff wall (Station 283+00) to the centerline of Howsley Road (Station 287+37) will be addressed as part of the USACE Natomas Project. The NCC south levee will be reevaluated for slope stability upon completion of the USACE Natomas Project.

Sacramento River East Levee - NCC to Powerline Road

The SREL - NCC to Powerline Road between Stations 0+00 and 654+50 has been evaluated for ULDC 7.4 landside slope stability (Kleinfelder, 2009b, 2009c, 2010a, 2010d, 2010e, 2010f; URS, 2015a). Improvements, specifically a new adjacent levee embankment, seepage berm, and seepage cutoff wall constructed as part of the NLIP, remediated stability issues identified during the problem identification phase of the program.

This levee appears to meet ULDC 7.4 for slope stability for intermittently loaded levees for the DWSE and the HTOL except where there is a window in the cutoff wall for Interstate 5 (between Stations 440+00 to 460+00) and does not meet. Closure of this window is currently being designed as part of the USACE Natomas Project. The SREL - NCC to Powerline Road will be reevaluated for slope stability upon completion of the USACE Natomas Project.

Sacramento River East Levee - Powerline Road to American River

The SREL - Powerline Road to the American River between Stations 654+50 and 956+90 has been evaluated for ULDC 7.4 landside slope stability as part of the DWR ULE Project (URS, 2015b). The levee between Station 692+00 to 737+00, Station 832+00 to 875+00, and Station 924+00 to 956+90 meet ULDC 7.4 for DWSE and the HTOL. Portions of this levee, Station 654+50 to 692+00, Station 737+00 to 832+00, and Station 875+00 to 924+50 do not meet ULDC 7.4 for slope stability for intermittently loaded levees due to: (1) elevated exit gradients at the levee toe resulting from underseepage, which lowers the soil shear strength and the resulting stability factor of safety (FOS), and; (2) a high phreatic surface development at the HTOL WSE in the coarse-grained core above the less-permeable retaining dike that exits on the levee embankment. Remediation of this levee is currently being designed as part of the USACE Natomas Project. The SREL - Powerline Road to the American River will be reevaluated for slope stability upon completion of the USACE Natomas Project.

American River North Levee

The American River north levee between Stations 0+00 and 115+63 has been evaluated for ULDC 7.4 landside slope stability by the USACE Natomas Project (Kleinfelder Geomatrix JV, 2012; URS, 2014). The levee between Station 0+00 to 2+63, Station 31+00 to 50+00, and Station 106+17 to 115+63 meet ULDC 7.4 for DWSE and the HTOL. Portions of this levee (Station 2+63 to 31+00 and Station 50+00 to 106+17) do not meet ULDC 7.4 for slope stability for intermittently loaded levees for DWSE and HTOL due to oversteepened landside levee slopes (steeper than 2H:1V), elevated gradients at the levee toe, and the phreatic surface exiting on the landside slope in silty sand. Remediation of this levee is currently being designed as part of the USACE Natomas Project. The SREL - Powerline Road to the American River will be reevaluated for slope stability upon completion of the USACE Natomas Project.

Natomas East Main Drainage Canal West Levee

The NEMDC west levee between Stations 0+00 and 675+65 has been evaluated for ULDC 7.4 landside slope stability as part of the DWR ULE Project (URS, 2015a). The levee between Station 37+00 to 76+50, Station 153+50 to 234+50, Station 379+00 to 436+00, Station 465+00 to 475+50, Station 644+50 to 675+65 meet ULDC 7.4 for DWSE and the HTOL. Portions of this levee between Station 0+00 to 37+00, Station 76+50 to 153+50, Station 234+50 to 379+00, Station 436+00 to 465+00, and Station 475+50 to 644+50 do not meet ULDC 7.4 for slope stability for intermittently loaded levees due to either oversteepened landside levee slopes (steeper than 2H:1V), or the phreatic surface exiting on the landside slope. Remediation of this levee is currently being designed as part of the USACE Natomas Project. The NEMDC west levee will be reevaluated for slope stability upon completion of the USACE Natomas Project.

Pleasant Grove Creek Canal West Levee

The PGCC west levee between Stations 287+00 and 461+31 has been evaluated for ULDC 7.4 landside slope stability as part of the DWR ULE Project (URS, 2015a). The levee between Stations 287+00 and 461+31 meet ULDC 7.4 for slope stability for intermittently loaded levees for the DWSE and the HTOL. This levee is being improved by USACE Natomas Project; upon completion, the PGCC west levee will be reevaluated to confirm slope stability.

ULDC 7.5: Underseepage For Intermittently Loaded Levees

Based on the USACE Engineering Manual (EM) 1110-2-1913 (as modified by ETL 1110-2-569) and the ULDC, the current guidance for acceptable exit gradients through soils with a minimum saturated unit weight of 112 pounds per cubic foot (pcf) at the toe of the levee (exit gradient) should be no greater than 0.5 and no greater than 0.8 at the toe of a seepage berm less than 300 feet wide. The allowable underseepage exit gradient through the combined seepage berm/blanket layer between the levee toe and the seepage berm toe is determined by interpolation, using 0.5 at the levee toe and 0.8 at a distance of 150 feet from the levee toe, with linear interpolation used for distances between these points. For points beyond 150 feet, the criteria is 0.8 up to a distance of 300 feet. Following USACE procedures, the maximum allowable exit gradient in a ditch, canal, or depression is 0.5 at the levee toe and 0.8 at 150 feet from the levee toe and beyond (up to 300 feet), with linear interpolation applying between the levee toe and 150 feet from the levee toe. When modeling a scenario that incorporates the HTOL, the allowable exit gradient is no greater than 0.6 at the levee toe. Steady-state seepage analyses were based on the DWSE or HTOL, respective to the analysis conducted, in use at the time of the referenced analyses. Using the parameters as described in Section 7.6, DWR has determined that these levees are intermittently loaded. Verification of the loading condition will be made and documented by SAFCA as part of the Non-Structural Actions to support ULDC certification.

Natomas Cross Canal South Levee

The NCC south levee between Stations 0+00 and 287+37 has been evaluated for ULDC 7.5 underseepage (Kleinfelder, 2009a; URS, 2015b). Improvements, specifically the seepage cutoff wall (generally between Stations 0+00 and 283+00), constructed as part of the NLIP remediated underseepage issues identified during the problem identification phase of the program.

The levee appears to meet ULDC 7.5 for underseepage between Stations 0+00 and 287+37 for intermittently loaded levees for the DWSE and the HTOL except where windows in the cutoff wall were left for pump stations (between Station 56+00 to 61+00 and Station 118+50 and 122+90) and for the Highway 99 crossing (between Stations 225+70 and 231+10) where they do not meet the criteria. Closure of these windows is currently being designed as part of the USACE Natomas Project. The remaining upstream 437 feet of the NCC, from the ending station of the cutoff wall (Station 283+00) to the centerline of Howsley Road (Station 287+37) will be addressed as part of the USACE Natomas Project. The NCC south levee will be reevaluated for underseepage upon completion of the USACE Natomas Project.

Sacramento River East Levee - NCC to Powerline Road

The SREL - NCC to Powerline Road between Stations 0+00 and 654+50 has been evaluated for ULDC 7.5 underseepage (Kleinfelder, 2009b, 2009c, 2010a, 2010d, 2010e, 2010f; URS, 2015b). Improvements, specifically the seepage cutoff wall and seepage berm, constructed as part of the NLIP, remediated underseepage issues identified during the problem identification phase of the program.

This levee appears to meet ULDC 7.5 for underseepage for intermittently loaded levees for DWSE and the HTOL, except where there is a window in the cutoff wall for Interstate 5 (between Station 440+00 to 460+00), and does not meet the criteria. Closure of this window is currently being designed as part of the USACE Natomas Project. The SREL - NCC to Powerline Road will be reevaluated for underseepage upon completion of the USACE Natomas Project.

Sacramento River East Levee - Powerline Road to American River

The SREL - Powerline Road to the American River between Stations 654+50 and 956+90 has been evaluated for ULDC 7.5 underseepage as part of the DWR ULE Project (URS, 2015c). The levee between Stations 924+50 to 956+90 was found to meet ULDC 7.5 for DWSE and the HTOL. The levee between Stations 654+50 to 924+50 does not meet ULDC 7.5 for underseepage for intermittently loaded levees for the DWSE and HTOL. Remediation of this levee is currently being designed by the USACE as part of the Natomas Project. The SREL - Powerline Road to the American River will be reevaluated for underseepage upon completion of the USACE Natomas Project.

American River North Levee

The American River north levee between Stations 0+00 and 115+63 has been evaluated for ULDC 7.5 underseepage by the USACE Natomas Project (Kleinfelder Geomatrix JV, 2012; URS, 2015c). The majority of the levee does not meet ULDC 7.5 for underseepage for intermittently loaded levees for the DWSE and HTOL. Remediation of this levee is currently being designed by the USACE as part of the Natomas Project for nearly the entire length of Reach I (Station 2+13 at Gateway Oaks Drive to Station 115+63 at Northgate Blvd). The American River north levee will be reevaluated for underseepage upon completion of the USACE Natomas Project.

Natomas East Main Drainage Canal West Levee

The NEMDC west levee between Station 0+00 and 675+65 has been evaluated for ULDC 7.5 underseepage as part of the DWR ULE Project (URS, 2015a). The levee between Stations 76+50 and 132+50, Station 153+50 to 195+50, Station 530+00 to 675+65 meet ULDC 7.5 for DWSE and the HTOL.

Portions of this levee (Station 0+00 to 76+50, Station 132+50 to 153+50, and Station 195+50 to 530+00) do not meet ULDC 7.5 for underseepage for intermittently loaded levees for the DWSE and HTOL. Remediation of this levee is currently being designed by the USACE as part of the Natomas Project. The NEMDC west levee will be reevaluated for underseepage upon completion of the USACE Natomas Project.

Pleasant Grove Creek Canal West Levee

The PGCC west levee between Stations 287+00 and 461+31 has been evaluated for ULDC 7.5 underseepage as part of the DWR ULE Project (URS, 2015a). The levee does not meet ULDC 7.5 for underseepage for intermittently loaded levees for the DWSE and the HTOL. Remediation of this levee is currently being designed by the USACE as part of the Natomas Project. The PGCC west levee will be reevaluated for underseepage upon completion of the USACE Natomas Project.

ULDC 7.6: Frequently Loaded Levees

ULDC 7.6 clarifies that frequently loaded levees are subject to more stringent requirements. Frequently loaded levees are those levees that experience a water surface elevation of 1 foot or higher above the elevation of the landside levee toe at least once a day for more than 36 days per year on average.

Natomas Cross Canal South Levee

As part of the ULE Program, DWR considered the Natomas Cross Canal south levee an intermittently loaded levee (URS, 2015b), therefore ULDC 7.6 for frequently loaded levees is not applicable. Verification of this conclusion will be made and documented by SAFCA as part of the Non-Structural Actions to support a ULDC certification.

Sacramento River East Levee - NCC to Powerline Road

As part of the ULE Program, DWR considered the SREL - Natomas Cross Canal to Powerline Road, an intermittently loaded levee (URS, 2015b), therefore ULDC 7.6 for frequently loaded levees is not applicable. Verification of this conclusion will be made and documented by SAFCA as part of the Non-Structural Actions to support a ULDC certification.

Sacramento River East Levee - Powerline Road to American River

As part of the ULE Program, DWR considered the SREL - Powerline Road to American River, an intermittently loaded levee (URS, 2015b), therefore ULDC 7.6 for frequently loaded levees is not applicable. Verification of this conclusion will be made and documented by SAFCA as part of the Non-Structural Actions to support a ULDC certification.

American River North Levee

As part of the ULE Program, DWR considered the American River north levee an intermittently loaded levee (URS, 2014), therefore ULDC 7.6 for frequently loaded levees is not applicable. Verification of this

conclusion will be made and documented by SAFCA as part of the Non-Structural Actions to support a ULDC certification.

Natomas East Main Drainage Canal West Levee

As part of the ULE Program, DWR considered the Natomas East Main Drainage Canal west levee an intermittently loaded levee (URS, 2015a), therefore ULDC 7.6 for frequently loaded levees is not applicable. Verification of this conclusion will be made and documented by SAFCA as part of the Non-Structural Actions to support a ULDC certification.

Pleasant Grove Creek Canal West Levee

As part of the ULE Program, DWR considered the Pleasant Grove Creek Canal west levee an intermittently loaded levee (URS, 2015a.), therefore ULDC 7.6 for frequently loaded levees is not applicable. Verification of this conclusion will be made and documented by SAFCA as part of the Non-Structural Actions to support a ULDC certification.

ULDC 7.7: Seismic Vulnerability

ULDC 7.7 requires an analysis of seismic vulnerability of the levee system for the 200-year return period ground motions. ULDC 7.7.1 indicates that if seismic damage to the levee from the 200-year return period ground motion is expected, a post-earthquake remediation plan is required as part of a flood safety plan developed in coordination with pertinent local, State, and Federal agencies.

As part of its ULE Program, DWR performed seismic vulnerability assessments following guidelines (URS, 2008a) established by DWR for the ULE Program. Seismic vulnerability assessments were performed for study area levees using existing conditions at the time. In this case, the analysis was performed prior to implementation of the NLIP. ULE criteria (Table 7) includes three seismic vulnerability classes (high, medium and low) based on a levee's post-seismic freeboard protection.

Table 7. ULE Criteria for Seismic Vulnerability Classifications for Intermittently Loaded Levees[1]

Amount of Crest[2] Displacement Relative to Landside Levee Height (percent)	Potential for Significant Damage to Internal Structures (e.g., Cutoff Walls)	Remaining Freeboard[2] for Post-Seismic Evaluation (10-Year Flood WSE +3 feet[3])	Vulnerability Class[4] (Post-Seismic Flood Protection Ability)
< 10	No	>0.3 m (1 foot)	Low Vulnerability
<20	Possibly	Between 0 and 0.3 m (1 foot)	Medium Vulnerability
≥20 (Flow Slide Condition)	Yes	None	High Vulnerability

Note:
1 Intermittently loaded levees are defined in the ULDC (DWR, 2012).
2 Vertical crest displacements can be estimated at 0.7 times the deviatoric deformation from simplified deformation analysis (such as Newmark type displacement), and by adding volumetric displacement as applicable.
3 Based on ULDC criteria for intermittently loaded levees (Section 7.7.1 of the ULDC [DWR, 2012]).
4 Analyses results must pass each of the criteria in the first three columns of the table at a given vulnerability class (the last column), or the corresponding segment should be rated at the next higher vulnerability class.

Seismic evaluations contained in the referenced ULE reports were reviewed along with Kleinfelder reports (where available) and form the basis for the findings in this section.

Natomas Cross Canal South Levee

The south levee along the NCC between Stations 0+00 and 287+37 has been evaluated for seismic vulnerability and post-seismic flood protection ability per ULDC 7.7 by DWR as part of the ULE Program and by Kleinfelder as part of the SAFCA NLIP (Kleinfelder, 2009a; URS, 2015b). The results of these evaluations are similar. However, an area between Station 0+00 and 7+00 was classified as Low Vulnerability by the DWR ULE Program and was considered High Vulnerability by Kleinfelder and an area between Station 75+15 to 85+05 was classified as Low Vulnerability by Kleinfelder and was considered High Vulnerability by the DWR ULE Program. Therefore, the High Vulnerability classification will be used in this area for this report. The results of this evaluation are shown in Table 8.

Table 8. Natomas Cross Canal South Levee Seismic Vulnerability Class

Stations	Vulnerability Class (Post-Seismic Flood Protection Ability)
NCC South 0+00 to 15+00 (Natomas North ULE Station 1112+41 to 1097+41)	High Vulnerability
NCC South 15+00 to 75+15 (Natomas North ULE Station 1097+41 to 1037+26)	Low Vulnerability
NCC South 75+15 to 85+05 (Natomas North ULE Station 1037+26 to 1027+36)	High Vulnerability
NCC South 85+05 to 271+00 (Natomas North ULE Station 1027+36 to 838+17) NCC South 271+00 to 287+37 (Natomas West ULE Station 838+17 to 850+00)	Low Vulnerability

Because a post-earthquake remediation plan has not been developed, and the seismic vulnerability analysis has not undergone review by the IPE, the NCC south levee does not meet ULDC 7.7. SAFCA will investigate the differences between the ULE Program and Kleinfelder results and will coordinate the preparation of a post-earthquake remediation plan as part of the Non-Structural Actions to support a ULDC certification.

Sacramento River East Levee - NCC to Powerline Road

The east levee along the SREL - NCC to Powerline Road between Stations 0+00 and 635+00 has been evaluated for seismic vulnerability and post-seismic flood protection ability per ULDC 7.7 by the DWR as part of the ULE Program, and by Kleinfelder as part of the SAFCA NLIP (Kleinfelder, 2010e; URS, 2015b). The results of these evaluations are similar; however, an area between Station 110+00 and 152+00 was classified as Low Vulnerability by the DWR ULE Program and was considered High Vulnerability by Kleinfelder. Therefore, the High Vulnerability classification will be used for this report. The results of this evaluation are shown in Table 9.

Table 9. Sacramento River East Levee, NCC to Powerline Road Seismic Vulnerability Class

Stations	Vulnerability Class (Post-Seismic Flood Protection Ability)
0+00 to 110+00 (Natomas North ULE Station 1105+40 to 1230+76)	Low Vulnerability
110+00 to 635+00 (Natomas North ULE Station 1230+76 to 1756+00)	High Vulnerability

Because a post-earthquake remediation plan has not been developed, and the seismic vulnerability analysis has not undergone review by the IPE, the SREL - NCC to Powerline Road does not meet ULDC 7.7. SAFCA will investigate the differences between the ULE Program and Kleinfelder results and will coordinate the preparation of a post-earthquake remediation plan as part of the Non-Structural Actions to support a ULDC certification.

Sacramento River East Levee - Powerline Road to American River

The east levee along the SREL - Powerline Road to the American River between Stations 635+00 and 956+90 has been evaluated for seismic vulnerability per ULDC 7.7 (URS, 2015b). This levee was evaluated in the DWR ULE Program for post-seismic flood protection and the results of this evaluation are shown in Table 10.

Table 10. Sacramento River East Levee, Powerline Road to American River Seismic Vulnerability Class

Stations	Vulnerability Class (Post-Seismic Flood Protection Ability)
635+00 to 638+00 (Natomas North ULE Station 1756+00 to 1759+09)	High Vulnerability
638+00 to 706+00 (Natomas North ULE Station 1759+09 to 11828+00)	Low Vulnerability
706+00 to 956+90 (Natomas North ULE Station 1828+00 to 2077+50)	High Vulnerability

Because a post-earthquake remediation plan has not been developed, and the seismic vulnerability analysis has not undergone review by the IPE, the SREL - Powerline Road to the American River does not meet ULDC 7.7. SAFCA will coordinate the preparation of a post-earthquake remediation plan as part of the Non-Structural Actions to support a ULDC certification.

American River North Levee

The north levee along the American River between Stations 0+00 and 115+63 has been evaluated for seismic vulnerability per ULDC 7.7 (URS, 2015a). This levee was evaluated in the DWR ULE Program for post-seismic flood protection and the results of this evaluation are shown in Table 11.

Table 11. American River North Levee Seismic Vulnerability Class

Stations	Vulnerability Class (Post-Seismic Flood Protection Ability)
0+00 to 3+00 (Natomas South ULE Station 2077+50 to 2080+50)	High Vulnerability
3+00 to 26+50 (Natomas North ULE Station 2080+50 to 2104+00)	Low Vulnerability
26+50 to 115+63 (Natomas North ULE Station 2104+00 to 2193+25)	Medium Vulnerability

Because a post-earthquake remediation plan has not been developed, and the seismic vulnerability analysis has not undergone review by the IPE, the American River north levee does not meet ULDC 7.7. SAFCA will coordinate the preparation of a post-earthquake remediation plan as part of the Non-Structural Actions to support a ULDC certification.

Natomas East Main Drainage Canal West Levee

The NEMDC west levee between Stations 0+00 and 675+65 has been evaluated for seismic vulnerability per ULDC 7.7 (URS, 2015c). This levee was evaluated in the DWR ULE Program for post-seismic flood protection and the results of this evaluation are shown in Table 12.

Table 12. Natomas East Main Drainage Canal West Levee Seismic Vulnerability Class

Stations	Vulnerability Class (Post-Seismic Flood Protection Ability)
0+00 to 1+50 (Natomas North ULE Station 2193+25 to 2194+75)	Medium Vulnerability
1+50 to 675+65 (Natomas North ULE Station 2194+75 to 2209+00) (NEMDC West ULE Station 0+00 to 660+00)	Low Vulnerability

Because a post-earthquake remediation plan has not been developed, and the seismic vulnerability analysis has not undergone review by the IPE, the NEMDC west levee does not meet ULDC 7.7. SAFCA will coordinate the preparation of a post-earthquake remediation plan as part of the Non-Structural Actions to support a ULDC certification.

Pleasant Grove Creek Canal West Levee

The west levee along the PGCC between Stations 287+37 and 461+31 has been evaluated for seismic vulnerability per ULDC 7.7 (URS, 2015c). This was evaluated in the DWR ULE Program for post-seismic flood protection and this levee was reported to have a "Low Vulnerability" between Stations 287+37 (NEMDC West ULE Station 834+00) and 461+31 (NEMDC West ULE Station 660+00). See Table 13 below.

Because a post-earthquake remediation plan has not been developed, and the seismic vulnerability analysis has not undergone review by the IPE, the PGCC west levee does not meet ULDC 7.7. SAFCA will coordinate the preparation of a post-earthquake remediation plan as part of the Non-Structural Actions to support a ULDC certification.

Table 13. Pleasant Grove Creek Canal West Levee Seismic Vulnerability Class

Stations	Vulnerability Class (Post-Seismic Flood Protection Ability)
287+37 to 461+31 (NEMDC West ULE Station 834+00 to 660+00)	Low Vulnerability

ULDC 7.8: Levee Geometry

ULDC 7.8 provides several sources of geometry guidelines for existing levees and also includes geometry requirements for new levees or levees with extensive reconstruction situated along major waterways (Table). At locations where a cutoff wall is present within the levee prism, the definition of a zoned embankment would be met per ULDC 7.8. Additional factors such as wide levees, central clay cores, landside filters or drains, or soil reinforcement will also be considered. Where a levee segment does not meet ULDC geometry criteria and a cutoff wall or other factor is not present, but the levee segment meets seepage and stability analysis criteria, does not have past performance issues, and does not have O&M concerns from the LMA, an exception will be prepared to support the ULDC certification.

Table 14. Levee Geometry Guidance

Case	Title 23 Requirements	ULDC Requirements for New or Extensively Reconstructed Levees Along Major Waterways
Minimum Crown Width	20 feet (major stream levees) 12 feet (minor stream levees)	20 feet
Minimum Waterside Levee Slope	3H:1V 4H:1V (bypass levees)	3H:1V 4H:1V (bypass levees)
Minimum Landside Levee Slope	2H:1V 3H:1V (bypass levees)	3H:1V

ULDC 7.8.1 allows levees wider than the minimum requirement to have steeper slopes if the minimum required dimensions would fit entirely within the actual levee, and if seepage and slope stability criteria are met (for both deep and shallow failure surfaces). In addition, levees with slopes steeper than the new minimum requirements may be acceptable with elements such as central clay cores, seepage cutoff walls, landside filters or drains, or soil reinforcement with confirmation from the LMA that they can adequately maintain the slope. ULDC 7.8.2 requires a patrol road along the crown of the levee for inspection, maintenance, and flood-fighting. The patrol road must be designed, constructed, and maintained to provide "all-weather" support of maintenance and patrolling vehicles.

Natomas Cross Canal South Levee

The south levee along the NCC between Stations 0+00 and 287+37 has been evaluated for geometry per ULDC 7.8 (Kleinfelder, 2009a; URS, 2015b). As-built drawings (Kleinfelder, 2010b, 2010c, 2011a, 2011b; URS, 2015b) demonstrate an upper waterside slope inclination of 3H:1V, a landside slope inclination of 3H:1V and a crown width of 20 feet. Therefore, the landside slope and crown width meet ULDC 7.8; however, lower waterside levee slopes are steeper than 3H:1V (as steep as 2.5H:1V) in some locations. Sudden drawdown stability analysis (Kleinfelder, 2009a) of these conditions appears to meet ULDC requirements and the levee contains a seepage cutoff wall; therefore, this levee appears to meet ULDC 7.8 requirements for geometry except where windows in the cutoff wall were left for pump stations (between Stations 56+00 to 61+00 and Stations 118+50 and 122+90); for the Highway 99 crossing (between Stations 225+70 and 231+10); and the upstream 437 feet where they do not meet criteria. Closure of the windows is currently being designed as part of the USACE Natomas Project. The remaining upstream 437 feet of the NCC, from the ending station of the cutoff wall (Station 283+00) to the centerline of Howsley

Road (Station 287+37) will be addressed as part of the USACE Natomas Project. A patrol road is present along the crown of the levee. The NCC south levee will be reevaluated for geometry upon completion of the USACE Natomas Project.

Sacramento River East Levee - NCC to Powerline Road

The east levee along the SREL - NCC to Powerline Road between Stations 0+00 and 654+50 has been evaluated for geometry per ULDC 7.8 (Kleinfelder, 2009b, 2009c, 2010a, 2010d, 2010e, 2010f; URS, 2015a). As-built drawings (Kleinfelder, 2013a, 2013b, 2015; URS, 2015b) demonstrate a landside slope inclination of 3H:1V and a crown width of 20 feet. The waterside levee slopes are steeper than 3H:1V (as steep as 2.5H:1V) in some locations. The waterside slope of the new adjacent levee constructed for the NLIP is the old Sacramento River levee, which has resulted in a wide levee section at in this reach. In addition, the NLIP included seepage cutoff walls and seepage berms. The Garden Highway, a paved county road, is on top of the old Sacramento River levee. In addition to the above, sudden drawdown stability analysis (Kleinfelder, 2010a, 2010e) of these conditions meet ULDC requirements; therefore, this levee appears to meet ULDC 7.8 requirements for geometry except where there is a window in the cutoff wall for Interstate 5 (between Stations 440+00 to 460+00) and does not meet. Closure of this window is currently being designed as part of the USACE Natomas Project. A patrol road is present along the crown of the adjacent levee. The SREL - NCC to Powerline Road will be reevaluated for geometry upon completion of the USACE Natomas Project.

Sacramento River East Levee - Powerline Road to American River

The SREL - Powerline Road to the American River (Stations 654+50 and 956+90) has been evaluated for geometry per ULDC 7.8 (Kleinfelder, 2010e; URS, 2015b). The levee has landside and waterside levee slopes which are steeper than 2H:1V and 3H:1V, respectively (as steep as 1.1H:1V landside and 2H:1V waterside) in some locations (Kleinfelder, 2010e; URS, 2015c) and a crest width ranging between 20 feet to over 50 feet. As discussed in Sections 7.4, portions of this levee do not meet ULDC 7.4 for slope stability (i.e., between Station 654+50 to 692+00, Station 737+00 to 832+00, and Station 875+00 to 924+50). Therefore, the levee segments appearing to meet ULDC 7.4 for slope stability (i.e., between Station 692+00 to 737+00, Station 832+00 to 875+00, and Station 924+00 to 956+90) are also appearing to meet the ULDC 7.8 requirements for geometry by exception. Garden Highway serves as a patrol road along the crown of the levee. Remediation of this levee is currently being designed by the USACE as part of the Natomas Project. The SREL - Powerline Road to the American River, will be reevaluated for geometry upon completion of the USACE Natomas Project.

American River North Levee

The American River north levee has been evaluated for geometry per ULDC 7.8 (Kleinfelder Geomatrix JV 2012 and URS 2015c). The levee crest width varies from 20 feet to over 50 feet. Landside and waterside levee slopes are steeper than 2H:1V and 3H:1V, respectively (as steep as 1.5H:1V landside and 1H:1V waterside). This is a wide levee; however, as discussed in Section 7.4, portions of this levee do not meet ULDC 7.4 for slope stability (i.e., between Station 2+63 to 31+00 and Station 50+00 to 106+17). Therefore, the levee segments appearing to meet ULDC 7.4 for slope stability (i.e., between Station 0+00 to 2+63, Station 31+00 to 50+00, and Station 106+17 to 115+63) are also appearing to meet ULDC 7.8 requirements for geometry by exception. Garden Highway serves as a patrol road along a majority of the crown of the levee. Adjacent to Interstate 5, a patrol road is present along the crown of the levee where the Garden Highway transitions to the levee toe. Remediation of this levee is currently being designed by

the USACE as part of the Natomas Project. The American River north levee will be reevaluated for geometry upon completion of the USACE Natomas Project.

Natomas East Main Drainage Canal West Levee

The west levee along the NEMDC between Stations 0+00 and 675+65 has been evaluated for geometry per ULDC 7.8 (URS 2015a). The levee crest is narrower than 20 feet in some locations, and the landside and waterside levee slopes are steeper than 2H:1V and 3H:1V, respectively, (as steep as 1.7H:1V landside and 2.3H:1V waterside) in some locations. As discussed in Section 7.4, portions of this levee do not meet ULDC 7.4 for slope stability for intermittently loaded levees. Therefore, the levee segments between Station 0+00 to 37+00, Station 76+50 to 153+50, Station 234+50 to 379+00, Station 436+00 to 465+00, and Station 475+50 to 644+50 do not meet ULDC 7.8 requirements for geometry. The remaining levee segments between Station 37+00 to 76+50, Station 153+50 to 234+50, Station 379+00 to 436+00, Station 465+00 to 475+50, Station 644+50 to 675+65 appear to meet ULDC 7.8 requirements for geometry through exception. Remediation of this levee is currently being designed by the USACE as part of the Natomas Project. A patrol road is present along a majority of the levee crown. The NEMDC west levee will be reevaluated for geometry upon completion of the USACE Natomas Project.

Pleasant Grove Creek Canal West Levee

The west levee along the PGCC between Stations 287+37 and 461+31 has been evaluated for geometry per ULDC 7.8 (URS 2015a). This levee has a crest width of between 17 feet and 27 feet, which is narrower than 20 feet in some locations. The landside levee slopes are flatter than 2H:1V and the waterside levee slopes are steeper than 3H:1V (as steep as 1.9H:1V waterside) in some locations. As discussed in Section 7.4, this levee meets stability for intermittently loaded levees. Therefore, this levee appears to meet ULDC 7.8 requirements for geometry through exception. Remediation of this levee is currently being designed by the USACE as part of the Natomas Project. A patrol road is present along the crown of the levee. The PGCC west levee will be reevaluated for geometry upon completion of the USACE Natomas Project.

ULDC 7.9: Interfaces and Transitions

ULDC 7.9 highlights the need to ensure that the levee system functions holistically, such that no levee reach is more susceptible to problems than an adjacent reach due to gaps in features, loading/demand concentrations, or other three-dimensional effects when designing interfaces, transitions, and connections that commonly occur at the ends of seepage berms, seepage cutoff walls, revetments, and floodwalls.

At this time the transitions will be reported as Do Not Meet, because a detailed evaluation has not yet been performed. Kleinfelder performed a screening level evaluation of some of the features, as was described in the PIR, but did not complete a detailed evaluation of the each structure with respect to the interface with the levee embankment. The action item for this will be to complete a future study performed by Kleinfelder and Mead & Hunt to review the as-built drawings and construction document for the flood walls and closure structures project wide. Specific attention will be made for the levee embankment to structure interfaces. Once this is complete a meeting will be held with Kleinfelder, Mead & Hunt, and the NLIP Designers to confirm that these transitions will meet ULDC 7.9 during final design and construction.

Natomas Cross Canal South Levee

The south levee along the NCC between Stations 0+00 and 287+37 has been evaluated for ULDC 7.9 interfaces and transitions (Kleinfelder 2009a and URS 2015a). This levee was improved through the NLIP from 2007 through 2010. During design of the NLIP, interfaces and transitions between and at the ends of seepage cutoff walls and between the new levee embankment material and the cutoff wall and existing levee embankment were analyzed and appropriate overlaps and design elements were incorporated in the project design and construction. Therefore, the portions of the NCC between Stations 0+00 and 237+87 that meet criteria for stability and underseepage are considered to meet ULDC 7.9 for interfaces and transitions. However, there remains windows in the cutoff wall for pump stations (between Station 56+00 to 61+00 and Station 118+50 and 122+90), and for the Highway 99 crossing (between Stations 225+70 and 231+10), which will be addressed by the USACE as part of the Natomas Project. This design will consider and plan for transitions and interfaces. The remaining upstream 437 feet of the NCC, from the ending station of the cutoff wall (Station 283+00) to the centerline of Howsley Road (Station 287+37) will be addressed as part of the USACE Natomas Project. The NCC south levee will be reevaluated for transitions and interfaces upon completion of the USACE Natomas Project.

Sacramento River East Levee - NCC to Powerline Road

The east levee along the SREL - NCC to Powerline Road between Stations 0+00 and 654+50 has been evaluated for ULDC 7.9 interfaces and transitions between remediation alternatives (Kleinfelder, 2009b, 2009c, 2010a, 2010d, 2010e, 2010f, and URS, 2015a). This levee was improved through the NLIP from 2009 through 2012. During design of the NLIP, interfaces and transitions between and at the ends of seepage cutoff walls, stability berms, the adjacent levee, and seepage berms and between the new adjacent levee embankment material and the cutoff wall, stability berms, seepage berms, and existing levee embankment were analyzed and appropriate overlaps and design elements were incorporated in the project design and construction. Therefore, the east levee along the SREL - NCC to Powerline Road between Stations 0+00 and 654+50 that meet criteria for stability and underseepage are considered to meet ULDC 7.9 for interfaces and transitions. However, there remains a window in the cutoff wall for Interstate 5 (between Stations 440+00 to 460+00), which will be addressed by the USACE as part of the Natomas Project. This design will consider and plan for transitions and interfaces. The SREL - NCC to Powerline Road, will be reevaluated for transitions and interfaces upon completion of the USACE Natomas Project.

Sacramento River East Levee - Powerline Road to American River

The east levee along the SREL - Powerline Road to the American River between Stations 654+50 and 956+90 has been evaluated for ULDC 7.9 interfaces and transitions between remediation alternatives (Kleinfelder, 2010e and URS, 2015a). Significant portions of this levee do not meet stability and/or underseepage criteria; therefore, this levee has not been evaluated for ULDC 7.9 interfaces and transitions. Remediation of the stability and seepage issues is currently being designed as part of the USACE Natomas Project. This design will consider and plan for transitions and interfaces. The SREL - Powerline Road to the American River, will be reevaluated for transitions and interfaces upon completion of the USACE Natomas Project.

American River North Levee

The north levee along the American River between Stations 0+00 and 115+63 has not been evaluated for ULDC 7.9 interfaces and transitions since significant portions of this levee do not meet stability and/or underseepage criteria. Remediation of the stability and seepage issues is currently being designed as part of the USACE Natomas Project. This design will consider and plan for transitions and interfaces. The American River north levee will be reevaluated for transitions and interfaces upon completion of the USACE Natomas Project.

Natomas East Main Drainage Canal West Levee

The west levee along the NEMDC between Stations 0+00 and 675+65 has not been evaluated for ULDC 7.9 interfaces and transitions since significant portions of this levee do not meet stability and/or underseepage criteria. Remediation of the stability and seepage issues is currently being designed as part of the USACE Natomas Project. This design will consider and plan for transitions and interfaces. The NEMDC west levee will be reevaluated for transitions and interfaces upon completion of the USACE Natomas Project.

Pleasant Grove Creek Canal West Levee

The west levee along the PGCC between Stations 287+37 and 461+31 has not been evaluated for ULDC 7.9 interfaces and transitions since significant portions of this levee do not meet underseepage criteria. Remediation of the seepage issues is currently being designed as part of the USACE Natomas Project. This design will consider and plan for transitions and interfaces. The PGCC west levee will be reevaluated for transitions and interfaces upon completion of the USACE Natomas Project.

ULDC 7.10: Erosion

Levees that pose an immediate erosional breaching hazard during either a flood or normal flow condition need to be repaired to meet ULDC. Similarly, levees that are likely to be significantly damaged during either a flood or normal flow condition should be protected with appropriate slope treatments. Erosion hazards are evaluated for the following conditions: (1) high-velocity flows coupled with erosive levee materials and/or poor hydraulic conditions; (2) large waves developed by wind over large, open bodies of water; and (3) boat wakes.

Natomas Cross Canal South Levee

In 2009, NHC conducted an erosion study of the NCC south levee and recommended 4,500 feet of repair along the levee bank. As part of the NLIP, SAFCA constructed a wider, raised levee which also shifted the levee template away from the canal. The new alignment mitigates the erosion that was previously identified and further remediation of erosion activity will be monitored and addressed as a maintenance action if required. Therefore, the NCC south levee appears to meet ULDC 7.10 for erosion. However, the erosion evaluation has not undergone review by the IPE and therefore, the NCC south levee does not meet ULDC 7.10.

Sacramento River East Levee - NCC to Powerline Road

Since 1998, the Sacramento River Bank Protection Program (SRBPP) has provided authority for the USACE to implement erosion protection projects along the Sacramento River, including the Natomas portion of the SREL. Prior to NLIP construction, the evaluations conducted as part of the SRBPP identified 3,816 feet of levee bank for repair along this section of SREL (USACE, 2007). In addition, in 2009 NHC conducted an erosion study and identified an additional 2,700 of levee bank was necessary for repair. The USACE has completed the erosion repair for the 3,816 feet, while SAFCA addressed the additional 2,700 through construction of the adjacent levee, which shifts the levee template away from the river bank. The SREL - NCC to Powerline Road appears to meet ULDC 7.10 for erosion. However, the erosion evaluation has not undergone review by the IPE and therefore, the SREL - NCC to Powerline Road, does not meet ULDC 7.10.

Sacramento River East Levee - Powerline Road to American River

As described for the SREL - from NCC to Powerline Road, the USACE conducted its erosion evaluation as part of the Sacramento River Bank Protection Program (USACE, 2007) and NHC subsequently conducted a separate erosion evaluation for between Powerline Road to American River (NHC, 2009). There were no erosion sites identified by either USACE or NHC along this section of SREL. The SREL - Powerline Road to the American River appears to meet ULDC 7.10 for erosion. However, the erosion evaluation has not undergone review by the IPE and therefore, the SREL - Powerline Road to American River, does not meet ULDC 7.10.

American River North Levee

NHC performed an erosion evaluation of the American River north levee in Natomas (NHC, 2009). There were no erosion sites identified as requiring remediation. The American River north levee appears to meet ULDC 7.10 for erosion. However, the erosion evaluation has not undergone review by the IPE and therefore, the American River north levee does not meet ULDC 7.10.

Natomas East Main Drainage Canal West Levee

NHC performed an erosion evaluation of the NEMDC west levee and identified 620 feet of potential erosion repair although it noted the site was not actively eroding (NHC, 2009). The erosion site is being monitored and will be addressed as a maintenance action if necessary. The USACE will be evaluating this levee as part of the Natomas Project and will make a determination of whether they think remediation is required for erosion. Since the site is not actively eroding and we have concluded it does not represent a threat to the integrity of the levee, the NEMDC west levee appears to meet ULDC 7.10 for erosion. However, the erosion evaluation has not undergone review by the IPE and therefore, the NEMDC west levee does not meet ULDC 7.10.

Pleasant Grove Creek Canal West Levee

NHC performed an erosion evaluation of the PGCC west levee and identified 1,500 feet of potential erosion repair, although it noted this site was not actively eroding (NHC, 2009). The erosion site is being monitored and will be addressed as a maintenance action if necessary. The USACE will be evaluating this levee as part of the Natomas Project and will make a determination of whether they think remediation is required for erosion. Since the site is not actively eroding and we have concluded it does not represent a threat to the integrity of the levee, the PGCC west levee appears to meet ULDC 7.10 for erosion. However,

the erosion evaluation has not undergone review by the IPE and therefore, the PGCC west levee does not meet ULDC 7.10.

ULDC 7.11: Right-of-Way

Per ULDC, right-of-way criteria for levees and floodwalls in urban and urbanizing areas need to allow adequate room for maintenance, inspection, patrolling during high water, and flood-fighting; allow additional room to expand facilities in the future; and prohibit excavations and land modifications that would endanger the integrity of the levee or floodwall.

Specifically, the ULDC requires fee title or an easement for the entire levee prism extending to a minimum of 20 feet beyond the landside toe of the flood protection system for access and inspection. Alternatives to obtaining the landward 20 feet in fee or easement, include obtaining a minimum 10-foot-wide landside access zone through fee or easement and/or securing visibility for the 20-foot zone landward of the levee toe. Furthermore, waterward of the levee prism, where there is sufficient area to do so without resulting in the loss of sensitive riparian habitat, consideration should be given to acquiring a 15-foot-wide zone for inspection and maintenance.

In addition to the minimums required by the ULDC for access and inspection, the ULDC recommends acquiring right-of-way that has a width equal to at least four times the levee height or 50 feet, whichever is greater, on the landside of the 20-foot clear zone for longer-term flood protection.

Lastly, the ULDC recommends that the City or County adopt restrictions on excavations within 200 to 400 feet depending on the levee height.

Natomas Cross Canal South Levee

As part of the NLIP, SAFCA acquired, in-fee title or easement of the newly constructed levee embankment, a 19-foot-wide elevated levee toe road (approximately 2 feet above landside grade), and additional right-of-way for operations and maintenance access. The NCC south levee appears to meet ULDC 7.11 for right-of-way. However, the right-of-way has not undergone review by the IPE and therefore, the NCC south levee does not meet ULDC 7.11.

Sacramento River East Levee - NCC to Powerline Road

RD 1000 has in-fee or easement rights to the former "Garden Highway Levee" extending from the landside toe of the levee to the river bank. As part of the NLIP, SAFCA acquired, in-fee title or easement, the newly constructed levee embankment and an O&M corridor along the landside levee toe. The SREL - NCC to Powerline Road will meet ULDC 7.11 for right-of-way. However, the right-of-way has not undergone review by the IPE and therefore, the SREL - NCC to Powerline Road does not meet ULDC 7.11.

Sacramento River East Levee - Powerline Road to American River

RD 1000 has in-fee or easement rights to the former "Garden Highway Levee" generally extending from a 10-foot area landward of the levee toe to the river bank along the SREL - Powerline Road to the American River. As part of the USACE Natomas Project, SAFCA and the State will be acquiring in-fee title or easement for a widened levee embankment and a minimum of 10-feet and 20-feet landside, where possible, landward of the levee toe. However, unique to the area is the significant waterside development. The SREL - Powerline Road to American River currently does not meet ULDC 7.11 for right-of-way. The levee is being improved as part of the USACE Natomas Project. The SREL - Powerline Road to American River, will be reevaluated for right-of-way upon completion of the USACE Natomas Project. Additionally, SAFCA is preparing a long term right-of-way plan as part of the Non-Structural Actions.

American River North Levee

In general, RD 1000 presently owns or has easements covering the levee embankment but does not presently own or have easements 20 feet landward of the toe along the American River north levee. As part of the USACE Natomas Project, SAFCA and the State will be acquiring in-fee title or easement for the levee embankment and a minimum of 10-feet, and 20-feet, where possible, landward of the levee toe. The SREL - Powerline Road to American River north levee does not currently meet ULDC 7.11 for right-of-way. The levee is being improved as part of the USACE Natomas Project. The American River north levee, will be reevaluated for right-of-way upon completion of the USACE Natomas Project. Additionally, SAFCA is preparing a long term right-of-way plan as part of the Non-Structural Actions.

Natomas East Main Drainage Canal West Levee

In general, RD 1000 presently owns or has easements covering the levee embankment but does not presently own or have easements 20 feet landward of the toe along the NEMDC west levee. As part of the USACE Natomas Project, SAFCA and the State will be acquiring in-fee title or easement for the widened levee embankment and a minimum of 10-feet and 20-feet, where possible, landward of the levee toe. The NEMDC west levee currently does not meet ULDC 7.11 for right-of-way. The levee is being improved as part of the USACE Natomas Project. The NEMDC west levee, will be reevaluated for right-of-way upon completion of the USACE Natomas Project. Additionally, SAFCA is preparing a long term right-of-way plan as part of the Non-Structural Actions.

Pleasant Grove Creek Canal West Levee

Similar to the NEMDC west levee, RD 1000 presently owns or has easements covering the levee embankment but does not presently own or have easements 20 feet landward of the toe along the PGCC west levee and therefore, the NEMDC west levee currently does not meet ULDC 7.11 for right-of-way. The PGCC west levee is being improved as part of the USACE Natomas Project. The PGCC west levee will be reevaluated for right-of-way upon completion of the USACE Natomas Project. Additionally, SAFCA is preparing a long term right-of-way plan as part of the Non-Structural Actions.

ULDC 7.12: ENCROACHMENTS

ULDC 7.12 requires a hazard assessment of each existing encroachment, permitted or not, to determine the encroachment's impact on the reliability of levee performance for the full range of loading up to the HTOL. The evaluation of encroachments within the channel, on the levee, and within the landside right-of-way considers the following: type, age, condition, performance history, impacts on the levee structural integrity, impacts on the hydraulic effect of the channel, and impacts on the O&M of the levee. If encroachments are considered high-hazard, additional evaluation and action is required. In addition, for existing encroachments that are not considered to be high-hazard, but either: (1) have not been permitted, or (2) interfere with operation, maintenance, or flood fight capability, the City or County is required to have an encroachment remediation plan in place.

Between 2006 and 2011, SAFCA performed an inventory of encroachments along the Natomas Levee System and numerous encroachments were documented in this levee system (Mead & Hunt, 2014). The levee system has not been evaluated for hazard assessments of the encroachments based on ULDC, which did not exist at the time of the inventory. Therefore, it is currently unknown if the Natomas Levee System appears to meet ULDC for encroachments. An analysis of encroachments will be conducted to support a ULDC certification and corrective action taken as necessary.

Natomas Cross Canal South Levee

As described above, SAFCA has performed an inventory of encroachments along the Natomas levee System, but the levee system has not been evaluated for hazard assessments based on ULDC. It should be noted that as part of the NLIP, SAFCA modified, removed, or replaced the majority of encroachments on the NCC south levee to bring them into ULDC compliance. While it is expected that the USACE Natomas Project will address any high hazard encroachments, SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to ensure there are no outstanding encroachments that would affect the reliable performance of the facility for the DWSE and HTOL.

SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to determine the impact of encroachments on the reliable performance of the facility for the DWSE and HTOL. In the case of any potential high hazard encroachment, SAFCA will facilitate removal or modification of the encroachment, or conduct a full engineering evaluation to determine if the hazard is acceptable. In addition, SAFCA will prepare an encroachment remediation plan for the County as part of the Non-Structural Actions.

Sacramento River East Levee - NCC to Powerline Road

As described above, SAFCA has performed an inventory of encroachments along the Natomas levee System, but the levee system has not been evaluated for hazard assessments based on ULDC. It should be noted that as part of the NLIP, SAFCA modified, removed, or replaced encroachments within levee section and landside on SREL from NCC to Powerline Road to bring them into ULDC compliance. Additionally, risk presented by encroachments related to waterside development was reduced through construction of the adjacent levee for the SREL from NCC to Powerline Road.

SAFCA will conduct a hazard assessment as part of the Non-Structural Actions and will facilitate removal or modification of the encroachment, or conduct a full engineering evaluation to determine if the hazard is acceptable. In addition, SAFCA will prepare an encroachment remediation plan for the County as part of the Non-Structural Actions.

Sacramento River East Levee - Powerline Road to American River

As described above, SAFCA has performed an inventory of encroachments along the Natomas levee System, but the levee system has not been evaluated for hazard assessments based on ULDC.

SAFCA and the USACE, as part of the Natomas Project, will modify, remove, or replace any encroachments within the project footprint. While it is expected that this will address any high-hazard encroachment, SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to ensure there are no outstanding encroachments that would affect the reliable performance of the facility for the DWSE and HTOL. In the case of any potential high hazard encroachment, SAFCA will facilitate removal or modification of the encroachment, or conduct a full engineering evaluation to determine if the hazard is acceptable. In addition, SAFCA will prepare an encroachment remediation plan for the City and County as part of the Non-Structural Actions.

American River North Levee

As described above, the Natomas Levee System has not been evaluated for high hazard encroachments and it currently unknown if the levee system appears to meet ULDC for encroachments. While it is expected that the USACE Natomas Project will address any high-hazard encroachments along the American River north levee, SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to ensure there are no outstanding encroachments that would affect the reliable performance of the facility for the DWSE and HTOL. In the case of any potential high hazard encroachment, SAFCA will facilitate removal or modification of the encroachment, or conduct a full engineering evaluation to determine if the hazard is acceptable. In addition, SAFCA will prepare an encroachment remediation plan for the City as part of the Non-Structural Actions.

Natomas East Main Drainage Canal West Levee

As described above, the Natomas Levee System has not been evaluated for high hazard encroachments and it currently unknown if the levee system appears to meet ULDC for encroachments. While it is expected that the USACE Natomas Project will address any high-hazard encroachments along the NEMDC west levee, SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to ensure there are no outstanding encroachments that would affect the reliable performance of the facility for the DWSE and HTOL. In the case of any potential high hazard encroachment, SAFCA will facilitate removal or modification of the encroachment, or conduct a full engineering evaluation to determine if the hazard is acceptable. In addition, SAFCA will prepare an encroachment remediation plan for the City and County as part of the Non-Structural Actions.

Pleasant Grove Creek Canal West Levee

As described above, the Natomas Levee System has not been evaluated for high hazard encroachments and it currently unknown if the levee system appears to meet ULDC for encroachments. While it is expected that the USACE Natomas Project will address any high-hazard encroachments along the PGCC west levee, SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to ensure there are no outstanding encroachments that would affect the reliable performance of the facility for the DWSE and HTOL. In the case of any potential high hazard encroachment, SAFCA will facilitate removal or modification of the encroachment, or conduct a full engineering evaluation to determine if the hazard is

acceptable. In addition, SAFCA will prepare an encroachment remediation plan for the County as part of the Non-Structural Actions.

ULDC 7.13: PENETRATIONS

ULDC 7.13 requires a hazard assessment of each existing penetration, permitted or not, to determine the penetrations impact on the reliability of levee performance for the full range of loading up to the HTOL. The evaluation of penetrations considers the type of utility, size and number of joints, closure structures, composition material, location in relation to DWSE, inspection reports, etc. If penetrations are considered high-hazard, additional evaluation and action are required. For other existing penetrations that are not considered to be high-hazard, but have not been permitted, the City or County is required to have a penetration remediation plan in place for the entire length of levee that the finding is to cover.

Between 2006 and 2011, SAFCA performed an inventory of penetrations along the Natomas Levee System (Mead & Hunt, 2015d). This inventory did not include a high hazard evaluation in accordance with ULDC requirements. Several penetrations are present in this levee system and will be evaluated for compliance with ULDC criteria.

Natomas Cross Canal South Levee

Penetrations through the NCC south levee meet ULDC requirements, except at the Natomas Central Mutual Water Company's (NCMWC) Bennett Pumping Plant, the NCMWC's Northern Main Pumping Plant, and the RD1000 Pumping Plant #4. Therefore, at this time, the NCC south levee does not meet ULDC 7.13 for penetrations. The Bennett and Northern Main pumping plants have since been removed, the penetrations capped, and the pipes will be removed as part of the USACE Natomas Project. Pumping Plant #4 is being replaced as part of the USACE Natomas Project. The NCC south levee will be reevaluated for penetrations upon completion of the USACE Natomas Project.

Sacramento River East Levee - NCC to Powerline Road

Penetrations through the SREL - NCC to Powerline levee meet ULDC requirements for penetrations, with the exception of the Natomas Central Mutual Water Company's Pritchard and Elkhorn Pumping Plants. Therefore, at this time, the Sacramento River east levee, NCC to Powerline does not meet ULDC 7.13 for penetrations. In addition, SAFCA will prepare a penetration remediation plan for the County as part of the Non-Structural Actions.

Sacramento River East Levee - Powerline Road to American River

As described above, while penetrations within the Natomas Levee System have been inventoried, they have not been evaluated and therefore, do not meet ULDC 7.13 for penetrations. Penetrations in this levee are planned for modification or replacement as part of the USACE Natomas Project. SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to determine the impact of penetrations on the reliable performance of the facility for the DWSE and HTOL. In addition, SAFCA will prepare a penetration remediation plan for the City and County as part of the Non-Structural Actions.

American River North Levee

As described above, while penetrations within the Natomas Levee System have been inventoried, they have not been evaluated and therefore, do not meet ULDC 7.13 for penetrations. Penetrations in this levee are planned for modification or replacement as part of the USACE Natomas Project. In any case, SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to determine the impact of penetrations on the reliable performance of the facility for the DWSE and HTOL. In addition, SAFCA will prepare a penetration remediation plan for the City as part of the Non-Structural Actions.

Natomas East Main Drainage Canal West Levee

As described above, while penetrations within the Natomas Levee System have been inventoried, they have not been evaluated and therefore, do not meet ULDC 7.13 for penetrations. Penetrations in this levee are planned for modification or replacement as part of the USACE Natomas Project. SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to determine the impact of penetrations on the reliable performance of the facility for the DWSE and HTOL. In addition, SAFCA will prepare a penetration remediation plan for the City and County as part of the Non-Structural Actions.

Pleasant Grove Creek Canal West Levee

As described above, while penetrations within the Natomas Levee System have been inventoried, they have not been evaluated and therefore, do not meet ULDC 7.13 for penetrations. Penetrations in this levee are planned for modification or replacement as part of the USACE Natomas Project. SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to determine the impact of penetrations on the reliable performance of the facility for the DWSE and HTOL. In addition, SAFCA will prepare a penetration remediation plan for the County as part of the Non-Structural Actions.

ULDC 7.14: Floodwalls, Retaining Walls, and Closure Structures

ULDC 7.14 presents requirements for design of special features such as floodwalls, retaining walls, and closure structures. This information is included in EM 1110-2-1913, EM 1110-2-2502, EC 1110-2-6067, and ETL 1110-2-571. All global slope stability and embankment through-seepage and underseepage safety criteria requirements are applicable for floodwalls, retaining walls, and closure structures on levees. In addition, the civil engineer must evaluate and address the potential for the floodwall to induce settlement in the levee.

Floodwalls and retaining walls should only be used where it is impractical to use a conventional earth embankment, such as where there is insufficient space due to preexisting improvements. If floodwalls are proposed on a levee, they should only be used for supplemental freeboard along the levee crest and account for impacts on operation and maintenance.

For closure structures, the civil engineer needs to provide the following information: maintaining entity, levee mile, Global Positioning System coordinates, Board permit number (if applicable), structure details, length of time to close structure, location and type of materials for closure, structure dimensions, age, and performance history.

Closure structures are required to be tested at least once a year before the flood season so that crews responsible for implementing the structures are familiar with their operation, and to provide assurance that all parts are present and in working order.

Retaining walls located on the levee slope and installed by adjacent landowners are considered to be encroachments (see ULDC 7.12).

Natomas Cross Canal South Levee

There are no permanent closure structures (miter gates) or retaining walls along the NCC south levee. There are existing floodwalls present where Highway 99 crosses the levee. The floodwalls have not been evaluated using ULDC, as this reach is planned for improvement as part of the USACE Natomas Project, which will include installation of stop log closure structures along the southern end of the Highway 99 bridges and improvements to the bridge abutments to resist uplift pressure during high water events. Therefore, the NCC south levee presently does not meet ULDC 7.14 criteria for floodwalls, retaining walls, and closure structures. This levee is being improved as part of the USACE Natomas Project; upon completion, the NCC south levee will be reevaluated for floodwalls, retaining walls, and closure structures.

Sacramento River East Levee - NCC to Powerline Road

There are no floodwalls, retaining walls, or closure structures along the Sacramento River east levee, NCC to Powerline Road. However, a floodwall is planned at the Interstate 5 crossing of the river. The floodwall has not been evaluated using ULDC, as this location is planned for improvement as part of the USACE Natomas Project. This floodwall has also not undergone review by the IPE, and therefore, the SREL – NCC to Powerline Road. Therefore, this levee appears to meet ULDC 7.14 for existing floodwalls, retaining walls, and closure structures. The existing and proposed structures have not undergone review by the IPE and therefore, the SREL - NCC to Powerline Road, does not meet ULDC 7.14. Verification of this conclusion will be made and documented by SAFCA as part of the Non-Structural Actions to support ULDC certification.

Sacramento River East Levee - Powerline Road to American River

There are no floodwalls or closure structures along the SREL - Powerline Road to American River. Retaining walls for outfall structures along the waterside slope are present. These retaining walls have not been evaluated using ULDC as this reach is planned for improvement as part of the USACE Natomas Project. Therefore, the Sacramento River east levee, Powerline Road to American River presently does not meet ULDC 7.14 floodwalls, retaining walls, and closure structures. This levee is being improved as part of the USACE Natomas Project; upon completion, the SREL - Powerline Road to American River will be reevaluated will be reevaluated for floodwalls, retaining walls, and closure structures.

American River North Levee

There are no floodwalls or closure structures along the American River north levee. Retaining walls for outfall structures along the waterside slope are present. These retaining walls have not been evaluated using ULDC as this levee is planned for improvement as part of the USACE Natomas Project. Therefore, the American River north levee presently does not meet ULDC 7.14 floodwalls, retaining walls, and closure structures. The American River north levee will be reevaluated for reevaluated for floodwalls, retaining walls, and closure structures upon completion of the USACE Natomas Project.

Natomas East Main Drainage Canal West Levee

There are no closure structures along the NEMDC west levee. Floodwalls along bridge crossings and retaining walls for outfall structures along the waterside slope are present. The floodwalls and retaining walls have not been evaluated using ULDC as this levee is planned for improvement as part of the USACE Natomas Project. Therefore, NEMDC west levee presently does not meet ULDC 7.14 floodwalls, retaining walls, and closure structures. The NEMDC west levee will be reevaluated for reevaluated for floodwalls, retaining walls, and closure structures upon completion of the USACE Natomas Project.

Pleasant Grove Creek Canal West Levee

There are no floodwalls or closure structures along the PGCC west levee. Retaining walls adjacent to bridge crossings at Howsley Road and Fifield Road along the waterside slope are present. The retaining walls have not been evaluated using ULDC as this levee is planned for improvement as part of the USACE Natomas Project. Therefore, this levee presently does not meet ULDC 7.14 for floodwalls, retaining walls, and closure structures. The PGCC west levee will be reevaluated for floodwalls, retaining walls, and closure structures upon completion of the USACE Natomas Project.

ULDC 7.15: Animal Burrows

Borrowing animals can present a significant threat to levee integrity and therefore, proactive animal control and damage repair are required as part of levee maintenance.

RD 1000, as the LMA, currently performs routine maintenance activities including rodent abatement. Based on the USACE's re-inspection of RD 1000 Natomas Levee System in 2013, the animal control status is minimally acceptable, which "would not prevent the system from performing as intended during the next flood season" (USACE 2013a). Therefore, the Natomas Levee System appears to meet ULDC 7.15 for animal burrows.

Natomas Cross Canal South Levee

Because the IPE has not reviewed the conclusion above, the Natomas Levee System does not meet ULDC 7.15. As part of SAFCA's Non-Structural Actions, RD 1000 will prepare a formal procedural document that will include specific abatement measures to control rodent populations.

Sacramento River East Levee - NCC to Powerline Road

As described above, the Natomas Levee System does not meet ULDC 7.15 for animal burrows. As part of SAFCA's Non-Structural Actions, RD 1000 will prepare a formal procedural document that will include specific abatement measures to control rodent populations.

Sacramento River East Levee - Powerline Road to American River

As described above, the Natomas Levee System does not meet ULDC 7.15 for animal burrows. As part of SAFCA's Non-Structural Actions, RD 1000 will prepare a formal procedural document that will include specific abatement measures to control rodent populations.

American River North Levee

As described above, the Natomas Levee System does not meet ULDC 7.15 for animal burrows. As part of SAFCA's Non-Structural Actions, RD 1000 will prepare a formal procedural document that will include specific abatement measures to control rodent populations.

Natomas East Main Drainage Canal West Levee

As described above, the Natomas Levee System does not meet ULDC 7.15 for animal burrows. As part of SAFCA's Non-Structural Actions, RD 1000 will prepare a formal procedural document that will include specific abatement measures to control rodent populations.

Pleasant Grove Creek Canal West Levee

As described above, the Natomas Levee System does not meet ULDC 7.15 for animal burrows. As part of SAFCA's Non-Structural Actions, RD 1000 will prepare a formal procedural document that will include specific abatement measures to control rodent populations.

ULDC 7.16: Vegetation Evaluation

ULDC 7.16.1 requires an engineering inspection and evaluation to identify trees and other woody vegetation on the levee, and within 15 feet of the levee toe that poses an unacceptable threat to the integrity of the levee. Those posing an unacceptable threat are to be removed; those not posing an unacceptable threat need not be removed. Additionally, ULDC requires vegetation in the vegetation management zone to be trimmed and thinned to maintain access and visibility. This vegetation management is an ongoing operation and maintenance activity. Inclusion of the vegetation maintenance requirements in the LMA's O&M manual will be accomplished as part of the Non-Structural Actions.

Unique to the Natomas Levee System is a USACE approved vegetation variance (USACE, 2010c). Once the NLIP and Natomas Project improvements have been implemented, the variance generally allows existing waterside vegetation to remain, although there are some exceptions. This variance will be documented in the evaluation supporting the ULDC certification.

Natomas Cross Canal South Levee

SAFCA performed an inventory and evaluation of vegetation along the Natomas Levee System as part of the NLIP between 2008 and 2009, but this vegetation has not been evaluated using ULDC for vegetation, which did not exist at the time of the previous inventory and evaluation. SAFCA will conduct a hazard assessment and access and visibility evaluation as part of the Non-Structural Actions, and will facilitate

removal or modification of the vegetation, or conduct a full engineering evaluation to determine if the hazard is acceptable. Vegetation maintenance requirements will be documented in the LMA's O&M manual as part of the Non-Structural Actions.

It should be noted that as part of the NLIP, SAFCA removed any vegetation within the construction footprint, including the entire landside levee slope.

Sacramento River East Levee - NCC to Powerline Road

As described above, the Natomas Levee System has not been evaluated using ULDC for vegetation. SAFCA will conduct a hazard assessment, and an access and visibility evaluation, as part of the Non-Structural Actions and will facilitate removal or modification of the vegetation, or conduct a full engineering evaluation to determine if the hazard is acceptable. Vegetation maintenance requirements will be documented in the LMA's O&M manual as part of the Non-Structural Actions.

It should be noted that as part of the NLIP, SAFCA removed any vegetation within the construction footprint including the entire landside levee slope. Significant waterside vegetation is present outside the theoretical levee prism.

Sacramento River East Levee - Powerline Road to American River

As described above, the Natomas Levee System as has not been evaluated using ULDC for vegetation. This levee is being improved as part of the USACE Natomas Project; upon completion, the SREL - Powerline Road to American River, will be reevaluated for vegetation. Vegetation maintenance requirements will be documented in the LMA's O&M manual as part of the Non-Structural Actions.

American River North Levee

As described above, the Natomas Levee System has not been evaluated using ULDC for vegetation. This levee is being improved as part of the USACE Natomas Project; upon completion, the SREL - Powerline Road to American River, will be reevaluated for vegetation. Vegetation maintenance requirements will be documented in the LMA's O&M manual as part of the Non-Structural Actions.

Natomas East Main Drainage Canal West Levee

As described above, the Natomas Levee System has not been evaluated using ULDC for vegetation. This levee is being improved as part of the USACE Natomas Project; upon completion, the NEMDC west levee will be reevaluated for vegetation.

Pleasant Grove Creek Canal West Levee

As described above, the Natomas Levee System has not been evaluated using ULDC for vegetation. This levee is being improved as part of the USACE Natomas Project; upon completion, the NEMDC west levee will be reevaluated for vegetation. Vegetation maintenance requirements will be documented in the LMA's O&M manual as part of the Non-Structural Actions.

ULDC 7.17: Wind Setup and Wave Runup

ULDC 7.17 requires a wind-wave analysis. The wind setup and wave runup distances must be computed and added to the median 200-year still WSE to determine the required elevation of the MTOL. Additionally, wind setup and wave runup must also be considered for analysis of erosion and overtopping impacts. The wind and wave analysis for the NLIP is documented in Mead and Hunt, 2008.

Natomas Cross Canal South Levee

Wind and wave analysis for this levee reach was completed in 2008 in accordance with the Shore Protection Manual and ETL 1110-2-1100 (Mead & Hunt, 2008). The maximum combined wind setup and wave runup is 2.21 feet. The NCC south levee wind-wave analysis appears to meet ULDC 7.17 for wind setup and wave runup. However, this evaluation has not undergone review by the IPE and therefore, the NCC south levee does not meet ULDC 7.17. Discussion of MTOL and erosion are found above.

Sacramento River East Levee - NCC to Powerline Road

Wind and wave analysis for this levee reach was completed in 2008 in accordance with the Shore Protection Manual and ETL 1110-2-1100 (Mead & Hunt, 2008). The maximum combined wind setup and wave runup is 2.34 feet. The SREL - NCC to Powerline Road wind-wave analysis appears to meet ULDC 7.17 for wind setup and wave runup. However, this evaluation has not undergone review by the IPE and therefore, the SREL - NCC to Powerline Road does not meet ULDC 7.17. Discussion of MTOL and erosion is found above.

Sacramento River East Levee - Powerline Road to American River

Wind and wave analysis for this levee reach was completed in 2008 in accordance with the Shore Protection Manual and ETL 1110-2-1100 (Mead & Hunt, 2008). The maximum combined wind setup and wave runup is 2.18 feet. The SREL - Powerline Road to the American River wind-wave analysis appears to meet ULDC 7.17 for wind setup and wave runup. However, this evaluation has not undergone review by the IPE and therefore, the SREL - Powerline Road to the American River, does not meet ULDC 7.17. Discussion of MTOL and erosion are found above.

American River North Levee

Wind and wave analysis for this levee reach was completed in 2008 in accordance with the Shore Protection Manual and ETL 1110-2-1100 (Mead & Hunt, 2008). The maximum combined wind setup and wave runup is 2.67 feet. The American River north levee wind-wave analysis appears to meet ULDC 7.17 for wind setup and wave runup. However, this evaluation has not undergone review by the IPE and therefore, the American River north levee does not meet ULDC 7.17. Discussion of MTOL and erosion are found above.

Natomas East Main Drainage Canal West Levee

Wind and wave analysis for this levee reach was completed in 2008 in accordance with the Shore Protection Manual and ETL 1110-2-1100 (Mead & Hunt, 2008). The maximum combined wind setup and wave runup is 3.05 feet. The NEMDC west levee wind-wave analysis appears to meet ULDC 7.17 for wind

setup and wave runup. However, this evaluation has not undergone review by the IPE and therefore, the NEMDC west levee does not meet ULDC 7.17. Discussion of MTOL and erosion are found above.

Pleasant Grove Creek Canal West Levee

Wind and wave analysis for this levee reach was completed in 2008 in accordance with the Shore Protection Manual and ETL1110-2-1100 (Mead & Hunt, 2008). The maximum combined wind setup and wave runup is 3.26 feet. The PGCC west levee wind-wave analysis appears to meet ULDC 7.17 for wind setup and wave runup. However, this evaluation has not undergone review by the IPE and therefore, the PGCC west levee does not meet ULDC 7.17. Discussion of MTOL and erosion are found above.

ULDC 7.18: Security

ULDC 7.18 requires a security plan to protect urban and urbanizing area levee systems from acts of terrorism and other malicious or negligent acts. The security plan is meant to identify security personnel, responsibilities, resources, and measures. In developing the security plan, the agency/agencies responsible for levee maintenance must consider and prioritize vulnerabilities, and employ an array of security measures from four basic categories to address vulnerabilities: networked detection (criterion 7.18.1); deterrence (criterion 7.18.2); physical security (criterion 7.18.3); and intrusion interdiction (criterion 7.18.4) during high-threat periods.

The City of Sacramento Department of Utilities developed the *2016 Comprehensive Flood Management Plan* (CFMP) (City, 2016) which serves as a guidance document to reduce flood risk by means of Structural and Non-Structural Actions. One of the several risk reduction tools discussed in the CFMP is focused on the levee security plan which refers to ULDC 7.18 as its model for implementing security measures to address vulnerabilities in the levee system.

Natomas Cross Canal South Levee

A security plan specifically for the Natomas Levee System does not currently exist and therefore, this levee system does not meet ULDC 7.18 for security; however, SAFCA, in cooperation with RD 1000, will initially adopt the levee security measures outlined in the CFMP and may implement additional security elements at a later date as part of the Non-Structural Actions.

Sacramento River East Levee - NCC to Powerline Road

A security plan for the Natomas Levee System does not currently exist and therefore, this levee system does not meet ULDC 7.18 for security. SAFCA, in cooperation with RD 1000, will develop a security plan as part of the Non-Structural Actions.

Sacramento River East Levee - Powerline Road to American River

A security plan for the Natomas Levee System does not currently exist and therefore, this levee system does not meet ULDC 7.18 for security. SAFCA, in cooperation with RD 1000, will develop a security plan as part of the Non-Structural Actions.

American River North Levee

A security plan for the Natomas Levee System does not currently exist and therefore, this levee system does not meet ULDC 7.18 for security. SAFCA, in cooperation with RD 1000, will develop a security plan as part of the Non-Structural Actions.

Natomas East Main Drainage Canal West Levee

A security plan for the Natomas Levee System does not currently exist and therefore, this levee system does not meet ULDC 7.18 for security. SAFCA, in cooperation with RD 1000, will develop a security plan as part of the Non-Structural Actions.

Pleasant Grove Creek Canal West Levee

A security plan for the Natomas Levee System does not currently exist and therefore, this levee system does not meet ULDC 7.18 for security. SAFCA, in cooperation with RD 1000, will develop a security plan as part of the Non-Structural Actions.

ULDC 7.19: Sea Level Rise

ULDC 7.19 requires that the effects of sea level rise be estimated and addressed for the duration during which a ULOP Finding may be valid. The sea level rise guidance adopted by the State of California Ocean Protection Council, *State of California Sea-Level Rise Guidance Document* (March 2013), was used for this evaluation, as recommended by the ULDC. The guidance provides sea level rise projection ranges for durations of 30 years, 50 years, and 100 years, using the year 2000 as the baseline.

For the purposes of making a ULDC certification, and establishing a ULDC DWSE that is applicable over the duration of a Finding, a sea level rise of 1.0 feet over a 30-year projection was applied. However, the 30-year projection was applied beginning in year 2015, and lasting through 2045, since the projection over the 30-year duration beginning in 2000 is more than half past.

Application of the 30-year sea level rise projection will result in a 0.05 foot increase at the downstream location of the Sacramento River at the Town of Freeport (at RM 45). Although this increase is considered negligible, it is included in the ULDC DWSE (MBK, 2016a).

Natomas Cross Canal South Levee

Estimation and consideration of sea level rise for the Natomas Levee System appears to meet ULDC 7.19 for sea level rise. However, this evaluation has not undergone review by the IPE and therefore, the Natomas Levee System does not meet ULDC 7.19.

Sacramento River East Levee - NCC to Powerline Road

As described above, the Natomas Levee System does not meet ULDC 7.19.

Sacramento River East Levee - Powerline Road to American River

As described above, the Natomas Levee System does not meet ULDC 7.19.

American River North Levee

As described above, the Natomas Levee System does not meet ULDC 7.19.

Natomas East Main Drainage Canal West Levee

As described above, the Natomas Levee System does not meet ULDC 7.19.

Pleasant Grove Creek Canal West Levee

As described above, the Natomas Levee System does not meet ULDC 7.19.

ULDC 7.20: Emergency Actions and Flood Safety Plans

ULDC 7.20 includes requirements for preparing flood safety plans, as it is important that local maintaining agencies and communities understand the responsibilities of flood risk management within their jurisdictions. Specifically, the ULDC requires each public agency with the responsibility for public safety for residents protected by levees and floodwalls, to have a plan for flood events and other natural or man-made flood-related incidents that could result in human casualties, property destruction, and economic losses.

Natomas Cross Canal South Levee

While there are several emergency planning documents related to flood safety, many of which include the required information to meet ULDC 7.20, SAFCA, in cooperation with RD 1000, the City, and the County will develop, and/or update their standard operating procedure documents, emergency action plans, and/or flood safety plans, as part of the Non-Structural Actions. Because existing emergency planning documents have not been evaluated for compliance with ULDC, the Natomas Levee System does not meet ULDC 7.20.

Sacramento River East Levee - NCC to Powerline Road

As described above, the Natomas Levee System does not meet ULDC 7.20.

Sacramento River East Levee - Powerline Road to American River

As described above, the Natomas Levee System does not meet ULDC 7.20.

American River North Levee

As described above, the Natomas Levee System does not meet ULDC 7.20.

Natomas East Main Drainage Canal West Levee

As described above, the Natomas Levee System does not meet ULDC 7.20.

Pleasant Grove Creek Canal West Levee

As described above, the Natomas Levee System does not meet ULDC 7.20.

PLAN OF LEVEE SYSTEM IMPROVEMENTS TO SUPPORT AN URBAN LEVEL OF FLOOD PROTECTION

The ULDC evaluation discussed above describes the levees currently meeting or not meeting ULDC. ULOP Criteria requires a plan to provide an urban level of flood protection by 2025 for APF. This plan is provided in a separate document titled *Sacramento Area Flood Control Agency, Urban Level of Flood Protection Plan and Adequate Progress Baseline Report*, being prepared in conjunction with this report. The below sections describe the specific projects and actions necessary for the physical flood management facilities in the Natomas Levee System to meet ULDC.

FOLSOM JOINT FEDERAL PROJECT

The Folsom Dam Joint Federal Project (JFP) is federally authorized (2007), and consists of physical and operational modifications to Folsom Dam and Reservoir. These improvements include a new gated auxiliary spillway constructed on a natural ridge in the area east of the main dam, at an elevation that will substantially increase the dam's low-level discharge capacity. This new facility includes a concrete-lined approach channel and discharge chute in the left abutment below the left wing dam leading down to Folsom Dam's existing stilling basin, which would be enlarged to handle the increased discharges through the spillway. These discharges would be controlled through the installation of six submerged tainter gates (23 feet wide by 33 feet high) that would be operated conjunctively during flood events with Folsom Dam's five existing main spillway gates. Construction of the Folsom Dam JFP was initiated in 2010, and is expected to be completed in the spring of 2017.

Additionally, with this new spillway operators will have the ability to limit releases from the dam to 160,000 cfs for the 200-year event. However, without improvement the downstream levees cannot safely pass 160,000 cfs for a sustained period.

- Effect: Construction of the auxiliary spillway and appurtenant features, jointly with the Folsom Dam Raise Project, provide the physical improvements to support the operational flexibility (Folsom Dam Water Control Manual Update) to reduce the flows from Folsom Dam during a 200-year event. Water surface elevations developed for this levee system assume completion of the Folsom JFP.
- Estimated Year of Completion: 2017
- Status: On Schedule

FOLSOM DAM RAISE PROJECT

The Folsom Dam Raise Project is federally authorized (2007), and consists of raising Folsom Dam's earthen dikes and wing dams by 3.5 feet, so as to equal the height of the Folsom's main dam, and modifying the dam's five main spillway gates and three emergency spillway gates to allow dam operators to add approximately 40,000 acre-feet of additional surcharge storage capacity to the flood management operation. Construction of the Folsom Dam Raise Project is expected to commence in 2018, and be completed by 2022. The projected cost of the project is $150 million. This cost includes improvements to Folsom Dam's facilities for managing the reservoir's cold water pool for environmental enhancement. Additionally, with this raised dam and new JFP spillway, operators will have the ability to limit releases from the dam to 115,000 cfs for the 200-year event.

- Effect: Construction of the Folsom Dam Raise Project will increase overall storage capacity which, jointly with the Folsom JFP, provides the physical improvements to support the operational flexibility (Folsom Dam Water Control Manual Update) to reduce the flows from Folsom Dam during a 200-year event. Water surface elevations developed for this levee system assume completion of the Folsom Dam Raise Project.
- Estimated Year of Completion: 2022
- Status: Project Partnership Agreements are being processed.

FOLSOM DAM WATER CONTROL MANUAL UPDATE

Anticipating the improvements to Folsom Dam by the Folsom JFP and Folsom Dam Raise Project, Congress directed USACE to update the 1987 water control manual to reflect the operational capacities created by these improvements and take advantage of the National Weather Service's improving ability to forecast extreme precipitation and runoff in the American River watershed. USACE is currently working with the U.S. Bureau of Reclamation (Reclamation), SAFCA, DWR, and the CVFPB to prepare an updated flood control manual. It is anticipated that the new manual will reduce the maximum flood control space allocation to 600,000 acre-feet, and will expand the criteria used to determine this space. The new criteria will include basin wetness and forecasted inflow in addition to upstream reservoir storage. The expected completion date of the new manual is fall of 2017, following completion of the Folsom Dam JFP. It will be adjusted as necessary to reflect the accomplishments of the Folsom Dam Raise Project upon completion in 2022.

A key objective of the new manual is to ensure that Folsom Dam can reliably manage the 200-year inflows in the American River watershed without releasing more than 160,000 cfs into the American River channel. Depending on modeling of 200-year inflows and the outcome of the update, maximum discharges into the American River could be reduced, possibly to as low as 115,000 cfs during a major flood.

- Effect: An updated Folsom Dam Water Control Manual will provide dam operators with the operational flexibility (Folsom Dam Water Control Manual Update) to reduce the flows released from Folsom Dam during a 200-year event. This update relies on the construction of the Folsom Dam Raise Project and JFP.
- Estimated Year of Completion: 2022

AMERICAN RIVER COMMON FEATURES NATOMAS PROJECT

In December 2010, USACE, the State, and SAFCA recommended a plan of improvements to reduce flood risk to the Natomas Basin in the *Natomas Basin Post Authorization Change Report (PACR) and Interim General Reevaluation Report (GRR)*. The plan, referred to as the Natomas Project, was authorized for construction by Congress in 2014. The authorized plan includes all the features previously authorized by Congress in 1996 and 1999 as part of the American River Common Features Project, and additional flood risk reduction features along the Natomas Cross Canal south levee, the Sacramento River east levee, the Pleasant Grove Creek Canal west levee and the southern portion of the Natomas East Main Drainage Canal west levees. These flood risk reduction features include seepage remediation, embankment stabilization, drainage improvements, habitat restoration and right-of-way acquisition to facilitate long-term operation and maintenance activities. The State and SAFCA, as part of the NLIP, constructed most of the improvements proposed for the NCC south levee and the Sacramento River east levee from NCC to Powerline Road.

The following improvements are proposed for implementation under the elements remaining for completion by USACE as part of the Natomas Project:

- American River North Levee – widen 2 miles of levee in place and install seepage cutoff wall through levee and foundation on the Lower American River.
- Sacramento River East Levee– construct 5 miles of adjacent levee, 3.3 miles of deep seepage cutoff walls, and 4.3 miles of seepage berm.
- PGCC West Levee - widen levee in place and install 5.7 miles a soil bentonite cutoff wall.
- NEMDC West Levee – widen 12.8 miles of existing levee and install 10.7 miles of cutoff wall.
- NCC – complete improvements at Bennett and Northern Main pumping plants and at the State Route 99 closure structure.

These improvements are currently in the design phase by USACE. Construction will be phased by reach and is expected to be complete by 2025.

- Effect: Remediation of outstanding seepage and stability concerns for the entire Natomas Levee System thereby also addressing other ULDC including: seismic vulnerability; geometry; interfaces and transitions; floodwalls, retaining walls, and closures structures; high hazard encroachments, penetrations, and vegetation; and securing a minimum 10- landside access zone, up to 20 feet where possible.
- Estimated Year of Completion: 2025
- Status: Project Partnership Agreements are being processed. Federal funding for construction received in 2016.

NON-STRUCTURAL ACTIONS

In addition to the improvements being planned, designed, constructed for the levee systems described in this Engineer's Report, there remains work to bring the levee systems into compliance with ULDC. These non-structural type activities include, but are not limited to:

- Evaluation, reevaluation, and/or verification of ULDC compliance for outstanding features (e.g., ULDC DWSE, NEMDC pumping plant; interfaces and transitions; loading condition, etc.).
- Development of technical memoranda documenting compliance with ULDC where evaluations have been completed, but documentation and/or design has not yet been finalized;
- Seismic deformation analysis, as needed, and development of post-earthquake remediation plan;
- Development of a right-of-way plan to secure a 20-foot landside visibility zone, and/or, fee and/or easement acquisition of a 10-foot landside access zone;
- Review and modification and/or removal, as appropriate, of encroachments, penetrations, and vegetation to eliminate high hazards;
- Revisions to the O&M Manual for rodent abatement, vegetation, etc.
- Development of security plans; and
- Development of a Flood Safety Plan, or review and modification, as necessary, of existing plans to meet ULDC.

SAFCA, as the common interest in all of these levee systems, will serve as the facilitator and liaison among the LMAs to accomplish the work described above. Some non-structural actions may begin immediately, whereas other non-structural actions cannot begin until other work (i.e., final design or construction) is complete.

- Effect: The Non-Structural Actions would result in the Natomas Levee System meeting ULDC for seismic, right-of-way, encroachments, penetrations, vegetation, security, and flood safety plans.

- Estimated Year of Completion: 2025

2.0 DRY CREEK LEVEE SYSTEM

DESCRIPTION OF DRY CREEK LEVEE SYSTEM

The Dry Creek Right Bank Levee System is comprised of a single levee: the Dry Creek north levee (Plate 3). It is owned by SAFCA, maintained by the American River Flood Control District (ARFCD), and is rated as Minimally Acceptable in the USACE NLD.

DRY CREEK NORTH LEVEE

The Dry Creek north levee is approximately 1.59 miles long and located along the right bank of Dry Creek. The Dry Creek north levee was constructed in 1995 by SAFCA. The downstream (western) boundary of this reach is located at the NEMDC stormwater pumping station embankment (station 7000+00). The upstream (eastern) boundary of this reach is located at the intersection of Rio Linda Boulevard (station 7085+58).

The Union Pacific Railroad (UPRR) crosses the levee near the NEMDC stormwater pumping station. A stoplog is used to block this crossing during flood events and is documented in the City's Emergency Operations Plans. There is no waterside development. Landside of the levee is rural suburban development although for the majority of the levee it is not directly adjacent to the levee toe.

Where the Dry Creek levee crosses the NEMDC, the NEMDC stormwater pumping station provides a transition between the Dry Creek North Levee and the Natomas Basin's NEMDC west levee. The pump station is a line of protection pumping plant built into levee. The facility's isolation gate is normally open to allow NEMDC flow-through, and closed during high NEMDC stages to prevent backflow. When the facility's isolation gate is closed, diesel driven pumps are used to lift local NEMDC drainage flows from areas north of the plant over the Dry Creek Levee north levee into the Dry Creek floodplain.

There was no reported distress from the 1997 high water event. However, in 2001 a longitudinal crack near the centerline of the levee, longitudinal crack along the waterside of the levee, and transverse cracks on the landside (located approximately between Station 7070+00 to 7075+00 [alignment parallel to 4th Street]) was observed. Field excavation was performed to investigate the extent and cause. A specific cause of the cracking was not determined, but the cracking appeared coincidental with the presence of a line of eucalyptus trees located near the landside levee toe, which were subsequently removed. The cracked area was excavated longitudinally along the levee with an excavator. The resulting trench was backfilled in lifts, moisture conditioned, and compacted. No evidence of continued cracking has been observed to date (Kleinfelder, 2001).

EVALUATION OF DRY CREEK LEVEE SYSTEM

To support an APF, an evaluation of the Dry Creek north levee system was performed to determine if it meets ULDC. The evaluation of each levee for each criterion is provided below.

ULDC 7.1: Design Water Surface Elevation

As described in Chapter 1, the ULDC DWSE for all of the levee systems was computed in February 2016 using the FEMA approach and MBK version of Release 4 of the USACE Sacramento River HEC-RAS model, hydrology developed by the USACE for the Sacramento and San Joaquin River Basins Comprehensive Study (Comp Study) for the Sacramento River, and a flow of 115,000 cfs[3] released from Folsom Dam (MBK, 2016a). The ULDC DWSE includes adjustments for debris loading, superelevation, climate change, updated hydraulic models, and sea level rise. The ULDC DWSE memorandum (MBK, 2016a) has not undergone review by the IPE, and the Folsom JFP and Folsom Dam Raise Projects need to be completed to achieve the ULDC DWSE, therefore the Dry Creek Levee System does not meet ULDC 7.1.

Dry Creek North Levee

The computed DWSEs for the Dry Creek north levee are provided in Table . As described above, MBK, 2016a has not undergone review by the IPE, and the Folsom JFP and Folsom Dam Raise Projects need to be completed to achieve the ULDC DWSE, therefore the Dry Creek north levee does not meet ULDC 7.1.

Table 15. DWSE for Dry Creek North Levee

Hydraulic Model River Station*	Levee Station (feet)	DWSE (feet NAVD88)
2.029	7084+00	43.3
1.503	7062+00	41.9
1.06	7040+00	41.6
0.545	7023+00	41.5
0.064	7001+00	41.5

* Comp Study RM

ULDC 7.2: Minimum Top of Levee

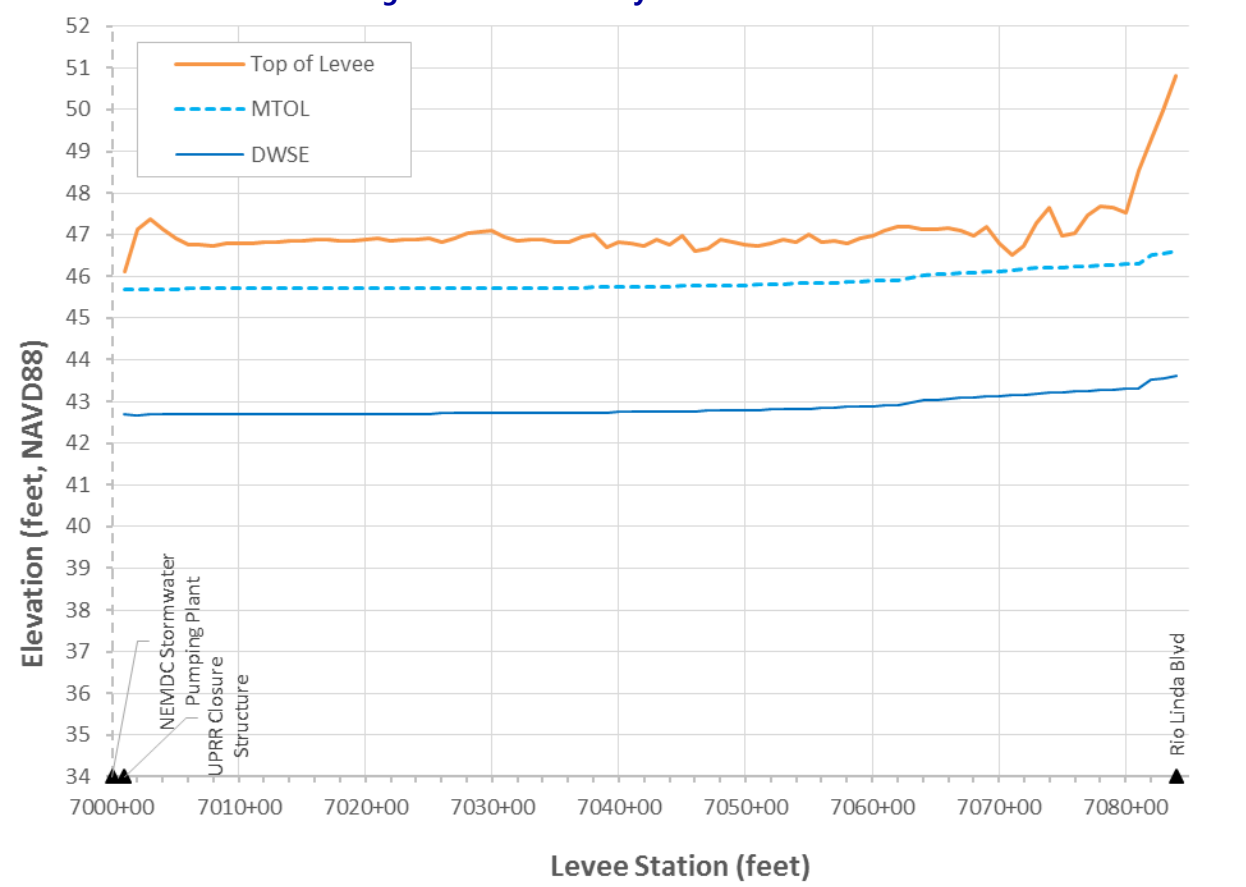
The requirements for ULDC 7.2 MTOL are described in Chapter 1.

[3] MBK determined that the 200-year release from Folsom Dam will be 115,000 cfs once the Folsom JFP and Folsom Raise projects are completed. The expected time of completion for the Folsom JFP is 2017 and for the Folsom Raise project is 2025, at which time a ULDC certification will be made.

Dry Creek North Levee

Wind setup and wave runup were computed by Mead & Hunt (Mead & Hunt, 2015a), and are discussed below in ULDC 7.17. There are no locations where wind and wave runup affects the MTOL along the Dry Creek north levee therefore the MTOL is the DWSE plus 3 feet. Figure 7 shows the computed MTOL and actual top of levee profiles. Dry Creek north levee appears to meet ULDC 7.2 for MTOL. However, because this evaluation has not undergone review by the IPE, the Dry Creek north levee does not meet ULDC 7.2.

Figure 7. MTOL for Dry Creek North Levee



ULDC 7.3: Soil Sampling, Testing, and Logging

The requirements for ULDC 7.3 soil sampling, testing, and logging are described in Chapter 1.

Dry Creek North Levee

Soil exploration information is contained in the data reports prepared by the DWR ULE Project and the SAFCA LAP (URS, 2015c; Kleinfelder, 2013a; URS, 2009). This levee was constructed in 1995 and Kleinfelder provided geotechnical observation and testing during construction. The exploration spacing described above was generally met for this levee with the exception of borings at the waterside toe and the field landside of the levee. This was a new levee rather than rehabilitation of an existing levee. Soil sampling, testing, and logging were generally performed following the guidance outlined above. The soil explorations that were obtained were used in combination with geology and geomorphology, geophysical resistivity surveys, past performance information, historical records, and construction records to provide an adequate assessment of the subsurface conditions as outlined in the SPK SOP-03 for levee evaluations. Because the soil sampling, testing, and logging do not strictly meet ULDC 7.3, an exception will be required. This exception will be prepared as part of the Non-Structural Actions in support of the ULDC certification.

ULDC 7.4: Slope Stability For Intermittently Loaded Levees

The requirements for ULDC 7.4 are described in Chapter 1. ULDC 7.4.2 requires a minimum safety factor of 1.0 to 1.2 for waterside slope stability during rapid drawdown conditions from the DWSE depending how long the embankment is saturated with the higher factor of safety used for longer duration events. A factor of safety of 1.0 was used for rapid drawdown for the Dry Creek north levee since this levee is subject to relatively short duration events. The HTOL for the Dry Creek north levee was calculated by MBK and provided for geotechnical analyses. DWR has determined that this levee is intermittently loaded as described in Section 7.6. Verification of the loading condition will be made and documented by SAFCA as part of the Non-Structural Actions to support ULDC certification.

Dry Creek North Levee

The north levee along Dry Creek was evaluated for landside slope stability as part of SAFCA's LAP (Kleinfelder, 2015a; URS, 2015a; Kleinfelder, 2013a). The levee appears to meet ULDC 7.4 for slope stability for intermittently loaded levees for the DWSE and the HTOL. However, because this evaluation has not undergone review by the IPE, the Dry Creek north levee does not meet ULDC 7.4.

ULDC 7.5: Underseepage For Intermittently Loaded Levees

The requirements for ULDC 7.5 underseepage for intermittently loaded levees is described in Chapter 1. DWR has determined that this levee is intermittently loaded as described in Section 7.6. Verification of the loading condition will be made and documented by SAFCA as part of the Non-Structural Actions to support ULDC certification.

Dry Creek North Levee

The north levee along Dry Creek was evaluated for ULDC 7.5 levee underseepage as part of SAFCA's LAP (Kleinfelder, 2015b; URS, 2015a; Kleinfelder, 2013a). The levee appears to meet ULDC 7.5 for underseepage for intermittently loaded levees for the DWSE and the HTOL. However, because this evaluation has not undergone review by the IPE, the Dry Creek north levee does not meet ULDC 7.5.

ULDC 7.6: Frequently Loaded Levees

The requirements for ULDC 7.6 frequently loaded levees is described in Chapter 1.

Dry Creek North Levee

As part of the ULE Program, DWR considered the Dry Creek north levee an intermittently loaded levee (URS, 2015b), therefore ULDC 7.6 for frequently loaded levees is not applicable. Verification of this conclusion will be made and documented by SAFCA as part of the Non-Structural Actions to support ULDC certification.

ULDC 7.7: Seismic Vulnerability

Chapter 1 describes the requirements for ULDC 7.7 seismic vulnerability and the guidelines and classifications developed DWR as part of the ULE Program.

Dry Creek North Levee

The Dry Creek north levee was evaluated for seismic vulnerability and post-seismic flood protection ability by the DWR, as part of the ULE Program, and by Kleinfelder as part of the SAFCA LAP (Kleinfelder, 2015b; Kleinfelder, 2013a). According to the DWR ULE Program findings, this levee has a "Low Vulnerability" due to the subsurface consisting of fine-grained, high-blow count soils. However, Kleinfelder's evaluation determined a portion of the levee to have "Medium Vulnerability" due to an exploration with a moderately thick layer of coarser-grained, relatively low-blow count subsurface soil. Table summarizes the Kleinfelder SAFCA LAP evaluation findings.

Table 16. Dry Creek North Levee Seismic Vulnerability Class

Stations	Vulnerability Class (Post-Seismic Flood Protection Ability)
7000+00 to 7068+00	Low Vulnerability
7068+00 to 7075+00	Medium Vulnerability
7075+00 to 7085+58	Low Vulnerability

Because a post-earthquake remediation plan has not been developed, and the seismic vulnerability analysis has not undergone review by the IPE, the Dry Creek north levee does not meet ULDC 7.7. SAFCA will coordinate the preparation of a post-earthquake remediation plan as part of the Non-Structural Actions to support a ULDC certification.

ULDC 7.8: Levee Geometry

The requirements for ULDC 7.8 levee geometry are described in Chapter 1.

Dry Creek North Levee

The north levee along Dry Creek was evaluated for geometry as part of SAFCA's LAP (Kleinfelder, 2015b; URS, 2015a; Kleinfelder, 2013a). The levee crest width varies and in locations is less than the required 20 feet. The landside levee slopes are as steep as 2H:1V and waterside levee slopes range between 3H:1V and 3.3H:1V. A patrol road is present along the crown of the levee. Although the levee does not strictly meet ULDC 7.8, the levee has performed well since its construction in 1995, and appears to meet ULDC 7 for stability. Therefore, the levee appears to meet ULDC 7.8 for geometry through an exception. However, because this evaluation and exception has not undergone review by the IPE, the Dry Creek north levee does not meet ULDC 7.8.

ULDC 7.9: Interfaces and Transitions

The requirements for ULDC 7.9 interfaces and transitions are described in Chapter 1.

Dry Creek North Levee

The Dry Creek north levee interfaces and transitions have not been evaluated. The Dry Creek north levee will be evaluated for ULDC 7.9 as part of the Non-Structural Actions in support of ULDC certification.

ULDC 7.10: Erosion

The requirements for ULDC 7.10 erosion are described in Chapter 1.

Dry Creek North Levee

In 2012, MBK performed an erosion evaluation of the Dry Creek North Levee System based on site inspection and analysis of results from hydraulic modeling (MBK, 2014). The average channel velocity along the right waterside slope of the Dry Creek north levee is approximately 1 to 1.5 fps. The low velocity and non-existent boating activity along Dry Creek diminish the likelihood of significant erosion

occurring along the waterside slope. Therefore, the Dry Creek north levee meets ULDC 7.10 for erosion. However, this evaluation has not undergone review by the IPE and therefore, the Dry Creek north levee does not meet 7.10.

ULDC 7.11: Right-of-way

The requirements for ULDC 7.11 right-of-way are described in Chapter 1.

Dry Creek North Levee

The entire length of Dry Creek north levee is located within property owned by SAFCA and the City of Sacramento which extends over 100 feet from the levee. Along the upstream portion of this levee, immediate access to the landside area of the levee is achieved by a public road, separated from the levee toe by a shallow ditch. The middle section of levee is located within a 130-foot wide parcel that bifurcated an existing private parcel, the floodplain portion that is now owned by SAFCA, providing adequate width for operations and emergency operations. The downstream portion of this levee is within City-owned property dedicated for open space. Based on the geographic conditions, the entire length of the Dry Creek north levee meets the ULDC 7.11 for right-of-way. However, this conclusion has not undergone review by the IPE and therefore, the Dry Creek north levee does not meet 7.11.

ULDC 7.12: Encroachments

The requirements for ULDC 7.12 encroachments are described in Chapter 1.

Dry Creek North Leveecccc

SAFCA performed a hazard assessment of encroachments along the Dry Creek north levee in 2013. This reach of levee is of modern construction, built in 1995, and limited encroachments are present. There are no encroachments that are considered to be either high-hazard or require removal to meet the ULDC (MBK, 2016b). This levee appears to meet ULDC 7.12 for encroachments. However, this evaluation has not undergone review by the IPE and therefore, the Dry Creek north levee does not meet 7.12. In addition, and if necessary, SAFCA will prepare an encroachment remediation plan as part of the Non-Structural Actions.

ULDC 7.13: Penetrations

The requirements for ULDC 7.13 penetrations are described in Chapter 1.

Dry Creek North Levee

Mead & Hunt performed a hazard assessment of penetrations along the Dry Creek north levee. (Mead & Hunt, 2014). This reach of levee is of modern construction, was built in 1995, and the limited penetrations were designed and constructed in accordance with modern levee standards. The penetrations are well maintained with no adverse performance issues. There are no penetrations that are considered to be either high-hazard or require removal to meet the ULDC penetration criterion. This levee appears to meet ULDC 7.13 for penetrations. However, this evaluation has not undergone review by the IPE and therefore, the Dry Creek north levee does not meet 7.13. In addition, and if necessary, SAFCA will prepare an encroachment, including penetration, remediation plan as part of the Non-Structural Actions.

ULDC 7.14: Floodwalls, Retaining Walls, and Closure Structures

The requirements for ULDC 7.14 floodwalls, retaining walls, and closure structures are described in Chapter 1.

Dry Creek North Levee

There are no floodwalls or retaining walls in the Dry Creek north levee. One closure structure for the UPRR is present, which was evaluated by SAFCA (Mead & Hunt, 2015c), and was found to be compliant with ULDC requirements. A successful trial installation was completed by the City of Sacramento in 2015 (Mead & Hunt, 2015b).

The NEMDC stormwater pumping station is a line of protection pump station and as such could be consider a closure structure. The facility is of modern construction, and was completed by SAFCA in 1997. The facility has not been evaluated using ULDC for closure structures. SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to determine the impact of the NEMDC stormwater pumping station on the reliable performance of the Dry Creek Levee. Because the evaluation performed has not undergone review by the IPE, and an evaluation of the NEMDC stormwater pumping station has not been performed, the Dry Creek north levee does not meet ULDC 7.14.

ULDC 7.15: Animal Burrows

The requirements for ULDC 7.15 animal burrows are described in Chapter 1.

Dry Creek North Levee

ARFCD, as the LMA, currently performs routine maintenance activities including rodent abatement. Based on the USACE's periodic inspection of Dry Creek North Levee System in 2010, the animal control status is minimally acceptable, which "would not prevent the system from performing as intended during the next flood season" (USACE, 2013a). The methods used for rodent abatement are consistent with the guidelines specified in Section 5 of the "*Superintendent's Guide to Operations & Maintenance of*

California's Flood Control Projects" (DWR, 1980). Therefore, the Dry Creek north levee appears to meet ULDC 7.15 for animal burrows. However, this conclusion has not undergone review by the IPE and therefore, the Dry Creek north levee does not meet ULDC 7.15. As part of SAFCA's Non-Structural Actions, ARFCD will prepare a formal procedural document that will include specific abatement measures to control rodent populations.

ULDC 7.16: Vegetation Evaluation

The requirements for ULDC 7.16 vegetation evaluation are described in Chapter 1.

Dry Creek North Levee

SAFCA conducted an inspection of the Dry Creek North Levee System in 2013. There is no vegetation on the Dry Creek north levee that poses an unacceptable threat (MBK, 2016c) to levee integrity or operation and maintenance. Therefore, this levee appears to meet ULDC 7.16 for vegetation. However, this evaluation has not undergone review by the IPE and therefore, the Dry Creek north levee does not meet ULDC 7.16. Vegetation maintenance requirements will be documented in the LMA's O&M manual as part of the Non-Structural Actions.

ULDC 7.17: Wind Setup and Wave Runup

The requirements for ULDC 7.17 wind setup and wave runup are described in Chapter 1.

Dry Creek North Levee

Wind and wave analysis for the Dry Creek north levee was completed in 2015, in accordance with the Shore Protection Manual and EM 1110-2-1100. Results (Mead & Hunt, 2015b) indicate that the maximum combined wind setup and wave runup is 2.03 feet. The Dry Creek north levee wind-wave analysis appears to meet ULDC 7.17 for wind setup and wave runup. However, this evaluation has not undergone review by the IPE and therefore, the Dry Creek north levee does not meet ULDC 7.17. Discussion of MTOL and erosion are found above.

ULDC 7.18: Security

The requirements for ULDC 7.18 security are described in Chapter 1.

Dry Creek North Levee

A security plan for the Dry Creek North Levee System does not currently exist and therefore, this levee system does not meet ULDC 7.18 for security. SAFCA, in cooperation with ARFCD, will develop a security plan as part of the Non-Structural Actions.

ULDC 7.19: Sea Level Rise

The requirements for ULDC 7.19 sea level rise are described in Chapter 1. Application of the 30-year sea level rise projection will result in a 0.05 foot increase at the downstream location of the Sacramento River at the Town of Freeport (at RM 45). Although this increase is considered negligible, it is included in the ULDC DWSE (MBK, 2016a).

Dry Creek North Levee

Although negligible, sea level rise is included in the ULDC DWSE (MBK, 2016a). Estimation and consideration of sea level rise for the Dry Creek Levee System appears to meet ULDC 7.19 for sea level rise. However, this evaluation has not undergone review by the IPE and therefore, the Dry Creek north levee does not meet ULDC 7.19.

ULDC 7.20: Emergency Actions and Flood Safety Plans

The requirements for ULDC 7.20 emergency actions and flood safety plans are described in Chapter 1.

Dry Creek North Levee

While there are several emergency planning documents related to flood safety, many of which include the required information to meet ULDC 7.20, SAFCA, in cooperation with the ARFCD, will develop and/or update their standard operating procedure documents, emergency action plans and/or flood safety plans as part of the Non-Structural Actions. Because existing emergency planning documents have not been evaluated for compliance with ULDC, the Dry Creek north levee does not meet ULDC 7.20.

PLAN OF LEVEE SYSTEM IMPROVEMENTS TO SUPPORT AN URBAN LEVEL OF FLOOD PROTECTION

As described in Chapter 1, below are the specific projects and actions necessary for the physical flood management facilities in the Dry Creek Levee System to meet ULDC.

FOLSOM JOINT FEDERAL PROJECT

A description of the Folsom JFP is provided in Chapter 1. Below is the effect the Folsom JFP will have on the Dry Creek Levee System:

- Effect: Construction of the auxiliary spillway and appurtenant features, jointly with the Folsom Dam Raise Project, provide the physical improvements to support the operational flexibility (Folsom Dam Water Control Manual Update) to reduce the flows from Folsom Dam during a 200-year event. Water surface elevations developed for this levee system assume completion of the Folsom JFP.
- Estimated Year of Completion: 2017
- Status: On Schedule

FOLSOM DAM RAISE PROJECT

A description of the Folsom Dam Raise Project is provided in Chapter 1. Below is the effect the Folsom Dam Raise Project will have on the Dry Creek Levee System:

- Effect: Construction of the Folsom Dam Raise Project will increase overall storage capacity which, jointly with the Folsom JFP, provides the physical improvements to support the operational flexibility (Folsom Dam Water Control Manual Update) to reduce the flows from Folsom Dam during a 200-year event. Water surface elevations developed for this levee system assume completion of the Folsom Dam Raise.
- Estimated Year of Completion: 2022
- Status: Project Partnership Agreements are being processed.

FOLSOM DAM WATER CONTROL MANUAL UPDATE

A description of the Folsom Dam Water Control Manual Update is provided in Chapter 1. Below is the effect the Folsom JFP will have on the Dry Creek Levee System:

- Effect: An updated Folsom Dam Water Control Manual will provide dam operators with the operational flexibility (Folsom Dam Water Control Manual Update) to reduce the flows released from Folsom Dam during a 200-year event. This update relies on the construction of the Folsom Dam Raise Project and JFP.
- Estimated Year of Completion: 2022
- Status: On Schedule

NON-STRUCTURAL ACTIONS

A description of the Non-Structural Actions is provided in Chapter 1. Below is the effect the Non-Structural Actions will have on the Dry Creek Levee System:

- Effect: The Non-Structural Actions would result in the Dry Creek Levee System meeting ULDC for seismic, right-of-way, encroachments, penetrations, vegetation, security, and flood safety plans.
- Estimated Year of Completion: 2024

3.0 ROBLA–ARCADE LEVEE SYSTEM

DESCRIPTION OF ROBLA–ARCADE LEVEE SYSTEM

The Robla – Arcade Levee System is comprised of 3 levees: Robla Creek south levee; NEMDC east levee, extending between Robla Creek and Arcade Creek; and Arcade Creek north levee (Plate 4). The system is approximately 7 miles in length. All three levees are operated and maintained by the ARFCD. The system is rated as Minimally Acceptable in the USACE NLD.

Overtopping of the railroad crossing of the Arcade Creek north levee adjacent to NEMDC east levee in 1986, also triggered the installation, in 1987, of several concrete stoplog structures throughout the Robla – Arcade levee system at railroad and road crossings where the rail or roadbed was lower than the levee crest. These structures were modified by SAFCA as part of the North Area Local Project in the mid-1990s.

ROBLA CREEK SOUTH LEVEE

The Robla Creek south levee, also known as the Linda Creek levee in the USACE 1956 construction documents, and officially named Dry Creek Left Bank (South) Levee, is the left bank or south levee of Robla Creek, which is located within the Dry Creek floodway. The levee is approximately 2.3 miles in length. The downstream portion of Robla Creek south levee (Station 6000+00 to 6052+00) was originally constructed in the 1950s by the USACE. In the 1990s, the existing levee was raised and the landside slopes were reconstructed by SAFCA, at which time the levee was extended from Station 6052+00 to 6106+66 and at which point the levee ties into high ground and continues eastward to Dry Creek Road (Station 6118+20) along the Magpie Creek Diversion Channel. A short spur levee starting at Station 6052+00, approximately 0.3 miles in length, and oriented parallel to and directly north of Claire Avenue, was constructed as part of the 1950s project and remains a Project levee although its regional flood protection purpose was overcome by the improvements made in the 1990s. The Claire Avenue levee still provides local flood protection.

The UPRR crosses the Robla Creek south levee near the NEMDC east levee where a closure structure is present. Stoplogs are used to block this crossing during flood events. There is no waterside development. Landward of the levee, land use is suburban development with some commercial use near the downstream end. Where present, this development is directly adjacent to the levee toe. The levee is crossed by Rio Linda Boulevard where floodwalls are attached to the bridge abutment and extend approximately 20 feet along the levee on each side of the bridge crossing. A temporary closure structure would be placed across the roadway during high stage events.

No past performance issues have been reported for this levee. There was no reported seepage or stability distress reported from either the 1986 or 1997 high water events.

NATOMAS EAST MAIN DRAINAGE CANAL EAST LEVEE - ROBLA CREEK TO ARCADE CREEK

The NEMDC east levee was constructed in the 1950s by the USACE, and extends from the American River to Robla Creek. The portion of the NEMDC east levee from Robla Creek to Arcade Creek is a part of the Robla-Arcade levee system. The portion of the NEMDC from Arcade Creek to the American River is part of the American River North levee system and is discussed later in this report.

The NEMDC east levee from Robla Creek to Arcade Creek (Station 3055+86 to 3192+23) is 2.4 miles long. In the 1990s, the levee was raised and the waterside and landside slopes were reconstructed.

A railroad embankment that predates the levee is located along the landside of the levee. A ditch, lined and unlined depending on location, is located approximately 50 feet from the landside railroad embankment toe (100 feet from the projected levee prism toe) for the majority of the levee reach. This ditch is associated with the City of Sacramento Drainage Pumping Plant No. 84. Additionally, an unlined drainage swale is located approximately 50 feet from the projected landside levee toe between Stations 3187+00 and 3192+25. There is no waterside development. Landward of the levee, aside from the railroad, land use is rural and suburban development with some commercial use in the upstream half; suburban development is present adjacent to the levee toe for the downstream half.

No past performance issues have been reported along this reach. There was no reported seepage or stability distress reported from either the 1986 or 1997 high water events.

ARCADE CREEK NORTH LEVEE

The Arcade Creek north levee was constructed in the 1950s by the USACE, and extends from its connection to the NEMDC east levee upstream approximately 2 miles to Marysville Boulevard. The levee is assigned a 5000 series Stationing (5000+00 to 5112+43). Levee raises or floodwalls and corresponding embankment widenings were constructed along the entire Arcade Creek north levee by SAFCA in the late 1990s. Specifically, a nearly continuous floodwall was constructed along the waterside edge of the levee crest between Stations 5075+00 and 5112+43 to meet FEMA freeboard requirements. Floodwall heights range between 1.3 and 6 feet above the levee embankment crest and slope with wall heights increasing upstream and tying into high ground at Marysville Boulevard.

The levee is crossed by Norwood Avenue, Rio Linda Boulevard, and the Sacramento Northern Bike Trail. The railroad, adjacent to the NEMDC east levee, crosses the Arcade Creek north levee at the connection of the two levees. There is no waterside development. Landward of the levee, suburban development is present adjacent to the levee toe.

There was no reported seepage or stability distress reported from either the 1986 or 1997 high water events. However, reports from ARFCD maintenance personnel reported overtopping of the temporary sandbag berm located across Rio Linda Boulevard Bridge during the 1986 flood, which overtopping flow inundated homes in the Strawberry Manor area with up to 8 feet of water. The flooding was attributed to backwater from the American River impeding the flow from NEMDC and Arcade Creek that caused the floodwater to overtop the bridge, which was a historic low spot in the levee system. Seepage during the 1986 event would not have been observed if it had occurred. The Rio Linda Boulevard Bridge was raised after the 1986 flood event and SAFCA tied the levee into the bridge railings in 1996; the Norwood Avenue

Bridge was subsequently raised. No closure structures are currently present at these crossings as they are elevated above the levee.

EVALUATION OF ROBLA–ARCADE LEVEE SYSTEM

To support an APF, an evaluation of the Robla – Arcade levee system was performed to determine if it meets ULDC. The evaluation of each levee for each criterion is provided below.

ULDC 7.1: DESIGN WATER SURFACE ELEVATION

As described in Chapter 1, the ULDC DWSE for all of the levee systems was computed in February 2016 using the FEMA approach and MBK version of Release 4 of the USACE Sacramento River HEC-RAS model, hydrology developed by the USACE for the Sacramento and San Joaquin River Basins Comprehensive Study (Comp Study) for the Sacramento River, and a flow of 115,000 cfs[4] released from Folsom Dam (MBK, 2016a). The ULDC DWSE includes adjustments for debris loading, superelevation, climate change, updated hydraulic models, and sea level rise. The ULDC DWSE memorandum (MBK, 2016a) has not undergone review by the IPE and the Folsom JFP and Folsom Dam Raise Projects need to be completed to achieve the ULDC DWSE, therefore the Robla-Arcade Levee System does not meet ULDC 7.1.

Robla Creek South Levee

The computed DWSEs for the Robla Creek South Levee are provided in Table . As described above, MBK, 2016a has not undergone review by the IPE, and the Folsom JFP and Folsom Dam Raise Projects need to be completed to achieve the ULDC DWSE, therefore the Robla Creek south levee does not meet ULDC 7.1.

Table 17. DWSE for Robla Creek South Levee

Hydraulic Model River Station*	Levee Station (feet)	DWSE (feet NAVD88)
1.978	6098+00	43.7
1.164	6057+00	41.8
0.378	6016+00	41.5
0.142	6003+00	41.5

* Comp Study RM

[4]MBK determined that the 200-year release from Folsom Dam will be 115,000 cfs once the Folsom JFP and Folsom Raise projects are completed. The expected time of completion for the Folsom JFP is 2017, and for the Folsom raise project is 2025, at which time a ULDC certification will be made.

Natomas East Main Drainage Canal East Levee – Robla Creek to Arcade Creek

The computed DWSEs for the NEMDC east levee are provided in Table 18. As described above, MBK, 2016a has not undergone review by the IPE, and the Folsom JFP and Folsom Dam Raise Projects need to be completed to achieve the ULDC DWSE, therefore the NEMDC east levee does not meet ULDC 7.1.

Table 18. DWSE for NEMDC, East Levee Robla Creek to Arcade Creek

Hydraulic Model River Station*	Levee Station (feet)	DWSE (feet NAVD88)
6.215	3191+50	42.0
6.068	3183+50	41.7
5.096	3132+00	40.5
4.265	3090+50	39.5
3.613	3055+50	38.9

* Comp Study RM

Arcade Creek North Levee

The computed DWSEs for the Arcade north levee are provided in Table . As described above, MBK, 2016a has not undergone review by the IPE, and the Folsom JFP and Folsom Dam Raise Projects need to be completed to achieve the ULDC DWSE, therefore the Arcade Creek north levee does not meet ULDC 7.1.

Table 19. DWSE for Arcade Creek North Levee

Hydraulic Model River Station*	Levee Station (feet)	DWSE (feet NAVD88)
1.841	5096+00	40.0
1.548	5080+00	39.4
1.01	5052+50	39.0
0.58	5029+00	39.00
0.048	5001+50	38.9

* Comp Study RM

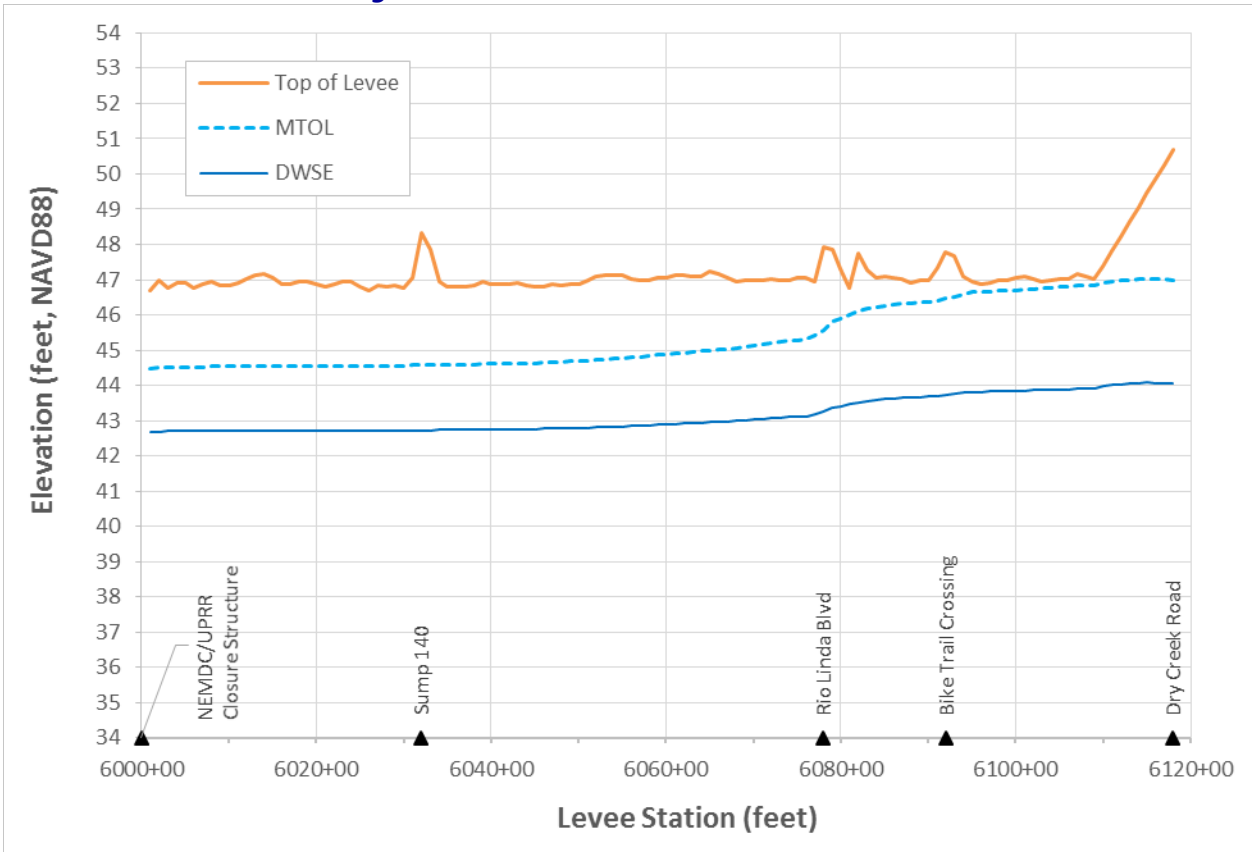
ULDC 7.2: Minimum Top of Levee

The requirements for ULDC 7.2 MTOL are described in Chapter 1. Wind setup and wave runup were computed by Mead & Hunt (Mead & Hunt, 2015a) and are discussed below in ULDC 7.17.

Robla Creek South Levee

There are no locations where wind and wave runup affects the MTOL along the Robla Creek south levee, therefore the MTOL is the DWSE plus 3 feet. Figure 8 shows the computed MTOL and actual top of levee profiles. Robla Creek south levee appears to meet ULDC 7.2 for MTOL. However, because this evaluation has not undergone review by the IPE, the Robla Creek south levee does not meet ULDC 7.2.

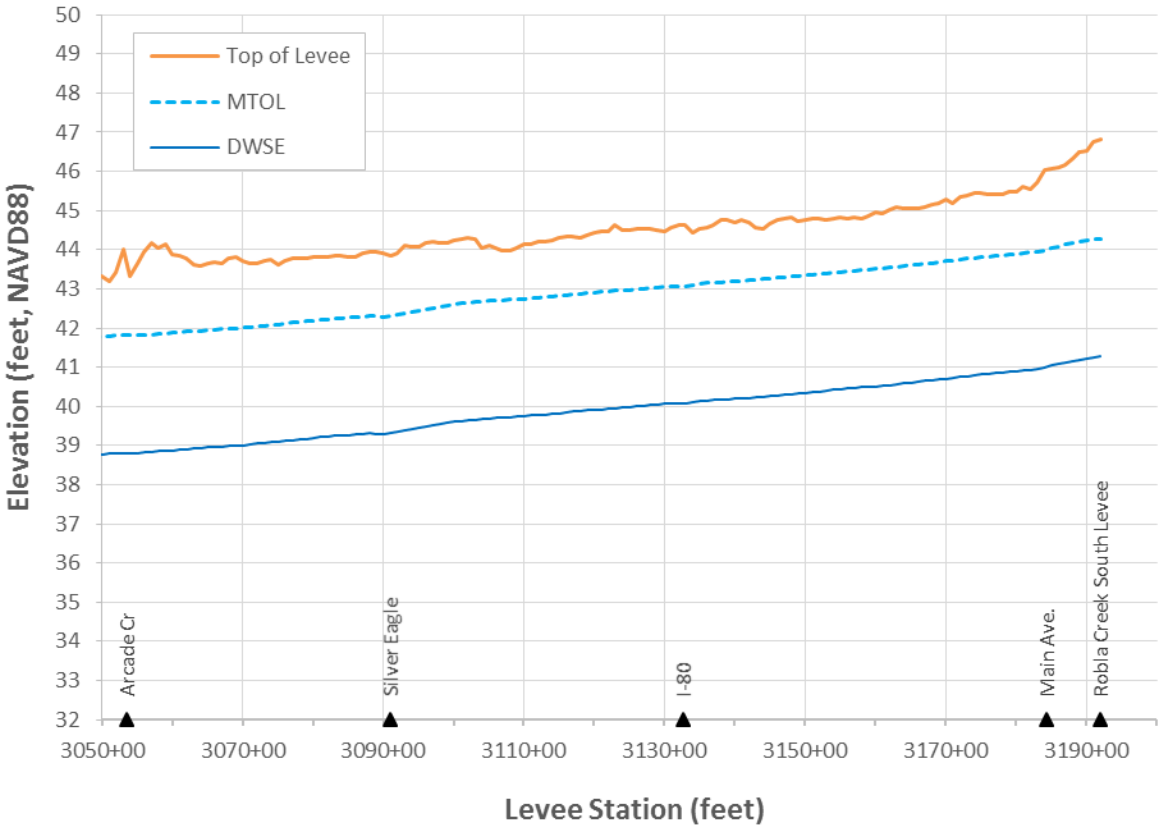
Figure 8. MTOL for Robla Creek South Levee



Natomas East Main Drainage Canal East Levee – Robla Creek to Arcade Creek

There are no locations where wind and wave runup affects the MTOL along the NEMDC east levee, between the Robla Creek and Arcade creek, therefore the MTOL is the DWSE plus 3 feet. Figure 9 shows the computed MTOL and actual top of levee profiles. NEMDC east levee, Robla Creek to Arcade Creek appears to meet ULDC 7.2 for MTOL. However, because this evaluation has not undergone review by the IPE, the NEMDC east levee, Robla Creek to Arcade Creek does not meet ULDC 7.2.

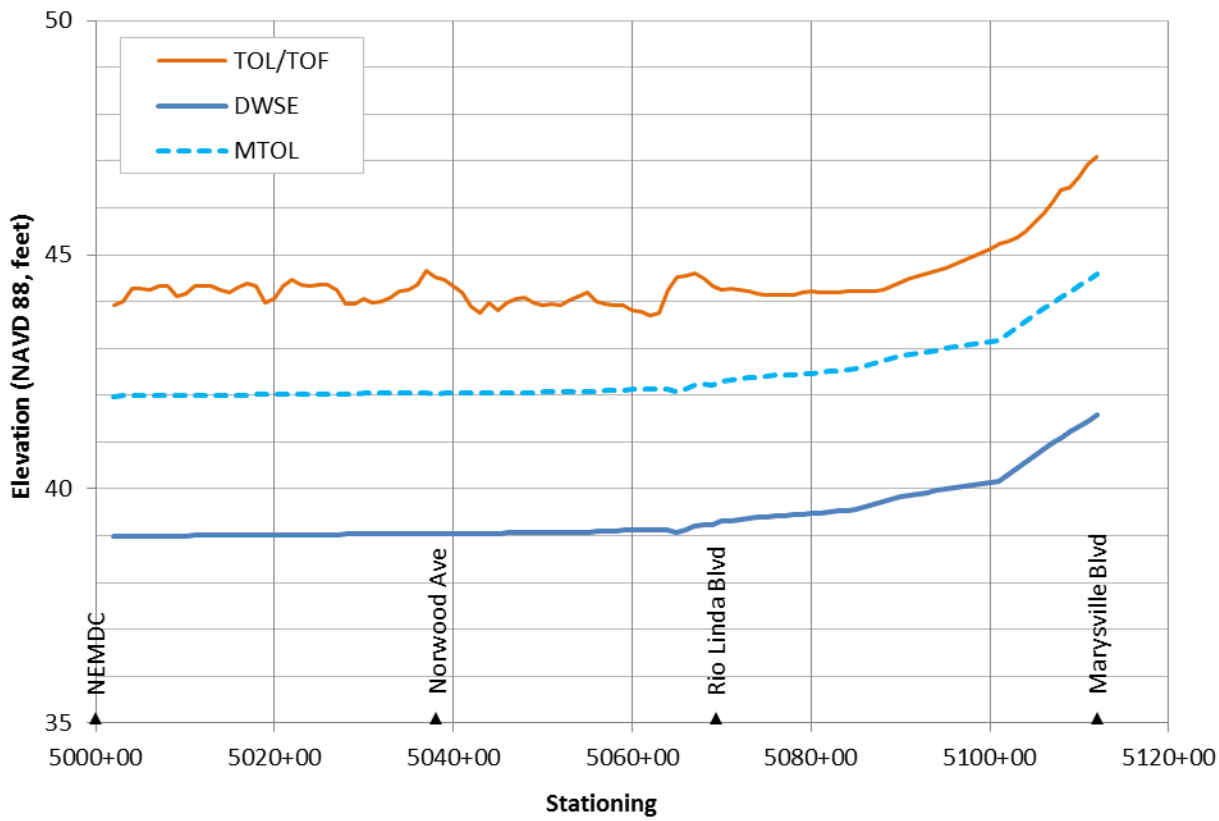
Figure 9. MTOL for NEMDC East Levee – Robla Creek to Arcade Creek



Arcade Creek North Levee

There are no locations where wind and wave runup affects the MTOL along the Arcade Creek north levee, therefore the MTOL is the DWSE plus 3 feet. Figure 10 shows the computed MTOL and actual top of levee profiles. Arcade Creek north levee appears to meet ULDC 7.2 for MTOL. However, because this evaluation has not undergone review by the IPE, the Arcade Creek north levee does not meet ULDC 7.2.

Figure 10. MTOL for Arcade Creek North Levee



ULDC 7.3: Soil Sampling, Testing, and Logging

The requirements for ULDC 7.3 soil sampling, testing, and logging are described in Chapter 1.

Soil exploration information for the Robla – Arcade Levee System is contained in the data reports prepared by the DWR ULE project, and the SAFCA LAP (URS, 2015a; Kleinfelder, 2013a; URS, 2009). The exploration spacing described above was generally met for the entire system with the exception of borings at the waterside toe, due to the presence of vegetation, the proximity of the levee to the water channel, and the landside toe due to existing development. The soil explorations that were obtained were used in combination with geology and geomorphology, geophysical resistivity surveys, past performance

information, historical records, and construction records to provide an adequate assessment of the subsurface conditions as outlined in the SPK SOP-03 for levee evaluations.

Robla Creek South Levee

Because the soil sampling, testing, and logging do not strictly meet ULDC 7.3, the Robla Creek south levee does not meet ULDC 7.3, and an exception will be required. This exception will be prepared as part of the Non-Structural Actions in support of ULDC Certification.

Natomas East Main Drainage Canal East Levee – Robla Creek to Arcade Creek

Because the soil sampling, testing, and logging do not strictly meet ULDC 7.3, the NEMDC east levee, Robla Creek to Arcade Creek does not meet ULDC 7.3, and an exception will be required. This exception will be prepared as part of the Non-Structural Actions in support of ULDC Certification.

Arcade Creek North Levee

Because the soil sampling, testing, and logging do not strictly meet ULDC 7.3, the Arcade Creek north levee does not meet ULDC 7.3, and an exception will be required. This exception will be prepared as part of the Non-Structural Actions in support of ULDC Certification.

ULDC 7.4: Slope Stability For Intermittently Loaded Levees

The requirements for ULDC 7.4 are described in Chapter 1. ULDC 7.4.2 requires a minimum safety factor of 1.0 to 1.2 for waterside slope stability during rapid drawdown conditions for the DWSE, depending on how long the embankment is saturated, with the higher factor of safety used for longer duration events. A factor of safety of 1.2 was used for rapid drawdown for the NEMDC downstream of Dry Creek and for Arcade Creek downstream of Norwood Avenue. A factor of safety of 1.0 was used for Robla Creek and for Arcade Creek upstream of Norwood Avenue. The Robla-Arcade Levee System was evaluated for landside slope stability as part of SAFCA's LAP (Kleinfelder, 2015b; URS, 2015b; Kleinfelder, 2013c). The HTOL for the Robla-Arcade Levee System was calculated by MBK (MBK, 2016a). DWR has determined that these levees are intermittently loaded as described in Section 7.6. Verification of the loading condition will be made and documented by SAFCA as part of the Non-Structural Actions to support a ULDC certification.

Robla Creek South Levee

The Robla Creek south levee appears to meet ULDC 7.4 for slope stability for intermittently loaded levees for the DWSE and the HTOL. However, because this evaluation has not undergone review by the IPE, the Robla Creek south levee does not meet ULDC 7.4.

Natomas East Main Drainage Canal East Levee – Robla Creek to Arcade Creek

The NEMDC east levee - Robla Creek to Arcade Creek was evaluated for landside slope stability as part of SAFCA's LAP (Kleinfelder, 2015b; URS, 2015b; Kleinfelder, 2013c). This levee appears to meet ULDC 7.4 for

slope stability for intermittently loaded levees for the DWSE and the HTOL. However, because this evaluation has not undergone review by the IPE, the NEMDC east levee - Robla Creek to Arcade Creek does not meet ULDC 7.4.

Arcade Creek North Levee

The Arcade Creek north levee between Stations 5000+00 and 5075+00 appears to meet ULDC 7.4 for slope stability for intermittently loaded levees for the DWSE and the HTOL. Portions of this levee, Station 5075+00 to 5112+43, do not meet ULDC 7.4 for slope stability due to oversteepened landside levee slopes (steeper than 2H:1V) and the phreatic seepage surface exiting on the landside slope in erodible levee fill soils.

Remediation of this levee is currently being designed as part of the SAFCA LAP. The Arcade Creek north levee will be reevaluated for slope stability upon completion of the SAFCA LAP.

ULDC 7.5: Underseepage For Intermittently Loaded Levees

The requirements for ULDC 7.5 underseepage for intermittently loaded levees is described in Chapter 1. The Robla – Arcade Levee System was evaluated for levee underseepage as part of SAFCA's LAP (Kleinfelder, 2015b; URS, 2015b; Kleinfelder, 2013c). DWR has determined that these levees are intermittently loaded as described in Section 7.6. Verification of the loading condition will be made and documented by SAFCA as part of the Non-Structural Actions to support a ULDC certification.

Robla Creek South Levee

The Robla Creek south levee appears to meet ULDC 7.5 for underseepage for intermittently loaded levees for the DWSE and the HTOL. However, because this evaluation has not undergone review by the IPE, the Robla Creek south levee does not meet ULDC 7.5.

Natomas East Main Drainage Canal East Levee – Robla Creek to Arcade Creek

The NEMDC east levee - Robla Creek to Arcade Creek appears to meet ULDC 7.5 for underseepage for intermittently loaded levees for the DWSE and the HTOL. However, because this evaluation has not undergone review by the IPE, the NEMDC east levee - Robla Creek to Arcade Creek does not meet ULDC 7.5.

Arcade Creek North Levee

The Arcade Creek north levee appears to meet ULDC 7.5 for underseepage for intermittently loaded levees for the DWSE and the HTOL except between Station 5023+00 and 5033+00 and between Stations 5038+50 and 5075+00 where the levees does not meet ULDC 7.5. Remediation of this levee is currently being designed as part of the SAFCA LAP. The Arcade Creek north levee will be reevaluated for underseepage upon completion of the SAFCA LAP.

ULDC 7.6: Frequently Loaded Levees

The requirements for ULDC 7.6 frequently loaded levees is described in Chapter 1.

Robla Creek South Levee

As part of the ULE Program, DWR considered the Robla Creek south levee an intermittently loaded levee (URS, 2015b), therefore ULDC 7.6 for frequently loaded levees is not applicable. Verification of this conclusion will be made and documented by SAFCA as part of the Non-Structural Actions to support ULDC certification.

Natomas East Main Drainage Canal East Levee – Robla Creek to Arcade Creek

As part of the ULE Program, DWR considered the Natomas East Main Drainage Canal east levee, Robla Creek to Arcade Creek, an intermittently loaded levee (URS, 2015b), therefore ULDC 7.6 for frequently loaded levees is not applicable. Verification of this conclusion will be made and documented by SAFCA as part of the Non-Structural Actions to support ULDC certification.

Arcade Creek North Levee

As part of the ULE Program, DWR considered the Arcade Creek north levee an intermittently loaded levee (URS, 2015b), therefore ULDC 7.6 for frequently loaded levees is not applicable. Verification of this conclusion will be made and documented by SAFCA as part of the Non-Structural Actions to support ULDC certification.

ULDC 7.7: Seismic Vulnerability

Chapter 1 describes the requirements for ULDC 7.7 seismic vulnerability and the guidelines and classifications developed DWR as part of the ULE Program.

Robla Creek South Levee

The Robla Creek south levee was evaluated for seismic vulnerability and post-seismic flood protection ability by the DWR as part of the ULE Program, and by Kleinfelder as part of the SAFCA LAP (Kleinfelder, 2015b; URS, 2015d; Kleinfelder, 2013c). According to the DWR ULE Program findings, the Robla Creek south levee has "Low Vulnerability" due to fine-grained, high-blow count subsurface soils. However, Kleinfelder's evaluation determined a portion of the levee to have "Medium Vulnerability" due to an exploration with a moderately thick layer of coarser-grained, relatively low-blow counts subsurface soil. Table summarizes the Kleinfelder SAFCA LAP evaluation findings.

Table 20. Dry Creek (Robla Creek) South Levee Seismic Vulnerability Class

Stations	Vulnerability Class (Post-Seismic Flood Protection Ability)
6000+00 to 6070+00	Low Vulnerability
6070+00 to 6085+00	Medium Vulnerability
6085+00 to 6118+20	Low Vulnerability

Because a post-earthquake remediation plan has not been developed, and the seismic vulnerability analysis has not undergone review by the IPE, the Robla Creek south levee does not meet ULDC 7.7. SAFCA will coordinate the preparation of a post-earthquake remediation plan as part of the Non-Structural Actions to support a ULDC certification.

Natomas East Main Drainage Canal East Levee – Robla Creek to Arcade Creek

The NEMDC east levee between Robla Creek and Arcade Creek was evaluated for seismic vulnerability and post-seismic flood protection ability by the DWR as part of the ULE Program, and by Kleinfelder as part of the SAFCA LAP (Kleinfelder, 2015b; URS, 2015d; Kleinfelder, 2013c). According to the DWR ULE Program findings, this levee has "Low Vulnerability" due to fine-grained, high-blow count subsurface soils. However, Kleinfelder's evaluation determined a portion of the levee to have "Medium Vulnerability" due to explorations with a moderately thick layer of coarser-grained, relatively low-blow counts subsurface soil. Table 21 below summarizes the Kleinfelder SAFCA LAP evaluation findings.

Table 21. NEMDC East Levee – Robla Creek to Arcade Creek Seismic Vulnerability Class

Stations	Vulnerability Class (Post-Seismic Flood Protection Ability)
3055+86 to 3175+00	Low Vulnerability
3175+00 to 3185+00	Medium Vulnerability
3185+00 to 3192+23	Low Vulnerability

Because a post-earthquake remediation plan has not been developed, and the seismic vulnerability analysis has not undergone review by the IPE, the NEMDC east levee – Robla Creek to Arcade Creek does not meet ULDC 7.7. SAFCA will coordinate the preparation of a post-earthquake remediation plan as part of the Non-Structural Actions to support a ULDC certification.

Arcade Creek North Levee

The Arcade Creek north levee was evaluated for seismic vulnerability and post-seismic flood protection ability by the DWR as part of the ULE Program and by Kleinfelder as part of the SAFCA LAP (Kleinfelder, 2015b; URS, 2015d; Kleinfelder, 2013c). According to the DWR ULE Program findings, this levee has "Low Vulnerability" due to fine-grained, high-blow count subsurface soils. However, Kleinfelder's evaluation determined a portion of the levee to have "Medium Vulnerability" due to an exploration with a moderately thick layer of coarser-grained, relatively low-blow counts subsurface soil. Table 22, summarizes the Kleinfelder SAFCA LAP evaluation findings.

Table 22. Arcade Creek North Levee Seismic Vulnerability Class

Stations	Vulnerability Class (Post-Seismic Flood Protection Ability)
5000+00 to 5047+00	Low Vulnerability
5047+00 to 5051+00	Medium Vulnerability
5051+00 to 5068+00	Low Vulnerability
5068+00 to 5081+00	Medium Vulnerability
5081+00 to 5112+43	Low Vulnerability

Because a post-earthquake remediation plan has not been developed, and the seismic vulnerability analysis has not undergone review by the IPE, the Arcade Creek north levee does not meet ULDC 7.7. SAFCA will coordinate the preparation of a post-earthquake remediation plan as part of the Non-Structural Actions to support a ULDC certification.

ULDC 7.8: Levee Geometry

The requirements for ULDC 7.8 levee geometry are described in Chapter 1.

Robla Creek South Levee

The Robla Creek south levee was evaluated for geometry as part of SAFCA's LAP (Kleinfelder, 2015b; URS, 2015d; Kleinfelder, 2013c). The levee crest width varies from 20 to 24 feet, landside levee slopes are as steep as 2H:1V, and the waterside levee slopes are steeper than 3H:1V (as steep as 2.6H:1V). A patrol road is present along the crown of the levee. Although the levee does not strictly meet ULDC 7.8, the levee has performed well since it was significantly improved in the 1990s, appears to meet ULDC 7.4 for stability, and therefore, the levee appears to meet ULDC 7.8 for geometry through an exception. However, because this evaluation and exception has not undergone review by the IPE, the Robla Creek south levee does not meet ULDC 7.8.

Natomas East Main Drainage Canal East Levee – Robla Creek to Arcade Creek

The NEMDC east levee - Robla Creek to Arcade Creek was evaluated for geometry as part of SAFCA's LAP (Kleinfelder, 2015b; URS, 2015d; Kleinfelder, 2013c). The levee crest width varies from 11 to 23 feet, and the landside levee slopes are steeper than 2H:1V (as steep as 1.8H:1V landside) and the waterside levee slopes are as steep as 3H:1V in some locations. A patrol road is present along the crown of the levee. This levee has performed well since it was significantly improved in the 1990s, appears to meet ULDC 7.4 for stability, and therefore, the levee appears to meet ULDC 7.8 for geometry through an exception. However, because this evaluation and exception has not undergone review by the IPE, the NEMDC east levee - Robla Creek to Arcade Creek does not meet ULDC 7.8.

Arcade Creek North Levee

The Arcade Creek north levee was evaluated for geometry as part of SAFCA's LAP (Kleinfelder, 2015b; URS, 2015d; Kleinfelder, 2013c). The levee crest is narrower than 20 feet in most locations and the landside

levee slope is as steep as 2H:1V and the waterside levee slope is steeper than 3H:1V (as steep as 2.5H:1V waterside) in some locations. The levee between Stations 5075+00 and 5112+43 does not meet criteria for stability and therefore, does not meet. ULDC 7.8 requirements for geometry. The levee between Stations 5000+00 to 5075+00 has performed well since it was significantly improved in the 1990s, appears to meet ULDC 7.4 for stability, and therefore, this portion of the levee appears to meet ULDC 7.8 for geometry through an exception. A patrol road is present along the crown of the levee. Remediation of this levee is currently being designed by the SAFCA LAP. The Arcade Creek north levee will be reevaluated for geometry upon completion of the SAFCA LAP.

ULDC 7.9: Interfaces and Transitions

The requirements for ULDC 7.9 interfaces and transitions are described in Chapter 1.

Robla Creek South Levee

The Robla Creek south levee interfaces and transitions have not been evaluated; therefore, this levee does not meet ULDC 7.9. The Robla Creek south levee will be evaluated for ULDC 7.9 as part of the Non-Structural Actions in support of ULDC certification.

Natomas East Main Drainage Canal East Levee – Robla Creek to Arcade Creek

The NEMDC east levee - Robla Creek to Arcade Creek interfaces and transitions have not been evaluated; therefore, this levee does not meet ULDC 7.9. The NEMDC east levee - Robla Creek to Arcade Creek will be evaluated for ULDC 7.9 as part of the Non-Structural Actions in support of ULDC certification.

Arcade Creek North Levee

The Arcade Creek north levee interfaces and transitions have not been evaluated; therefore, the Arcade Creek north levee does not meet ULDC 7.9. The Arcade Creek north levee will be evaluated for ULDC 7.9 as part of the Non-Structural Actions in support of ULDC certification.

ULDC 7.10: Erosion

The requirements for ULDC 7.10 erosion are described in Chapter 1. In 2012, SAFCA performed an erosion evaluation of the Robla – Arcade Levee System based on site inspection and analysis of results from hydraulic modeling (MBK, 2014).

Robla Creek South Levee

The low velocity of flow and non-existent boating activity on Robla Creek diminish the likelihood of significant erosion to occur along the waterside levee slope and there is no immediate erosional breach hazard. Therefore, the Robla Creek south levee meets the ULDC 7.10 for erosion. However, this

evaluation has not undergone review by the IPE and therefore, the Robla Creek south levee does not meet 7.10.

Natomas East Main Drainage Canal East Levee – Robla Creek to Arcade Creek

The low velocity of flow and non-existent boating activity on the NEMDC diminish the likelihood of significant erosion to occur along the waterside levee slope and there is no immediate erosional breach hazard. Therefore, the NEMDC east levee - Robla Creek to Arcade Creek meets the ULDC 7.10 for erosion. However, this evaluation has not undergone review by the IPE and therefore, the NEMDC east levee – Robla Creek to Arcade Creek does not meet 7.10.

Arcade Creek North Levee

Arcade Creek is a flashy stream with a short duration of flooding and there is no boating activity on Arcade Creek that would generate waves upon the levee bank. The low flow channel of Arcade Creek is an average of 45 feet away from the levee and while there is some erosion of the streambank occurring, it is maintained to avoid becoming an unacceptable hazard to the levee. There are no erosion sites present that present an immediate erosional breaching hazard. Therefore, the Arcade Creek north levee meets the ULDC 7.10 for erosion. However, this evaluation has not undergone review by the IPE and therefore, the Arcade Creek north levee does not meet 7.10.

ULDC 7.11: RIGHT-OF-WAY

The requirements for ULDC 7.11 right-of-way are described in Chapter 1.

Robla Creek South Levee

ARFCD and SAFCA do not presently own or have easement to the all lands encompassing the levee embankment, or the area 10 feet landward of the landside toe. Presently, for the majority of the levee, the right-of-way requirements are met by the presence of either a 10-foot landside access zone, although not yet secured through fee or easement, and/or 20-foot landside visibility zone. Therefore, the majority of the Robla Creek south levee appears to meet ULDC 7.11. However, there are some portions where a 10-foot access zone or 20-foot visibility zone is not present, and therefore, those portions of the levee do not meet ULDC 7.11 for right-of-way. SAFCA is preparing a long term right of way plan as part of the Non-Structural Actions that will provide for securement of a 10-foot landside zone and/or visibility for the 20-foot zone landward of the levee toe.

Natomas East Main Drainage Canal East Levee – Robla Creek to Arcade Creek

ARFCD does not presently own or have easement to all the lands encompassing the levee embankment or 10 feet landward of the toe along the NEMDC east levee between Robla Creek and Arcade Creek. Most of these lands are owned by UPRR. Presently, for the majority of the levee, the right-of-way requirements are met by the presence of 20-foot landside visibility zone; and the presence of a 10-foot landside access zone near the downstream end. Therefore, the majority of the NEMDC east levee between Robla Creek and Arcade Creek appears to meet ULDC 7.11 for right-of-way; however, there are some portions where a

10-foot access zone or 20-foot visibility zone is not present, and therefore, those portions of the levee do not meet ULDC 7.11 for right-of-way. SAFCA is preparing a long term right of way plan as part of the Non-Structural Actions that will provide for securement of a 10-foot landside zone and/or visibility for the 20-foot zone landward of the levee toe.

Arcade Creek North Levee

ARFCD and SAFCA do not presently own or have easement to all the lands encompassing the levee embankment and 10 feet landward of the toe along the Arcade Creek north levee. This is especially true upstream of Rio Linda Boulevard where no landside toe access road is present and access is very limited due to private properties located very close to the landside toe. Downstream of Rio Linda Boulevard, a landside toe access road is present within property owned by City of Sacramento, Sacramento San Joaquin Drainage District, and SAFCA. Because existing rights and access meet the intent of the ULDC, portions of the Arcade Creek north levee meet ULDC 7.11 for right-of-way. However, there are some portions where a 10-foot access zone or 20-foot visibility zone is not present, and therefore, those portions of the levee do not meet ULDC 7.11 for right-of-way. SAFCA is preparing a long term right of way plan as part of the Non-Structural Actions that will provide for securement of a 10-foot landside zone and/or visibility for the 20-foot zone landward of the levee toe.

ULDC 7.12: Encroachments

The requirements for ULDC 7.12 encroachments are described in Chapter 1.

Robla Creek South Levee

SAFCA conducted a survey and evaluation of encroachments in the Robla – Arcade Levee System from 2013-2015. There are no high hazard encroachments identified along the Robla Creek south levee (MBK, 2016b). This levee appears to meet ULDC 7.12 for encroachments. However, this evaluation has not undergone review by the IPE and therefore, the Robla Creek south levee does not meet 7.12. In addition, SAFCA will prepare an encroachment remediation plan as part of the Non-Structural Actions.

Natomas East Main Drainage Canal East Levee – Robla Creek to Arcade Creek

SAFCA conducted a survey and evaluation of encroachments in the Robla – Arcade Levee System from 2013-2015. There are no high hazard encroachments identified along the NEMDC east levee - Robla Creek to Arcade Creek (MBK, 2016b). This levee appears to meet ULDC 7.12 for encroachments. However, this evaluation has not undergone review by the IPE and therefore, the NEMDC east levee - Robla Creek to Arcade Creek does not meet 7.12. In addition, SAFCA will prepare an encroachment remediation plan as part of the Non-Structural Actions.

Arcade Creek North Levee

SAFCA conducted a survey and evaluation of encroachments in the Robla – Arcade Levee System from 2013-2015. High hazard encroachments are present (MBK, 2016b) along the Arcade Creek north levee therefore this levee does not meet ULDC 7.12 for encroachments. Implementation of the SAFCA LAP is

anticipated to address many of these high hazard encroachments. Following implementation, SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to ensure there are no outstanding encroachments that would affect the reliable performance of the facility for the DWSE and HTOL. In the case of any potential high hazard encroachment, SAFCA will facilitate removal or modification of the penetration or conduct a full engineering evaluation to determine if the hazard is acceptable. In addition, SAFCA will prepare an encroachment remediation plan as part of the Non-Structural Actions.

ULDC 7.13: PENETRATIONS

The requirements for ULDC 7.13 penetrations are described in Chapter 1.

Robla Creek South Levee

SAFCA conducted a survey and evaluation of penetrations in the Robla – Arcade Levee System from 2013-2015. There are no high hazard penetrations identified along the Robla Creek south levee. This levee appears to meet ULDC 7.13 for penetrations. However, this evaluation has not undergone review by the IPE and therefore, the Robla Creek south levee does not meet 7.13. In addition, SAFCA will prepare an encroachment, including penetration, remediation plan as part of the Non-Structural Actions.

Natomas East Main Drainage Canal East Levee – Robla Creek to Arcade Creek

SAFCA conducted a survey and evaluation of penetrations in the Robla – Arcade Levee System from 2013-2015. There are no high hazard penetrations identified along the NEMDC east levee - Robla Creek to Arcade Creek. This levee appears to meet ULDC 7.13 for penetrations. However, this evaluation has not undergone review by the IPE and therefore, the NEMDC east levee - Robla Creek to Arcade Creek does not meet 7.13. In addition, SAFCA will prepare an encroachment, including penetration, remediation plan as part of the Non-Structural Actions.

Arcade Creek North Levee

SAFCA conducted a survey and evaluation of penetrations in the Robla – Arcade Levee System from 2013-2015. High hazard penetrations are present along the Arcade Creek north levee, therefore this levee does not meet ULDC 7.13 for penetrations. Implementation of the SAFCA's LAP is anticipated to address most of these high hazard penetrations. Following implementation, SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to ensure there are no outstanding encroachments that would affect the reliable performance of the facility for the DWSE and HTOL. In the case of any potential high hazard penetrations, SAFCA will facilitate removal or modification of the penetration or conduct a full engineering evaluation to determine if the hazard is acceptable. In addition, SAFCA will prepare an encroachment, including penetration, remediation plan as part of the Non-Structural Actions.

ULDC 7.14: Floodwalls, Retaining Walls, and Closure Structures

The requirements for ULDC 7.14 floodwalls, retaining walls, and closure structures are described in Chapter 1.

Robla Creek South Levee

There are 2 floodwalls, 1 retaining wall, and 1 closure structure in the Robla Creek south levee. These structures were evaluated by SAFCA (Mead & Hunt, 2014) and meet ULDC 7.14 for floodwalls, retaining walls, and closure structures. However, additional analysis to confirm that global stability meets criteria is necessary and will be performed as part of the Non-Structural Actions; therefore, the Robla Creek south levee does not meet ULDC 7.14.

A successful trial installation of the closure structure at UPRR was completed by the City of Sacramento in 2015 (Mead & Hunt, 2015b).

Natomas East Main Drainage Canal East Levee – Robla Creek to Arcade Creek

There are no closure structures along NEMDC east levee - Robla Creek to Arcade Creek. There are floodwalls and retaining walls on the waterside slope of the levee near the City's Sump 157 Pump Station outfall structure which have not been evaluated for compliance with ULDC 7.14. These features will be evaluated as part of the Non-Structural Actions; therefore, the NEMDC east levee - Robla Creek to Arcade Creek does not meet ULDC 7.14.

Arcade Creek North Levee

There are 3 floodwalls and 1 closure structure in the Arcade Creek north levee. These structures were evaluated by SAFCA (Mead & Hunt, 2014) and meet ULDC 7.14 for floodwalls, retaining walls, and closure structures. However, additional analysis to confirm global stability meets criteria is necessary and will be performed as part of the Non-Structural Actions; therefore, the Arcade Creek north levee does not meet ULDC 7.14.

A successful trial installation of the closure structure at UPRR was completed by the City of Sacramento in 2015 (Mead & Hunt, 2015b).

ULDC 7.15: Animal Burrows

The requirements for ULDC 7.15 animal burrows are described in Chapter 1.

Robla Creek South Levee

ARFCD, as the LMA, currently performs routine maintenance activities including rodent abatement. Based on the USACE's periodic inspection of Robla – Arcade Levee System in 2010, the animal control status is minimally acceptable, which "would not prevent the system from performing as intended during the next flood season" (USACE, 2013a). The methods used for rodent abatement are consistent with the guidelines

specified in Section 5 of the "*Superintendent's Guide to Operations & Maintenance of California's Flood Control Projects*", released by DWR circa 1980. Therefore, the Robla – Arcade Levee System appears to meet ULDC 7.15 for animal burrows. However, this conclusion has not undergone review by the IPE and therefore, the Robla – Arcade Levee System does not meet ULDC 7.15. As part of SAFCA's Non-Structural Actions, ARFCD will prepare a formal procedural document that will include specific abatement measures to control rodent populations.

Natomas East Main Drainage Canal East Levee – Robla Creek to Arcade Creek

As described for the Robla Creek south levee, the Robla – Arcade Levee System does not meet ULDC 7.15 for animal burrows. As part of SAFCA's Non-Structural Actions, ARFCD will prepare a formal procedural document that will include specific abatement measures to control rodent populations.

Arcade Creek North Levee

As described above, the Robla – Arcade Levee System does not meet ULDC 7.15 for animal burrows. As part of SAFCA's Non-Structural Actions, ARFCD will prepare a formal procedural document that will include specific abatement measures to control rodent populations.

ULDC 7.16: Vegetation Evaluation

The requirements for ULDC 7.16 vegetation evaluation are described in Chapter 1.

Robla Creek South Levee

SAFCA conducted an inspection of the Robla – Arcade Levee System in 2013. There is no vegetation on the Robla Creek south levee that poses an unacceptable threat to levee integrity or operation and maintenance (MBK, 2016c). Therefore, this levee appears to meet ULDC 7.16 for vegetation. However, this evaluation has not undergone review by the IPE and therefore, the Robla Creek south levee does not meet ULDC 7.16. Vegetation maintenance requirements will be documented in the LMA's O&M manual as part of the Non-Structural Actions.

Natomas East Main Drainage Canal East Levee – Robla Creek to Arcade Creek

SAFCA conducted an inspection of the Robla – Arcade Levee System in 2013. There is no vegetation on the NEMDC east levee - Robla Creek to Arcade Creek that poses an unacceptable threat to levee integrity or operation and maintenance (MBK, 2016c). Therefore, this levee appears to meet ULDC 7.16 for vegetation. However, this evaluation has not undergone review by the IPE and therefore, the NEMDC east levee - Robla Creek to Arcade Creek does not meet ULDC 7.16. Vegetation maintenance requirements will be documented in the LMA's O&M manual as part of the Non-Structural Actions.

Arcade Creek North Levee

SAFCA conducted an inspection of the Robla – Arcade Levee System in 2013. There are 7 high-hazard trees on the Arcade Creek north levee that have been identified (MBK, 2016c) for removal by 2018,

concurrent with implementation of SAFCA's LAP. Therefore, this levee does not meet ULDC 7.16. Vegetation maintenance requirements will be documented in the LMA's O&M manual as part of the Non-Structural Actions.

ULDC 7.17: Wind Setup and Wave Runup

The requirements for ULDC 7.17 wind setup and wave runup are described in Chapter 1.

Robla Creek South Levee

Wind and wave analysis for the Robla – Arcade Levee System was completed in 2015 in accordance with the Shore Protection Manual and EM 1110-2-1100. Results (Mead & Hunt, 2015a) indicate that the maximum combined wind setup and wave runup is 2.30 feet for the Robla Creek south levee. The Robla – Arcade Levee System wind-wave analysis appears to meet ULDC 7.17 for wind setup and wave runup. However, this evaluation has not undergone review by the IPE and therefore, the Robla Creek south levee does not meet ULDC 7.17. Discussion of MTOL and erosion are found above.

Natomas East Main Drainage Canal East Levee – Robla Creek to Arcade Creek

Wind and wave analysis for the Robla – Arcade Levee System was completed in 2015 in accordance with the Shore Protection Manual and EM 1110-2-1100. Results (Mead & Hunt, 2015a) indicate that the maximum combined wind setup and wave runup is 1.62 feet for the NEMDC east levee between Robla Creek and Arcade Creek. The Robla – Arcade Levee System wind-wave analysis appears to meet ULDC 7.17 for wind setup and wave runup. However, this evaluation has not undergone review by the IPE and therefore, NEMDC east levee – Robla Creek and Arcade Creek - does not meet ULDC 7.17. Discussion of MTOL and erosion are found above.

Arcade Creek North Levee

Wind and wave analysis for the Robla – Arcade Levee System was completed in 2015 in accordance with the Shore Protection Manual and EM 1110-2-1100. Results (Mead & Hunt, 2015a) indicate that the maximum combined wind setup and wave runup is 1.17 feet for the Arcade Creek north levee. The Robla – Arcade Levee System wind-wave analysis appears to meet ULDC 7.17 for wind setup and wave runup. However, this evaluation has not undergone review by the IPE and therefore, the Arcade Creek north levee does not meet ULDC 7.17. Discussion of MTOL and erosion are found above.

ULDC 7.18: Security

The requirements for ULDC 7.18 security are described in Chapter 1.

Robla Creek South Levee

A security plan for the Robla-Arcade Levee System does not currently exist and therefore, this levee system does not meet ULDC 7.18 for security. SAFCA, in cooperation with ARFCD, will develop a security plan as part of its Non-Structural Actions.

Natomas East Main Drainage Canal East Levee – Robla Creek to Arcade Creek

A security plan for the Robla-Arcade Levee System does not currently exist and therefore, this levee system does not meet ULDC 7.18 for security. SAFCA, in cooperation with ARFCD, will develop a security plan as part of its Non-Structural Actions.

Arcade Creek North Levee

A security plan for the Robla-Arcade Levee System does not currently exist and therefore, this levee system does not meet ULDC 7.18 for security. SAFCA, in cooperation with ARFCD, will develop a security plan as part of its Non-Structural Actions.

ULDC 7.19: Sea Level Rise

The requirements for ULDC 7.19 sea level rise are described in Chapter 1. Application of the 30-year sea level rise projection will result in a 0.05 foot increase at the downstream location of the Sacramento River at the Town of Freeport (at RM 45). Although this increase is considered negligible, it is included in the ULDC DWSE (MBK 2016a).

Robla Creek South Levee

Although negligible, sea level rise is included in the ULDC DWSE. Therefore, estimation and consideration of sea level rise for the Robla – Arcade Levee System appears to meet ULDC 7.19 for sea level rise. However, this evaluation has not undergone review by the IPE and therefore, the Robla – Arcade Levee System does not meet ULDC 7.19.

Natomas East Main Drainage Canal East Levee – Robla Creek to Arcade Creek

Although negligible, sea level rise is included in the ULDC DWSE. Therefore, estimation and consideration of sea level rise for the Robla – Arcade Levee System appears to meet ULDC 7.19 for sea level rise. However, this evaluation has not undergone review by the IPE and therefore, the Robla – Arcade Levee System does not meet ULDC 7.19.

Arcade Creek North Levee

Although negligible, sea level rise, is included in the ULDC DWSE. Therefore, estimation and consideration of sea level rise for the Robla – Arcade Levee System appears to meet ULDC 7.19 for sea level rise. However, this evaluation has not undergone review by the IPE and therefore, the Robla – Arcade Levee System does not meet ULDC 7.19.

ULDC 7.20: Emergency Actions and Flood Safety Plans

The requirements for ULDC 7.20 emergency actions and flood safety plans security are described in Chapter 1.

Robla Creek South Levee

While there are several emergency planning documents related to flood safety, many of which include the required information to meet ULDC 7.20, SAFCA, in cooperation with the ARFCD will develop and/or update their standard operating procedure documents, emergency action plans and/or flood safety plans as part of the Non-Structural Actions. Because existing emergency planning documents have not been evaluated for compliance with ULDC, the Robla – Arcade Levee System does not meet ULDC 7.20.

Natomas East Main Drainage Canal East Levee – Robla Creek to Arcade Creek

As described above, the Robla – Arcade Levee System does not meet ULDC 7.20.

Arcade Creek North Levee

As described above, the Robla – Arcade Levee System does not meet ULDC 7.20.

PLAN OF LEVEE SYSTEM IMPROVEMENTS TO SUPPORT AN URBAN LEVEL OF FLOOD PROTECTION

As described in Chapter 1, below are the specific projects and actions necessary for the physical flood management facilities in the Robla–Arcade Levee System to meet ULDC and support an ULDC certification.

Folsom Joint Federal Project

A description of the Folsom JFP is provided in Chapter 1. Below is the effect the Folsom JFP will have on the Robla–Arcade Levee System:

- Effect: Construction of the auxiliary spillway and appurtenant features, jointly with the Folsom Dam Raise Project, provide the physical improvements to support the operational flexibility (Folsom Dam Water Control Manual Update) to reduce the flows from Folsom Dam during a 200-year event. Water surface elevations developed for this levee system assume completion of the Folsom JFP.
- Estimated Year of Completion: 2017
- Status: On Schedule

FOLSOM DAM RAISE PROJECT

A description of the Folsom Dam Raise Project is provided in Chapter 1. Below is the effect the Folsom Dam Raise Project will have on the Robla–Arcade Levee System:

- Effect: Construction of the Folsom Dam Raise Project will increase overall storage capacity which, jointly with the Folsom JFP, provides the physical improvements to support the operational flexibility (Folsom Dam Water Control Manual Update) to reduce the flows from Folsom Dam during a 200-year event. Water surface elevations developed for this levee system assume completion of the Folsom JFP.
- Estimated Year of Completion: 2022
- Status: Project Participation Agreements are being developed.

FOLSOM DAM WATER CONTROL MANUAL UPDATE

A description of the Folsom Dam Water Control Manual Update is provided in Chapter 1. Below is the effect the Folsom JFP will have on the Robla–Arcade Levee System:

- Effect: An updated Folsom Dam Water Control Manual will provide dam operators with the operational flexibility (Folsom Dam Water Control Manual Update) to reduce the flows released from Folsom Dam during a 200-year event. This update relies on the construction of the Folsom Dam Raise Project and JFP.
- Estimated Year of Completion: 2022
- Status: On Schedule

LEVEE ACCREDITATION PROJECT

Beginning in 2013, SAFCA undertook an investigation of the levees protecting the Sacramento area outside the Natomas Basin to evaluate their ability to meet ULDC. These investigations resulted in the problem identification reports (Kleinfelder, 2013c) that serve as the basis for SAFCA's LAP. The LAP includes all the structural work necessary for the levees to meet ULDC as well as the removal or modification of encroachments, penetrations, and vegetation as required to meet ULDC. It does not include those non-structural activities also required by ULDC like the security plan which are being addressed by the Non-Structural Actions. SAFCA's *Final Environmental Impact Report, North Sacramento Streams, Sacramento River East Levee, Lower American River and Related Flood Improvements Project*, certified June 2016, describes the LAP in detail. The LAP is divided into three main sub-projects:

- North Sacramento Streams Project – improvements to the Arcade Creek north and south levees, and NEMDC east levee to remediate seepage, stability, and address high hazard encroachments and vegetation;
- Sacramento River East Levee Project – improvements to up to 6 miles of the Sacramento River east levee in the American River South-Sacramento River East Levee System to remediate seepage, stability, erosion, and address high hazard encroachments and vegetation; and

- American River and Beach Lake Levee High Hazard Levee Encroachment and Vegetation Removal – modification and removal of high hazard encroachments and vegetation along the American River north and south levees and the Beach Lake north levee.

The North Sacramento Streams work is currently in the design phase and is expected to be constructed in 2017. The Sacramento River East Levee project is also in the design phase. Construction is expected is begin in 2018 and take up to 2 years to complete. High hazard encroachment, penetration, and vegetation modification and removal along the NEMDC east levee, Arcade Creek levees, American River levees, Sacramento River east levee, and Beach Lake north levee will begin in 2016, and completed by 2023. In addition to these projects, the LAP would also include any future structural actions identified as necessary for meeting ULDC. Below is the effect the LAP will have on the American River North Levee System:

- Effect: Remediation of outstanding seepage and stability concerns for the Robla-Arcade Levee System thereby also addressing other ULDC include: seismic vulnerability; geometry; interfaces and transitions; floodwalls, retaining walls, and closures structures; high hazard encroachments, penetrations, and vegetation, and securing a minimum 10-foot landside access zone or 20-foot landside visibility zone.
- Estimated Year of Completion: 2023
- Status: *Final EIR North Sacramento Streams, Sacramento River East Levee, Lower American River and Related Flood Improvements Project*, certified June 2016.

NON-STRUCTURAL ACTIONS

A description of the Non-Structural Actions is provided in Chapter 1. Below is the effect the Non-Structural Actions will have on the Robla–Arcade Levee System:

- Effect: The Non-Structural Actions would result in the Robla–Arcade Levee System meeting ULDC for seismic, right-of-way, encroachments, penetrations, retaining walls, vegetation, security, and flood safety plans.
- Estimated Year of Completion: 2024

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4.0 AMERICAN RIVER NORTH LEVEE SYSTEM

DESCRIPTION OF AMERICAN RIVER NORTH LEVEE SYSTEM

The American River North Levee System is comprised of 3 levees: the Arcade Creek south (left) levee/floodwall; NEMDC east (left) levee from Arcade Creek to the American River; and the American River north (right bank) levee from NEMDC to Arden Way (upstream end) (Plate 5). The total levee length is approximately 14 miles. The levee is rated as Minimally Acceptable in the USACE NLD. All levees in this system are maintained by ARFCD.

ARCADE CREEK SOUTH LEVEE

The Arcade Creek south levee was originally constructed by local forces in the early 1930s and extends from the NEMDC (Station 4000+00) upstream approximately 2 miles to Marysville Boulevard (Station 4110+00).

The downstream portion (Station 4000+00 to 4068+00) was improved by the USACE in the 1950s and included construction of a waterside slope liner. In the 1990s, SAFCA raised the upstream levee crown and constructed a continuous floodwall along the waterside edge of the crest between Rio Linda Boulevard (station 4068+00, approximately) and Marysville Boulevard (station 4110+00). Floodwall heights range between 0.5 and 3.5 feet above the levee embankment crest with wall heights increasing upstream and tying into high ground at Marysville Boulevard.

The levee is crossed by three bridges at Norwood Avenue, Rio Linda Boulevard, and the Sacramento Northern Bike Trail. The UPRR railroad, adjacent to the NEMDC east levee, crosses the Arcade Creek south levee at the connection of the two levees. There is no waterside development. Landward of the levee, suburban development is present adjacent to the levee toe. The Rio Linda Boulevard Bridge was raised after the 1986 flood event, and SAFCA tied the levee into the bridge railings in 1996; the Norwood Avenue and Rio Linda Boulevard bridges were subsequently raised. No closure structures are currently present at these crossings as they are elevated above the levee.

No past performance issues have been reported along this reach. There was no reported seepage or stability distress reported from either the 1986 or 1997 high water events.

NATOMAS EAST MAIN DRAINAGE CANAL EAST LEVEE – ARCADE CREEK TO AMERICAN RIVER

The NEMDC east levee was originally constructed by local forces in the early 1930s, and was improved in the 1950s by the USACE. The NEMDC east levee extends from Arcade Creek to the American River. The NEMDC east levee from Robla Creek to Arcade Creek is a part of the Robla-Arcade levee system discussed in Chapter 3.

The NEMDC east levee from Arcade Creek south levee to the American River north levee (Station 2986+49 to 3051+61) is approximately 1.2 miles long. In the 1990s, SAFCA raised the levee and reconstructed the waterside and landside slopes from approximately Station 3001+50 to 3051+61.

The railroad and the levee meet at approximately Station 3001+50, and continue to 3051+61. A discontinuous ditch, lined and unlined depending on location, is located approximately 10 to 45 feet from the landside railroad embankment toe (50 to 90 feet from the projected levee prism toe) from Station 3002+50 to 3051+61. There is no waterside development. Landward of the levee, land use is suburban development with a few undeveloped parcels and commercial properties.

No past performance issues (besides inadequate freeboard above the design flood level) have been reported along this reach. There was no reported seepage or stability distress reported from either the 1986 or 1997 high water events.

American River North Levee

The American River north levee was originally constructed by local forces in the late 1800s and early 1900s and was subsequently improved by USACE in the mid-1900s as part of the Sacramento River Flood Control Project and the American River Levee Project. Beginning in 1998 and extending through the early 2000s, USACE installed significant lengths of cutoff wall in the levee as part of the American River Watershed Common Features Project. Most of the levee was constructed prior to construction of the Folsom Dam and is therefore generally setback from the channel. The federally authorized American River north levee extends from the NEMDC (Station 3000+00) upstream to approximately Claremont Rd, upstream of Arden Way (Station 3582+00). However, the portion of levee upstream of Arden Way, i.e., between Station 3548+50 and 3582+00, does not function as a levee for flows up to, and including 192,000 cfs and therefore, is not relied on for the ULDC certification. The USACE is considering this reach for deauthorization; therefore, the portion of the American River north levee upstream of Arden Way is not evaluated in this Engineer's Report. The levee being evaluated is approximately 10.4 miles. Cutoff walls are present for almost the entire length of levee upstream of Cal Expo. While the original cutoff wall that was constructed left gaps at road crossings and utilities, those gaps have been subsequently improved to pass the Common Features design flow of 160,000 cfs. The USACE is in the process of providing a letter to SAFCA to document this conclusion.

The levee is crossed by several transportation routes: Del Paso Boulevard, Highway 160, Capital City Freeway (Interstate 80 Business Route), UPRR, Southern Pacific RR, H Street, Guy West Bridge (pedestrian walkway), Howe Avenue, Watt Avenue, Harrington Way, and River Walk Way. Several residential streets terminate at the landside of the levee. A Sacramento County Sheriff's training facility and sewage treatment plan are located on the waterside of the levee near River Walk Way. Land use on the landside of the levee consists predominantly of commercial and industrial development up to Cal Expo Fairgrounds. Upstream of Cal Expo, landside use is predominately suburban development and occasional commercial development. Recreation land uses (i.e. parks and bike trails) are present along the waterside of the levee.

Past performance issues include erosion, which is now largely mitigated through waterside bank protection placed over time, and through and underseepage and instability, which is now largely mitigated through installation of cutoff walls.

Following the historic 1986 flood, and under the direction of Congress, the USACE undertook a general investigation for reducing flood risk to the City of Sacramento. In 1996, the USACE ultimately recommended several incrementally justified elements that were common to the different plans the investigation developed. These "common features" included remediation of 24 miles of the American River north and south levees. The proposed remediation for the American River levees was subsequently expanded to include some levee raising, erosion protection, and additional seepage remediation. All of the remediation authorized in 1996, and subsequently augmented in 1999, has been constructed by the USACE. Additional improvements are proposed as part of the USACE's general reevaluation of the USACE Common Features Project. These features have not yet been constructed.

The design of features along the American River, constructed by the USACE as part of the USACE Common Features Project, were completed prior to the development of the ULDC and the requirements for an ULOP which did not exist at the time. Specifically, upon completion of the features being proposed as part of the general reevaluation, the American River levees will be able to pass a flow of 160,000 cfs, which is greater than the flow of 115,000 cfs that is being used for the ULDC certification. The USACE Sacramento District, Engineering Division Chief has determined (USACE, n.d.) that the Lower American River levees meet USACE freeboard (i.e., MTOL), slope stability, and seepage criteria for a Folsom Dam release of 115,000 cfs. Because USACE has provided this letter, and the DWSE for the project exceeds the DWSE required for ULDC, the evaluation in this Engineer's Report relies on the USACE letter for its conclusions related to MTOL, stability, and seepage for the American River north and south levees.

EVALUATION OF AMERICAN RIVER NORTH LEVEE SYSTEM

To support an APF, an evaluation of the levee system was performed to determine if it meets ULDC. The evaluation of each levee for each criterion is provided below.

ULDC 7.1: DESIGN WATER SURFACE ELEVATION

As described in Chapter 1, the ULDC DWSE for all of the levee systems was computed in February 2016 using the FEMA approach and MBK version of Release 4 of the USACE Sacramento River HEC-RAS model, hydrology developed by the USACE for the Sacramento and San Joaquin River Basins Comprehensive Study (Comp Study) for the Sacramento River, and a flow of 115,000 cfs[5] released from Folsom Dam (MBK, 2016a). The ULDC DWSE includes adjustments for debris loading, superelevation, climate change, updated hydraulic models, and sea level rise. The ULDC DWSE memorandum (MBK, 2016a) has not undergone review by the IPE, and the Folsom JFP and Folsom Dam Raise Projects need to be completed to achieve the ULDC DWSE, therefore the American River North Levee System does not meet ULDC 7.1.

[5] MBK determined that the 200-year release from Folsom Dam will be 115,000 cfs once the Folsom JFP and Folsom Raise projects are completed. The expected time of completion for the Folsom JFP is 2017 and for the Folsom Dam Raise project is 2025, at which time a ULDC certification will be made.

Arcade Creek South Levee

The computed DWSEs for the Arcade Creek south levee are provided in Table . As described above, MBK, 2016a has not undergone review by the IPE and the Folsom JFP and Folsom Dam Raise Projects need to be completed to achieve the ULDC DWSE, therefore the Arcade Creek south levee does not meet ULDC 7.1.

Table 23. DWSE for Arcade Creek South Levee

Hydraulic Model River Station*	Levee Station (feet)	DWSE (feet NAVD88)
1.841	4094+00	40.0
1.548	4079+00	39.4
1.01	4051+00	39.0
0.58	4029+00	39.0
0.048	4001+00	38.9

* Comp Study RM

Natomas East Main Drainage Canal East Levee – Arcade Creek to American River

The computed DWSEs for the NEMDC east levee - Arcade Creek to American River are provided in Table 24. As described above, MBK, 2016a has not undergone review by the IPE and the Folsom JFP and Folsom Dam Raise Projects need to be completed to achieve the ULDC DWSE, therefore the NEMDC east levee - Arcade Creek to American River does not meet ULDC 7.1.

Table 24. DWSE for NEMDC, Arcade Creek Levee to American River

Hydraulic Model River Station*	Levee Station (feet)	DWSE (feet NAVD88)
2.778	3037+00	38.4
2.646	3030+00	38.2
2.128	3000+00	36.9
1.92	2988+59	36.6

* Comp Study RM

American River North Levee

The computed DWSEs for the American River north levee are provided in

Table 25. However, as described above, the USACE design for the Common Features Project was based on a flow of 160,000 cfs in American River, which is greater than the flow of 115,000 cfs that was used to develop the ULDC DWSE. MBK, 2016a has not undergone review by the IPE and the Folsom JFP and Folsom Dam Raise Projects need to be completed to achieve the ULDC DWSE, therefore the American River north levee does not meet ULDC 7.1.

Table 25. DWSE for American River North Levee

Hydraulic Model River Station*	Levee Station (feet)	DWSE (feet NAVD88)
13.75	3579+50	60.0
10.75	3458+50	51.8
9.14	3375+50	48.0
7.62	3295+00	46.0
6.47	3241+00	42.9
3.9	3100+50	38.3
2.0	3016+00	36.6

* Comp Study RM

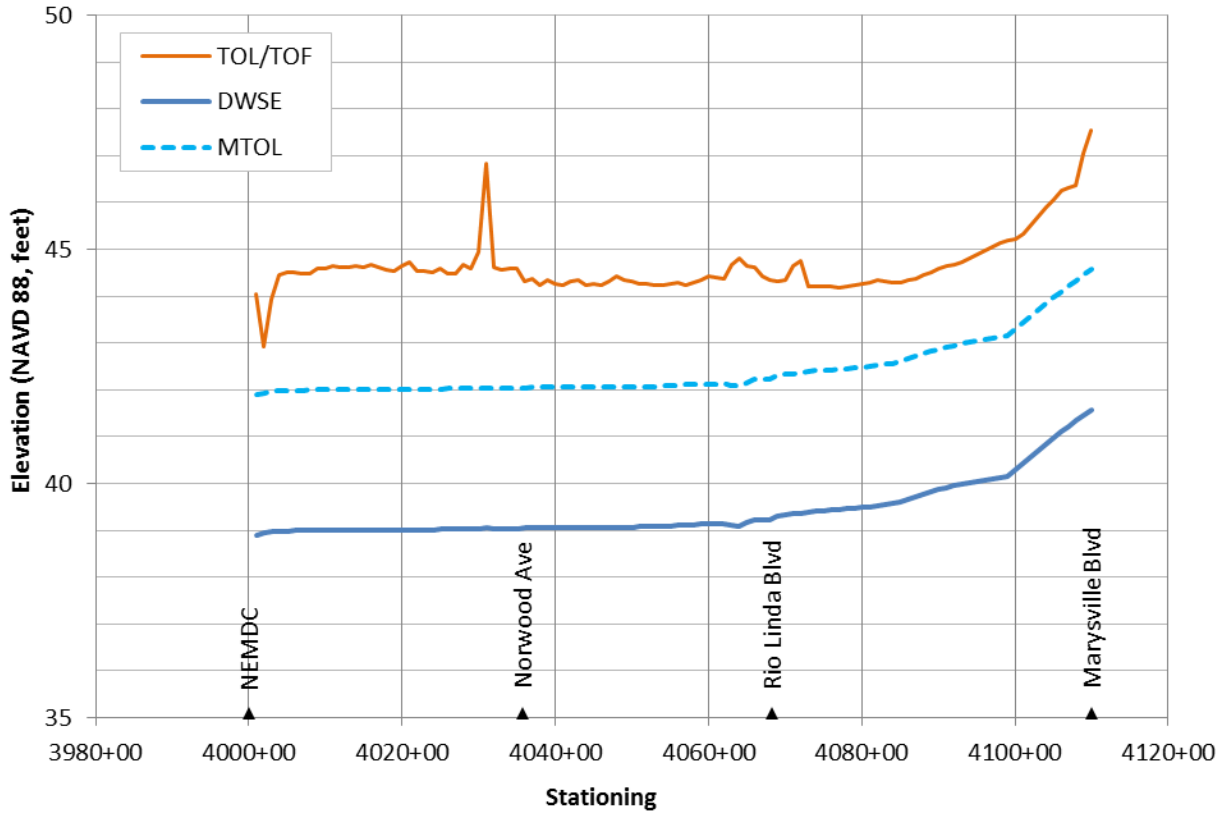
ULDC 7.2: Minimum Top of Levee

The requirements for ULDC 7.2 MTOL are described in Chapter 1.

Arcade Creek South Levee

Wind setup and wave runup were computed by Mead & Hunt (Mead & Hunt, 2015a) and are discussed below in ULDC 7.17. There are no locations where wind and wave runup affects the MTOL along the Arcade Creek south levee, therefore the MTOL is the DWSE plus 3 feet. Figure 11 shows the computed MTOL and actual top of levee profiles. Arcade Creek south levee appears to meet ULDC 7.2 for MTOL. However, because this evaluation has not undergone review by the IPE, the Arcade Creek south levee does not meet ULDC 7.2.

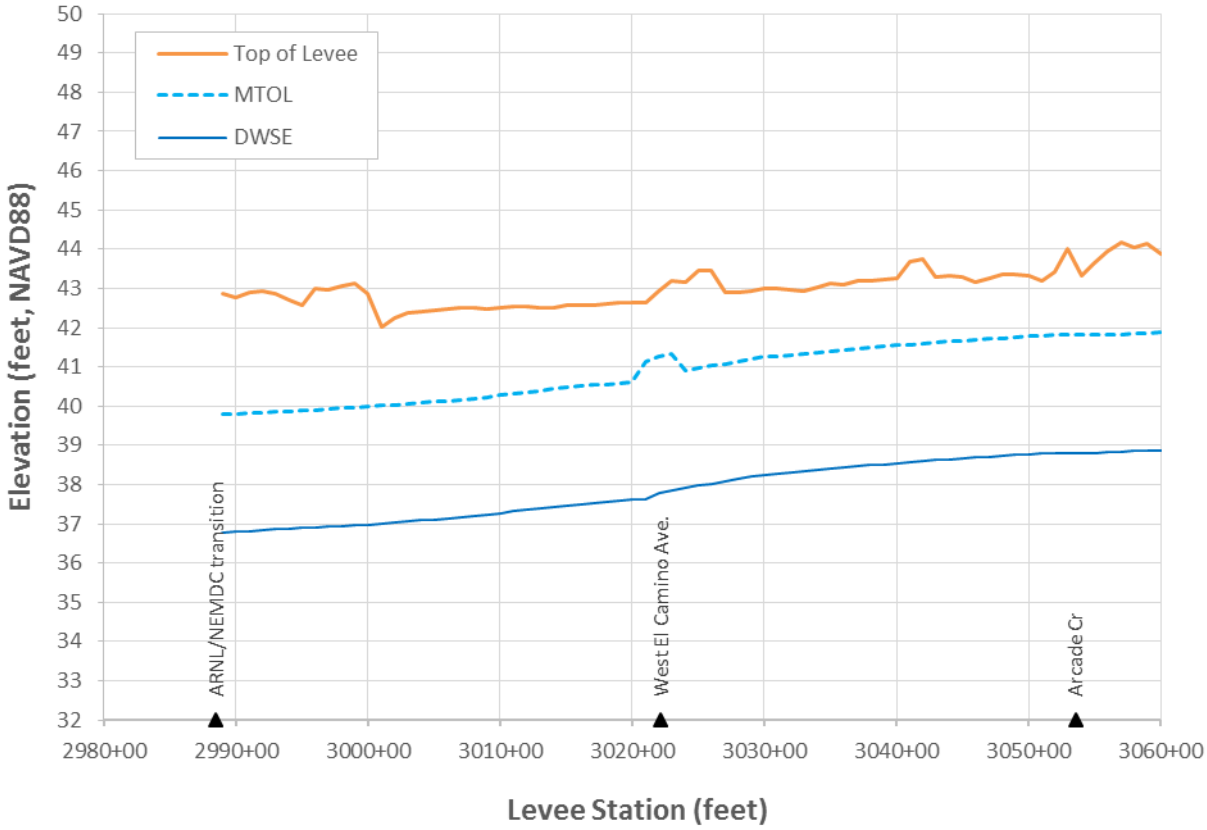
Figure 11. MTOL for Arcade Creek South Levee



Natomas East Main Drainage Canal East Levee –Arcade Creek to American River

Wind setup and wave runup were computed by Mead & Hunt (Mead & Hunt, 2015a) and are discussed below in ULDC 7.17. The maximum combined wind set and wave run up in this reach is 3.49 ft. Therefore, the MTOL is the DWSE plus the maximum of 3 feet or wind and wave runup. Figure 12 shows the computed MTOL and actual top of levee profiles. NEMDC east levee, Arcade Creek to American River appears to meet ULDC 7.2 for MTOL. However, because this evaluation has not undergone review by the IPE, the NEMDC east levee, Arcade Creek to American River does not meet ULDC 7.2.

Figure 12. MTOL for NEMDC East Levee, Arcade Creek Levee to American River



American River North Levee

USACE determined (USACE, n.d.) that the American River north levee has sufficient freeboard. Therefore, the American River north levee appears to meet ULDC 7.2 for MTOL. However, this conclusion is not effective until completion of the Folsom JFP, Folsom Raise Project, and the Folsom Dam Water Control Manual Update, described later, which provide for a Folsom release of 115,000 cfs. Therefore, the American River north levee does not meet ULDC 7.4.

ULDC 7.3: Soil Sampling, Testing, and Logging

The requirements for ULDC 7.3 soil sampling, testing, and logging are described in Chapter 1.

Soil exploration information for the American River North Levee System is contained in the data reports prepared by the DWR ULE Project and the SAFCA LAP as indicated below. The exploration spacing described above was generally met for the entire system with the exception of borings at the waterside toe due to the presence of vegetation and the proximity of the levee to the water channel and the landside toe due to existing development. The soil explorations that were obtained were used in combination with geology and geomorphology, geophysical resistivity surveys, past performance information, historical records, and construction records to provide an adequate assessment of the subsurface conditions as outlined in the SPK SOP-03 for levee evaluations.

Arcade Creek South Levee

Soil exploration information is contained in the data reports prepared by the DWR ULE Program and the SAFCA LAP (URS, 2015a; Kleinfelder, 2013a; URS, 2009).

Because the soil sampling, testing, and logging do not strictly meet ULDC 7.3, the Arcade Creek south levee does not meet ULDC 7.3 and an exception will be required. This exception will be prepared as part of the Non-Structural Actions in support of ULDC Certification.

Natomas East Main Drainage Canal East Levee –Arcade Creek to American River

Soil exploration information is contained in the data reports prepared by the DWR ULE project and the SAFCA LAP (URS, 2015c; Kleinfelder, 2013d; URS, 2009). In addition, SAFCA has recently performed additional geotechnical investigations as part of the design phase of the LAP. Data obtained through these investigations is available. Because the soil sampling, testing, and logging do not strictly meet ULDC 7.3, the NEMDC east levee, Arcade Creek to American River, does not meet ULDC 7.3 and an exception will be required. This exception will be prepared as part of the Non-Structural Actions in support of ULDC Certification.

American River North Levee

USACE determined (USACE, n.d.) that the American River north levee meets USACE design standards for stability and seepage. These analyses were based on soil sampling, testing and logging performed by USACE. Therefore, the American River north levee appears to meet ULDC 7.3 for soil sampling, testing, and logging. The documentation that formed the basis of this conclusion will be provided as part of the

ULDC Certification. However, this conclusion is not effective until completion of the Folsom JFP, Folsom Raise Project, and Folsom Dam Water Control Manual Update, described later, which provide for a Folsom Dam release of 115,000 cfs. Therefore, the American River north levee dos not meet ULDC 7.3.

ULDC 7.4: Slope Stability For Intermittently Loaded Levees

The requirements for ULDC 7.4 are described in Chapter 1. ULDC 7.4.2 requires a minimum factor of safety of 1.0 to 1.2 for waterside slope stability during rapid drawdown conditions for the DWSE depending on how long the embankment is saturated, with the higher factor of safety used for longer duration events. A factor of safety of 1.2 was used for rapid drawdown for the American River, NEMDC downstream of Dry Creek, and Arcade Creek downstream of Norwood Avenue. A safety factor of 1.0 was used for Arcade Creek upstream of Norwood Avenue. The HTOLs for the Arcade Creek south levee and NEMDC east levee were calculated by MBK and are documented in the MBK, 2016a. The American River north levee was evaluated by USACE as part of the USACE Common Features Project. DWR has determined that these levees are intermittently loaded as described in Section 7.6. Verification of the loading condition will be made and documented by SAFCA as part of the Non-Structural Actions to support a ULDC certification.

Arcade Creek South Levee

The Arcade Creek south levee was evaluated for landside slope stability as part of SAFCA's LAP (Kleinfelder, 2015a; URS, 2015c; Kleinfelder, 2013a). This levee does not meet ULDC 7.4 for slope stability due to oversteepened landside levee slopes (steeper than 2H:1V). Remediation for this levee is currently being designed as part of the SAFCA LAP. The Arcade Creek south levee will be reevaluated for slope stability upon completion of the SAFCA LAP.

Natomas East Main Drainage Canal East Levee –Arcade Creek to American River

The NEMDC east levee - Arcade Creek to American River was evaluated for landside slope stability as part of SAFCA's LAP (Kleinfelder, 2015a; URS, 2015c; Kleinfelder, 2013a). The levee appears to meet ULDC 7.4 for slope stability for intermittently loaded levees for the DWSE and the HTOL except between Stations 2986+49 and 3001+50 and Stations 3030+00 and 3041+25, due to oversteepened landside levee slopes (steeper than 2H:1V) and the phreatic seepage surface exiting on the landside slope in erodible levee fill soils. Remediation for this levee is currently being designed as part of the SAFCA LAP. The NEMDC east levee - Arcade Creek to American River will be reevaluated for slope stability upon completion of the SAFCA LAP.

American River North Levee

USACE determined (USACE, n.d.) that the American River north levee meets USACE design standards for stability. Therefore, the American River north levee appears to meet ULDC 7.4 for slope stability. However, this conclusion is not effective until completion of the Folsom JFP, Folsom Raise Project, and the Folsom Dam Water Control Manual Update, described later, which provided for a Folsom release of 115,000 cfs. Therefore, the American River north levee does not meet ULDC 7.4.

ULDC 7.5: Underseepage For Intermittently Loaded Levees

The requirements for ULDC 7.5 underseepage for intermittently loaded levees is described in Chapter 1. DWR has determined that these levees are intermittently loaded as described in Section 7.6. Verification of the loading condition will be made and documented by SAFCA as part of the Non-Structural Actions to support a ULDC certification.

Arcade Creek South Levee

The Arcade Creek south levee was evaluated for levee underseepage as part of SAFCA's LAP (Kleinfelder, 2015a; URS, 2015c; Kleinfelder, 2013a). The levee appears to meet ULDC 7.5 for underseepage for intermittently loaded levees for the DWSE and the HTOL except between Stations 4000+00 and 4068+00 where it does not meet requirements. Remediation of this levee is currently being designed as part of the SAFCA LAP. The Arcade Creek south levee will be reevaluated for underseepage upon completion of the SAFCA LAP.

Natomas East Main Drainage Canal East Levee - Arcade Creek to American River

The NEMDC east levee Arcade Creek to American River was evaluated for underseepage as part of SAFCA's LAP (Kleinfelder, 2015a; URS, 2015c; Kleinfelder, 2013a). The levee appears to meet ULDC 7.5 for underseepage for intermittently loaded levees for the DWSE and the HTOL except between Stations 2986+49 and 3001+50 and between Stations 3030+00 and 3041+25 where it does not meet requirements. Remediation of this levee is currently being designed as part of the SAFCA LAP. The NEMDC east levee Arcade Creek to American River will be reevaluated for underseepage upon completion of the SAFCA LAP.

American River North Levee

USACE determined (USACE, n.d.) that the American River north levee meets USACE design standards for seepage. Therefore, the American River north levee appears to meet ULDC 7.5 for underseepage. However, this conclusion is not effective until completion of the Folsom JFP, Folsom Raise Project, and the Folsom Dam Water Control Manual Update, described later, which provide for a Folsom release of 115,000 cfs. Therefore, the American River north levee does not meet ULDC 7.5.

ULDC 7.6: Frequently Loaded Levees

The requirements for ULDC 7.6 frequently loaded levees is described in Chapter 1.

Arcade Creek South Levee

As part of the ULE Program, DWR considered the Arcade Creek south levee an intermittently loaded levee (URS, 2015b), therefore ULDC 7.6 for frequently loaded levees is not applicable. Verification of this conclusion will be made and documented by SAFCA as part of the Non-Structural Actions to support ULDC certification.

Natomas East Main Drainage Canal East Levee –Arcade Creek to American River

As part of the ULE Program, DWR considered the NEMDC east levee - Arcade Creek to American River an intermittently loaded levee (URS, 2015b), therefore ULDC 7.6 for frequently loaded levees is not applicable. Verification of this conclusion will be made and documented by SAFCA as part of the Non-Structural Actions to support ULDC certification.

American River North Levee

As part of the ULE Program, DWR considered the American River North levee an intermittently loaded levee (URS, 2015b), therefore ULDC 7.6 for frequently loaded levees is not applicable. Verification of this conclusion will be made and documented by SAFCA as part of the Non-Structural Actions to support ULDC certification.

ULDC 7.7: SEISMIC VULNERABILITY

Chapter 1 describes the requirements for ULDC 7.7 seismic vulnerability and the guidelines and classifications developed DWR as part of the ULE Program.

Arcade Creek South Levee

The Arcade Creek south levee was evaluated for seismic vulnerability and post-seismic flood protection ability by the DWR as part of the ULE Program, and by Kleinfelder as part of the SAFCA LAP (Kleinfelder, 2015b; URS, 2015d; Kleinfelder, 2013c). According to the DWR ULE program findings, this levee has "Low Vulnerability" due to fine-grained, high-blow count subsurface soils. However, Kleinfelder's evaluation determined a portion of the levee to have "Medium Vulnerability" due to an exploration with a moderately thick layer of coarser-grained, relatively low-blow counts subsurface soil. Table 26 summarizes the Kleinfelder SAFCA LAP evaluation findings.

Table 26. Arcade Creek South Levee Seismic Vulnerability Class

Stations	Vulnerability Class (Post-Seismic Flood Protection Ability)
4000+00 to 4100+00	Low Vulnerability
4100+00 to 4110+00	Medium Vulnerability

Because a post-earthquake remediation plan has not been developed, and the seismic vulnerability analysis has not undergone review by the IPE, the Arcade Creek south levee does not meet ULDC 7.7. SAFCA will coordinate the preparation of a post-earthquake remediation plan as part of the Non-Structural Actions to support a ULDC certification.

Natomas East Main Drainage Canal East Levee –Arcade Creek to American River

The east levee along the NEMDC between Arcade Creek (Station 3050+20) and American River (Station 2986+49) was evaluated for seismic vulnerability (Kleinfelder, 2015b; URS, 2015b; Kleinfelder, 2013c). This evaluation was performed by the DWR ULE program and the Kleinfelder SAFCA LAP for post-seismic flood protection ability. According to both DWR ULE Program and Kleinfelder's findings, this levee was reported to have a "Low Vulnerability" due to fine-grained, high-blow count subsurface soils as summarized in Table .

Table 27. Natomas East Main Drainage Canal East Levee –Arcade Creek to American River Seismic Vulnerability Class

Stations	Vulnerability Class (Post-Seismic Flood Protection Ability)
2986+49 to 3150+20	Low Vulnerability

Because a post-earthquake remediation plan has not been developed, and the seismic vulnerability analysis has not undergone review by the IPE, the NEMDC east levee – Arcade Creek to American River does not meet ULDC 7.7. SAFCA will coordinate the preparation of a post-earthquake remediation plan as part of the Non-Structural Actions to support a ULDC certification.

American River North Levee

The American River north levee was evaluated for seismic vulnerability as part of the DWR ULE Program (URS, 2015). The results of this evaluation are shown in Table .

Table 28. American River North Levee Seismic Vulnerability Class

Stations	Vulnerability Class (Post-Seismic Flood Protection Ability)
3000+00 to 3016+00	Low Vulnerability
3016+00 to 3044+48	High Vulnerability
3044+48 to 3085+35	Low Vulnerability
3085+35 to 3088+60	High Vulnerability
3088+60 to 3167+50	Low Vulnerability
3167+50 to 3306+00	High Vulnerability
3306+00 to 3458+85	Low Vulnerability
3458+85 to 3482+50	High Vulnerability
3482+50 to 3582+79	Low Vulnerability

Because a post-earthquake remediation plan has not been developed, and the seismic vulnerability analysis has not undergone review by the IPE, the American River north levee does not meet ULDC 7.7. SAFCA will coordinate the preparation of a post-earthquake remediation plan as part of the Non-Structural Actions to support a ULDC certification.

ULDC 7.8: Levee Geometry

The requirements for ULDC 7.8 levee geometry are described in Chapter 1.

Arcade Creek South Levee

The Arcade Creek south levee was evaluated for geometry as part of SAFCA's LAP (Kleinfelder, 2015b; URS, 2015d; Kleinfelder, 2013c). The levee crest width varies from 11 to 19 feet, which is narrower than 20 feet. The landside and waterside levee slopes are steeper than 2H:1V and 3H:1V, respectively, (as steep as 1.7H:1V landside and 2H:1V waterside) in some locations. This levee does not meet ULDC criteria for stability and therefore, this levee does not meet ULDC 7.8 requirements for geometry. A patrol road is present along the crown of the levee. Remediation of this levee is currently being designed by the SAFCA LAP. The Arcade Creek south levee will be reevaluated for geometry upon completion of the SAFCA LAP.

Natomas East Main Drainage Canal East Levee –Arcade Creek to American River

The NEMDC east levee - Arcade Creek to American River was evaluated for geometry as part of SAFCA's LAP (Kleinfelder, 2015b; URS, 2015d; Kleinfelder, 2013c). The levee crest width varies from 11 to 20 feet, and the landside and waterside levee slopes are steeper than 2H:1V and 3H:1V, respectively, (as steep as 1.6H:1V landside and 2.5H:1V waterside). The levee between Stations 2986+49 and 3001+50 and between Stations 3030+00 and 3041+25 does not meet ULDC criteria for stability, therefore these levee portions do not meet ULDC 7.8 requirements for geometry. The levee was significantly improved in 1995 and 1996 as part of the SAFCA North Area Local Project and has performed well. The levee between Stations 3001+50 and 3030+00 and Stations 3041+25 and 3056+00 does not strictly meet ULDC 7.8, but the levee has performed well since it was significantly improved in the 1990s, appears to meet ULDC 7.4 for stability, and therefore, the levee appears to meet ULDC 7.8 for geometry through an exception. A patrol road is present along the crown of the levee. Remediation of this levee is currently being designed by the SAFCA LAP. The NEMDC east levee - Arcade Creek to American River will be reevaluated for geometry upon completion of the SAFCA LAP.

American River North Levee

USACE determined (USACE, n.d.) that the American River north levee meets USACE design for stability. A patrol road is present along the crown of the levee. Therefore, the American River north levee appears to meet ULDC 7.8 for geometry. The documentation that formed the basis of this conclusion will be provided as part of the ULDC certification. Therefore, the American River north levee does not currently meet ULDC 7.3.

ULDC 7.9: Interfaces and Transitions

The requirements for ULDC 7.9 interfaces and transitions are described in Chapter 1.

Arcade Creek South Levee

The Arcade Creek south levee interfaces and transitions have not been evaluated; therefore, this levee does not meet ULDC 7.9. The Arcade Creek south levee will be evaluated for ULDC 7.9 as part of the Non-Structural Actions in support of ULDC certification.

Natomas East Main Drainage Canal East Levee –Arcade Creek to American River

The NEMDC east levee - Arcade Creek to American River interfaces and transitions have not been evaluated; therefore, this levee does not meet ULDC 7.9. The NEMDC east levee - Arcade Creek to American River will be evaluated for ULDC 7.9 as part of the Non-Structural Actions in support of ULDC certification.

American River North Levee

USACE determined (USACE, n.d.) that the American River north levee meets USACE design standards for stability and seepage requirements. Therefore, the American River north levee appears to meet ULDC 7.9 for interfaces and transitions. However, this conclusion is not effective until completion of the Folsom JFP, Folsom Raise Project, and the Folsom Dam Water Control Manual Update, described later, which provide for a Folsom release of 115,000 cfs. Therefore, the American River north levee does not meet ULDC 7.9.

ULDC 7.10: Erosion

The requirements for ULDC 7.10 erosion are described in Chapter 1. In 2012, MBK performed an erosion evaluation of the American River North Levee System based on site inspection and analysis of results from hydraulic modeling (MBK, 2014).

Arcade Creek South Levee

Arcade Creek is a flashy stream with a short duration of flooding and there is no boating activity that would generate waves upon the levee bank. The low flow channel of Arcade Creek is an average of 45 feet away from the levee and while there is some erosion of the streambank occurring, it is maintained to avoid becoming an unacceptable hazard to the levee. There are no erosion sites present that present an immediate erosional breaching hazard. Therefore, the Arcade Creek south levee meets the ULDC 7.10 for erosion. However, this evaluation has not undergone review by the IPE and therefore, the Arcade Creek south levee does not meet 7.10.

Natomas East Main Drainage Canal East Levee –Arcade Creek to American River

The low velocity of flow and non-existent boating activity on the NEMDC diminish the likelihood of significant erosions to occur along the waterside levee slopes and there is no immediate erosional breach hazard. Therefore, the NEMDC east levee - Arcade Creek to American River meets the ULDC 7.10 for erosion. However, this evaluation has not undergone review by the IPE and therefore, the NEMDC east levee – Arcade Creek to American River does not meet 7.10.

American River North Levee

Erosion along the American River north levee is common and can be significant during large flood events. However, following the 1986 and 1997 floods, bank protection was placed along the levee. Since 2005, an erosion evaluation of the American River north levee has been conducted on an annual basis by MBK, ARFCD, and SAFCA. Over the past several years, new erosion sites have been identified and subsequently repaired based on their potential impact to levee integrity while other sites that do not threaten the integrity of the levee are monitored (MBK, 2014). Therefore, the American River north levee meets the ULDC 7.10 for erosion. However, this evaluation has not undergone review by the IPE and therefore, the American River north levee does not meet 7.10.

ULDC 7.11: Right-of-Way

The requirements for ULDC 7.11 right-of-way are described in Chapter 1.

Arcade Creek South Levee

ARFCD owns the lands encompassing the levee embankment for the entire length of the Arcade Creek south levee. However, ARFCD does not presently own or have easement to the area 10 feet landward of the toe for the entire length of the levee. Downstream of Norwood Avenue, ARFCD owns the levee and area 20 feet landward of the landside toe. Upstream of Norwood Avenue, access along the landside toe is very limited due to several private properties located very close to the landside toe. Visibility from the levee to 20 feet beyond the levee toe is limited due to several obstructions including fencing and vegetation. Therefore, the Arcade Creek south levee from Norwood Ave downstream (to NEMDC) appears to meet ULDC 7.11 for right-of-way, but the levee upstream of Norwood Avenue does not meet ULDC 7.11 for right-of-way. SAFCA is preparing a long term right of way plan as part of the Non-Structural Actions that will provide for securement of a 10-foot landside zone and/or visibility for the 20-foot zone landward of the levee toe.

Natomas East Main Drainage Canal East Levee –Arcade Creek to American River

ARFCD does not presently own or have easement to all the lands encompassing the levee embankment or the area 10 feet landward of the landside toe. These lands are owned by the UPRR. Presently, for the majority of the levee, right-of-way requirements are met by the presence of a 20-foot landside visibility zone. Therefore, most of the NEMDC east levee - Arcade Creek to American River appears to meet ULDC 7.11 for right-of-way. There are some locations where a visibility zone is not present and these portions of levee do not meet ULDC for right-of-way. SAFCA is preparing a long term right of way plan as part of the Non-Structural Actions that will provide for securement of a 10-foot landside zone and/or visibility for the 20-foot zone landward of the levee toe.

American River North Levee

The lands encompassing the levee embankment for the entire length of the American River north levee are owned by public agencies, primarily by the City. Presently, for the majority of the levee, the right-of-way requirements are met by the presence of either a 10-foot landside access zone and/or 20-foot

landside visibility zone. Therefore, the majority of the American River north levee appears to meet ULDC 7.11 for right-of-way. There are some locations where a visibility zone is not present and these portions of levee do not meet ULDC for right-of-way. SAFCA is preparing a long term right of way plan as part of the Non-Structural Actions that will provide for securement of a 10-foot landside zone and/or visibility for the 20-foot zone landward of the levee toe.

ULDC 7.12: ENCROACHMENTS

The requirements for ULDC 7.12 encroachments are described in Chapter 1.

Arcade Creek South Levee

SAFCA conducted a survey and evaluation of encroachments in the American River North Levee System from 2013-2015. High hazard encroachments are present along the Arcade Creek south levee (MBK, 2016b), therefore this levee does not meet ULDC 7.12 for encroachments. Implementation of the SAFCA's LAP is anticipated to address many of these high hazard encroachments. Following implementation SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to ensure there are no outstanding encroachments that would affect the reliable performance of the facility for the DWSE and HTOL. In the case of any potential high hazard encroachment, SAFCA will facilitate removal or modification of the encroachment or conduct a full engineering evaluation to determine if the hazard is acceptable. In addition, SAFCA will prepare an encroachment remediation plan as part of the Non-Structural Actions.

Natomas East Main Drainage Canal East Levee –Arcade Creek to American River

SAFCA conducted a survey and evaluation of encroachments in the American North Levee System from 2013-2015. There are no high hazard encroachments identified along the NEMDC east levee between Arcade Creek and American River (MBK, 2016b). This levee appears to meet ULDC 7.12 for encroachments. However, this evaluation has not undergone review by the IPE and therefore, the NEMDC east levee - Arcade Creek to American River does not meet 7.12. In addition, SAFCA will prepare an encroachment remediation plan as part of the Non-Structural Actions.

American River North Levee

SAFCA conducted a survey and evaluation of encroachments in the American North Levee System from 2013-2015. High hazard encroachments are present along the American north levee (MBK, 2016b), therefore this levee does not meet ULDC 7.12 for encroachments. Implementation of the SAFCA's LAP is anticipated to address many of these high hazard encroachments. Following implementation, SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to ensure there are no outstanding encroachments that would affect the reliable performance of the facility for the DWSE and HTOL. In the case of any potential high hazard encroachment, SAFCA will facilitate removal or modification of the encroachment or conduct a full engineering evaluation to determine if the hazard is acceptable. In addition, SAFCA will prepare an encroachment remediation plan as part of the Non-Structural Actions.

ULDC 7.13: PENETRATIONS

The requirements for ULDC 7.13 penetrations are described in Chapter 1.

Arcade Creek South Levee

SAFCA conducted a survey and evaluation (Mead & Hunt, 2015d) of penetrations in the American North Levee System from 2013-2015. Potentially high hazard penetrations are present along the Arcade Creek south levee; therefore, this levee does not meet ULDC 7.13 for penetrations. Implementation of the SAFCA's LAP is anticipated to address most of these high hazard penetrations. Following implementation, SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to ensure there are no outstanding penetrations that would affect the reliable performance of the facility for the DWSE and HTOL. In the case of any potential high hazard penetrations, SAFCA will facilitate removal or modification of the encroachment or conduct a full engineering evaluation to determine if the hazard is acceptable. In addition, SAFCA will prepare an encroachment, including penetration, remediation plan as part of the Non-Structural Actions.

Natomas East Main Drainage Canal East Levee – American River to Arcade Creek

SAFCA conducted a survey and evaluation (Mead & Hunt, 2015d) of penetrations in the American North Levee System from 2013-2015. Potentially high hazard penetrations are present along the NEMDC east levee between Arcade Creek and American River; therefore, this levee does not meet ULDC 7.13 for penetrations. Implementation of the SAFCA's LAP is anticipated to address most of these high hazard penetrations. Following implementation, SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to ensure there are no outstanding penetrations that would affect the reliable performance of the facility for the DWSE and HTOL. In the case of any potential high hazard penetrations, SAFCA will facilitate removal or modification of the encroachment or conduct a full engineering evaluation to determine if the hazard is acceptable. In addition, SAFCA will prepare an encroachment, including penetration, remediation plan as part of the Non-Structural Actions.

American River North Levee

SAFCA conducted a survey and evaluation (Mead & Hunt, 2015d) of penetrations in the American North Levee System from 2013-2015. Potentially high hazard penetrations are present along the American River north levee; therefore, this levee does not meet ULDC 7.13 for penetrations. Implementation of the SAFCA's LAP is anticipated to address most of these high hazard penetrations. Following implementation, SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to ensure there are no outstanding penetrations that would affect the reliable performance of the facility for the DWSE and HTOL. In the case of any potential high hazard penetrations, SAFCA will facilitate removal or modification of the encroachment or conduct a full engineering evaluation to determine if the hazard is acceptable. In addition, SAFCA will prepare an encroachment, including penetration, remediation plan as part of the Non-Structural Actions.

ULDC 7.14: Floodwalls, Retaining Walls, and Closure Structures

The requirements for ULDC 7.14 floodwalls, retaining walls, and closure structures are described in Chapter 1.

Arcade Creek South Levee

There are no retaining walls along Arcade Creek south levee. There is 1 closure structure and 1 floodwall present in the Arcade Creek south levee. These structures were evaluated by SAFCA (Mead & Hunt, 2014), and meet ULDC 7.14 for floodwalls, retaining walls, and closure structures. However, additional analysis to confirm that global stability meets criteria is necessary and will be performed as part of the Non-Structural Actions; therefore, the Arcade Creek south levee does not meet ULDC 7.14.

A successful trial installation of the UPRR stoplog closure structure was completed by the City of Sacramento in 2015, as seen in the Technical Memorandum, "*Union Pacific Railroad (UPRR) Stop Log Structure Trial Installation Assessment*" (Mead & Hunt, 2015b).

Natomas East Main Drainage Canal East Levee –Arcade Creek to American River

There are no closure structures or retaining walls along the NEMDC east levee - Arcade Creek to American River. Two floodwalls are present at the El Camino Bridge crossing and were evaluated by SAFCA (Mead & Hunt, 2015c) and found to meet ULDC 7.14 for floodwalls, retaining walls, and closure structures. However, additional analysis to confirm that global stability meets criteria is necessary and will be performed as part of the Non-Structural Actions; therefore, the NEMDC east levee - Arcade Creek to American River does not meet ULDC 7.14.

American River North Levee

There are no floodwalls or retaining walls along the American River north levee. There are 2 closure structures in the American River north levee. These structures were evaluated by SAFCA (Mead & Hunt, 2015c) and meet ULDC 7.14 for floodwalls, retaining walls, and closure structures. However, additional analysis to confirm that global stability meets criteria is necessary and will be performed as part of the Non-Structural Actions; therefore, the American River north levee does not meet ULDC 7.14.

A successful trial installation of the UPRR stoplog closure structure was completed by the City of Sacramento in 2015, as seen in the Technical Memorandum, "*Union Pacific Railroad (UPRR) Stop Log Structure Trial Installation Assessment*" (Mead & Hunt, 2015b). The floodgates at the Del Paso Road crossing are also exercised each year.

ULDC 7.15: Animal Burrows

The requirements for ULDC 7.15 animal burrows are described in Chapter 1.

Arcade Creek South Levee

ARFCD, as the LMA, currently performs routine maintenance activities including rodent abatement. Based on the USACE's periodic inspection of American River North Levee System in 2010, the animal control status is minimally acceptable, which "would not prevent the system from performing as intended during the next flood season" (USACE, 2013a). The methods used for rodent abatement are consistent with the guidelines specified in Section 5 of the "*Operations & Maintenance of California's Flood Control Projects*", (DWR, 1980). Therefore, the American River North Levee System appears to meet ULDC 7.15 for animal burrows. However, this conclusion has not undergone review by the IPE and therefore, the American River North Levee System does not meet ULDC 7.15. As part of SAFCA's Non-Structural Actions, ARFCD will prepare a formal procedural document that will include specific abatement measures to control rodent populations.

Natomas East Main Drainage Canal East Levee –Arcade Creek to American River

As described for the Arcade Creek south levee, the American River North Levee System does not meet ULDC 7.15 for animal burrows. As part of SAFCA's Non-Structural Actions, ARFCD will prepare a formal procedural document that will include specific abatement measures to control rodent populations.

American River North Levee

As described for the Arcade Creek south levee, the American River North Levee System does not meet ULDC 7.15 for animal burrows. As part of SAFCA's Non-Structural Actions, ARFCD will prepare a formal procedural document that will include specific abatement measures to control rodent populations.

ULDC 7.16: Vegetation Evaluation

The requirements for ULDC 7.16 vegetation evaluation are described in Chapter 1.

Arcade Creek South Levee

SAFCA conducted an inspection of the American River North Levee System in 2013. There are 2 high-hazard trees on the Arcade Creek south levee that have been identified (MBK, 2016c) for removal by 2018, concurrent with implementation of SAFCA's LAP. Therefore, this levee does not meet ULDC 7.16 for vegetation. Vegetation maintenance requirements will be documented in the LMA's O&M manual as part of the Non-Structural Actions.

Natomas East Main Drainage Canal East Levee –Arcade Creek to American River

SAFCA conducted an inspection of the American River North Levee System in 2013. There is no vegetation on the NEMDC east levee - Arcade Creek to American River that poses an unacceptable threat (MBK, 2016c). Therefore, this levee appears to meet ULDC 7.16 for vegetation. However, this evaluation has not undergone review by the IPE and therefore, the NEMDC east levee - Arcade Creek to American River does not meet ULDC 7.16. Vegetation maintenance requirements will be documented in the LMA's O&M manual as part of the Non-Structural Actions.

American River North Levee

SAFCA conducted an inspection of the American River North Levee System in 2013. There are 44 high-hazard trees on the American River north levee that have been identified (MBK, 2016c) for removal by 2020, concurrent with implementation of SAFCA's LAP. Therefore, this levee does not meet ULDC 7.16 for vegetation. Vegetation maintenance requirements will be documented in the LMA's O&M manual as part of the Non-Structural Actions.

ULDC 7.17: Wind Setup and Wave Runup

The requirements for ULDC 7.17 wind setup and wave runup are described in Chapter 1.

Arcade Creek South Levee

Wind and wave analysis for the American River North Levee System was completed in 2015 in accordance with the Shore Protection Manual and EM 1110-2-1100. Results (Mead & Hunt, 2015a) indicate that the maximum combined wind setup and wave runup is 1.12 feet for the Arcade Creek south levee. The American River North Levee System wind-wave analysis appears to meet ULDC 7.17 for wind setup and wave runup. However, this evaluation has not undergone review by the IPE and therefore, the American River North Levee System does not meet ULDC 7.17. Discussion of MTOL and erosion are found above.

Natomas East Main Drainage Canal East Levee –Arcade Creek to American River

Wind and wave analysis for the American River North Levee System was completed in 2015 in accordance with the Shore Protection Manual and EM 1110-2-1100. Results (Mead & Hunt, 2015a) indicate that the maximum combined wind setup and wave runup is 3.49 feet for the NEMDC east levee between Arcade Creek and American River. The American River North Levee System wind-wave analysis appears to meet ULDC 7.17 for wind setup and wave runup. However, this evaluation has not undergone review by the IPE and therefore, the American River North Levee System does not meet ULDC 7.17. Discussion of MTOL and erosion are found above.

American River North Levee

Wind and wave analysis for the American River North Levee System was completed in 2015 in accordance with the Shore Protection Manual and EM 1110-2-1100. Results (Mead & Hunt, 2015a) indicate that the maximum combined wind setup and wave runup is 2.83 feet for the American River north levee. The American River North Levee System wind-wave analysis appears to meet ULDC 7.17 for wind setup and wave runup. However, this evaluation has not undergone review by the IPE and therefore, the American River North Levee System does not meet ULDC 7.17. Discussion of MTOL and erosion are found above.

ULDC 7.18: Security

The requirements for ULDC 7.18 security are described in Chapter 1.

Arcade Creek South Levee

A security plan for the American River North Levee System does not currently exist and therefore, this levee system does not meet ULDC 7.18 for security. SAFCA, in cooperation with ARFCD, will develop a security plan as part of its Non-Structural Actions.

Natomas East Main Drainage Canal East Levee –Arcade Creek to American River

A security plan for the American River North Levee System does not currently exist and therefore, this levee system does not meet ULDC 7.18 for security. SAFCA, in cooperation with ARFCD, will develop a security plan as part of the Non-Structural Actions.

American River North Levee

A security plan for the American River North Levee System does not currently exist and therefore, this levee system does not meet ULDC 7.18 for security. SAFCA, in cooperation with ARFCD, will develop a security plan as part of its Non-Structural Actions.

ULDC 7.19: Sea Level Rise

The requirements for ULDC 7.19 sea level rise are described in Chapter 1. Application of the 30-year sea level rise projection will result in a 0.05 foot increase at the downstream location of the Sacramento River at the Town of Freeport (at RM 45). Although this increase is considered negligible, it is included in the ULDC DWSE (MBK, 2016a).

Arcade Creek South Levee

Although negligible, sea level rise is included in the ULDC DWSE (MBK, 2016a). Estimation and consideration of sea level rise for the American River North Levee System appears to meet ULDC 7.19 for sea level rise. However, this evaluation has not undergone review by the IPE and therefore, the American River North Levee System does not meet ULDC 7.19.

Natomas East Main Drainage Canal East Levee –Arcade Creek to American River

Although negligible, sea level rise is included in the ULDC DWSE (MBK, 2016a). Estimation and consideration of sea level rise for the American River North Levee System appears to meet ULDC 7.19 for sea level rise. However, this evaluation has not undergone review by the IPE and therefore, the American River North Levee System does not meet ULDC 7.19.

American River North Levee

Although negligible, sea level rise is included in the ULDC DWSE (MBK 2016a). Estimation and consideration of sea level rise for the American River North Levee System appears to meet ULDC 7.19 for sea level rise. However, this evaluation has not undergone review by the IPE and therefore, the American River North Levee System does not meet ULDC 7.19.

ULDC 7.20: Emergency Actions and Flood Safety Plans

The requirements for ULDC 7.20 emergency actions and flood safety plans security are described in Chapter 1.

Arcade Creek South Levee

While there are several emergency planning documents related to flood safety, many of which include the required information to meet ULDC 7.20, SAFCA, in cooperation with the ARFCD, will develop and/or update their standard operating procedure documents, emergency action plans and/or flood safety plans as part of the Non-Structural Actions. Because existing emergency planning documents have not been evaluated for compliance with ULDC, the American River North Levee System does not meet ULDC 7.20.

Natomas East Main Drainage Canal East Levee – American River to Arcade Creek

As described above, the American River North Levee System does not meet ULDC 7.20.

American River North Levee

As described above, the American River North Levee System does not meet ULDC 7.20.

PLAN OF LEVEE SYSTEM IMPROVEMENTS TO SUPPORT AN URBAN LEVEL OF FLOOD PROTECTION

As described in Chapter 1, below are the specific projects and actions necessary for the physical flood management facilities in the American River North Levee System to meet ULDC and support an ULDC certification.

FOLSOM JOINT FEDERAL PROJECT

A description of the Folsom JFP is provided in Chapter 1. Below is the effect the Folsom JFP will have on the American River North Levee System:

- Effect: Construction of the auxiliary spillway and appurtenant features, jointly with the Folsom Dam Raise Project, provide the physical improvements to support the operational flexibility (Folsom Dam Water Control Manual Update) to reduce the flows from Folsom Dam during a 200-year event. Water surface elevations developed for this levee system assume completion of the Folsom JFP.
- Estimated Year of Completion: 2017
- Status: On Schedule

FOLSOM DAM RAISE PROJECT

A description of the Folsom Dam Raise Project is provided in Chapter 1. Below is the effect the Folsom Dam Raise Project will have on the American River North Levee System:

- Effect: Construction of the Folsom Dam Raise Project will increase overall storage capacity which, jointly with the Folsom JFP, provides the physical improvements to support the operational flexibility (Folsom Dam Water Control Manual Update) to reduce the flows from Folsom Dam during a 200-year event. Water surface elevations developed for this levee system assume completion of the Folsom Dam Raise Project.
- Estimated Year of Completion: 2022
- Status: Project Partnership Agreements are being developed.

FOLSOM DAM WATER CONTROL MANUAL UPDATE

A description of the Folsom Dam Water Control Manual Update is provided in Chapter 1. Below is the effect the Folsom JFP will have on the American River North Levee System:

- Effect: An updated Folsom Dam Water Control Manual will provide dam operators with the operational flexibility (Folsom Dam Water Control Manual Update) to reduce the flows released from Folsom Dam during a 200-year event. This update relies on the construction of the Folsom Dam Raise Project and JFP.
- Estimated Year of Completion: 2022
- Status: On Schedule

Levee Accreditation Project

A description of SAFCA's LAP is provided in Chapter 3 under "*Plan of Levee System Improvements to Support an Urban Level of Flood Protection*". Below is the effect the LAP will have on the American River North Levee System:

- Effect: Remediation of outstanding seepage and stability concerns for the American River North Levee System thereby also addressing other ULDC include: seismic vulnerability; geometry; interfaces and transitions; floodwalls, retaining walls, and closures structures; high hazard encroachments, penetrations, and vegetation, and securing a minimum 10-foot landside access zone or 20-foot landside visibility zone.
- Estimated Year of Completion: 2023
- Status: *Final EIR North Sacramento Streams, Sacramento River East Levee, Lower American River and Related Flood Improvements Project*, certified June 2016

Non-Structural Actions

A description of the Non-Structural Actions is provided in Chapter 1. Below is the effect the Non-Structural Actions will have on the American River North Levee System:

- Effect: The Non-Structural Actions would result in the American River North Levee System meeting ULDC for seismic, right-of-way, encroachments, penetrations, vegetation, security, and flood safety plans.
- Estimated Year of Completion: 2024

5.0 AMERICAN RIVER SOUTH – SACRAMENTO RIVER EAST LEVEE SYSTEM

DESCRIPTION OF AMERICAN RIVER SOUTH - SACRAMENTO RIVER EAST LEVEE SYSTEM

The American River South and Sacramento River East Levee System is comprised of 3 levees: American River south (left) levee, Sacramento River east (left) levee, and Beach Lake north (right) levee (Plates 6A and 6B). The total length of the levee system is approximately 30 miles.

AMERICAN RIVER SOUTH LEVEE

The American River south levee was originally constructed by local forces in the late 1800s and early 1900s and was subsequently improved by USACE in the mid-1900s as part of the Sacramento River Flood Control Project and the American River Levee Project. In the early 2000s, USACE installed significant lengths of cutoff wall in the levee as part of the American River Watershed Common Features Project. The downstream portion of the levee was constructed prior to construction of the Folsom Dam. The federally authorized American River south levee extends from the confluence of the Sacramento and American Rivers (Station 1000+00) upstream 10.5 miles to the Mayhew Drain closure structure (Station 1552+45). However, the levee on the Mayhew Drain upstream of the Mayhew Drain closure structure is being evaluated for deauthorization as part of the USACE Common Features Project. SAFCA anticipates deauthorization to occur prior to 2025; therefore, the portion of the American River south levee upstream of the Mayhew Drain closure structure (Station 1552+45 – 1635+49) is not evaluated in this Engineer's Report. ARCFD maintains the American River south levee. Cutoff walls are present for almost the entire length of levee; a gap is present for approximately 1 mile near the City's landfill where high ground extends inland of the landside slope.

The levee is crossed by several transportation routes: Interstate 5, Del Paso Boulevard, Highway 160, Capital City Freeway (Interstate 80 Business Route), UPRR, Southern Pacific RR, H Street, Guy West Bridge (pedestrian walkway), Howe Avenue, Watt Avenue, and a low water crossing at the foot of Watt Avenue. Mayhew Drain, which continues towards the river from Mayhew Road, crosses through the levee at the closure structure.

Downstream of Capital City Freeway, land use on the landside of the levee consists predominantly of commercial and industrial development. Upstream of Capital City Freeway, landside use is predominately urban and suburban development with occasional open lands associated with parks and schools. There is no waterside development.

Past performance issues include erosion, which is now largely mitigated through waterside bank protection placed over time, overtopping, and seepage, which is now largely mitigated through cutoff walls.

Following the historic 1986 flood and under the direction of Congress, the USACE undertook a general investigation for reducing flood risk to the City of Sacramento. In 1996, the USACE ultimately recommended several incrementally justified elements that were common to the different plans the investigation developed. These "common features" included remediation of 24 miles of the American River north and south levees. The proposed remediation for the American River levees was subsequently expanded to include some levee raising, erosion protection, and additional seepage remediation. All of the remediation authorized in 1996, and subsequently augmented in 1999, has been constructed by the USACE.

The design of features along the American River constructed by the USACE as part of the USACE Common Features Project were completed prior to the development of the ULDC and the requirements for an ULOP which did not exist at the time. Specifically, upon completion of the authorized features and the features being proposed as part of the general reevaluation, the American River levees will be to pass a flow of 160,000 cfs, which is greater than the flow of 115,000 cfs that is being used for the ULDC certification. The USACE Sacramento District, Engineering Division Chief has determined (USACE, n.d.) that the Lower American River levees meet USACE freeboard (i.e., MTOL), slope stability, and seepage criteria for a Folsom Dam release of 115,000 cfs. Because USACE has provided this letter, and the DWSE for the project exceeds the DWSE required for ULDC, the evaluation in this Engineer's Report relies on the USACE letter for its conclusions related to MTOL, stability, and seepage for the American River north and south levees.

SACRAMENTO RIVER EAST LEVEE

The Sacramento River east levee was built and improved by local forces and the USACE from the late 1800s to mid-1900s. The portion of the Sacramento River east levee included in this levee system extends from the confluence of the American and Sacramento Rivers, at downtown Sacramento (Station 1000+00), and extends downstream 14.6 miles to the town of Freeport, specifically where the levee meets the Beach Lake north levee near Cliff's Marina (Station 1770+00).

The Sacramento River east levee continues downstream to its terminus at the Sacramento San Joaquin Delta. The downstream limit of the Sacramento River east levee defined in this Engineer's Report represents the transition from urban to non-urban levee designation. To support the future ULDC certification, SAFCA will conduct an analysis of the Sacramento River east levee downstream of Station 1770+00 to consider whether a breach scenario along this downstream reach could affect the protected, urban floodplain. A coincident frequency analysis will also be performed to determine a representative 200-year condition in this location.

Following the 1986 flood event, it became evident that significant levee improvements were needed to prevent seepage and reduce flood risk. Since the 1986 flood, several efforts from 1990-2006 were undertaken by the USACE, State, and SAFCA to construct levee improvements. As a result of these improvements, a cutoff wall is present for approximately 12 miles of this portion of the Sacramento River east levee. A drained seepage berm is present between Pioneer Reservoir and the levee toe between Stations 1095+54 and 1102+07. Relief wells, six at Pioneer Reservoir and ten at Sump 132, were installed in 2006 and 2003, respectively. There are two major sections of retaining/floodwall along the river side of the levee in the downtown area: an older wall which is in part a seawall between I-Street and the Tower Bridge, and a newer wall of sheet pile and concrete retaining wall between Tower Bridge and the southern end of the waterfront promenade, all between Station 1040+00 and 1082+00). The floodwall north of Tower Bridge has numerous gaps for waterside pedestrian access that include stoplog closures. For the

majority of this reach of the Sacramento River east levee there is a railroad present either on the crown or along the landside of the levee, and a bike trail on, or adjacent to, the levee. Additionally, Interstate 5 is adjacent to the landside of the levee from downtown to the Little Pocket area. At the downstream end, a removable stoplog structure provides freeboard in the Cliff's Marina parking lot. Significant urban development is present along the landside of the entire levee. In the downtown and Miller Park area, there is waterside commercial development.

Multiple agencies maintain the Sacramento River east levee. ARFCD maintains the most upstream portion of the levee from Station 1000+00 to 1020+85 near the Sacramento River water intake facility. The City of Sacramento maintains the levee from Station 1020+85 to 1215+95 which is through the downtown area to approximately Sutterville Road; and DWR Maintenance Area 9 (MA9) maintains the levee from Station 1215+95, downstream to Station 1770+00, i.e., approximately Sutterville Road to Beach Lake North Levee, downstream of the Town of Freeport.

The performance history of this portion of the Sacramento River east levee is detailed in the Kleinfelder PIR (Kleinfelder, 2013a). In summary, the levee has experienced significant issues over its lifetime primarily related to seepage and erosion, both of which occurred every year from 1995-1998. Seepage also occurred in 1999, 2000, and 2006.

Beach Lake North Levee

The Beach Lake north levee is located on the north (right) bank of Morrison Creek extending approximately 3.7 miles from the UPRR embankment (Station 1183+00), and extending downstream, dog-legging, until it joins the Sacramento River east levee near Cliff's Marina (Station 987+18).

The Beach-Stone Lakes basin is located along the downstream portion of Morrison Creek which receives all flow from the South Sacramento Streams Group (i.e., Morrison Creek, Elder Creek, Florin Creek, and Unionhouse Creek). Morrison Creek serves as the main stormwater conveyance channel along the City's southern boundary and terminates at Beach-Stone Lakes basin where the discharged water flows through a series of drainage channels, reclaimed lands, and permanent wetlands until eventually reaching the Sacramento River. During floods, flows from Morrison Creek and backwater from the downstream system result in extensive ponding.

The levee was significantly improved from 2005-2006 by USACE as part of the South Sacramento Streams project. Specifically, the project including 4.4 miles of levee raising (includes levee reaches upstream of the UPRR embankment), 0.5 miles of new levee between Interstate 5 and Highway 160, 50 relief wells, and floodwalls. Similar to the American River north and south levees, to support an ULDC certification, SAFCA is relying on the USACE's certification of the levees as meeting USACE design standards for the ULDC DWSE. SAFCA has requested, and is awaiting receipt of the USACE's certification.

The dominant land uses in the Beach-Stone Lakes basin are wildlife preserve, agriculture, sewage treatment (Sacramento Regional Wastewater Treatment Plant), and open space. The Beach Lake north levee is maintained by the City of Sacramento.

EVALUATION OF AMERICAN RIVER SOUTH AND SACRAMENTO RIVER EAST LEVEE SYSTEM

To support an APF, an evaluation of the levee system was performed to determine if it meets ULDC. The evaluation of each levee for each criterion is provided below.

ULDC 7.1: DESIGN WATER SURFACE ELEVATION

As described in Chapter 1, the ULDC DWSE for all of the levee systems was computed in February 2016 using the FEMA approach and MBK version of Release 4 of the USACE Sacramento River HEC-RAS model, hydrology developed by the USACE for the Sacramento and San Joaquin River Basins Comprehensive Study (Comp Study) for the Sacramento River, and a flow of 115,000 cfs[6] released from Folsom Dam (MBK, 2016a). The ULDC DWSE includes adjustments for debris loading, superelevation, climate change, updated hydraulic models, and sea level rise. The ULDC DWSE memorandum (MBK, 2016a) has not undergone review by the IPE and the Folsom JFP and Folsom Dam Raise Projects need to be completed to achieve the ULDC DWSE, therefore the American River South, and Sacramento River East Levee System do not meet ULDC 7.1.

American River South Levee

The computed DWSEs for the American River south levee are provided in Table . However, as described above, the USACE design for the Common Features Project was based on a flow of 160,000 cfs in American River, which is greater than the flow of 115,000 cfs that was used to develop the ULDC DWSE. As described above, MBK, 2016a has not undergone review by the IPE and the Folsom JFP and Folsom Dam Raise Projects need to be completed to achieve the ULDC DWSE, therefore the American River south levee does not meet ULDC 7.1.

Table 29. DWSE for American River South Levee

Hydraulic Model River Station*	Levee Station (feet)	DWSE (feet NAVD88)
10.75	1597+00	51.8
9.14	1468+00	48.0
7.62	1386+50	46.0
6.47	1320+50	42.9
3.9	1204+00	38.3
2.0	1100+50	36.6
0.28	1014+00	35.4

* Comp Study RM

[6] MBK determined that the 200-year release from Folsom Dam is likely to be 115,000 cfs once the Folsom JFP and Folsom Raise projects are completed. The expected time of completion for the Folsom JFP is 2017, and for the Folsom Raise Projects is 2025, at which time a ULOP finding will be made.

Sacramento River East Levee

The computed DWSEs for the Sacramento River east levee – American River to Freeport - are provided in Table . As described above, MBK, 2016a has not undergone review by the IPE and the Folsom JFP and Folsom Dam Raise Projects need to be completed to achieve the ULDC DWSE, therefore the Sacramento River east levee does not meet ULDC 7.1.

Table 30. DWSE for Sacramento River East Levee – ARSL to Freeport

Hydraulic Model River Station*	Levee Station (feet)	DWSE (feet NAVD88)
60.5	1000+00	35.2
59.7	1039+00	34.9
58.5	1102+50	34.3
56.2	1215+50	32.8
50.1	1540+50	30.2
47.6	1671+00	29.1
46.4	1730+00	28.5

* Comp Study RM

Beach Lake North Levee

As described above, the USACE completed significant improvements to the Beach Lake north levee in 2006. Since there are multiple hydrologic inputs that affect the flood stage in the Beach Lake floodplain, it is prudent to conduct a coincident frequency analysis to better determine the stage-frequency relationship among the pertinent frequency curves. SAFCA is currently conducting this coincident frequency analysis as part of the Non-Structural Actions and therefore, a ULDC DWSE has not yet been finalized. Therefore, the Beach Lake north levee does not meet ULDC for DWSE.

ULDC 7.2: Minimum Top of Levee

The requirements for ULDC 7.2 MTOL are described in Chapter 1.

American River South Levee

USACE determined (USACE, n.d.) that the American River south levee has sufficient freeboard. Therefore, the American River south levee appears to meet ULDC 7.2 for MTOL. However, this conclusion is not effective until completion of the Folsom JFP, Folsom Raise Project, and the Folsom Dam Water Control Manual Update, described later, which provide for a Folsom release of 115,000 cfs. Therefore, the American River south levee does not meet ULDC 7.4.

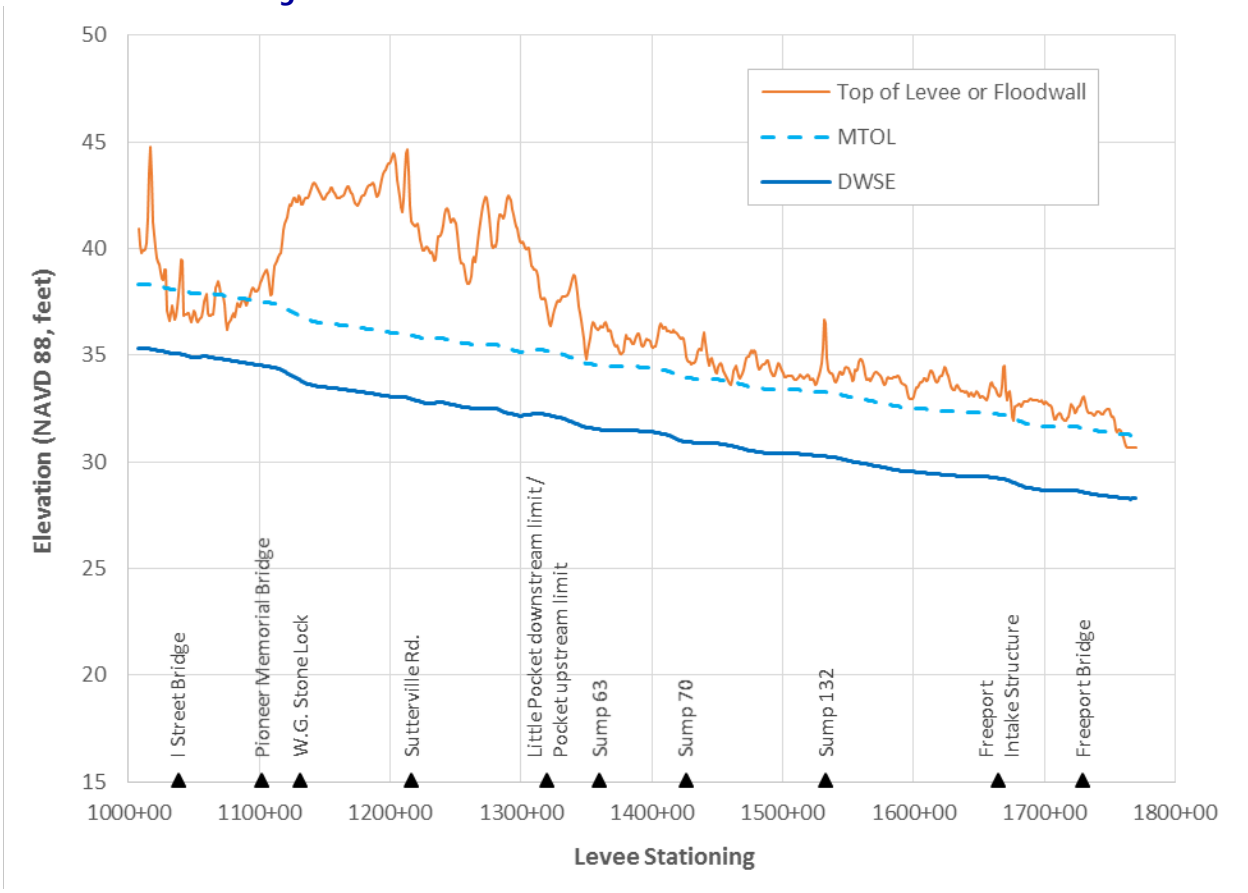
Sacramento River East Levee

Wind setup and wave runup were computed by Mead & Hunt (Mead & Hunt, 2014) and are discussed below in ULDC 7.17. For the Sacramento River east levee – American River to Freeport, the maximum wind and wave runup is up to 3.05 feet, near Station 1320+00. Therefore, the MTOL is the DWSE plus the maximum of 3 feet or wind and wave runup. Figure 13 shows the computed MTOL and actual top of levee profiles.

The majority of the SREL meets the MTOL criterion with the exception of the upstream reach between I Street and Pioneer Memorial bridges where hydraulic control is represented by high ground and floodwalls. The specific station ranges where the SREL does not meet MTOL are as follows:

- 1030+00 to 1066+00: the levee reach from 1030+00 to 1040+00 consists of high ground adjacent to an elevated on-ramp. Old Sacramento and the floodwall along the boardwalk is represented from Station 1040+00 to 1060+00 (i.e., from I Street Bridge to Tower Bridge). The upstream portion of the Docks Riverfront Promenade is located from 1060+00 to 1066+00. The average freeboard height along these reaches is approximately 2.2 feet.
- 1074+00 to 1086+00: this levee reach includes the downstream portion of the Docks Riverfront Promenade (from 1074+00 to 1081+00) with an average freeboard height of approximately 2.4 feet.
- 1761+00 to 1770+00: this levee reach represents the most downstream section of SREL in the study area at the intersection of the Beach Lake North Levee. The average freeboard height is approximately 2.5 feet.

Figure 13. MTOL for Sacramento River East Levee



SAFCA is currently evaluating remediation of the MTOL deficiency. Remediation will occur as part of the SAFCA LAP.

Beach Lake North Levee

USACE determined that the Beach Lake north levee has sufficient freeboard as part of the South Sacramento Streams project. However, additional hydraulic analysis is being conducted to confirm the ULDC design water surface. Therefore, the Beach Lake north levee does not meet ULDC 7.2 for MTOL.

ULDC 7.3: Soil Sampling, Testing, and Logging

The requirements for ULDC 7.3 soil sampling, testing, and logging are described in Chapter 1.

American River South Levee

USACE determined (USACE, n.d.) that the American River south levee meets USACE design standards for stability and seepage. These analyses were based on soil sampling, testing and logging performed by

USACE. Therefore, the American River south levee appears to meet ULDC 7.3 for soil sampling, testing, and logging. However, because this conclusion has not undergone review by the IPE, the American River south levee does not meet ULDC 7.3.

Sacramento River East Levee

Soil exploration information for the Sacramento River east levee – American River to Freeport- is contained in the data reports prepared by the DWR ULE Project and the SAFCA LAP (Kleinfelder, 2013a; URS, 2009, 2014b). Soil exploration locations were selected based upon a review of the geology and geomorphology, past performance information, historical records, and construction records. The exploration spacing described above was generally met for this levee with the exception of borings at the waterside toe due to the presence heavy vegetation at the waterside toe, and the proximity of the levee to the water channel. Soil sampling, testing, and logging were generally performed following the guidance outlined above. The soil explorations that were obtained were used in combination with geology and geomorphology, geophysical resistivity surveys, past performance information, historical records, and construction records to provide an adequate assessment of the subsurface conditions as outlined in the SPK SOP-03 for levee evaluations. Because the soil sampling, testing, and logging do not strictly meet ULDC 7.3, the Sacramento River east levee – American River to Freeport, does not meet ULDC 7.3 and an exception will be required. This exception will be prepared as part of the Non-Structural Actions in support of ULDC certification.

Beach Lake North Levee

USACE determined that the Beach Lake north levee meets USACE design standards for stability and seepage. These analyses were based on soil sampling, testing and logging performed by USACE. Therefore, the Beach Lake north levee appears to meet ULDC 7.3 for soil sampling, testing, and logging. Documentation of this conclusion is being prepared by USACE and will be provided as part of the ULDC Certification. As this documentation is not yet finalized, the Beach Lake north levee does not meet ULDC 7.3.

ULDC 7.4: Slope Stability For Intermittently Loaded Levees

The requirements for ULDC 7.4 are described in Chapter 1. ULDC 7.4.2 requires a minimum factor of safety of 1.0 to 1.2 for waterside slope stability during rapid drawdown conditions for the DWSE depending on how long the embankment is saturated, with the higher factor of safety used for longer duration events. A factor of safety of 1.2 was used for rapid drawdown for the Sacramento River, the American River, and the Beach Lake North Levee. The referenced DWR ULE and Kleinfelder reports for this these levees used a factor of safety of 1.1 for waterside slope stability. When these models were referenced, the calculated factor of safety was compared to the factor of safety stated above for each levee (e.g., 1.0 or 1.2) to determine if the levee met criteria. The HTOL for the Sacramento River east levee – American River to Freeport, was calculated by MBK and are documented (MBK, 2016a). The slope stability evaluations performed for the Sacramento River east levee – American River to Freeport, are documented as indicated below. The American River south levee was evaluated by USACE as part of the USACE Common Features Project. The Beach Lake North Levee was evaluated by USACE as part of the South Sacramento Streams Project. DWR has determined that these levees, and the Sacramento River

east levee – American River to Freeport, are intermittently loaded as described in Section 7.6. Verification of the loading condition will be made and documented by SAFCA as part of the Non-Structural Actions to support a ULDC certification.

American River South Levee

USACE determined (USACE, n.d.) that the American River south levee meets USACE design standards for stability. Therefore, the American River south levee appears to meet ULDC 7.4 for slope stability. However, this conclusion is not effective until completion of the Folsom JFP, Folsom Raise Project, and the Folsom Dam Water Control Manual Update, described later, which provide for a Folsom release of 115,000 cfs. Therefore, the American River south levee does not meet ULDC 7.4.

Sacramento River East Levee

The Sacramento River east levee – American River to Freeport, was evaluated for landside slope stability as part of SAFCA's LAP (Kleinfelder, 2013b). The Sacramento River east levee between Stations 1080+00 to 1150+00, Station 1185+00 to 1206+00, Station 1244+00 to 1261+75, Station 1285+75 to 1418+00, Station 1424+50 to 1570+00, and 1600+00 to 1640+00, does not meet ULDC 7.4 for slope stability for intermittently loaded levees. The remainder of this levee appears to meet ULDC 7.4 for slope stability for intermittently loaded levees for the DWSE and the HTOL. Remediation of this levee is currently being designed as part of the SAFCA LAP. The Sacramento River east levee – American River to Freeport, will be reevaluated for slope stability upon completion of the SAFCA LAP.

Beach Lake North Levee

USACE determined that the Beach Lake north levee meets USACE design standards for stability. Therefore, the Beach Lake north levee appears to meet ULDC 7.4 for slope stability. Documentation of this conclusion is being prepared by USACE and will be provided as part of the ULDC Certification. As this documentation is not yet finalized, the Beach Lake north levee does not meet ULDC 7.4.

ULDC 7.5: Underseepage For Intermittently Loaded Levees

The requirements for ULDC 7.5 underseepage for intermittently loaded levees is described in Chapter 1. The American River south levee was evaluated by USACE as part of the USACE Common Features Project. The Beach Lake North Levee was evaluated by USACE as part of the South Sacramento Streams Project. DWR has determined that these levees, and the Sacramento River east levee – American River to Freeport, are intermittently loaded as described in Section 7.6. Verification of the loading condition will be made and documented by SAFCA as part of the Non-Structural Actions to support a ULDC certification.

American River South Levee

USACE determined (USACE, n.d.) that the American River south levee meets USACE design standards for seepage. Therefore, the American River south levee appears to meet ULDC 7.5 for underseepage. However, this conclusion is not effective until completion of the Folsom JFP, Folsom Raise Project, and the

Folsom Dam Water Control Manual Update, described later, which provide for a Folsom release of 115,000 cfs. Therefore, the American River south levee does not meet ULDC 7.5.

Sacramento River East Levee

The Sacramento River east levee – American River to Freeport, was evaluated for underseepage as part of SAFCA's LAP (Kleinfelder, 2013b). The Sacramento River east levee between Stations 1080+00 to 1150+00, Station 1185+00 to 1206+00, Station 1244+00 to 1261+75, Station 1285+75 to 1418+00, Station 1424+50 to 1570+00, and Station 1600+00 to 1640+00 does not meet ULDC 7.5 for underseepage. The remainder of this levee appears to meet ULDC 7.5 for underseepage for intermittently loaded levees for the DWSE and the HTOL. Remediation of this levee is currently being designed as part of the SAFCA LAP. The Sacramento River east levee – American River to Freeport, will be reevaluated for slope stability upon completion of the SAFCA LAP.

Beach Lake North Levee

USACE determined that the Beach Lake north levee meets USACE design standards for seepage. Therefore, the Beach Lake north levee appears to meet ULDC 7.5 for underseepage. Documentation of this conclusion is being prepared by USACE and will be provided as part of the ULDC Certification. As this documentation is not yet finalized, the Beach Lake north levee does not meet ULDC 7.5.

ULDC 7.6: Frequently Loaded Levees

The requirements for ULDC 7.6 frequently loaded levees is described in Chapter 1.

American River South Levee

As part of the ULE Program, DWR considered the American River south levee an intermittently loaded levee (URS, 2015b), therefore ULDC 7.6 for frequently loaded levees is not applicable. Verification of this conclusion will be made and documented by SAFCA as part of the Non-Structural Actions to support ULDC certification.

Sacramento River East Levee

As part of the ULE Program, DWR considered The Sacramento River east levee – American River to Freeport, an intermittently loaded levee (URS, 2015b), therefore ULDC 7.6 for frequently loaded levees is not applicable. Verification of this conclusion will be made and documented by SAFCA as part of the Non-Structural Actions to support ULDC certification.

Beach Lake North Levee

As part of the ULE Program, DWR considered the Beach Lake north levee an intermittently loaded levee (URS 2015b), therefore ULDC 7.6 for frequently loaded levees is not applicable. Verification of this conclusion will be made and documented by SAFCA as part of the Non-Structural Actions to support ULDC certification.

ULDC 7.7: SEISMIC VULNERABILITY

Chapter 1 describes the requirements for ULDC 7.7 seismic vulnerability and the guidelines and classifications developed DWR as part of the ULE Program.

American River South Levee

The American River south levee was evaluated for seismic vulnerability as part of the DWR ULE Program (URS, 2015a). The results of this evaluation are shown in Table .

Table 31. American River North Levee Seismic Vulnerability Class

Stations	Vulnerability Class (Post-Seismic Flood Protection Ability)
1000+00 to 1135+00	High Vulnerability
1135+00 to 1195+00	(Not evaluated due to presence of high ground)
1195+00 to 1335+86	High Vulnerability
1335+86 to 1381+93	Low Vulnerability
1381+93 to 1431+25	High Vulnerability
1431+25 to 1552+45	Low Vulnerability

Because a post-earthquake remediation plan has not been developed, and the seismic vulnerability analysis has not undergone review by the IPE, the American River south levee does not meet ULDC 7.7. SAFCA will coordinate the preparation of a post-earthquake remediation plan as part of the Non-Structural Actions to support a ULDC certification.

Sacramento River East Levee

The Sacramento River east levee – American River to Freeport, was evaluated for seismic vulnerability as part of the SAFCA LAP (Kleinfelder, 2013b). The entire length of the Sacramento River east levee – American River to Freeport, was determined to have high seismic vulnerability due to relatively thick layers of low-blow count and coarse-grained soils in combination with a high groundwater table.

Because a post-earthquake remediation plan has not been developed, and the seismic vulnerability analysis has not undergone review by the IPE, the Sacramento River east levee – American River to Freeport, does not meet ULDC 7.7. SAFCA will coordinate the preparation of a post-earthquake remediation plan as part of the Non-Structural Actions to support a ULDC certification.

Beach Lake North Levee

The Beach Lake north levee between Stations 987+18 and 1189+00 was evaluated for seismic vulnerability as part of the DWR ULE Program (URS, 2015b). The results of this evaluation are shown in Table .

Table 32. Beach Lake North Levee Seismic Vulnerability Class

Stations	Vulnerability Class (Post-Seismic Flood Protection Ability)
987+18 to 993+18	High Vulnerability
993+18 to 1004+40	Low Vulnerability
1004+40 to 1034+10	High Vulnerability
1034+10 to 1183+00	Low Vulnerability

Because a post-earthquake remediation plan has not been developed, and the seismic vulnerability analysis has not undergone review by the IPE, the Beach Lake north levee does not meet ULDC 7.7. SAFCA will coordinate the preparation of a post-earthquake remediation plan as part of the Non-Structural Actions to support a ULDC certification.

ULDC 7.8: Levee Geometry

The requirements for ULDC 7.8 levee geometry are described in Chapter 1.

American River South Levee

USACE determined (USACE n.d.) that the American River south levee meets USACE design for stability requirements. Therefore, the American River south levee appears to meet ULDC 7.8 for geometry. A patrol road is present along the crown of the levee. The documentation that formed the basis of this conclusion will be provided as part of the ULDC Certification. Therefore, the American River north levee does not meet ULDC 7.3.

Sacramento River East Levee

The Sacramento River east levee – American River to Freeport, was evaluated for geometry per ULDC 7.8 as part of SAFCA's LAP (Kleinfelder, 2013b; URS, 2014b). Stations 1000+00 to 1040+00, 1317+00 to 1407+50, and 1424+50 to 1640+00 have crest widths narrower than 20 feet; Stations 1080+00 to 1371+00, 1407+50 to 1490+00, and 1540+00 to 1640+00 have landside slopes steeper than 2H:1V; and Stations 1000+00 to 1770+00 have waterside slopes steeper than 3H:1V. The following levee portions meet ULDC 7.4 for stability and have performed well; therefore, these levee portions appears to meet ULDC 7.8 for geometry through exception: Stations 1000+00 to 1080+00, Stations 1150+00 to 1185+00, Stations 1206+00 to 1244+00, Stations 1261+75 to 1285+75, Stations 1418+00 to 1424+50, Stations 1570+00 to 1600+00, and Stations 1640+00 to 1770+00. The remainder of the levee does not meet ULDC 7.8 requirements for geometry. A patrol road is present along the crown of the levee, except at for locations where the railroad tracks sit on the levee crown (i.e., near Miller Park and Town of Freeport). In these two locations, alternate access via a waterside road at Miller Park, and the landside Freeport Boulevard near the Town of Freeport, is adequate for operation and maintenance. Remediation for this levee is currently being designed by the SAFCA LAP. The Sacramento River east levee – American River to Freeport, will be reevaluated for slope stability upon completion of the SAFCA LAP.

Beach Lake North Levee

USACE determined that the Beach Lake north levee meets USACE design for stability requirements. Therefore, the Beach Lake north levee appears to meet ULDC 7.8 for geometry. A patrol road is present along the crown of the levee. Documentation of this conclusion is being prepared by USACE and will be provided as part of the ULDC Certification. As this documentation is not yet finalized, the Beach Lake north levee does not meet ULDC 7.8.

ULDC 7.9: Interfaces and Transitions

The requirements for ULDC 7.9 interfaces and transitions are described in Chapter 1.

American River South Levee

USACE determined (USACE, n.d.) that the American River south levee meets USACE design standards for stability and seepage requirements. Therefore, the American River south levee appears to meet ULDC 7.9 for interfaces and transitions. However, this conclusion is not effective until completion of the Folsom JFP, Folsom Raise Project, and the Folsom Dam Water Control Manual Update, described later, which provide for a Folsom release of 115,000 cfs. Therefore, the American River south levee does not meet ULDC 7.9.

Sacramento River East Levee

The Sacramento River east levee – American River to Freeport, interfaces and transitions have not been evaluated; therefore, this levee does not meet ULDC 7.9. The Sacramento River east levee – American River to Freeport, will be evaluated for ULDC 7.9 as part of the Non-Structural Actions in support of ULDC certification.

Beach Lake North Levee

USACE determined that the Beach Lake north levee meets USACE design standards for stability and seepage requirements. Therefore, the Beach Lake north levee appears to meet ULDC 7.9 for interfaces and transitions. Documentation of this conclusion is being prepared by USACE and will be provided as part of the ULDC Certification. As this documentation is not yet finalized, the Beach Lake north levee does not meet ULDC 7.9.

ULDC 7.10: Erosion

The requirements for ULDC 7.10 erosion are described in Chapter 1.

American River South Levee

Erosion along the American River south levee is common and can be significant during large flood events. However, following the 1986 and 1997 floods, bank protection was placed along the levee. Since 2005, an erosion evaluation of the American River south levee has been conducted on an annual basis by MBK, ARFCD, and SAFCA. Additionally, in 2012 MBK performed an erosion survey for the purposes of FEMA and ULDC certification (MBK, 2014). Over the past several years, new erosion sites have been identified and subsequently repaired based on their potential impact to levee integrity while other sites that do not threaten the integrity of the levee are monitored. Therefore, the American River south levee meets the ULDC 7.10 for erosion. However, this evaluation has not undergone review by the IPE and therefore, the American River south levee does not meet 7.10.

Sacramento River East Levee

In 2012, MBK performed an erosion evaluation of the Sacramento River east levee – American River to Freeport, based on site inspection and analysis of results from hydraulic modeling (MBK, 2014). The primary cause of erosion along the levee can be attributed to wind generated waves and boat wakes that often damage the toe and lead to progressive failure of the levee. The average velocity along the waterside of levee is generally low (1-3 fps) during a high-water event (MBK, 2014). Although the levee has been heavily armored over time, approximately 2,500 feet of erosion was identified for near term repair. Therefore, the Sacramento River east levee – American River to Freeport, does not meet ULDC 7.10 for erosion. Remediation of the erosion sites is currently being designed as part of the SAFCA LAP.

Beach Lake North Levee

In 2012, MBK performed an erosion evaluation of the Beach Lake north levee based on field investigations and results from hydraulic modeling at the time (MBK, 2014). The levee is not subject to high velocities, but is subject to wind generated waves. To remediate this issue, the levee is heavily armored along the upper one-third of the waterside slope and vegetation has been planted to serve as a wind-wave buffer. There is currently no evidence of erosion activity along the waterside slope. The Beach Lake north levee appears to meet ULDC 7.10 for erosion. However, this evaluation has not undergone review by the IPE, therefore the Beach Lake north levee does not meet 7.10.

ULDC 7.11: Right-of-Way

The requirements for ULDC 7.11 right-of-way are described in Chapter 1.

American River South Levee

The lands encompassing the levee embankment for the entire length of the American River south levee are owned by public agencies, primarily by the County. Presently, for the majority of the levee, the right-of-way requirements are met by the presence of either a 10-foot landside access zone and/or 20-foot landside visibility zone and these portions meet ULDC 7.11 for right-of-way. However, there are some portions where a 10-foot access zone or 20-foot visibility zone is not present, and therefore, those portions of the levee do not meet ULDC 7.11 for right-of-way. SAFCA is preparing a long term right of

way plan as part of the Non-Structural Actions that will provide for securement of a 10-foot landside zone and/or visibility for the 20-foot zone landward of the levee toe.

Sacramento River East Levee

The LMAs along the Sacramento River east levee – American River to Freeport, do not presently own or have easement to the all lands encompassing the levee embankment or the area 10 feet landward of the landside toe, which are owned by public agencies, private residents, and private commercial entities. A 20-foot visibility zone is present for portions of the levee, but not all. Upstream of Miller Park, the levee is generally bordered by commercial and industrial uses where a 20-foot visibility zone exists. Downstream of Miller Park the levee is generally bordered by urban development where the lands encompassing the levee are owned by residents and visibility requirements are not met. Therefore, Sacramento River east levee – American River to Freeport, does not meet ULDC 7.11 for right-of-way. SAFCA is preparing a long term right of way plan as part of the Non-Structural Actions that will provide for securement of a 10-foot landside zone and/or visibility for the 20-foot zone landward of the levee toe.

Beach Lake North Levee

The City of Sacramento, the LMA along the Beach Lake north levee, does not presently own or have easement to all the lands encompassing the levee embankment or areas 10 feet landward of the landside toe. However, most of these lands are undeveloped and owned by public agencies, including the City, with the exception of a large, privately-owned parcel at the upstream end of the levee. Therefore, the right-of-way requirements are met by the presence a 20-foot landside visibility zone. The Beach Lake north levee appears to meet ULDC 7.11 for right-of-way. SAFCA is preparing a long term right of way plan as part of the Non-Structural Actions that will provide for securement of a 10-foot landside zone and/or visibility for the 20-foot zone landward of the levee toe.

ULDC 7.12: ENCROACHMENTS

The requirements for ULDC 7.12 encroachments are described in Chapter 1.

American River South Levee

SAFCA conducted a survey and evaluation of encroachments in the American River South – Sacramento River East Levee System from 2013-2015. High hazard encroachments are present along the American River south levee therefore this levee does not meet ULDC 7.12 for encroachments (MBK, 2016b). Implementation of the SAFCA's LAP is anticipated to address many of these high hazard encroachments. Following implementation, SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to ensure there are no outstanding encroachments that would affect the reliable performance of the facility for the DWSE and HTOL. In the case of any potential high hazard encroachment, SAFCA will facilitate removal or modification of the encroachment or conduct a full engineering evaluation to determine if the hazard is acceptable. In addition, SAFCA will prepare an encroachment remediation plan as part of the Non-Structural Actions.

Sacramento River East Levee

SAFCA conducted a survey and evaluation of encroachments in the American River South – Sacramento River East Levee System from 2013-2015. High hazard encroachments are present along the Sacramento River east levee – American River to Freeport, therefore this levee does not meet ULDC 7.12 for encroachments (MBK, 2016b). Implementation of the SAFCA's LAP is anticipated to address many of these high hazard encroachments. Following implementation, SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to ensure there are no outstanding encroachments that would affect the reliable performance of the facility for the DWSE and HTOL. In the case of any potential high hazard encroachment, SAFCA will facilitate removal or modification of the encroachment or conduct a full engineering evaluation to determine if the hazard is acceptable. In addition, SAFCA will prepare an encroachment remediation plan as part of the Non-Structural Actions.

Beach Lake North Levee

SAFCA conducted a survey and evaluation of encroachments in the American River South – Sacramento River East Levee System from 2013-2015. There are no high hazard encroachments identified along the Beach Lake north levee (MBK, 2016b). This levee appears to meet ULDC 7.12 for encroachments. However, this evaluation has not undergone review by the IPE and therefore, the Beach Lake north levee does not meet 7.12. In addition, SAFCA will prepare an encroachment remediation plan as part of the Non-Structural Actions.

ULDC 7.13: PENETRATIONS

The requirements for ULDC 7.13 penetrations are described in Chapter 1. SAFCA conducted a survey and evaluation of penetrations in the American River South – Sacramento River East Levee System from 2013-2015. These penetrations are catalogued in a database maintained by Mead & Hunt.

American River South Levee

The American River south levee does not meet ULDC 7.13 for penetrations. Implementation of the SAFCA's LAP is anticipated to address most of these high hazard penetrations. Following implementation, SAFCA will conduct a hazard assessment as part of the Non-Structural Actions to ensure there are no outstanding penetrations that would affect the reliable performance of the facility for the DWSE and HTOL. In the case of any potential high hazard penetrations, SAFCA will facilitate removal or modification of the encroachment or conduct a full engineering evaluation to determine if the hazard is acceptable. In addition, SAFCA will prepare an encroachment, including penetration, remediation plan as part of the Non-Structural Actions.

Sacramento River East Levee

This evaluation identified several potentially high hazard penetrations that do not meet ULDC age or elevation criteria. The Sacramento River east levee – American River to Freeport, does not meet ULDC 7.13 for penetrations. Implementation of the SAFCA's LAP is anticipated to address most of these high hazard penetrations. Following implementation, SAFCA will conduct a hazard assessment as part of the

Non-Structural Actions to ensure there are no outstanding penetrations that would affect the reliable performance of the facility for the DWSE and HTOL. In the case of any potential high hazard penetrations, SAFCA will facilitate removal or modification of the encroachment or conduct a full engineering evaluation to determine if the hazard is acceptable. In addition, SAFCA will prepare an encroachment, including penetration, remediation plan as part of the Non-Structural Actions.

Beach Lake North Levee

Penetrations determined to be potentially high hazard were subjected to a full engineering evaluation (Mead & Hunt, 2015d). The Beach Lake north levee appears to meet ULDC 7.13 for penetrations. However, this evaluation has not undergone review by the IPE, and therefore, the Beach Lake north levee does not meet 7.12. In addition, SAFCA will prepare an encroachment, including penetration, remediation plan as part of the Non-Structural Actions.

ULDC 7.14: Floodwalls, Retaining Walls, and Closure Structures

The requirements for ULDC 7.14 floodwalls, retaining walls, and closure structures are described in Chapter 1.

American River South Levee

There are no floodwalls or closure structures along the American River south levee. Several retaining walls that are non-compliant with ULDC 7.14 (Mead & Hunt, 2014) are present. These features will be evaluated as part of the Non-Structural Actions; therefore, the American River south levee does not meet ULDC 7.14.

Sacramento River East Levee

There is one closure structure along the Sacramento River east levee – American River to Freeport; it was found to meet the requirements for closure structures and for which the annual testing was verified by the City. At least one floodwall and several retaining walls were found to be non-compliant with 7.14 (Mead & Hunt., 2014). The Sacramento River east levee – American River to Freeport, does not meet ULDC 7.14 for floodwalls, retaining walls, and closure structures. These features will be evaluated as part of the Non-Structural Actions; therefore, the Sacramento River east levee – American River to Freeport, does not meet ULDC 7.14.

Beach Lake North Levee

There are 3 floodwalls in the Beach Lake north levee. These were installed by the USACE from 2005-2006. USACE determined that the Beach Lake north levee meets USACE design standards for floodwalls as part of the South Sacramento Streams project. Therefore, the Beach Lake north levee appears to meet ULDC 7.14 for floodwalls, retaining walls, and closure structures. Additionally, a retaining wall is also present in the system. Documentation of this conclusion is being prepared by USACE and will be provided as part of the ULDC Certification. As this documentation is not yet finalized, the Beach Lake north levee does not meet ULDC 7.4.

ULDC 7.15: Animal Burrows

The requirements for ULDC 7.15 animal burrows are described in Chapter 1.

American River South Levee

ARFCD, as the LMA, currently performs routine maintenance activities including rodent abatement. Based on the USACE's periodic inspection of American River South – Sacramento River East Levee System in 2010, the animal control status is minimally acceptable, which "would not prevent the system from performing as intended during the next flood season" (USACE, 2010a). The methods used for rodent abatement are consistent with the guidelines specified in Section 5 of "*Operations & Maintenance of California's Flood Control Projects*" (DWR, 1980). Therefore, the American River South – Sacramento River East Levee System appears to meet ULDC 7.15 for animal burrows. However, this conclusion has not undergone review by the IPE and therefore, the American River South – Sacramento River East Levee System does not meet ULDC 7.15. As part of SAFCA's Non-Structural Actions, ARFCD will prepare a formal procedural document that will include specific abatement measures to control rodent populations.

Sacramento River East Levee

ARFCD, City of Sacramento, MA 9, as the LMAs, currently perform routine maintenance activities including rodent abatement. Based on the USACE's periodic inspection of American River South – Sacramento River East Levee System in 2010, the animal control status is minimally acceptable, which "would not prevent the system from performing as intended during the next flood season" (USACE, 2010a). The methods used for rodent abatement are consistent with the guidelines specified in Section 5 of the "*Operations & Maintenance of California's Flood Control Projects*" (DWR, 1980). Therefore, the American River South – Sacramento River East Levee System appears to meet ULDC 7.15 for animal burrows. However, this conclusion has not undergone review by the IPE and therefore, the American River South – Sacramento River East Levee System does not meet ULDC 7.15. As part of SAFCA's Non-Structural Actions, the LMAs will prepare a formal procedural document that will include specific abatement measures to control rodent populations.

Beach Lake North Levee

The City of Sacramento, as the LMA, currently performs routine maintenance activities including rodent abatement. The methods used for rodent abatement are consistent with the guidelines specified in Section 5 of "*Operations & Maintenance of California's Flood Control Projects*" (DWR, 1980). Therefore, the American River South – Sacramento River East Levee System appears to meet ULDC 7.15 for animal burrows. However, this conclusion has not undergone review by the IPE and therefore, the American River South – Sacramento River East Levee System does not meet ULDC 7.15. As part of SAFCA's Non-Structural Actions, the City of Sacramento will prepare a formal procedural document that will include specific abatement measures to control rodent populations.

ULDC 7.16: Vegetation Evaluation

The requirements for ULDC 7.16 vegetation evaluation are described in Chapter 1.

American River South Levee

SAFCA conducted an inspection of the American River South – Sacramento River East Levee System in 2013. There are 90 high-hazard trees along the American River south levee that have been identified for removal by 2020, concurrent with implementation of SAFCA's LAP (MBK, 2016c). Therefore, this levee does not meet ULDC 7.16 for vegetation. Vegetation maintenance requirements will be documented in the LMA's O&M manual as part of the Non-Structural Actions.

Sacramento River East Levee

SAFCA conducted an inspection of the American River South – Sacramento River East Levee System in 2013. There are 627 high-hazard trees along the Sacramento River east levee – American River to Freeport, that have been identified for removal by 2020, concurrent with implementation of SAFCA's LAP (MBK, 2016c). Therefore, this levee does not meet ULDC 7.16 for vegetation. Vegetation maintenance requirements will be documented in the LMA's O&M manual as part of the Non-Structural Actions.

Beach Lake North Levee

SAFCA conducted an inspection of the American River South – Sacramento River East Levee System in 2013. There are 90 high-hazard trees along the Beach Lake north levee that have been identified for removal by 2020, concurrent with implementation of SAFCA's LAP (MBK, 2016c). Therefore, this levee does not meet ULDC 7.16 for vegetation. Vegetation maintenance requirements will be documented in the LMA's O&M manual as part of the Non-Structural Actions.

ULDC 7.17: Wind Setup and Wave Runup

The requirements for ULDC 7.17 wind setup and wave runup are described in Chapter 1.

American River South Levee

Wind and wave analysis for the American River South – Sacramento River East Levee System was completed in 2015 in accordance with the Shore Protection Manual and EM 1110-2-1100. Results (Mead & Hunt, 2015a) indicate that the maximum combined wind setup and wave runup is 3.44 feet for the American River south levee. The American River South – Sacramento River East Levee System wind-wave analysis appears to meet ULDC 7.17 for wind setup and wave runup. However, this evaluation has not undergone review by the IPE and therefore, the American River South – Sacramento River East Levee System does not meet ULDC 7.17. Discussion of MTOL and erosion are found above.

Sacramento River East Levee

Wind and wave analysis for the American River South – Sacramento River East Levee System was completed in 2015 in accordance with the Shore Protection Manual and EM 1110-2-1100. Results (Mead & Hunt, 2015a) indicate that the maximum combined wind setup and wave runup is 3.05 feet for the Sacramento River east levee. The American River South – Sacramento River East Levee System wind-wave analysis appears to meet ULDC 7.17 for wind setup and wave runup. However, this evaluation has not undergone review by the IPE and therefore, the American River South – Sacramento River East Levee System does not meet ULDC 7.17. Discussion of MTOL and erosion are found above.

Beach Lake North Levee

Wind and wave analysis for the American River South – Sacramento River East Levee System was completed in 2015 in accordance with the Shore Protection Manual and EM 1110-2-1100. Results (Mead & Hunt, 2015a) indicate that the maximum combined wind setup and wave runup is 5.07 feet for the Beach Lake north levee. The American River South – Sacramento River East Levee System wind-wave analysis appears to meet ULDC 7.17 for wind setup and wave runup. However, this evaluation has not undergone review by the IPE and therefore, the American River South – Sacramento River East Levee System does not meet ULDC 7.17. Discussion of MTOL and erosion are found above.

ULDC 7.18: SECURITY

The requirements for ULDC 7.18 security are described in Chapter 1.

American River South Levee

A security plan for the American River South – Sacramento River East Levee System does not currently exist and therefore, this levee system does not meet ULDC 7.18 for security. SAFCA, in cooperation with the LMAs, will develop a security plan as part of the Non-Structural Actions.

Sacramento River East Levee

A security plan for the American River South – Sacramento River East Levee System does not currently exist and therefore, this levee system does not meet ULDC 7.18 for security. SAFCA, in cooperation with the LMAs, will develop a security plan as part of the Non-Structural Actions.

Beach Lake North Levee

A security plan for the American River South – Sacramento River East Levee System does not currently exist and therefore, this levee system does not meet ULDC 7.18 for security. SAFCA, in cooperation with the City of Sacramento as the LMA, will develop a security plan as part of the Non-Structural Actions.

ULDC 7.19: Sea Level Rise

The requirements for ULDC 7.19 sea level rise are described in Chapter 1. Application of the 30-year sea level rise projection will result in a 0.05 foot increase at the downstream location of the Sacramento River at the Town of Freeport (at RM 45). Although this increase is considered negligible, it is included in the ULDC DWSE (MBK, 2016a).

American River South Levee

Although negligible, sea level rise is included in the ULDC DWSE (MBK, 2016a). Estimation and consideration of sea level rise for the American River South – Sacramento River East Levee System appears to meet ULDC 7.19 for sea level rise. However, this evaluation has not undergone review by the IPE and therefore, the American River south levee does not meet ULDC 7.19.

Sacramento River East Levee

Although negligible, sea level rise is included in the ULDC DWSE (MBK, 2016a). Estimation and consideration of sea level rise for the American River South – Sacramento River East Levee System appears to meet ULDC 7.19 for sea level rise. However, this evaluation has not undergone review by the IPE and therefore, the Sacramento River east levee does not meet ULDC 7.19.

Beach Lake North Levee

As previously indicated, SAFCA is currently conducting a coincident frequency analysis and the sea level projection and rise as described above will be applied during development. As the ULDC DWSE has not yet been finalized, the Beach Lake north levee does not meet ULDC for sea level rise.

ULDC 7.20: Emergency Actions and Flood Safety Plans

The requirements for ULDC 7.20 emergency actions and flood safety plans security are described in Chapter 1.

American River South Levee

While there are several emergency planning documents related to flood safety, many of which include the required information to meet ULDC 7.20, SAFCA, in cooperation with the ARFCD will develop and/or update their standard operating procedure documents, emergency action plans and/or flood safety plans as part of the Non-Structural Actions. Because existing emergency planning documents have not been evaluated for compliance with ULDC, the American River South – Sacramento River East Levee System does not meet ULDC 7.20.

Sacramento River East Levee

While there are several emergency planning documents related to flood safety, many of which include the required information to meet ULDC 7.20, SAFCA, in cooperation with the ARFCD, the City, and MA9, will

develop and/or update their standard operating procedure documents, emergency action plans and/or flood safety plans as part of the Non-Structural Actions. Because existing emergency planning documents have not been evaluated for compliance with ULDC, the American River South – Sacramento River East Levee System does not meet ULDC 7.20.

Beach Lake North Levee

While there are several emergency planning documents related to flood safety, many of which include the required information to meet ULDC 7.20, SAFCA, in cooperation with the City, will develop and/or update their standard operating procedure documents, emergency action plans and/or flood safety plans as part of the Non-Structural Actions. Because existing emergency planning documents have not been evaluated for compliance with ULDC, the American River South – Sacramento River East Levee System does not meet ULDC 7.20.

PLAN OF LEVEE SYSTEM IMPROVEMENTS TO SUPPORT AN URBAN LEVEL OF FLOOD PROTECTION

As described in Chapter 1, below are the specific projects and actions necessary for the physical flood management facilities in the American River South – Sacramento River East Levee System to meet ULDC and support an ULDC certification.

FOLSOM JOINT FEDERAL PROJECT

A description of the Folsom JFP is provided in Chapter 1. Below is the effect the Folsom JFP will have on the American River South – Sacramento River East Levee System:

- Effect: Construction of the auxiliary spillway and appurtenant features, jointly with the Folsom Dam Raise Project, provide the physical improvements to support the operational flexibility (Folsom Dam Water Control Manual Update) to reduce the flows from Folsom Dam during a 200-year event. Water surface elevations developed for this levee system assume completion of the Folsom JFP.
- Estimated Year of Completion: 2017
- Status: On Schedule

FOLSOM DAM RAISE PROJECT

A description of the Folsom Dam Raise Project is provided in Chapter 1. Below is the effect the Folsom Dam Raise Project will have on the American River South – Sacramento River East Levee System:

- Effect: Construction of the Folsom Dam Raise Project will increase overall storage capacity which, jointly with the Folsom JFP, provides the physical improvements to support the operational flexibility (Folsom Dam Water Control Manual Update) to reduce the flows from Folsom Dam

during a 200-year event. Water surface elevations developed for this levee system assume completion of the Folsom Dam Raise Project.

- Estimated Year of Completion: 2022
- Status: Project Participation Agreements are being developed.

Folsom Dam Water Control Manual Update

A description of the Folsom Dam Water Control Manual Update is provided in Chapter 1. Below is the effect the Folsom JFP will have on the American River South – Sacramento River East Levee System:

- Effect: An updated Folsom Dam Water Control Manual will provide dam operators with the operational flexibility (Folsom Dam Water Control Manual Update) to reduce the flows released from Folsom Dam during a 200-year event. This update relies on the construction of the Folsom Dam Raise Project and JFP.
- Estimated Year of Completion: 2022
- Status: On Schedule

Levee Accreditation Project

A description of SAFCA's LAP is provided in Chapter 3 under "Plan of Levee System Improvements to Support an Urban Level of Flood Protection". Below is the effect the LAP will have on the American River South – Sacramento River East Levee System:

- Effect: Remediation of erosion and outstanding seepage and stability concerns for the American River South – Sacramento River East Levee System thereby also addressing other ULDC include: seismic vulnerability; geometry; interfaces and transitions; floodwalls, retaining walls, and closures structures; high hazard encroachments, penetrations, and vegetation, and securing a minimum 10-foot landside access zone or 20-foot landside visibility zone.
- Estimated Year of Completion: 2023
- Status: *Final EIR North Sacramento Streams, Sacramento River East Levee, Lower American River and Related Flood Improvements Project*, certified June 2016.

Non-Structural Actions

A description of the Non-Structural Actions is provided in Chapter 1. Below is the effect the Non-Structural Actions will have on the American River South – Sacramento River East Levee System:

- Effect: The Non-Structural Actions would result in the American River South – Sacramento River East Levee System meeting ULDC for seismic, right-of-way, encroachments, penetrations, vegetation, security, and flood safety plans.
- Estimated Year of Completion: 2024

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6.0 SOUTH SACRAMENTO STREAMS LEVEE SYSTEM

DESCRIPTION OF SOUTH SACRAMENTO STREAMS LEVEE SYSTEM

The South Sacramento Streams levee system is comprised of the levees and floodwalls on Morrison Creek, Florin Creek, Elder Creek, and Unionhouse Creek located upstream of the UPRR which is approximately at the confluence of the Morrison Creek and Unionhouse Creek. Specifically, this includes the Morrison Creek right and left bank levees and floodwalls from Stockton Boulevard to the UPRR and Unionhouse Creek confluence; Florin Creek right and left bank levee and floodwall from Stockton Boulevard to the confluence with Elder Creek; Elder Creek right and left bank levees from Highway 99 to the confluence with Morrison Creek; and the Unionhouse right and left bank levees and floodwalls from Center Parkway to the UPRR embankment at the confluence with Morrison Creek.

The USACE and SAFCA have undertaken significant improvements to this levee system over the past several years. These improvements were not specifically designed to meet ULDC. The South Sacramento Stream Levee System is being evaluated for ULDC by SAFCA as part of the Non-Structural Improvements. Any required improvements would be implemented as a future project under the SAFCA LAP. Despite the improvements made by USACE to this levee system to reduce flood risk, a ULDC evaluation is not complete and therefore, the South Sacramento Stream Levee System does not meet ULDC.

The Morrison Creek right (west) bank levee located downstream from UPRR Bridge over Morrison Creek is referred to as the Beach Lake north levee, and is discussed in the American River South and Sacramento River East Levee System chapter. The Beach Lake north levee protects the Pocket Area and areas in south Sacramento from flooding from the Beach-Stone Lakes area and associated flooding from the Morrison Creek watershed.

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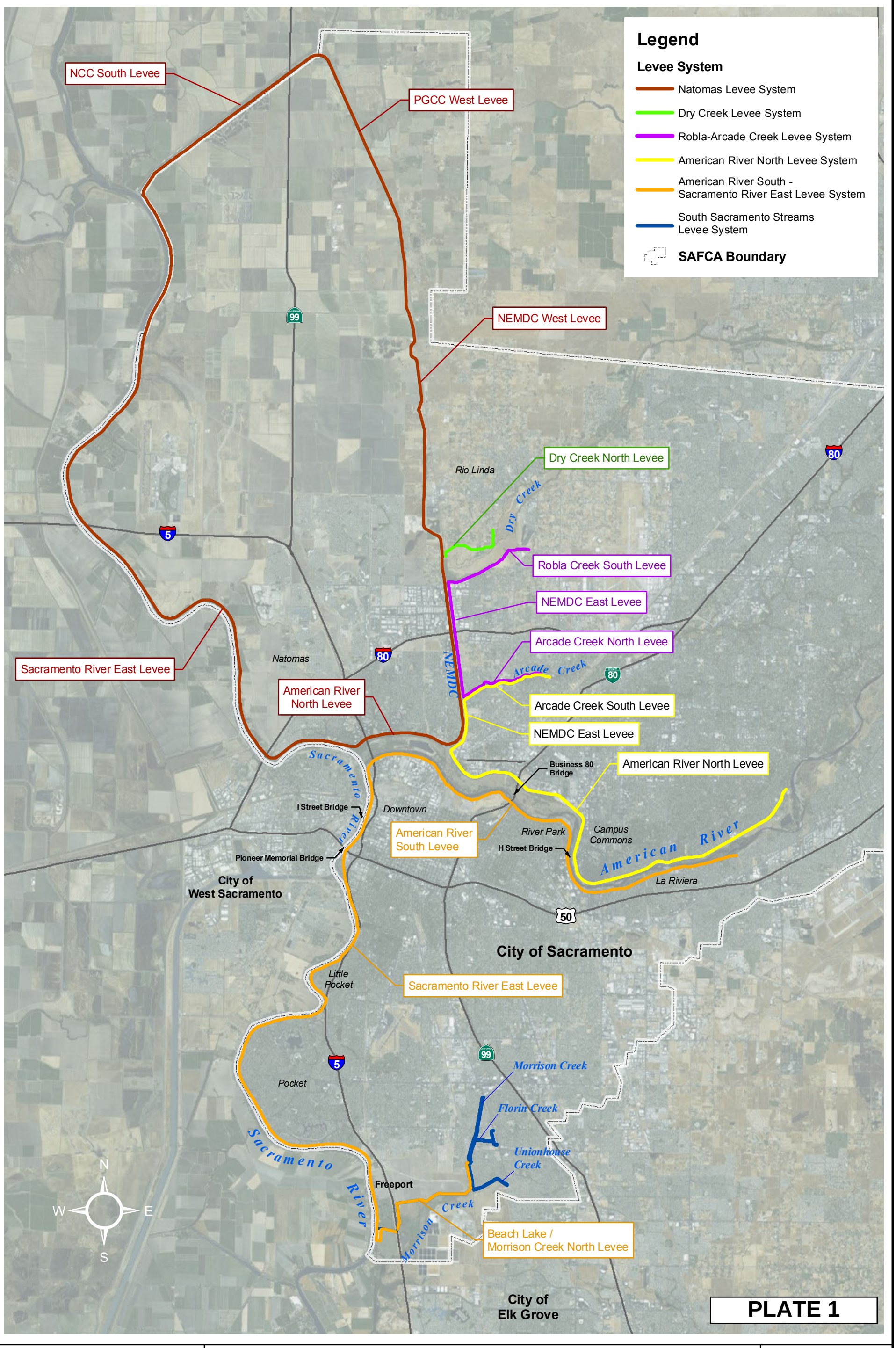
PLATES



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SACRAMENTO AREA FLOOD CONTROL AGENCY

ADEQUATE PROGRESS TOWARDS AN URBAN LEVEL OF FLOOD PROTECTION - ENGINEER'S REPORT

SACRAMENTO LEVEE SYSTEMS

0 1 2
Miles

R:_Flood Control\SAFCA\Adequate_Progress\ProjectData\GIS\mxds\SAFCA Levee Systems 020816.mxd

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SACRAMENTO AREA FLOOD CONTROL AGENCY

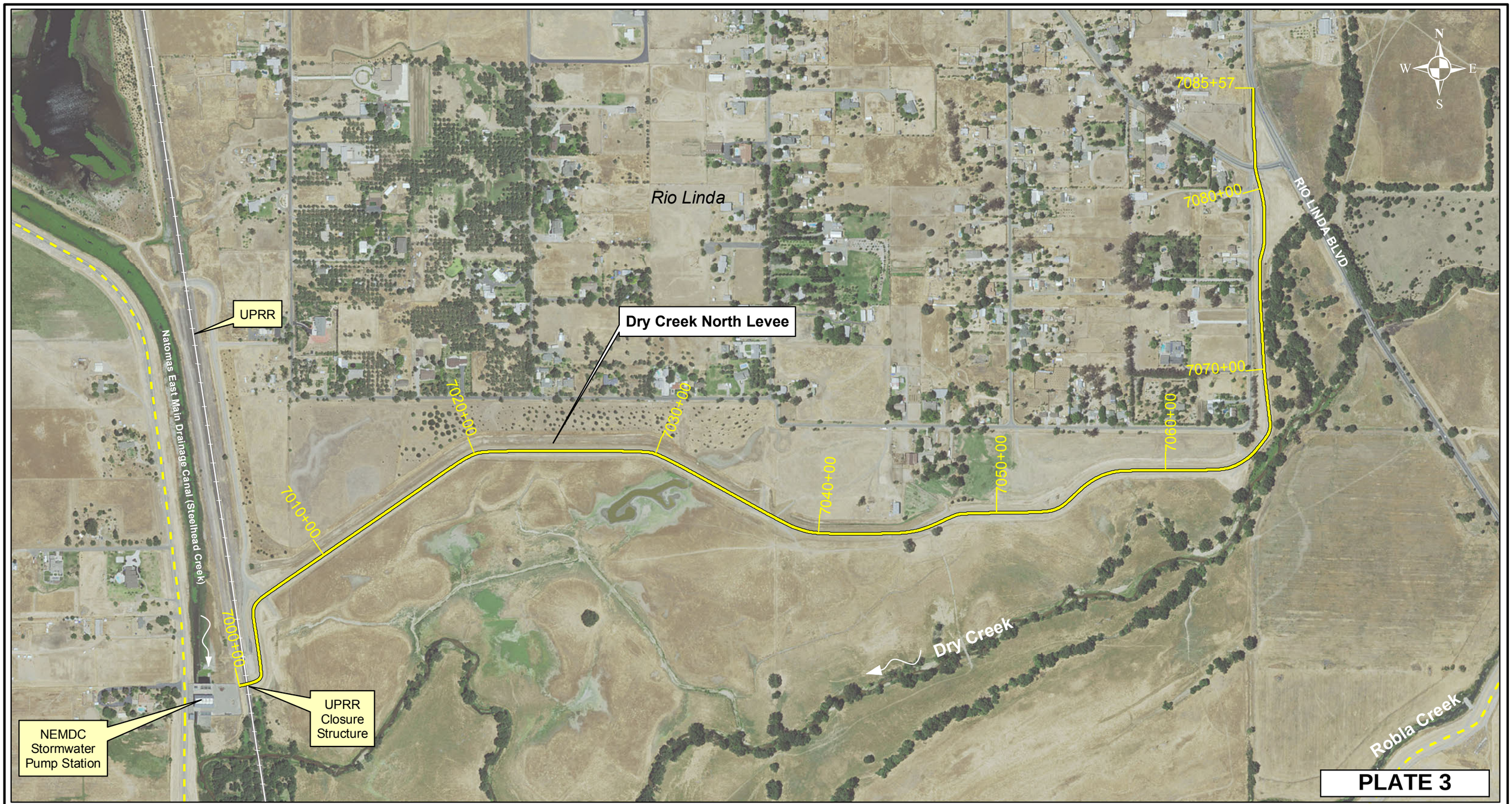
ADEQUATE PROGRESS TOWARDS AN URBAN LEVEL OF FLOOD PROTECTION ENGINEER'S REPORT

NATOMAS LEVEE SYSTEM

Legend

- ARNL
- NCC
- NEMDC
- PGCC
- SREL
- Other Levees in Sacramento

0 3,000 6,000 12,000 Feet



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SACRAMENTO AREA FLOOD CONTROL AGENCY

ADEQUATE PROGRESS TOWARDS AN URBAN LEVEL OF FLOOD PROTECTION ENGINEER'S REPORT

DRY CREEK LEVEE SYSTEM

Legend

- Dry Creek Levee System
- Other Levees

0 250 500 1,000 Feet

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SACRAMENTO AREA FLOOD CONTROL AGENCY

ADEQUATE PROGRESS TOWARDS AN URBAN LEVEL OF FLOOD PROTECTION ENGINEER'S REPORT

ROBLA-ARCADE LEVEE SYSTEM

Legend

- Robla-Arcade Levee System
- Other Levees

0 1,250 2,500 5,000 Feet

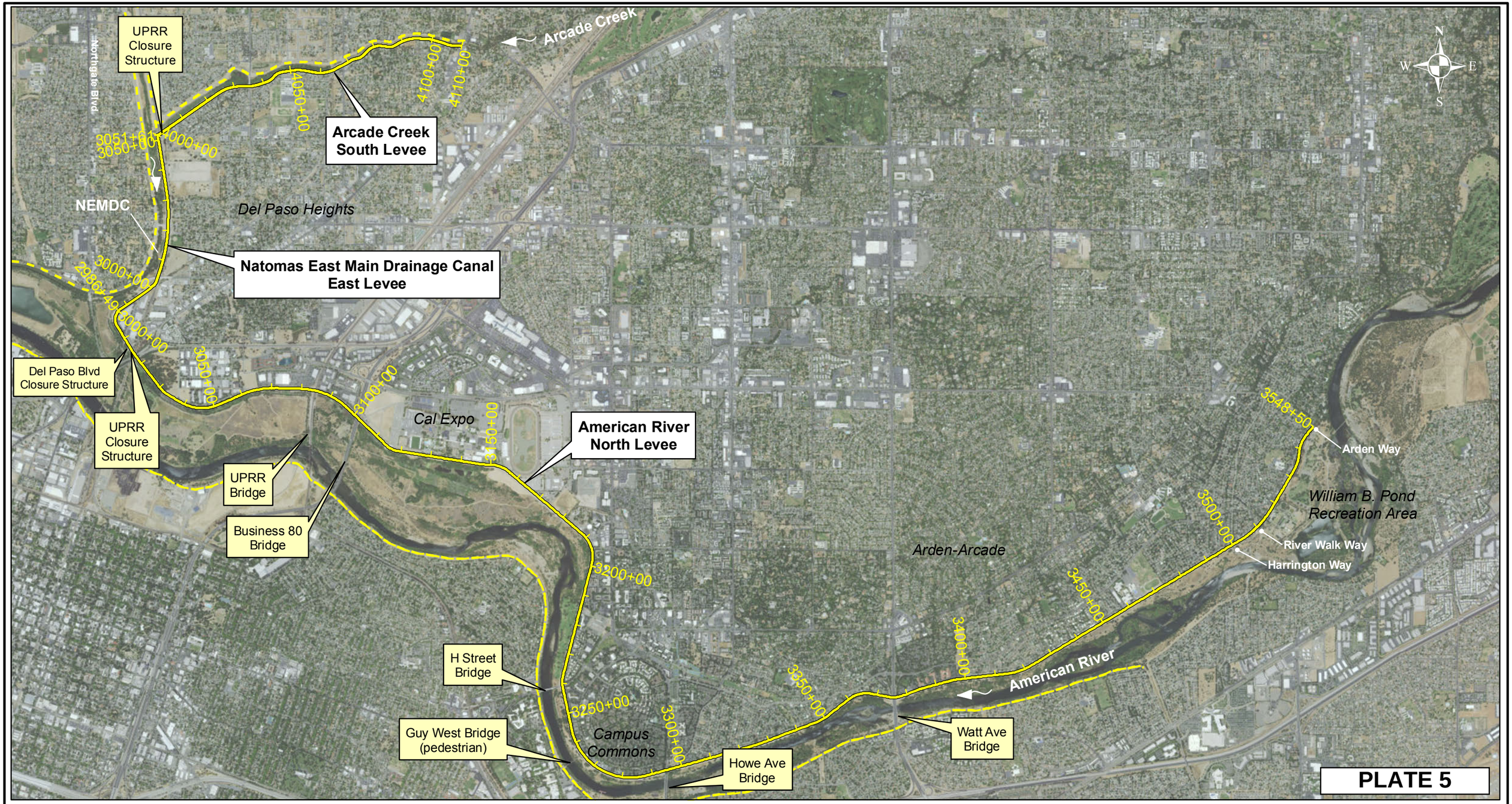

PLATE 5

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SACRAMENTO AREA FLOOD CONTROL AGENCY

ADEQUATE PROGRESS TOWARDS AN URBAN LEVEL OF FLOOD PROTECTION ENGINEER'S REPORT

AMERICAN RIVER NORTH LEVEE SYSTEM

Legend

- American River North Levee System
- Other Levees

0 1,500 3,000 6,000 Feet

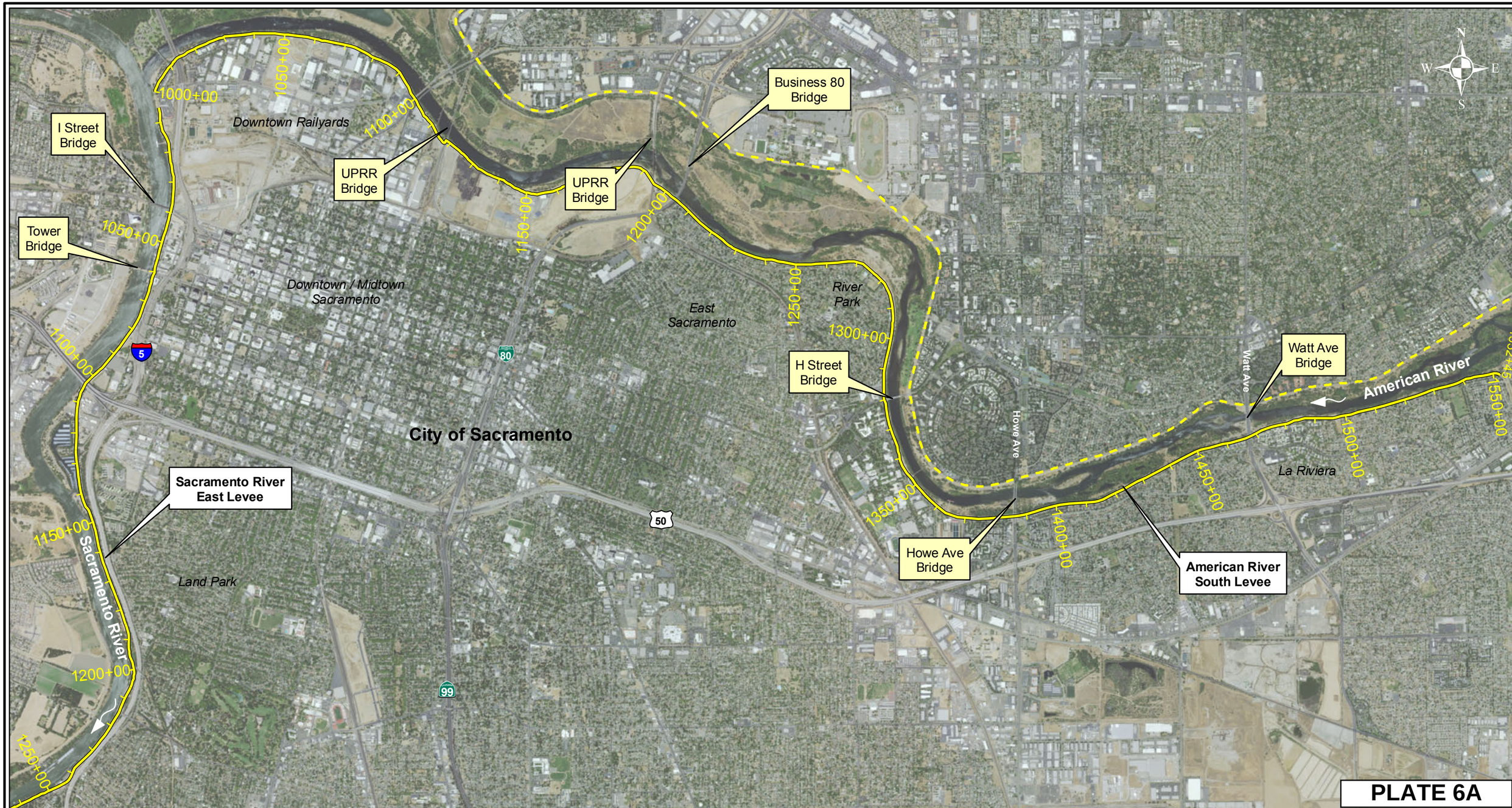

PLATE 6A

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SACRAMENTO AREA FLOOD CONTROL AGENCY

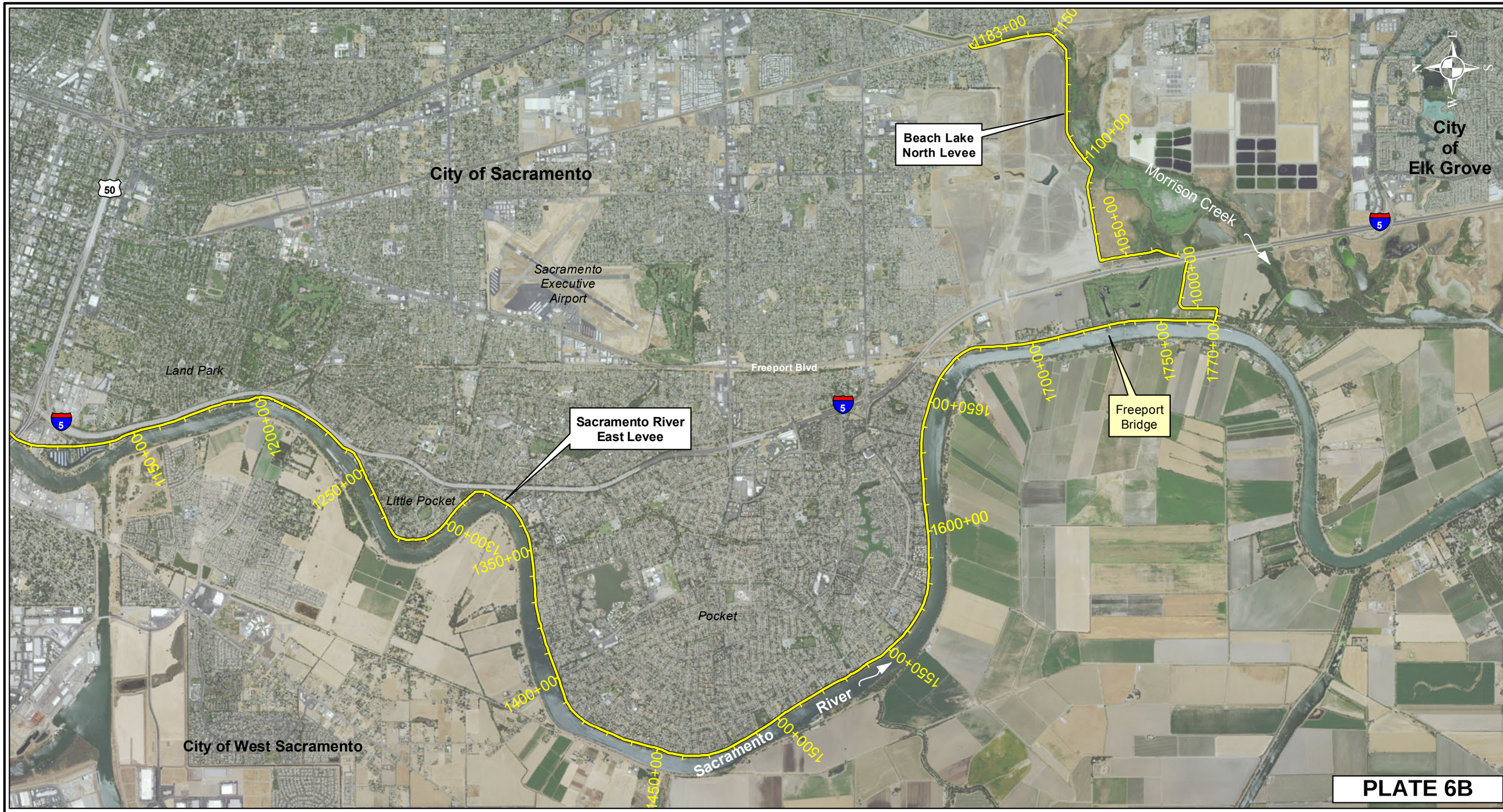
ADEQUATE PROGRESS TOWARDS AN URBAN LEVEL OF FLOOD PROTECTION ENGINEER'S REPORT

AMERICAN RIVER SOUTH - SACRAMENTO RIVER EAST LEVEE SYSTEM

Legend

- American River South - Sacramento River East Levee System
- Other Levees in Sacramento

0 1,500 3,000 6,000 Feet



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ADEQUATE PROGRESS TOWARDS AN URBAN LEVEL OF FLOOD PROTECTION ENGINEER'S REPORT

AMERICAN RIVER SOUTH - SACRAMENTO RIVER EAST LEVEE SYSTEM

Legend

American River South - Sacramento River East Levee System

0 1,750 3,500 7,000 Feet

APPENDICES

Appendix A

Review by an

Independent Panel of Experts (IPE)

MEMORANDUM

ENGINEER'S RESPONSE TO

INDEPENDENT PANEL OF EXPERTS REPORT ON THE REVIEW OF SACRAMENTO AREA FLOOD CONTROL AGENCY'S, ADEQUATE PROGRESS TOWARDS AN URBAN LEVEL OF FLOOD PROTECTION, ENGINEER'S REPORT

PREPARED BY: RICHARD G. REINHARDT, P.E.

JUNE 1, 2016

The Sacramento Area Flood Control Agency issued the final *Adequate Progress Towards an Urban Level of Flood Protection, Engineer's Report (Engineer's Report)* in May 2016. Subsequently, the Independent Panel of Experts (IPE) issued its report (Letter, Subject: *Sacramento Area Flood Control Agency, Adequate Progress Towards an Urban Level of Flood Protection, Independent Panel of Experts Review of Engineer's Report)* on their review of the *Engineer's Report* on May 31, 2016. Urban Level of Flood Protection Criteria (ULOP Criteria) requires a response by the Engineer to the IPE's comments.

The IPE reviewed a draft of the *Engineer's Report*, as documented in the attached comment and response table. As a result, the *Engineer's Report* was revised to address the IPE's comments. IPE review of the administrative final *Engineer's Report* resulted in closure of most of the comments. Final revision of the *Engineer's Report* addressed the comments not previously closed. Therefore, there are no outstanding or unresolved comments from the IPE. A final comment and response table documenting the IPE's review and Engineer's responses is attached.

ATTACHMENT

1. Review by the Independent Panel of Experts, Final Comment and Response Table

Dr. Leslie F. Harder, Jr., PE, GE
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Folsom California 95630

George L. Sills, PE
George Sills Geotechnical Engineering Consultant, LLC
470 Dogwood Lake Drive
Vicksburg, Mississippi 39183

Dr. David T. Williams, PE, PH, CFM, DWRE
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1112 Oakridge Drive, Suite 104, PMB 236
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May 31, 2016

Mr. Pete Ghelfi, PE
Sacramento Area Flood Control Agency
1007 7th Street, 7th Floor
Sacramento, CA 95814

Dear Mr. Ghelfi:

Subject: Sacramento Area Flood Control Agency (SAFCA)
Adequate Progress Towards an Urban Level of Flood Protection
Independent Panel of Experts Review of Engineer's Report

Introduction

This letter serves as the Independent Panel of Experts' (IPE) report on the review of the Sacramento Area Flood Control Agency's *Adequate Progress Towards an Urban Level of Flood Protection Engineer's Report* (Engineer's Report) for levees in the Sacramento Area. The Engineer's Report was prepared by MBK Engineers. The IPE concurs that there is substantial evidence in the record demonstrating that the six levee systems described in the Engineer's Report will provide a 200-year Urban Level of Flood Protection upon completion of the actions identified in the Engineer's Report.

Background

The City of Sacramento, County of Sacramento, and County of Sutter intend on making an Adequate Progress Finding (APF) towards an Urban Level of Flood Protection for several basins in the Sacramento Area. These basins are protected by the following six levee systems:

- Natomas Levee System
- Dry Creek Levee System
- Robla-Arcade Levee System
- American River North Levee System
- American River South – Sacramento River East Levee System
- South Sacramento Streams Levee System

Senate Bill 5, enacted in 2007, requires cities and counties within the Sacramento-San Joaquin Valley to make findings related to an Urban Level of Flood Protection before approving certain land-use decisions. These findings include a finding that the levee system meets an Urban Level of Flood Protection, or a finding that adequate progress is being made towards providing an Urban Level of Flood Protection, as in this case. The criteria associated with an Urban Level of Flood Protection and what is required for substantial evidence in the record to support an APF are contained in the following two documents:

1. Urban Levee Design Criteria (ULDC) – published by the Department of Water Resources (DWR) in May 2012, this document provides the engineering criteria and guidance for the design, evaluation, operation, and maintenance of levees and floodwalls that provide a 200-year Urban Level of Flood Protection. It outlines 20 technical areas associated with levee integrity and the evaluations needed to assure an Urban Level of Flood Protection:

   - Section 7.1 - Design Water Surface Elevation
   - Section 7.2 - Minimum Top of Levee
   - Section 7.3 - Soil Sampling, Testing, and Logging
   - Section 7.4 - Slope Stability for Intermittently Loaded Levees
   - Section 7.5 - Underseepage for Intermittently Loaded Levees
   - Section 7.6 - Frequently Loaded Levees
   - Section 7.7 - Seismic Vulnerability
   - Section 7.8 - Levee Geometry
   - Section 7.9 - Interfaces and Transitions
   - Section 7.10 - Erosion
   - Section 7.11 - Right-of-Way
   - Section 7.12 - Encroachments
   - Section 7.13 - Penetrations
   - Section 7.14 - Floodwalls, Retaining Walls, and Closure Structures
   - Section 7.15 - Animal Burrows
   - Section 7.16 - Levee Vegetation
   - Section 7.17 - Wind Setup and Wave Runup
   - Section 7.18 - Security
   - Section 7.19 - Sea Level Rise
   - Section 7.20 - Emergency Actions

2. Urban Level of Flood Protection (ULOP) Criteria – published in November 2013 by DWR, this document describes the procedures for making findings, including the processes for having substantial evidence in the record to make an APF.

   To support an APF, the ULOP Criteria includes the following requirements:

   *"**EVD-3**: Substantial evidence in the record to support a finding related to an urban level of flood protection based on adequate progress on the construction of a flood protection system shall include the following, at a minimum:*

   - *A report prepared by a Professional Civil Engineer registered in California to document the data and analyses for demonstrating the property, development project, or subdivision will have an urban level of flood protection at the time when the flood protection system is completed.*
   - *A report by an Independent Panel of Experts on the review of the report prepared by the Professional Civil Engineer.*
   - *A response by the Professional Civil Engineer to the comments from the Independent Panel of Experts."*

The ULOP EVD-3 Criteria has other requirements as well, but the subject of this report by the IPE pertains to the second bullet outlined above. Under Section 3.0, Other Considerations, the ULOP Criteria also states:

> *"The report prepared by a Professional Civil Engineer registered in California should provide the following information as evidence that an urban level of flood protection exists or will exist for the area under consideration:*
>
> - *A list of the flood management facilities utilized in providing an urban level of flood protection, including, but not limited to, SPFC facilities.*
> - *The location of the flood management facilities utilized in providing an urban level of flood protection.*
> - *The entities that operate and maintain the flood management facilities utilized in providing an urban level of flood protection.*
> - *A list of, and consideration of, reports, evaluations, inspections, and performance history of the flood management facilities utilized in providing an urban level of flood protection since the previous finding, if any, was made.*
> - *The response to the Independent Panel of Experts."*

Also under Section 3.0, Other Considerations, the ULOP Criteria states:

> *"The report by an Independent Panel of Experts should consider the assertions made in the Professional Civil Engineer's report and determine whether:*
>
> - *An urban level of flood protection from the identified sources of flooding exists or will exist for the area under consideration, or*
> - *The subject flood management facilities meet the Urban Levee Design Criteria (DWR, 2012).*
>
> *If the panel does not concur with the assertions made in the Professional Civil Engineer's report, the report by the Independent Panel of Experts should state the reason(s) for not concurring."*

<u>Engineer's Report Prepared by MBK Engineers</u>

The IPE has reviewed two drafts of the Engineer's Report prepared by MBK Engineers. The first draft reviewed by the IPE was dated March 2016. The IPE had several comments and questions regarding the report. As a result, MBK Engineers substantially revised the report and modified many of the original findings contained to address IPE comments and submitted a revised draft entitled *Admin Final* and dated April 2016. The *April 2016 Admin Final* revision addressed the vast majority of the IPE comments, but there were a few relatively minor non-safety related technical comments that had not been fully addressed by the *April 2016 Admin Final* revision. These remaining technical issues were later addressed by MBK Engineers in May 2016 by providing additional responses to the remaining IPE comments. The additional

responses provided by MBK Engineers contained further revisions proposed for portions of the text in the Engineer's Report which addressed the remaining IPE comments. As a result, the IPE closed all remaining review comments on May 31, 2016. The IPE comments, MBK Engineers' responses to IPE comments, IPE Backcheck Reviews, and closures of IPE comments are contained in an Excel Spreadsheet that is attached to this report (see Attachment 1).

Composition of the IPE

The ULOP Criteria requires an IPE review of the Engineer's Report when flood management facilities are relied upon to provide an Urban Level of Flood Protection. As described in ULOP Criteria EVD-5, the ULOP Criteria requires a panel of at least three experts with different expertise, including at least one with expertise in hydrology and hydraulics, and at least two with expertise in design and construction of flood management facilities relevant to those under review, in this case, levee systems protecting urbanized areas. This IPE is comprised of Dr. Leslie F. Harder and Mr. George L. Sills, both of whom have expertise in the design and construction of levees and other flood management facilities, and Dr. David T. Williams who has expertise in hydrology and hydraulics. Copies of the resumes for the three IPE members are attached to this report (see Attachment 2).

IPE Review of the Engineer's Report

The IPE makes the following observations with regard to the *April 2016 Admin Final* version of the Engineer's Report prepared by MBK Engineers:

1. The Engineer's Report has been prepared under the direction of a licensed Civil Engineer in the State of California; Mr. Richard G. Reinhardt, who has signed and stamped the document.

2. The Engineer's Report has prepared a complete list of the flood management facilities that will be utilized in providing an Urban Level of Flood Protection, namely the levees, floodwalls, closure structures, and pump stations. The Engineer's Report is organized to have the descriptions and conditions of the levee system described in separate chapters – one set for each of the six levee systems. Each chapter also provides a brief history of the facilities, how they performed in recent floods, and any recent modifications or improvements to them.

3. The Engineer's Report identifies in text and in plates the locations of the flood protection facilities as well as levee/floodwall stationing.

4. The Engineer's Report identifies the local maintaining agencies that operate and maintain the flood management facilities that will be utilized in providing an Urban Level of Flood Protection, including Reclamation District 1000, American River Flood Control Agency, City of Sacramento, and DWR's Maintenance Area 9.

5. The Engineer's Report contains a large reference list of reports, evaluations, inspections, and performance history documents related to the flood management facilities. These reports were discussed and considered in the Engineer's Report.

6. MBK Engineers provided detailed responses to the review comments submitted by the IPE (see Attachment 1) and made substantial changes, clarifications, and improvements to the Engineer's Report to address IPE review comments.

7. The Engineer's Report demonstrates a clear understanding of the requirements of DWR's ULDC and discusses the current status of each levee system in meeting or not meeting each of the 20 ULDC criteria previously outlined.

8. The Engineer's Report describes ongoing and future programs to bring the levee systems to an Urban Level of Flood Protection. In addition to levee improvements, additional future projects include the Folsom Joint Federal Project, the Folsom Dam Raise Project, the Folsom Dam Water Control Manual Update, and other non-structural measures.

9. It is important to note that many of the planned levee and floodwall improvements have not yet been completed and that the IPE has <u>not reviewed all</u> of the evaluations and designs for every levee system. Nevertheless, it is also important to note that the IPE <u>has</u> been involved with <u>numerous portions</u> of the levee systems. For example, the IPE has reviewed various aspects for much of the evaluation, design, and construction work completed to date, including numerous geotechnical evaluations, remedial design and construction documents, hydrology and hydraulic analyses, right-of-way approaches, plans to address encroachments, and plans to address levee vegetation, all of which comprise a record of substantial evidence. The IPE believes that all of the improvement work that the IPE has been involved with and carried out to date has met or will meet ULDC criteria.

Finally, the IPE notes the tremendous amount of levee upgrades that have been completed over the last several years by the Sacramento Area Flood Control Agency and its partners to meet an Urban Level of Flood Protection. These include:

- ✓ Construction of several miles of slurry cutoff walls in the American River north and south levees to address through seepage, underseepage, and slope stability (~2002)

- ✓ Construction of deep cutoff walls in the Sacramento River East Levee in the Pocket Area to address deep underseepage problem areas (~2006)

- ✓ Reconstruction of the Natomas Cross Canal South Levee and construction of slurry cutoff walls to address through seepage, underseepage, and slope stability issues (~2009)

- ✓ Construction of an adjacent levee along the Sacramento River East Levee in the Natomas area, together with cutoff walls and berms, to address issues related to underseepage, slope stability, encroachments and levee vegetation (~2010–2014).

Conclusion of the IPE

The IPE has reviewed the Engineer's Report and the assertions made therein and concurs that there is substantial evidence in the record demonstrating that the six levee systems will provide an Urban Level of Flood Protection upon completion of the actions identified in the Engineer's Report.

Respectfully submitted,

Dr. Leslie F. Harder, Jr., PE, GE

George L. Sills, PE

Dr. David T. Williams, PE, PH, CFM, DWRE

Attachments:

1) Excel Spreadsheet with IPE Comments, Responses from MBK Engineers, and IPE Backchecks
2) Resumes for members of the Independent Panel of Experts

Attachment 1:

Excel Spreadsheet with IPE Comments, Responses by MBK Engineers, and IPE Backchecks

REVIEW BY THE INDEPENDENT PANEL OF EXPERTS

No.	LOCATION IN DOCUMENT	EXPERTS' COMMENT (April 2016)	ENGINEER'S RESPONSE (April 2016)	EXPERTS' COMMENT (April 2016)	ENGINEER'S RESPONSE (May 2016)	EXPERTS' FINAL COMMENT (May 2016)
1	General	The document appears to need a general introduction to describe that the overall plan is for each of the 5 basins to meet ULDC criteria and a ULOP finding by the prescribed 2025 date per SB-5 and state law. This Engineers Report is a status report describing what issues/criteria need to be met, where the levees stand now, how many of them meet or do not meet each criterion, and the methods and approaches to be used to meet them. This information is being used to provide a basis of Adequate Progress based on the recent evaluations and construction work and sets a Baseline for the future efforts. Some of the language on Pages 47-50 could be used in the overall introduction of the report to document future efforts. In this introductory section, some description of which initiatives (e.g. USACE Natomas, SAFCA SREL, etc...) will be used to complete the remaining work necessary to meet ULDC/ULOP criteria by 2025.	Each chapter (levee system) includes a section that discusses the information requested. The ER does not discuss the overall "Plan" for supporting an APF; this Plan is being prepared separately by SAFCA. The ER is intended to document the current state of the levee system and identify which projects will bring the levee systems into compliance with ULDC. Additional clarifying text has been added to the report organization section to clarify intentions. Per other comments made by the IPE, the stoplight tables have been removed and conclusions have been revised to reflect a DNM status.	Response accepted, close comment.		
2	General	There appears to be no succinct list of EXCEPTIONS to the ULDC or reasons/justifications for the EXCEPTIONS These should probably be summarized in one table, and each one provided a reasoning and justification as to why the EXCEPTIONS is made and why is it appropriate. In this way, the IPE can review and provide comments about concurrence. If these are not fully ready to be discussed or reviewed, at least a table listing the EXCEPTIONS that will be used should be prepared.	Anticipated exceptions were identified in the compliance tables at the beginning of the chapters; however, per other comments made by the IPE, the stoplight tables have been removed and conclusions have been revised to reflect a DNM status. As we work with the IPE on their post ER report review of the supporting information we will develop a list of exceptions that are needed and seek concurrence from the IPE that the exceptions are justified.	Response accepted, close comment.		
3	General	Where ULDC criteria are being met by EXCEPTION, should these be colored **green** and indicated as passing if the EXCEPTION has not yet been made, justified, and concurred with by the BOSC? If not, then shouldn't this be considered as not meeting criteria and colored **red?** It may be better to make and justify the Exception now and have the BOSC concur rather than defer this to later.	Per this and other comments made by the IPE, the stoplight tables have been removed and conclusions have been revised to reflect a DNM status. Note, as a subsequent effort, SAFCA intends on seeking interim ULDC documentation for all items identified as currently meeting.	Response accepted, close comment.		
4	General	If supporting analyses or other documentation are "*in progress* " and not yet available, is it appropriate to conclude that ULDC criteria is met when the documentation is not yet complete? This refers to various reports including MBK reports dated 2016.	Per this and other comments made by the IPE, the stoplight tables have been removed and conclusions have been revised to reflect a DNM status. Note, as a subsequent effort, SAFCA intends on seeking interim ULDC documentation for all items identified as currently meeting. Specific to the MBK 2016 memos, these memos have been drafted and references update. Reference to Kleinfelder exception memo(s) have been removed.	Response accepted, close comment.		
5	General	The use of the letter P in a green band indicating that portions of the levee reach meet certain ULDC criteria in the summary stoplight tables (e.g. Table 1) is somewhat less than satisfying. It doesn't give a good picture of how much of the levee reach meets or does not meet criteria. Since the largest amount of effort to meet ULDC criteria will likely be associated with MTOL and the geotechnical criteria (Seepage, Underseepage, Slope Stability), you might consider adding a summary table for each of the 5 basins summarizing how much of the levee reaches currently meet ULDC criteria for these 4 criteria. These tables would immediately follow the "lighthouse" tables at the beginning of each chapter, but would give specific percentages of levee miles - see Draft table prepared as an example for the Natomas Basin - attached separately. **Ideally, such tables would be prepared for all ULDC criteria, or at least as many as feasible.**	Per this and other comments made by the IPE, the stoplight tables have been removed and conclusions have been revised to reflect a DNM status. However, a table of the levees, and the efforts that will bring them into compliance is being developed.	Response accepted, close comment.		
6	General	In the beginning of each chapter is a table showing "stoplight" colors for the 20 different ULDC criteria to be met. These tables could use a bit more introduction/discussion of what they mean and how they should be interpreted. While some explanation is provided in the following subsections, a better introduction in front of the first such table is warranted to allow the reader to better understand what information the tables are trying to convey.	Per this and other comments made by the IPE, the stoplight tables have been removed and conclusions have been revised to reflect a DNM status.	Response accepted, close comment.		

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7	General	There is a tremendous amount of repetition in the different sections that address ULDC criteria for each basin. While it is understood that the thinking may be that the different chapters covering different basins may later be split apart, there remains a lot of duplicate sentences/paragraphs addressing each levee reach for each criterion in every single chapter, not to mention across chapters. This duplication/repetition could be drastically reduced if the general introductory section for each criterion summarized the criterion and the ways to address it, and then only address succinctly in follow-on sections what applies to that particular levee reach.	Introductory information has been reduced across chapters by referencing Chapter 1. Repetition within each criterion is present, but only to the minimum amount necessary to make a conclusion and maintain document organization.	Response accepted, close comment.		
8	General	There is some inconsistency in describing/labeling the current status for some of the levee reaches to meet ULDC criteria. In some cases, the statement is "*will meet* " when actually it appears that the correct description is "***does not meet*** " criteria since the work is not yet done. This should be carefully reviewed and corrected throughout the entire document.	Per this and other comments made by the IPE, the stoplight tables have been removed and conclusions have been revised to reflect a DNM status.	Response accepted, close comment.		
9	General	Please spell out abbreviations the first time they are used. Examples include NALP, NLIP, NCC, ULE, RIP, LMA, NLD, LAP, etc...	Final formatting of the document, to occur after delivery of the Admin Final, will spell out first use of acronyms.	Response accepted, close comment.		
10	General	Most of the comments on the various chapters were made initially for Chapter 1.0 for the Natomas Basin. However, most if not all of these comments also apply to subsequent chapters as the same issues generally apply there as well. Rather than repeating theses comments again for subsequent chapters, please apply the comments for Natomas for most of the other chapters as well.	Noted.	Response accepted, close comment.		
11	Certification letter	Suggest putting the project name above "CERTIFICATION". Don't know what the project was being certified until the end of the second paragraph.	Comment is understood, however, there is no "project name" and using a project name could potentially confuse which levee systems are being certified. Second sentence which identifies purpose. Was moved to be first sentence to help clarify.	Response accepted, close comment.		
12	Certification letter	Should cite the relevant sections in the ULDC (e.g., Section 3.0) and Urban Level of Flood Protection (e.g., Section 2.0, Findings) Criteria that defines what is "adequate progress" to assure what is in this document adheres to the requirements. This helps the reviewer gauge the "progress" against what is expected.	Letter was revised to include Section 2 of the ULOP Criteria and Section 7.0 of ULDC.	Response accepted, close comment. <u>Minor comment</u>: Capitalize design in Urban Levee design Criteria in letter.	Text was revised as suggested.	
13	Certification letter	At the end, it says "I, Ric Reinhardt". Should have Richard since that is what is on the seal.	Letter was revised as suggested.	Response accepted, close comment.		
14	Certification letter	"Failure to demonstrate meaningful and adequate progress towards providing an urban level of flood protection by the State of California deadline, as determined by me." This certification letter is good for up to 10 years. Ric may not be the "responsible" engineer for such a long time. Suggest adding something like " .. by me or a duly qualified designated successor." Also do for next two paragraph.	This condition was removed as ULOP Criteria do not require a determination of adequate progress by the engineer. The suggested text was added to the other conditions.	Response accepted, close comment.		
15	Certification letter, Certification statement	Should "Certification of Analysis" be indented and item 2?	Certification of Analysis is indented.	Response accepted, close comment.		
16	Certification letter, last paragraph	"will exist by 2025". Should give date? "will exist by July 2, 2025."	Statement was removed as the certification is not based on a date but rather completion of the efforts identified.	Response accepted, close comment.		
17	Certification letter	Urban Levee Design Criteria (May 2012) and Urban Level of Flood Protection Criteria (November 2013) are not in the Chapter 1 references.	ULDC and ULOP are not cited throughout the document, but have been added to the report references.	Response accepted, close comment.		
18	Introduction, second paragraph, Page 1	It states the County of Sacramento is represented by (County) but Sutter County is not represented by (County). Later, it states ".. The urban areas of the City and County ..." Does this include Sutter or just Sacramento County or both?	(County) has been added after County of Sutter. County is intended to refer to the applicable county (their jurisdiction does not overlap).	Response accepted, close comment. Note: It would seem that their jurisdictions do overlap as Sutter County must make a finding before approving development in Natomas just as Sacramento County must make a finding before approving development in Natomas.	The County jurisdictions do not overlap. However, both counties' jurisdiction does include portions of Natomas.	
19	Introduction, third paragraph, Page 1	It states that this APF considers only structural facilities. What about non-structural parts of a flood control project such as O&M, emergency action plans, post-earthquake remediation plan, etc.?	Agreed, text has been revised to indicate that non-structural items in relation to the physical facilities were also evaluated.	Response accepted, close comment. Recommend that text also state that future final finding also address O&M plan, EAP, and Post-EQ remediation plan.	Text was revised as suggested.	
20	Introduction, last paragraph, Page 1	It states "A report prepared by SAFCA demonstrating adequate progress has been prepared separately from this report." Will the IPE be reviewing this?	No. The APF report does not require review by an independent panel of experts, but will be provided for awareness.	Response accepted, close comment.		
21	Introduction, Report Organization, Page 2	The South Sacramento Stream Levee System is not mentioned in the Certification letter.	Letter and report were revised to include SSS Levee System for certification. The report has been revised to state that Corps has constructed a project to improve the SSSG. The LAP team is in the process of evaluating whether that project meets ULDC.	Response accepted, close comment.		
22	Introduction, Report Organization, Page 2	Will there be a requirement for an accompanying IPE Certification/concurrence Letter and if so, will it be part of this report?	ULOP Criteria requires a report from the IPE.	Response accepted, close comment.		
23	Introduction, Page 2	There is mention of individual certifications that are to be provided in Appendix A to this report, but no Appendix A was found.	Text has been removed. No certifications are being provided as part of this Engineer's Report.	Response accepted, close comment.		

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24	Introduction, Page 2	Add that the requirement for a report by an Independent Panel of Experts is required by ULOP Criteria EVD-5	Document revised to add EVD-3	Response accepted, close comment.		
25	NATOMAS LEVEE SECTION, Page 3	Please add that there are over 120,000 people residing in this basin and that it contains critical infrastructure including the region's international airport, two interstate freeways, numerous public safety (e.g. firehouses), and other important infrastructure.	ULOP Criteria does not require a description of the protected area. This information is included in the accompanying SAFCA APF report.	Response accepted, close comment. We are not sure why you didn't just add this information to the report as requested.		
26	NATOMAS LEVEE SECTION, Table 1, Page 7	Please identify the left column of numbers as ULDC requirements. Same comment to all other "stoplight" tables.	Tables have been removed.	Response accepted, close comment.		
27	ULDC 7.1, Page 8	Please explain why the 2008 NLIP DWSE, which is stated as not meeting ULDC criteria as it did not include adjustments for debris loading or sea level rise, is higher than the 2016 ULDC DWSE. Also, if it is higher, then doesn't it meet the ULDC criteria if the 2016 ULDC DWSE meets criteria? Does the ULDC DWSE meet criteria? Is the difference simply a less conservative hydrology? Please explain. Also note that accounting for sea level rise is not required to meet ULDC criteria. Also, please properly reference the USACE "Comp" study. We believe it is USACE (2002) Sacramento and San Joaquin River Basins Comprehensive Study, Technical Studies Documentation, December 2002.	ULDC requires that certain factors be considered in developing the DWSE; since the 2008 NLIP DWSE predated ULDC and did not consider these factors, it does not meet the requirements of ULDC. The WSE itself has no bearing on whether or not it meets ULDC 7.1. The ULDC DWSE meets ULDC 7.1 although documentation of the development of the DWSE is not complete. The reason for the ULDC DWSE meeting criteria is it is based on updated hydrology from CVHS, that has lower flows (and therefore lower stages) for the 200 year event on the tributaries surrounding Natomas. Language on 200 year release from Folsom has been revised to be more definitive. MTOL sections have been revised to state that they do not meet. An effort subsequent to the ER report will package MTOL information for review by the IPE. Reference to comp study revised.	Response accepted, close comment.		
28	ULDC 7.1,Table 2, Page 8	In the footnote, it states "MBK determined that the 200-year release from Folsom Dam is likely to be 115,000 cfs .." Would suggest stronger language. "MBK recommended that the 200-year release from Folsom Dam be 115,000 cfs and was accepted by the USACE ...." Same for pages 56, 75, 107, 138. Also, no top of levee elevations are presented for the levees to compare to the DWSE in the tables. Please put them in. Also, explicitly say they meet ULDC.	Footnote text was revised. Top of levee elevations are provided in the MTOL sections.	Response accepted, close comment.		
29	ULDC 7.1, Page 8	The text states that the 2016 ULDC DWSE relies upon the completion of the Folsom JFP (nearly complete) and the Folsom Raise (not started). Since the Folsom Raise is not started, how can we conclude that the DWSE currently **meets** ULDC? This also applies to other aspects of the ULDC which relies upon the DWSE such as MTOL or Underseepage. Please explain or revise	Conclusions for almost all levees have been revised per comments from the IPE regarding the ULDC DWSE assumptions and the status of documentation or concurrence from the IPE.	Response accepted, close comment. Note: The Folsom JFP and Rise Projects are mentioned briefly on Page 6 as needing to be completed to achieve the ULDC DWSE, but this should be more prominently highlighted. Note in the various sections for ULDC 7.1 that a statement is made that the DWSE has not been reviewed by the IPE and therefore does not meet ULDC criteria. But it is also because the DWSE depends upon facility modifications that have not yet been completed. Recommend adding this information in the various DWSE sections for ULDC 7.1, and also for ULDC 7.2.	"*and the Folsom JFP and Raise Projects need to be completed to achieve the ULDC DWSE*" was added to each levee conclusion.	
30	ULDC 7.1, Pages 9 and 10	Please explain why you are using the same RM from the Comp study in some analyses, and different RM in other analyses and tables. Suggest you use consistent footnotes such as * for Comp Study RM and ** for Different from Comp Study RM in Tables 3 through 7. Table 7 is missing a footnote * after Hydraulic Model River Station. For Table 6, suggest footnote be added to clarify "**NEMDC Stormwater Pumping Plant - assumed in operation."	Errors were found in latest USACE HEC-RAS model. MBK modified the RM stationing along east side of Natomas to reflect actual distances along creek. Therefore, the two RM systems (Comp Study vs. HEC-RAS) needed to be specified. Table notes in 6 and 7 were revised as suggested.	Response accepted, close comment.		
31	ULDC 7.2, Figure 1-1, MTOL, Page 11	In addition to the three levee gaps at Bennett PP, Northern PP, and Highway 99 crossing, the MTOL appears to take a dip at Howsley Road. Is this a typo? If not, it is not discussed.	Levee improvements ended 400' upstream of Howsley. Work across Howsley will be included in the USACE PGCC (Reach E) project. Text was revised to clarify.	Response accepted, close comment.		
32	ULDC 7.2, Figure 1-2, Page 12	Figure 1-2 appears to be intended to cover both of the SREL reaches: NCC to Powerline Road and Powerline Road to American River. As such, the title should be referenced to do this. In addition, the lines in the figure should be extended/continued to the location of the American River instead of stopping short. There should be a brief discussion or explanation of the gap in the TOL at Interstate 5.	Plots will be separated for each reach along SREL in Natomas. The downstream end of SREL does stop short of American River as the levee curves eastward to become ARNL. The stationing is correct and extends to the American River. An additional label in the plot will be added to include the transition point between SREL and ARNL for clarification.	Statement on Page 10 that the SREL-NCC to Powerline Road, meets ULDC 7.2 is incorrect as Figure 1-2 indicates it fails to meet criteria at Interstate 5. Recommend that this statement be reworded to state that it " meets criteria in most of the reach." Why does the text state that the levee improvements near Powerline Road do not meet ULDC 7.2 criteria when the information in Figure 1-2 indicates that it does? Also, title in Figure 1-2 is incorrect. This is the reach between NCC and Powerline Road, not Powerline Road to American River.	Statement on page 10 was revised to: The SREL - NCC to Powerline Road, meets ULDC 7.2 for MTOL except for the portion of levee under the Interstate 5 overpass (400 feet in length); where levee improvements will be addressed as part of the USACE Natomas Project. Statement regarding levee portion near Powerline Road was removed. Figure 1-2 i title was corrected as suggested.	Response accepted, comment closed.
33	ULDC 7.2, NEMDC, Page 13	The text here appears to be silent about how the Sankey Gap will be addressed. Please add plan or options to address.	The Sankey Gap is designed for overflow. The interior floodplain associated with the 200 year event will be mapped by the City and Counties as part of the ULOP finding. Information will be provided to the IPE for future review to demonstrate that this meets criteria (because it is designed for overflow), but will require an exception.	Please add this information to the report.	Added the following to the end of the Natomas Description section under PGCC: "*Past performance issues are primarily related to seepage and the entering of floodwaters into the basin at Sankey Gap which is designed for overflow. The interior floodplain associated with the overflow at the Sankey Gap during a 200-year event will be mapped by the City and Counties as part of the ULOP finding* ."	Response accepted, comment closed.

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34	ULDC 7.3, Page 15	Should add that these guidance documents also call for the use geomorphology and geophysics to supplement boreholes and CPTs, and that these measures have been carried out in Natomas and other basins. Please give full reference (2008) to SPK SOP and also consider adding USACE documents EM 1110-2-1913 (2000) and ETL 1110-2-569 (2005) for guidance on explorations.	Concur. Additional discussion and references were added as suggested.	Response accepted, close comment.		
35	ULDC 7.3, Pages 16-17	This is a ULDC criterion where the guidance is met by EXCEPTION. It should be noted that the Kleinfelder explorations filled in gaps left by previous exploration programs carried out over several decades by multiple agencies. Because of this, explorations added to define critical levee and foundation conditions had to fill in existing gaps and were not uniform in spacing. Further, environmental and physical access limitations forced the general elimination of waterside borings. Therefore, the spacings were **not** generally met, but the important point is that the number of explorations per mile were generally met, but instead based on past programs, geomorphology, geophysics, and past performance - just not using uniformly spaced borings. The sentences in each of these levee reaches that the spacings were generally met is not strictly true. I would also add that in the case of NCC and SREL northern portion, the explorations were supplemented by mapping and trench logging of cutoff wall excavations during the construction of cutoff walls.	An Exception Memo for this section (and subsequent sections) has been prepared to include the number of explorations per mile and to reference more completely the additional information used to form the opinion that the reach meets by exception. The Exception Memo will be provided for IPE review as part of review of information subsequent to the ER.	Response accepted, close comment.		
36	ULDC 7.4, Page 18	Should clarify in text that ULDC 7.4 also addresses through levee seepage in addition to slope stability factors of safety. A few sentences discussing this should be added to the text on Page 18. Same comment for similar sections in other chapters.	Additional discussion of through seepage was added.	Response accepted, close comment.		
37	ULDC 7.4, Page 18	A couple of items to clarify: 1) The RDD analyses assume water surface starts at DWSE, not the HTOL 2) The amount of RDD was determined well in advance of any 2016 analysis by MBK.	Concur. Clarification was added to the 7.4 Sections	The revised text on Page 18 describing the minimum factor of safety for slope stability for HTOL steady-state seepage (FS = 1.2) is confused with criteria for RDD (FS > 1.0-1.2). Also, the text states that ULDC requires a minimum FS for RDD of 1.2, but this is also not true. In actuality, different minimum FS values for RDD were actually assumed for different levee/river/stream areas, but this is not accurately described in the text. For example, Kleinfelder used FS = 1.0 for NEMDC and FS=1.1 for RDD for SREL. The text states that FS = 1.2 was used for these evaluations. Please review and revise.	The introductory text was replaced with the following: *ULDC 7.4.1 requires a minimum factor of safety of 1.4 for steady state seepage conditions, based on the DWSE, for failure surfaces that intersect the levee crown and are greater than a few feet deep in the levee slope. It also requires a minimum factor of safety of 1.2, based on the Hydraulic Top of Levee (HTOL), for failure surfaces that intersect the levee crown and are greater than a few feet deep in the levee slope. ULDC 7.4.2 requires a minimum factor of safety of 1.0 to 1.2 for waterside slope stability during rapid drawdown conditions for the DWSE depending on how long the embankment is saturated, with the higher factor of safety used for longer duration events. A factor of safety of 1.2 was used for rapid drawdown for the Sacramento River, American River, NCC, NEMDC downstream of Dry Creek, and PGCC due to the long duration events in the Sacramento and American Rivers and backwater effects of these rivers in the NEMDC, PGCC, and NCC. A factor of safety of 1.0 was used for the NEMDC between Dry Creek and the PGCC. The referenced DWR ULE reports used a factor of safety of 1.1 for waterside slope stability. When these models were referenced, the calculated factor of safety was compared to the factor of safety stated above for each levee (e.g. 1.0 or 1.2) to determine if the levee met criteria. ...* The FOS of 1.0 or 1.2 were used to be consistent with the LAP designers.	Response accepted, comment closed. Recommend double-checking again that the RDD factors of safety quoted above for specific projects/levee reaches were actually the minimum acceptable values used in the evaluations and designs.
38	ULDC 7.4, Page 18	The text states that the levee reaches meet criteria for intermittently-loaded levees, but does not address/document whether these levees are intermittently loaded or frequently loaded - please add documentation or reference ULDC Section 7.6.	Reference to ULDC 7.6 added.	Response accepted, close comment.		
39	ULDC 7.4, Page 19	It is surprising that much of the levee within the SREL Powerline to ARN was found to be deficient for slope stability - isn't most of this levee fitted with wither a shallow cutoff wall or stability berms installed in the 1990s?	The reaches did not meet slope stability due to high exit gradients at the levee toe that lowered the factor of safety and/or seepage above the levee toe (old hydraulic fill berm) in erodible soils. These areas are being studied for remediation by USACE, so additional effort was not expended to clarify or refine the determination.	Response did not address IPE's comment. In this levee reach, it was our understanding that USACE SPK installed shallow cutoff walls or berms in the 1990's to address through seepage in the hydraulic fill. Response did not address our comment. Recommend stating that this reach is considered to be deficient due to underseepage concerns and that this may also impact slope stability. Through seepage issues will also be reevaluated in the future USACE SPK designs.	This response is based on the analysis contained in the DWR ULE Report for this reach. We agree that the cutoff wall would likely cutoff seepage through the levee; however, the referenced analysis did show the phreatic surface exiting on the landside of the levee above the retaining dike in erodible soils for the HTOL at several reaches. This result is likely a result of steady state seepage and the high HTOL WSE, and a transient analysis would probably not show this condition. We agree that the underseepage issues in this reach also lowers the FOS for stability and have added emphasis to that fact in the report.	Response accepted, comment closed.
40	ULDC 7.3 and 7.4 Pages 18 and 20	The window in the cutoff wall at Interstate 5 in SREL NCC to Powerline Road is listed as between Stations 440 and 460 on Page 18 and between Station 443 and 445 on Page 20 - please correct inconsistencies.	Location of cutoff wall windows at Interstate 5 has been corrected.	Response accepted, close comment.		

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41	ULDC 7.5, Page 20	The criteria for underseepage in the ULDC also calls for a maximum allowable exit gradient of 0.8 at a distance of 150 feet beyond the landside levee toe, and to be interpolated between 0.5 and 0.8 at distances of less than 150 feet. **This should be presented in the criteria for underseepage in all of the chapters.**	Text was revised introduction for 7.5.	The revised text stating that the minimum allowable exit gradient is 0.8 at the seepage berm toe greater than 150 feet and interpolation between 0.5 at the levee toe and 0.8 at the seepage berm toe is incorrect. The correct description is 0;5 at the landside levee toe and 0.8 at a distance of 150 feet, with interpolation for distances intermediate between these points. For points beyond 150 feet, the criteria is 0.8 up to a distance of 300 feet. The current description is not quite correct. Please correct.	Text revised to state: *The allowable underseepage exit gradient through the combined seepage berm/blanket layer between the levee toe and the seepage berm toe is determined by interpolation, using 0.5 at the levee toe and 0.8 at a distance of 150 feet from the levee toe, with interpolation used for distances between these points. For points beyond 150 feet, the criteria is 0.8 up to a distance of 300 feet. Following USACE procedures, the maximum allowable exit gradient in a ditch, canal, or depression is 0.5 at the levee toe and 0.8 at 150 feet from the levee toe and beyond (up to 300 feet), with linear interpolation applying between the levee toe and 150 feet from the levee toe.*	Response accepted, comment closed.
42	ULDC 7.5, Page 21	I don't think the levee subreaches in American River North Levee (Reach I) are accurately characterized. The USACE is planning to place new slurry wall and/or seepage berms in these areas - please review and correct	Stationing extents along ARNL have been revised in the ER. There will be no work along SREL/ARNL between SREL station 956+00 (location of Pumping Plants 1A and 1B near RD 1000's office) and ARNL 20+50 (Interstate 5 crossing).	Description of levee reaches meeting criteria and future levee reach improvements remains incorrect. Current text indicates that much of Reach I meets criteria. This is incorrect. USACE SPK and HDR currently designing a new cutoff wall starting approximately 200 feet east of Gateway Oaks Drive at Station 2+13 as part of Reach I work. The wall will continue to about Station 19 near Interstate 5 where a seepage/stability berm will be added beneath Interstate 5. The cutoff wall will then resume near Station 30 and continue to Station 106. The design is currently at the 90 percent level and construction is scheduled for 2017. Please update/correct incorrect descriptions.	Text now reads: The majority of the levee does not meet ULDC 7.5 for underseepage for intermittently loaded levees for the DWSE and HTOL. Remediation of this levee is currently being designed by the USACE as part of the Natomas Project for nearly the entire length of Reach I (Station 2+13 at Gateway Oaks Drive to Station 115+63 at Northgate Blvd).	Response accepted, comment closed.
43	ULDC 7.6 Frequently Loaded Levees, Pages 21-22	The text states that for the different Natomas levee reaches that DWR's ULE program did not consider them to be frequently loaded levees. I think it is required for the certifying engineer or a member of the SAFCA team make this determination based on past hydrology, document this in a signed and stamped TM. This section should be modified accordingly. **Same comment applies to other Chapters**.	This certification will be made as part of the future ULDC Finding. This information will be documented, certified, and provided to the IPE for concurrence as part of the forthcoming, subsequent IPE review.	Response accepted, close comment.		
44	ULDC 7.7, Seismic Vulnerability, Page 23	It is confusing to label the DWR table as Table 7-1 between Tables 7 (Page 10) and 8 (Page 23). Recommend changing numbering of Table 7-1 to Table 8 and reference DWR source document. Subsequent table numbers would then increase by one. **Same comment in other chapters.**	Table renamed as suggested	Response accepted, close comment.		
45	ULDC 7.7 Seismic Vulnerability, Pages 22-26	The text refers to analyses by DWR regarding seismic levee vulnerability, but the certifying engineer here should be clear whether he/she has reviewed and concurred with these assessments - it is the certifying engineer that is making these statements about conditions and adequate progress. Further, it was my understanding the Kleinfelder made their own seismic stability assessment of NLIP - if so, these are not mentioned.	Kleinfelder has reviewed and concurs with the findings of the ULE program for the reaches noted. Where there were differences between the conclusion reached by Kleinfelder and those reached by ULE program, the more conservative interpretation was generally used. The report sections for Natomas NCC and SREL NCC to Powerline have been updated to reflect this. Kleinfelder completed a seismic analysis for NCC, and SREL 1, 2, and 3 only. The seismic analysis for the remainder of the basin was prepared to the draft level and not reviewed or finalized. Therefore, we relied more on the ULE program analysis to be consistent with the remainder of the report. This will be documented in the final ULDC report.	Response accepted, close comment. Please note that the descriptions in the text do not appear consistent with the summaries in the tables. For example, for the NCC the text states that the results for Station 0+00 to 0+70 was classified as Low Vulnerability by DWR by High Vulnerability by Kleinfelder. Therefore, the High Vulnerability classification will be used. However, what is reported in the table is for Station 0+00 to 7+00, a much larger reach - is this just a typo? Further, other reaches are described as High Vulnerability (e.g. Station 85+00 to Station 95+00) but are not discussed. Further discussion is warranted. Perhaps the results of both the ULE and Kleinfelder evaluations can be presented and compared. Right now, the results are confused.	The NCC Station 0+70 was a typo; it should have been 7+00. Table for NCC was also revised. Given the preliminary nature of the seismic assessments, additional discussions is not being provided as part of this adequate progress ER; however, it is understood that additional discussion is necessary as part of ULDC certification.	
46	ULDC 7.8 Levee Geometry, Page 26-27	The ULDC also allows for alternate geometries and steeper slopes for zoned levee embankments, which is what a levee becomes when a slurry wall is installed through the embankment - this can allow for steeper landside slopes and should be pointed out here.	At locations where a cutoff wall is present within the levee prism, the definition of a zoned embankment would be met per ULDC 7.8 and will be referenced in the report. Additional factors such as wide levees, central clay cores, landside filters or drains, or soil reinforcement were/will also be considered. Where a levee segment does not meet ULDC geometry criteria and a cutoff wall or other factor is not present, but the levee segment meets seepage and stability analysis criteria, does not have past performance issues, and does not have O&M concerns from the LMA, an exception will be prepared as an NSA to support the ULOP Finding.	Response accepted, close comment. Note that an EXCEPTION for a zoned levee is not needed as it meets ULDC criteria.	Understood.	
47	ULDC 7.8, Levee Geometry NCC to Powerline Road, Page 27	It should be pointed out that the waterside slope of the old hydraulic fill levee is basically sacrificial with the addition of the adjacent levee. The text should be modified to discuss the very wide levee section created by the adjacent levee. Not that since there is a cutoff wall, the levee becomes a zoned embankment and not subject to the same requirements as a homogeneous levee embankment. Further, there is an additional all-weather road on the paved county Garden Highway in addition to the crown road on top of the adjacent levee.	Text has been revised as suggested.	Response accepted, close comment.		
48	ULDC 7.8, NEMDC, Page 28	For clarification, the text states that the NEMDC does not meet seepage and stability criteria, but earlier sections indicated that about a third of this levee did meet criteria. Please review and correct for consistency.	Text was revised to identify reaches that meet (same as the stability and underseepage sections).	Response accepted, close comment.		
49	ULDC 7.8, PGCC, Page 29	For clarification, the text states that the PGCC does not meet seepage criteria and therefore does not meet levee geometry criteria, but earlier sections indicated that it met ULDC 7.4 which includes seepage (not underseepage). Please review and correct for consistency - it may be that levee geometry is met if stability is met.	The PGCC does not meet underseepage criteria. The IPE clarified that "seepage" in 7.8 was intended to mean through seepage, not underseepage and that simply meeting seepage (through) and stability alone is not sufficient to meet 7.8. Since the PGCC is not a zoned or overwidened embankment in all locations, it would not meet criteria currently. Planned USACE improvements would extensively improve the embankment (e.g. a seepage cutoff wall or a stability or seepage berm) and this levee is expected to meet criteria upon completion of this work. Introductory text in 7.8 has been revised to clarify the criteria per input received by the IPE on conf call. Conclusions have also been revised to reflect correct interpretation. Note that conclusions also reflect other comments and therefore are generally a conclusion of DNM.	Recommend elimination of text on Page 30 that states that geometry requirements will be met by an EXCEPTION. Reasoning for the Exception is not explained and you don't yet know that you will need one. Consider adding . This discussion is inadequate to support meeting criteria.	Agree that the discussion is not sufficient for ULDC certification. Statement was revised to use language used in other sections . From - *Therefore, this levee meets ULDC 7.8 requirements for geometry through exception.* To - *Therefore, this levee would meet ULDC 7.8 requirements for geometry through exception.*	Response accepted, comment closed.
50	ULDC 7.10, Erosion, Pages 31 - 32	Please include dates for all of the NHC and USACE analyses for specific areas. **Same comment for other sections.**	References were added.	Response accepted, close comment.		

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51	ULDC 7.10 Erosion, Page 31	For the NCC south levee, please explain how raising the levee a few feet mitigates previously identified erosion problems - this does not make sense	Additional explanation was provided in the ER, i.e.. widening and raising the levee has shifted the template away from the streambank and erosion does not threaten the levee. Erosion sites will be monitored and addressed as a maintenance action as necessary.	Response accepted, close comment.		
52	ULDC 7.10 Erosion, Page 31	For the SREL NCC to Powerline Road reach, please explain how the construction of the adjacent levee addresses the previously identified erosion features.	Same response as 51	Response accepted, close comment. Could have stated that the addition of the Adjacent Levee results in the previous Garden Highway levee embankment being somewhat sacrificial.	Noted.	
53	ULDC 7.10 Erosion, Page 31	For the NEMDC levee, NHC identified 620 feet of potential erosion repair and this is not planned for an immediate repair as it is not actively eroding. However, it would seem that an erosion feature identified for a future fix would not lead to a conclusion that the levee currently meets erosion criteria regardless of whether imminent failure is predicted. Please review and correct. **Same comment for other levee reaches such as for the PGCC levee reach.C38**	The erosion evaluation performed by MBK in 2014 was for the 100-year flow. The discussion is being rewritten to indicate that a new evaluation is required. However, it is important to note that there are no active erosion sites presenting an immediate breaching hazard, or are of any significant concern to levee integrity. The erosion is being monitored as a maintenance activity.	Response accepted, close comment.		
54	ULDC 7.10 Erosion, Page 32	For the PGCC levee, it would seem that an erosion feature identified for a future fix would not lead to a conclusion that the levee currently meets erosion criteria regardless of whether imminent failure is predicted. Please review and correct.	Same response as 53	Response accepted, close comment.		
55	ULDC 7.11 Right-of-way, Pages 32-33	For the NCC, please detail the amount of additional right-of-way obtained. Also clarify which parameters of the ULDC criteria (and there were many cited) that are being met. For the SREL levees (NCC to Powerline), the descriptions are incomplete (actually incomplete sentences). Please provide more specific detail on the right-of-way acquired. Also, the discussion of the SWIF is incomplete - we can't tell what it means. Finally, what is meant by "*will* ***meet*** **"** as opposed to "*meets?*" It would appear that it currently does **not** meet criteria. Should clarify that waterside development is on sacrificial portion of the waterside levee and should therefore meet criteria as an **Exception.**	NCC - Text indicates that the entire embankment and a landside O&M corridor exists. ROW documentation will be prepared to support the ULOP finding and submitted to the IPE for review. SREL NCC - Powerline - Text indicates that the entire embankment and a landside O&M corridor exists. ROW documentation will be prepared to support the ULOP finding and submitted to the IPE for review. References to SWIF have been removed. Conclusions have been changed to DNM since we do not have concurrence from the IPE. Exception - The homes on the waterside of the levee are considered encroachments. Encroachments have not yet been evaluated for Natomas. However, the team anticipates these will meet criteria and not need an exception. it would be helpful for the IPE to provide additional information on why they think an exception is required for waterside development.	Statement that SREL waterside development meets ULDC 7.11 appears to be unsupported. Probably needs an Exception. Text should probably be modified to state that it is expected to meet criteria with an Exception. With regard to the reasoning for an Exception as being necessary, ULDC 7.11 requires property rights (fee title or easement) for the entire levee prism. There is a waterside portion of the levee prism associated with the Adjacent Levee. If we project the waterside slope of the adjacent levee down a 3:1 slope to the elevation of the landside toe (as was done for the Vegetation Variance for SREL in Natomas), doesn't this cross into the footprint of the Garden Highway and the private residences along the riverside area of the Garden Highway? If so, isn't this within the levee prism? Does SAFCA or the State of California have rights to maintain, access, or repair this area? If not, then an Exception is likely to be needed. Treating the waterside residences and Garden Highway as Encroachments implies that SAFCA/State of California has some rights - are there such rights?	RD 1000 has fee ownership or easement to the former Garden Highway levee. These rights expanded (landward) as part of NLIP and construction of the adjacent levee. We do not foresee the need for an exception. Text in document has been revised to clarify that rights were expanded.	Response accepted, comment closed.
56	ULDC 7.11 Right-of-way, Page 33	For the ARNL, it might be mentioned that the levee is generally oversized. Also, what newly constructed levee embankment is envisioned? Is this for a raise in the levee? Please clarify. Same comment for other levee reaches such as for the PGCC West Levee.	The proposed improvements along ARNL primarily include installation of a 37-foot deep cutoff wall along the waterside slope which would require excavation and recompaction along the waterside half of the levee. The text will be revised to replace "newly" with "reconstructed". Similar text changes will be applied to other levee reaches in NLIP section. For the PGCC west levee, it simply says the levee is being improved. Since we don't have a high degree of confidence on what the Corps will do in this reach, we prefer to keep it generic. Since ROW will have to be required by the USACE, how we word it wouldn't seem to make a difference for purposes of the ROW section.	Response accepted, close comment. Please note that the description of the planned work along the ARNL is out of date. Levee will not be significantly degraded as a CB wall is planned to minimize disruption and construction time. Also, depth of cutoff wall cited is not accurate.	Term "reconstructed" was removed from text to avoid implying a full degrade.	
57	ULDC 7.12 Encroachments, Pages 34-35	The first paragraph in the NCC South Levee section should be moved to the general introductory section as it addresses all of the encroachments/inventory in Natomas. In subsequent sections for the different levee reaches, the same general paragraph is repeated. Recommend eliminating this unnecessary duplication and simply state in the NCC and SREL NCC to Powerline Road sections that many if not all encroachments were remediated during recent construction. There is very little to say about the other levee reaches.	The first paragraph has been moved as suggested. However, paraphrase of this paragraph in subsequent paragraphs has not been removed to maintain document organization.	Response accepted, close comment.		

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58	ULDC 7.12, Encroachments, Page 34	It is not enough to just address high hazard encroachments. All encroachments need to be permitted and evaluated for potential to interfere with maintenance and floodfighting. See excerpt below from Page 7-29 in the ULDC: *"For other existing encroachments which are not considered to be a high hazard, but either: (1) have not been permitted, or (2) interfere with operation, maintenance, or flood fight capability, the city or county is required to have an encroachment remediation plan in place, or reference such a plan, for the entire length of levee that the Finding is to cover. To the extent allowable by law, this plan needs to address eventual removal or permitting of all such encroachments. In some cases, permits may need to provide for access by qualified officials. The city or county must work with the levee maintaining agency and the entity responsible for issuing encroachment permits to establish, document, and publicize a realistic target schedule for implementation of this plan. An example target schedule would be to remove or permit 50 percent of the currently noncompliant encroachments within 5 years and to address the remaining 50 percent in the subsequent 5 years."* <u>Same comment to other chapters.</u> **This hasn't been addressed in the document which implies that the levees do not meet ULDC criteria for encroachments**	Document has been revised to (1) add this requirement to the criterion introduction and (2) indicate that an encroachment remediation plan is being prepared as part of the NSA.	Response accepted, close comment.		
59	ULDC 7.13 Penetrations, Pages 35-36	The first two sentences in the NCC South Levee section and in the SREL NCC to Powerline Road section should be moved to the introductory section and not repeated in subsequent sections. It is hard to believe that the penetrations in the SREL NCC to Powerline Road reach do not meet criteria as the adjacent levee reworked/replaced all of the existing penetrations in this reach. Could mention that the upcoming Reach I work along the ARNL will remediate many of the penetration issues in this reach..	First two sentences have been moved to introduction section. Text has been revised to clarify. Sentence on USACE Natomas Project added to ARNL section.	Response accepted, close comment. Note that the two sentences were removed from the NCC South levee system, but it remains in the SREL section and not added to the introductory section.	This is because their status is different from NCC and SREL NCC to Powerline.	
60	ULDC 7.13, Penetrations, Pages 39-40	Should locations that state "penetrations have not been evaluated" also state that it "does not meet ULDC 7.13 for penetrations."? This is not clear in the ULDC. Same comment for other ULDC sections where "it has not been evaluated." ULDC says "The civil engineer needs to assess existing penetrations and render an opinion as to their impact on the reliable performance of the levee/floodwall for the full range of loading up to the HTOL." If he/she cannot render an opinion because he/she has not evaluated it, then we would interpret this as not meeting ULDC.	Conclusions for almost all levees have been revised per comments from the IPE regarding the ULDC DWSE assumptions and the status of documentation or concurrence from the IPE.	Response accepted, close comment.		
61	ULDC 7.15 Animal Burrows, Pages 39-40	Consider making the point that with the use of slurry cutoff walls, particularly the older ones with cement in them, that these mitigate the effects of animal burrows in the levee. Does RD 1000 grout the animal burrows once they are found? If not, why not? Grouting is the preferred treatment of animal burrow distress. Some additional description of the burrow remediation/repair process is warranted. **<u>Same comment for other chapters.</u>**	Language added on benefits of slurry walls. Concur that additional information should be provided to support a ULOP Finding. A "rodent abatement program" document will be prepared as part of the NSA. RD 1000 does not grout the rodent holes. They fill them with dirt and compact it. This has been their traditional treatment method and their is growing environmental problems (GGS impacts) from grouting.	Response accepted, close comment. For the ULOP finding, the abatement document that will be prepared to describe animal control and damage repair will need to be proactive and demonstrated to be effective.	Understood, as with vegetation maintenance.	
62	ULDC 7.16 Vegetation Evaluation, Pages 40-41	The first paragraphs of the NCC South Levee section should be moved up to the general introductory section. Should quote the USACE Vegetation Variance received for Natomas. It would seem that with the recent reconstruction of the NCC and the adjacent levee along SREL between NCC and Powerline Road that the levees **meet** ULDC criteria for vegetation. The waterside vegetation is largely sacrificial and with the variance would meet ULDC criteria, particularly along the SREL in this reach. Specific measures contained in the ULDC that would need to be met in future years should be mentioned, including trimming and thinning of trees, removing all trees with DBH less than 4 inches, assessing trees for unacceptable threats, and Life Cycle Management. **<u>Same comment to other Chapters</u>**.	Introductory text was revised to include first sentence of NSS and reference Natomas veg variance. The IPE is correct in that the vegetation along NCC and SREL between NCC and Powerline Road will likely meet ULDC however, such (evaluation) and conclusions have not yet been documented and their concerns about landscaping on the water side of the levee that impede operation and maintenance. Additionally, this will need to be reviewed the IPE. Therefore the conclusion will be DNM. Trimming and thinning requirements were added to the introduction for the criterion.	In order to make the ULOP finding, the tree assessment, removal of trees with unacceptable threats, and thinning and trimming will need to have been completed <u>prior</u> to the finding. Provisions in the O&M manual alone are not acceptable. The O&M program will need to be made to <u>keep</u> the levees maintained to ULDC standards, not to get them there.	Engineer understands that assessment and any required modification or removal must be complete at the time of the ULOP Certification and Finding. Engineer understands the need for LMAs to conduct vegetation management as required by ULDC to maintain access and visibility. Sentence in the text indicating O&M is an ongoing action is intended to capture this. Text was revised to state the vegetation in the VMZ needs to be trimmed and thinned to maintain access and visibility.	Response accepted, comment closed.
63	ULDC 7.17 Wind Setup and Wave Runup, Pages 42 - 43	More details about how the wind setup and wave runup distances were calculated and how they meet ULDC criteria should be included in the introductory section. In the subsequent sections, it is not clear why there are statements that the calculated analyses meet ULDC 7.17 - is it because they follow ULDC procedures and criteria? If so, this should be more discussed in the introductory section with the results summarized in the subsequent sections for each levee reach. Or is it that the calculated values fall within the MTOL? Please explain. A table summarizing the calculated combined wind setup and wave runup values for each reach would be useful. **<u>Same comment for other chapters</u>**.	Details regarding the wind setup and run distances are included in the referenced document. Tables summarizing calculated combined setup and runup values are also included in the referenced Wind and Wave Document, although the text provides a max computed WW. A discussion of MTOL is in the MTOL section. Conclusions for WW are being revised to DNM since the IPE has not reviewed the evaluation.	Response accepted, comment closed		

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64	ULDC 7.19, Sea Level Rise, Pages 44-45	Please explain whether the 1-foot rise in sea level over 30 years represents the median estimate or a conservative estimate, and what impacts that choice represents on the determined DWSE. Please explain in the introductory section how the impacts to the DWSE at the various river systems were determined from an assumed 1-foot rise in sea level. Would a 2-foot rise double the increased values? How does a 0.05 foot increase near Freeport impact the water surfaces in Natomas or other areas of Sacramento? The text states that this was incorporated in the ULDC DWSE - how was this done? Please discuss further in introductory section.	The 1 foot 30yr projection is a conservative estimate based on the source document. This doc gives a 2000-2030 sea level rise projection range of 0.13 to 0.98 feet. We used the max value of the range and assumed the estimate was applicable as a 30-yr projection starting now (i.e. 2000 to 2030 = 2016 to 2046). There's some additional conservatism in that we are using the 30-year projection as a 20-year projection for the ULOP finding. The ULDC water surface report will include documentation on inclusion of sea level rise. We don't believe getting into this level of detail is appropriate for the Engineers Report as this is a summary document.	Response accepted, comment closed It would be helpful to include some of the information in the comment response into this section of the Engineers Report.	Noted. Some of this is already included: *However, the 30-year projection was applied beginning in year 2015 and lasting through 2045, since the projection over the 30-year duration beginning in 2000 is more than half past.*	
65	ULDC 7.20, Emergency Actions and Flood Safety Plans, Pages 45 and 46	The paragraph in the NCC South Levee section should be moved to the introductory chapter. Since the required emergency preparedness documents appear to not be fully developed at the present time, recommend changing "*will meet* " to "***does not meet*** " for current conditions in each of the subsequent sections for the different levee reaches. Recommend listing out the various flood preparedness documents and Emergency Action Plans that will be developed. This should include the reading of piezometers, high water staking, and documentation of levee performance and distress to confirm levee design and integrity.	Conclusion has been revised. A listing of documents to be prepared is currently unknown and the ULDC 7.20 does not specifically require that those items be included.	Response accepted, comment closed		
66	Plan of Levee System Improvements, Pages 47-50	Much of the information in these sections would seem to apply to all 5 of the basins and should probably be placed into an introductory section of the report as a whole, and not repeated here. It is my understanding that the Folsom JFP is currently now basically functional, and represents a significant portion of Adequate Progress. Missing from here is the proposed widening of the Sacramento Weir and Bypass. For each of these planned improvements, list out the ULDC criteria (e.g. 7.2. 7.3, 7.4, etc...) that will be fully resolved by it implementation. Same comment for the non-structural measures.	Subsequent chapters include only a summary of the projects identified in previous chapters. The Sacramento Weir and Bypass is not listed in the report as it is not required to meet ULOP. A table cross-referencing the projects and the levee systems has been developed.	Response accepted Where is the table?	This table is being developed as part of the ULDC certification effort.	
67	Section 2.0, Dry Creek Levee System, Page 54	Please state whether the stop logs cited here for the closure are fully described and incorporated into the O&M manual.	Stop logs are not in the O&M manuals, but are covered in the City's Emergency Operations plans. Review of all closure structures for listing/operation in O&M manuals will be performed and addressed as part of the Non-Structural Actions	Response accepted, comment closed		
68	Section 2.0, Dry Creek Levee System, Page 54	Please describe the dimensions of the crack, location on the levee and the depth of trenching to remediate 1997 cracking. Please also clarify why the presence of trees along the landside toe were thought to have been associated with the cracking, and then removed, while other trees along the levee further south can be seen still remaining today.	Location of crack is as describe in report (near centerline from Sta 7070+00 to 7075+00), The specific cause of the crack was not determined and association with eucalyptus trees was geographical. Kleinfelder provided scope of work document that specifies width and depth of crack repair. Reference information was added to report.	Response accepted, comment closed		
69	Section 2.0, Dry Creek Levee System, ULDC 7.1, Page 56	How do the other DWSE values mentioned here and that may be used in different portions of the report differ from the 2016 ULDC DWSE? Are they always conservative? Why is the DWSE cited in Table 15 different from those in Tables 4 through 7 for Natomas? In Table 15, the values are given an ** stating that the results may change upon completion of the formal DWSE report, but these asterisks are not present in Tables 4 through 7. Should the document explicitly state that the 200-year DWSE explicitly **meets** ULDC criteria? This may not be stated correctly if it is relying upon a future Folsom Dam Raise.	Asterisks will be removed from table. DWSE presented in table 15 are the same as the 2016 ULDC DWSE. The NLIP used a DWSE developed prior to ULDC. However, it is higher than the ULDC water surface. A conclusion has been added to the text to indicate the evaluation is complete but still DNM since no concurrence by IPE.	Response accepted, comment closed		
70	Section 2.0, Dry Creek Levee System, ULDC 7.2, Page 57	Clarify that when the text states that there are no locations where wind and wave runup affects the MTOL along the Dry Creek north levee that you mean that the wind and wave runup are always calculated to be less than 3 feet. Please cite the actual range of values calculated.	Text revised to indicate where the WW is less than 3 feet, the MTOL is the DWSE +3ft. WW values were not cited in the MTOL section unless greater than 3 feet. WW values are provided in 7.17.	Response accepted, comment closed This issue could still be made clearer in the report. We would like to see the wording in these report sections improved.	Noted. As part of the ULDC certification, a technical memorandum will be prepared documenting how the MTOL was calculated for each levee.	
71	Section 2.0 Dry Creek Levee System, ULDC 7.4, Page 58	The text states that a factor of safety of 1.2 was used for Rapid Drawdown slope stability analyses, but Kleinfelder was using 1.0 or 1.1 for at least portions of some of the North Area streams. This issue may apply to other areas as well. Please clarify and correct.	This will be corrected Text will be corrected. 1.0 used for short term events. 1.2 used for long term events. ULE uses 1.1 for intermediate. Discussion to be added to clarify other guidance documents.	Response accepted, comment closed Note that FS criteria for HTOL (FS=1.2) in this section was not described.	Noted.	
72	Section 2.0 Dry Creek Levee System, ULDC 7.6, Page 59	The text states that DWR considered the Dry Creek North Levee to be an intermittently loaded levee. However, DWR is not certifying that the levees meet ULDC/ULOP criteria. The SAFCA team should do this certification.	This certification will be made as part of the ULDC Finding. This information will be documented, certified, and provided to the IPE for concurrence as part of the forthcoming, subsequent IPE review. (see also 43)	Response accepted, comment closed		

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73	Section 2.0 Dry Creek Levee System, ULDC 7.8, Page 61	The text states that the levee crown is between 10 and 19 feet in width, less than the minimum 20-foot-width criterion in the ULDC. It then goes on to state that it meets ULDC criteria because the levee meets seepage and stability criteria. This is not true. The ULDC states that steeper slopes can be accepted if seepage and stability criteria are met, but only for oversized levees (see. Pages 7-19 and 7-20), or if the levee is designed as a zoned levee. It would seem that this criterion would only pass by EXCEPTION, but this is not noted as such. At face value, this would not meet ULDC criterion. Please revise, correct, and/or propose an EXCEPTION.	At locations where a cutoff wall is present within the levee prism, the definition of a zoned embankment would be met per ULDC 7.8 and will be referenced in the report. Additional factors such as wide levees, central clay cores, landside filters or drains, or soil reinforcement were/will also be considered. Where a levee segment does not meet ULDC geometry criteria and a cutoff wall or other factor is not present, but the levee segment meets seepage and stability analysis criteria, does not have past performance issues, and does not have O&M concerns from the LMA, an exception will be prepared as an NSA to support the ULDC Finding. (see also 46)	Response accepted, comment closed		
74	Section 2.0, Dry Creek Levee System, ULDC 7.9, Page 62	There is no discussion of the interfaces with the UPRR closure section or the connection with the NEMDC Pumping Plant. Please provide summaries of these evaluations and how they met criteria, and the references where the studies are fully documented - as I remember, they are not in the Kleinfelder reports.	An evaluation of the NEMDC PP has not been performed. Additionally, as indicated in other responses, specific, focused evaluation of transitions has not been performed. As discussed in the meeting on April 7, 2016, Mead & Hunt and Kleinfelder will prepare a summary of transitions in the project area to include in the ULDC report and be submitted for review by the IPE.	Response accepted, comment closed		
75	Section 2.0, Dry Creek Levee System, ULDC 7.11, Page 63	Please detail how the SAFCA property rights provide the minimum access for the levee, and in particular, the more than 20 feet landward of the levee. The current description is not specific enough to state how these requirements are met (e.g. property rights/easements are held for the entire footprint of the levee, 40 feet waterward of the waterside levee toe, and 50 feet landward of the landside levee toe and are owned by SAFCA).	Additional description is provided in ER. SAFCA is working with the City and County to develop a plan to address ULDC criteria for ROW. Conclusions have been revised since no concurrence from IPE to date.	Response accepted, comment closed		
76	Section 2.0, Dry Creek Levee System, ULDC 7.13, Page 64	The ULDC criteria for penetrations requires that the City or County have a remediation plan in place or to reference the entire length of the levee to ensure that they are permitted and/or remediated over time. This is not addressed in this section and implies that the levee **does not meet criteria** for this requirement. It all of the penetrations actually are currently permitted and meet all criteria, not just for high hazard, then this should be stated more clearly. **Same comment for other chapters.**	Hazard assessment conducted did not consider permitting status. An encroachment remediation plan will be prepared as part of the NSA, and text has been revised to indicate such.	Response accepted, comment closed		
77	Section 2.0, Dry Creek Levee System, ULDC 7.14, Page 65	Please provide references where all of the criteria for the closure structure are documented as being met. Also, it is assumed that this closure structure is the UPRR crossing - if true, it is not mentioned here. In addition to the UPRR closure structure, the levee connects to the NEMDC Pumping Plant - should this be discussed here as well? If not, why not?	Documentation of compliance with criteria referenced in paragraph above is provided in the 2015 Mead & Hunt report. 2nd sentence will add Mead & Hunt, 2015c reference at end of sentence. The closure structure is at the UPRR crossing. As discussed in the meeting on April 7, 2016, Mead & Hunt and Kleinfelder will prepare a summary of transitions in the project area and determine what analysis and documentation is required to meet ULDC. Conclusions being revised to DNM to reflect lack of concurrence form IPE on status.	Response accepted, comment closed		
78	Section 2.0, Dry Creek Levee System, ULDC 7.15	For the animal control procedures, are these documented in the current O&M manual? If not, why not? Also, there is referent that as part of SAFCA's Non-Structural Actions, ARFCD will prepared a formal procedural document that will include specific abatement procedures - if this hasn't yet been done, should this be counted now? How do both of these document issues affect current statement about meeting criteria? **Same comment for other chapters.**	Animal control procedures are not specifically in the O&M manual, but included in the "Superintendent's Guide to O&M of CA's Flood Control Projects". We view this document to be sufficient and applicable for the purposes of meeting ULDC; however, we recognize that these guidelines should undergo revision due to the time elapsed since their initial release (circa 1980). therefore, as part of the ULDC Finding, a rodent abatement program will be documented, or used to supplement the Superintendent's Guide. Additionally, conclusions for almost all levees have been revised per comments from the IPE.	Response accepted, comment closed Note that citing DWR guidance is not the same thing as explicitly stating that the procedures have been adopted.	Understood. Procedures will be implemented.	
79	Section 2.0, Dry Creek Levee System, ULDC 7.16	The text states that this levee meets ULDC Vegetation criteria because there is no vegetation that poses an unacceptable threat. However, there are other requirements such as thinning and trimming requirements and for removing trees with a DBH less than 4 inches. The text is silent on this and it is not clear if this levee actually meets criteria or not. **Same comment for other Chapters.**	The comment is more along the lines of is O&M occurring to trim vegetation. Text added to introduction of vegetation to indicate requirement for trimming and thinning.	Response accepted, comment closed See previous notes on vegetation management for Natomas.	Understood, as with rodent abatement	
80	Section 2.0, Dry Creek Levee System, ULDC 7.20, Page 67	Since the emergency actions and flood safety plans have not yet been fully developed to meet ULDC criteria, it would seem that (just as for the Security Plan) the existing plans **do not meet** criteria instead of stating "*will meet.*" Please correct.	The emergency operation plans have been developed; however, these have not been reviewed for conformance to ULDC. This will be done and provided to the IPE for review prior to the ULDC report. Approach to conclusions has been changed throughout document.	Response accepted, comment closed		
81	Section 2.0, Dry Creek Levee System, Non-Structural Actions, Page 69	The text states that Non-Structural Actions will be completed in 2024 and that this will allow for the Dry Creek Levee System to meet ULDC criteria for seismic, right-of-way, encroachments, penetrations, vegetation, security, and flood safety plans. Since many of these criteria are listed in the text and in Table 14 as meeting criteria now, this seems to be inconsistent and at least partially incorrect. Please correct.	Conclusions for almost all levees have been revised per comments from the IPE regarding the ULDC DWSE assumptions and the status of documentation or concurrence from the IPE.	Response accepted, comment closed		
82	Section 2.0, Dry Creek Levee System, References, Page 70	What is the Kleinfelder (20XX) document referring to Exceptions TM supposed to cover, and if it doesn't exist yet, should it be here in the list of references? There are also many references that are simply stated as "in progress Report" without indicating what it may cover. Should these be here as well? It might be good to list references that are expected to be completed by 2025 to support a final finding under a separate heading. Similar comment to references on Page 166 and other locations.	Reference for exception has been deleted. An exception is not being prepared to support this ER. The exceptions will be developed and provided to the IPE for review prior to the ULDC report being developed.	Response accepted, comment closed		

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83	Section 3.0, Robla-Arcade Levee System, Page 72	In the introduction there is reference to "*The North Sacramento Streams Levee System*." Shouldn't this be changed to "***Robla-Arcade Levee System***" as the NAS are not listed in the title of this section and would seem to pertain to other areas such as Dry Creek North.	Text revised except where specifically referencing the NSS/NAS project.	Response accepted, comment closed		
84	Section 3.0, Robla-Arcade Levee System, Page 72	In the Robla Creek South Levee discussion, there is reference to floodwalls being present where the levee is crossed by Rio Linda Boulevard. Please clarify where these floodwalls are as they are not introduced earlier and also indicate if a closure structure is present here. In addition, there is reference to a "stoplog" to block flood flows at the railroad crossing in this levee - do you mean that there is a closure structure here with closure provided by placement of stoplogs? If so, please say so.	Robla Creek South levee floodwalls are at the Rio Linda Blvd crossing bridge abutment and road crossing is high enough to prevent outflanking (crest of bridge is higher than the levee crossing). Floodwalls are documented as meeting under 7.14, page 92. RR stoplogs are a closure structure; text was revised.	Response accepted, comment closed Actually, stoplogs are not a closure structure - the structure that holds the stoplogs is the closure structure.	Noted.	
85	Section 3.0, Robla-Arcade Levee System, Page 73	For the Arcade Creek North Levee, mention is made that the levee is cross by Norwood Avenue, Rio Linda Boulevard, and the Sacramento Northern Bike Trail as well as the railroad. Are there closure structures here as well? Please clarify.	There are no closure structures at the crossings mentioned. The Norwood and Rio Linda bridges were replaced and roadway was raised therefore no closure structure needed. The UPRR has a stoplog structure.	We believe that the language provided in the response should be incorporated into the report. It would be helpful to clarify that the road crossings are elevated above the levee and that the UPRR crossing has a stoplog closure structure.	The following text was added to the descriptions of both the Arcade Creek north and south levees: *The Rio Linda Boulevard Bridge was raised after the 1986 flood event; the Norwood Avenue and Rio Linda Boulevard bridges were subsequently raised. No closure structures are present at these crossings as they are elevated above the levee.*	Response accepted, comment closed.
86	Section 3.0, Robla-Arcade Levee System, Page 73	The last paragraph on this page states that the overtopping of the railroad crossing in 1986 resulted in the construction of several concrete stoplog structures throughout the NAS study area. A few comments: 1. Please change NAS to Robla - Arcade or something appropriate as NAS is not defined. 2. Should this paragraph be in the introductory section near the beginning of this chapter? 3. Are all of the closure structures mentioned/described in the appropriate sections? If not, please add them.	Revisions were made per 1 and 2. See section 7.9.	Third comment not addressed in response.	Section 7-14 has been verified to describe all closure structures. As part of the ULDC certification effort, SAFCA is preparing a figure which shows all transitions.	Response accepted, comment closed.
87	Section 3.0, Robla-Arcade Levee System, ULDC 7.2, Page 77	It appears that the actual levee crown dips slightly below the MTOL near Station 6080 in Figure 3-1. Please address in the text.	An error was found in the profile data where the levee crosses the bridge. The TOL profile has been revised.	The figure appears unchanged and the Top of Levee at Station 6080 still appears to dip below the MTOL	Corrected figure was included.	Response accepted, comment closed.
88	Section 3.0, Robla-Arcade Levee System, ULDC 7.7, Page 83	See previous comment about the ULE Table for Seismic Vulnerability Classes and table numbering. Also note that this version of the table on Page 83 incorrectly lists the table as Table 7.7-1 instead of the referenced Table 7-1. This only reinforces the need for consistent table numbering, and the use of referencing to the DWR ULE document. This same typo is found in subsequent tables in other chapters.	Table was incorporated into Chapter 1 and removed from subsequent introductions.	Response accepted, comment closed		
89	Section 3.0, Robla-Arcade Levee System, ULDC 7.8, Page 85	The text states that the levee crown is between 11 and 23 feet in width for the NEMDC East Levee and between 8 and 20 feet in width for the Arcade Creek North Levee, both generally less than the minimum 20-foot-width criterion in the ULDC. It then goes on to state that it meets ULDC criteria because the levees meet seepage and stability criteria. As for the Dry Creek North Levee, this is not true. The ULDC states that steeper slopes can be accepted if seepage and stability criteria are met, but only for oversized levees (see. Pages 7-19 and 7-20), or if the levee is designed as a zoned levee. It would seem that this criterion would only pass by EXCEPTION, but this is not noted as such. At face value, this would not meet ULDC criterion. Please revise, correct, and/or propose an EXCEPTION.	At locations where a cutoff wall is present within the levee prism, the definition of a zoned embankment would be met per ULDC 7.8 and will be referenced in the report. Additional factors such as wide levees, central clay cores, landside filters or drains, or soil reinforcement were/will also be considered. Where a levee segment does not meet ULDC geometry criteria and a cutoff wall or other factor is not present, but the levee segment meets seepage and stability analysis criteria, does not have past performance issues, and does not have O&M concerns from the LMA, an exception will be prepared as an NSA to support the ULDC Finding. (see also 46 and 73)	Response accepted, comment closed		
90	Section 3.0, Robla-Arcade Levee System, ULDC 7.9, Pages 86-87	The subsections here state that Kleinfelder (2013c) and Kleinfelder (2015b) analyzed the levees and that the levee/floodwall/closure structure transitions and interfaces met criteria. I don't remember these analyses being in these documents, or actually having seen them in any document. <u>Just because the levee section passes criteria doesn't mean that there might not be a problem at the interface where concentrated/preferred seepage or stability issues may be present</u>. I also don't think the floodwall or closure structure analyses are in these two Kleinfelder documents. Please detail exactly what analyses were performed and where they are documented to show that all of these transitions and interfaces meet criteria.	A detailed evaluation has not yet been performed. Kleinfelder performed a screening level evaluation of some of the features as was described in the PIR, but did not complete a detailed evaluation of the each structure with respect to the interface with the levee embankment. The action item for this will be to complete a future study performed by Kleinfelder and Mead & Hunt to review the as-builts and construction document for the flood walls and closure structures project wide. Specific attention will be made for the levee embankment to structure interfaces. Once this is complete a meeting with Kleinfelder, Mead & Hunt, and the LAP Designers to confirm these transitions will be analyzed during final design and construction.	Response accepted, comment closed		
91	Section 3.0, Robla-Arcade Levee System, ULDC 7.10, Page 88	For the Arcade Creek North Levee, the text states "...while there is some erosion of the streambank occurring, it is maintained to avoid an unacceptable hazard to the levee." The text then states that the ULDC criterion is met. However, to meet ULDC, there should be an analysis of erosion potential for the 200-year event. Just maintaining it does not assure it will not erode during a 200-year event. Thus, at face value, the ULDC criterion is not met. However, the introductory paragraph states that MBK had performed hydraulic modeling for the Robla-Arcade Levee System. The velocities/results from that modeling should be summarized and discussed for each of the levee reaches discussed in this section to help demonstrate that the levees meet erosion criteria. If the velocities are low, why is erosion happening on the riverbank? Please provide additional supporting information. **<u>Same comment to other Chapters</u>**.	The level of detail requested by the reviewer would not be appropriate for the summary report, but will be included in the reference document used to support the ULOP finding. Text changed to does not meet.	Response accepted, comment closed		

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92	Section 3.0, Robla-Arcade Levee System, ULDC 7.11, Pages 88-89.	Table 18 indicates that the three levee reaches in the Robla-Arcade Levee System Partially meet ULDC criteria. But the text generally indicates that rights-of-way for access and visibility and even the levee have generally not yet been secured - much of the rights-of-way apparently belong currently to UPRR and other public agencies, and the text states that there will be a plan developed a long-term right-of-way plan. Since this plan has not yet been developed, should this be considered as **does not meet** criteria? Alternatively, should an Exception be considered? Either way, it doesn't look like this currently meets criteria.	Table 18 was removed. ROW criteria includes visibility and access of levee slope and beyond the levee toe regardless of fee title or easement. For this levee system, there is adequate visibility from the crown and access on the levee toe. Statements made in report are valid, although the ROW Plan has been now been developed. Conclusion, since we do not have concurrence from the IPE, will be revised to DNM.	Response accepted, comment closed		
93	Section 3.0, Robla-Arcade Levee System, ULDC 7.14, Pages 91-92.	The text states that Mead & Hunt evaluated the structures associated with the floodwalls and closure structures - were they also evaluated by Kleinfelder for global stability during flood loadings? If so, where is this documented and what criteria did they follow and what were the results of the evaluations?	A detailed evaluation has not yet been performed. Kleinfelder performed a screening level evaluation of some of the features as was described in the PIR, but did not complete a detailed evaluation of the each structure with respect to the interface with the levee embankment. The action item for this will be to complete a future study performed by Kleinfelder and Mead & Hunt to review the as-builts and construction document for the flood walls and closure structures project wide. Specific attention will be made for the levee embankment to structure interfaces. Once this is complete a meeting with Kleinfelder, Mead & Hunt, and the LAP Designers to confirm these transitions will be analyzed during final design and construction.	Response accepted, comment closed		
94	Section 3.0, Robla-Arcade Levee System, ULDC 7.20, Pages 96-97	The text states that emergency action plans and flood safety plans will be updated or developed, but the text is silent on whether this currently meets ULDC criteria (although Table 18 states that it hasn't yet been evaluated). So, shouldn't this be a "**does not meet**" criteria result? **Same comment to other Chapters.**	Per this and other comments made by the IPE, the stoplight tables have been removed and conclusions have been revised to reflect a DNM status.	Response accepted, comment closed		
95	Section 4.0 American River North levee System, Description, Page 104	The description of the extent of the American River North Levee is hard to follow as the roads referenced are not shown in Plate 4 - please add them to the plate. In addition, the stationing for one of the locations seems incorrect: should 2582+00 actually be 3582+00? Another part of the confusion is that Arden Way is also located near the beginning of the North Levee as well as at its end point.	Plates were revised to include roads and stationing corrected.	Response accepted, comment closed		
96	Section 4.0 American River North levee System, Description, Page 105	The slurry cutoff walls constructed in the American River North Levee by the USACE had several gaps associated with highways, roads, and major pipelines. Have these gaps all been fitted with more recent cutoff walls or other measures? Please address these potential weak spots.	The Corps has completed the work necessary on the gaps to meet criteria for a flow of 160,000 cfs. They are preparing a letter to document this conclusion.	The report has not been revised to incorporate this response.	The geotechnical embankment improvements authorized in 1996 and 1999 for a flow of 160,000cfs are complete and all gaps are fixed/closed. Text was not revised although we note the text in the last paragraph under ARNL description states: "Specifically, upon completion of the 2014 authorized features and the features being proposed as part of the general reevaluation, the American River levees will be able to pass a flow of 160,000 cfs, which is greater than the flow of 115,000 cfs that is being used for the ULDC certification." No revisions are required.	Response accepted, comment closed.
97	Section 4.0 American River North levee System, Description, Page 105	The text makes reference to an undated and unstamped letter from the USACE stating the Lower American River levees meet MTOL, slope stability and seepage criteria for a flow of 115,000 cfs. The text also states that the evaluation in this Engineer's Report relies on the USACE letter for conclusions regarding MTOL, slope stability, and seepage criteria. However, it would seem that this undated and unstamped letter would be inadequate in providing sufficient evidence in the record as required by the ULOP. Further, it isn't just the MTOL, slope stability and seepage criteria, but also criteria like ULDC 7.3 Soil Sampling, ULDC 7.8 Levee Geometry, etc... Recommend that the USACE survey, geotechnical, design, and construction information related to this be copied from USACE sources, compiled and reviewed by members of the SAFCA team and if they concur, to prepare a stamped TM documenting their findings. Alternatively, in addition to providing the documentation, the USACE could provide a stamped TM documenting their findings. Same comment in other places in the report where this is discussed.	Text will be revised to clarify the letter has been signed the Sacramento Division of Engineering Chief. Per IPE conference call on 4/7, the letter is sufficient for demonstrating adequate progress, but SAFCA team will collect existing information and consider for use in the ULDC report.	Response accepted, comment closed The IPE would like to reiterate that this letter is adequate for APF, but not for eventual ULOP finding. Language in response should be incorporated into this Engineer's Report that additional evidence needs to be provided in the record to support the eventual ULOP finding. Was the CD attached to the letter that purportedly contained design and as-built information found? Please note that the substantial evidence in the record must be reviewed by the IPE and reviewing a letter does not allow the IPE to conduct an independent peer review of the substantial evidence per the requirements of EC 1165-2-214 that is cited in the ULOP	Engineer acknowledges IPE opinion regarding USACE letter. The record of substantial evidence for all levee systems is being built as part of the ULDC certification. This record will be sufficient to support ULDC certification and ULOP Finding.	
98	Section 4.0 American River North levee System, ULDC 7.2, Page 110	The text states that it is relying upon the undated USACE letter to show that the American River North Levee meets ULDC MTOL criteria. However, can't you just show the water surface elevations from Table 29 together with the MTOL freeboard requirements to compare the actual top of levee to make this determination? It would be better than relying upon an undated, unstamped letter - by the way, what is the estimated date of the letter? 2002?	Per conference call with the IPE, the Engineer is relying on the USACE letter for certification of embankment (seepage, stability, etc.) criteria including MTOL. However, the Corps information will be reviewed by the team for consideration in how to address in the ULDC report.	Response accepted, comment closed		
99	Section 4.0 American River North levee System, ULDC 7.5, Page 113	The use of the undated/unstamped USACE letter to assure underseepage raises the question about the gaps left in the cutoff walls. Some of the gaps have since been filled in or remediated, but have all of them been? Also, when was the undated USACE letter written as the USACE knew that there were gaps in the cutoff walls that left the area unsafe and that they had to be addressed? This calls into question the usefulness of this letter. **Same comment on Slope Stability and other issues.**	Text will be revised to clarify the letter has been signed the Sacramento Division of Engineering Chief. Per IPE conference call on 4/7, the letter is sufficient for demonstrating adequate progress, but SAFCA team will collect existing information and consider in the ULDC report. Text has also been revised in section 4.0 to state gaps in slurry wall have been addressed. (see also 96)	Response accepted, comment closed		

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100	Section 4.0 American River North levee System, ULDC 7.6, Page 113	Again, the report states that it relying upon the DWR ULE studies to conclude that these levees are not frequently loaded. While this conclusion is no doubt true, it seems insufficient as significant evidence in the record. DWR's ULE program was a screening/planning level project. DWR's conclusions may not have represented approval and stamped by a professional engineer on this subject. Someone on the SAFCA team should review and stamp a TM covering this issue.	This certification will be made as part of the ULDC Finding. It is expected that this information will be documented, certified, and provided to the IPE for concurrence as part of the forthcoming, subsequent IPE review. (see also 72 and 43)	Response accepted, comment closed		
101	Section 4.0 American River North Levee System, ULDC 7.9, Page 118	Just because the USACE may have determined that the American River North levees meet seepage and slope stability criteria (which is not documented) - that does not mean that they have addresses preferred seepage or stability issues at interfaces between the levees and closure structures or floodwalls. This requires more substantiation before the ULDC criteria is met.	Similar to other works completed by USACE, SAFCA will rely on USACE design and as-built information to verify ULDC compliance. Conclusion has been changed to indicate that the conclusion is not effective until completion of JFP and Raise.	Response accepted, comment closed		
102	Section 4.0 American River North Levee System, ULDC 7.10, Page 119	For the Arcade Creek South Levee, the text mentions that there is some erosion occurring and that the average velocity along the waterside slope of the levee near Marysville Boulevard is approximately 4 fps. Is the levee near Marysville Boulevard where the erosion is occurring? This is not necessarily clear. How do the estimated velocities compare with soil types and allowable velocities. There should be additional information conveyed in this summary to document why erosion is not a problem. Simply stating the erosion areas will be maintained does not seem adequate to meet ULDC standards. **Same comment to other levee reaches along both sides of the American River.**	The level of detail requested would be appropriate for demonstration of compliance with ULDC. This information will be included in the reference document used to support the ULOP finding. Text changed to does not meet.	Response accepted, comment closed		
103	Section 4.0 American River North Levee System, ULDC 7.14, Pages 123-124	Again, while Mead & Hunt may have evaluated the structural stability of the floodwalls and closure structures, did they or Kleinfelder check for global stability or seepage issues? If not, this would not meet criteria. **Same comment for other levee reaches in other chapters.**	A detailed evaluation has not yet been performed. Kleinfelder performed a screening level evaluation of some of the features as was described in the PIR, but did not complete a detailed evaluation of the each structure with respect to the interface with the levee embankment. The action item for this will be to complete a future study performed by Kleinfelder and Mead & Hunt to review the as-builts and construction document for the flood walls and closure structures project wide. Specific attention will be made for the levee embankment to structure interfaces. Once this is complete a meeting with Kleinfelder, Mead & Hunt, and the LAP Designers to confirm these transitions will be analyzed during final design and construction. (see also 90 and 93)	Response accepted, comment closed		
104	Section 4.0 American River North Levee System, ULDC 7.17, Page 126	The text states that the combined wind setup and wave runup is 3.49 feet for the NEMDC east levee between Arcade Creek and the American River. However, for the ULDC 7.2 MTOL criteria discussion on Page 109, the text states that there are no locations where wind and wave runup affects the MTOL, and only 3 feet was used to define the MTOL elevation above the DWSE in Figure 4-2. While there appears to be plenty of freeboard available to accommodate an extra 0.49 feet, the report is inconsistent/incorrect in at least one locations. Please correct these inconsistencies.	Text is section 7.2 has been revised to correctly indicate a max ww of 3.49 feet. Other sections have also been checked.	Statement on Page 91 that there are no locations where wind and wave runup affects the MTOL along the NEMDC and that the MTOL is the DWSE plus 3 feet appears to remain incorrect. MTOL in Figure 4-2 appears unchanged and still appears to use 3 feet vs 3.5 feet for setting MTOL above DWSE.	Statement was removed. Figure 4-2 uses 3.5 where appropriate. Figure revised to show localized increases.	Response accepted, comment closed.
105	Section 5.0 American River South Levee - Sacramento River East Levee System, Description, Page 135	In the description of the flood protection systems along the SREL, no mention was made of the relief wells installed near Pioneer Reservoir or at Sump 132 - please add for completeness.	Text added to introduction	Response accepted, comment closed		
106	Section 5.0 American River South Levee - Sacramento River East Levee System, Description, Page 136	It was hard to follow the description of Morrison Creek, Unionhouse Creek, and Beach Lake without seeing where they are in Plate 5B - please add labels. Also, consider adding the SREL portion in the legend for Plate 5B - right now it is labeled American River South Levee System, but it actually covers the Sacramento River East Levee	Labels added to Plate 00. Plate 6 does not show these streams. Legend was changed on 5A and 5B.	Response accepted, comment closed		
107	Section 5.0 American River South Levee - Sacramento River East Levee System, Description, Page 135, Table 34, and ULDC 7.1 Page	The text in these locations indicate that the hydrology for the southern portion of this basin, and in particular the Beach Lake North Levee, has not yet considered downstream breaches on the SREL or other issues. Consequently, it does not yet meet ULDC 7.1 criteria for the DWSE. However, Table 34 indicates **green** for this levee and criterion, which appears to be in error. Please correct.	Per this and other comments made by the IPE, the stoplight tables have been removed and conclusions have been revised to reflect a DNM status.	Response accepted, comment closed		
108	Section 5.0 American River South Levee - Sacramento River East Levee System, ULDC 7.2, Page 141	Earlier, it was determined that the DWSE for the Beach Lake North Levee was not yet finalized and did not meet criteria. If so, how can the MTOL meet criteria in this levee reach. The statement that this levee reach meets ULDC MTOL criteria would therefore seem to be incorrect.	ER will state that DWSE has yet to be determined and therefore does not meet ULDC. ER will mention current H&H efforts to determine 200-year WSE to demonstrate adequate progress. Conclusions based on the ULDC DWSE will be revised to indicate they do not meet.	Response accepted, comment closed		

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109	Section 5.0 American River South Levee - Sacramento River East Levee System, ULDC 7.3, Page 142	As for the American River levees, previous work by the USACE is being used to satisfy many of the requirements of the ULDC for the Beach Lake North Levee.. However, this work was done by the ULDC and the reliance of an undated, unstamped letter for substantial evidence in the record would not be sufficient for a final finding. This seems even more of an issue for the Beach Lake North Levee because the work was likely not done for a substantially higher DWSE, and there also does not appear to be even an undated, unstamped letter from the USACE for this levee reach. **This comment also applies to many other ULDC criteria for both the American River Levee System and the Beach Lake North Levee.**	Text indicates that SAFCA has awaiting USACE's certification letter. Conclusions have been revised to DNM as this documentation has not yet been received.	Response accepted, comment closed		
110	Section 5.0 American River South Levee - Sacramento River East Levee System, ULDC 7.13, Page 152	For the Beach Lake North Levee, the text states that potentially high hazard were subjected to a full engineering evaluation by Mead & Hunt. However, it doesn't state what the results were - please add this information. If there are any high hazard penetrations that have not yet been removed or remediated, then this levee reach would not meet criteria. **As for all other levee reaches in all of the basins, in addition to evaluating and remediating potentially high hazard encroachments and penetrations, ULDC requirements for penetrations and encroachments also require a plan to address any other existing encroachments or penetrations that have either not been permitted or that might impact O&M or flood fighting. Such encroachments and penetrations need to be permitted or removed. Such plans do not appear to have yet been developed for any of the levee reaches in the 5 basins. Therefore, while progress has been made on the hazardous encroachments and pipelines, and this may represent adequate progress, it does not meet ULDC criteria.**	Hazard assessment conducted did not consider permitting status. An encroachment remediation plan will be prepared as part of the NSA, and text has been revised to indicate such.	Response accepted, comment closed		
111	Section 6.0 South Sacramento Streams Levee System, Page 164	The South Sacramento Streams Levee System is described as being not part of the current Adequate Progress determination and not impacting the 5 basins that are the subject of the Engineers Report. If so, it would seem unnecessary and distracting to include this page, even as a placeholder. Please consider removing this section.	Per discussion with the IPE, the recent improvements constructed by USACE are sufficient for adequate progress. The document will be revised to reflect this understanding and indicate that SAFCA is conducting a ULDC compliance evaluation.	Response accepted, comment closed		
112	General	There are many typos and inconsistencies in the report. A few are noted below.	Document will be reviewed prior to finalization for formatting and typographical errors.	Response accepted, comment closed		
113	Section 1.0 Natomas Levee System, Page 3	It is believed that there are about 42 miles of levees protecting the Natomas Basin, not 36 miles.	Text corrected.	Response accepted, comment closed		
114	Sacramento River East Levee, Page 4	I believe that the levees along the SREL were first constructed using suction dredging and placement of hydraulic fill in 1911, not the 1800s. Similar comments on other portions of the basin.	Construction of the comprehensive flood control system began in early 1900s. But prior to that, locals had been building levees (i.e., bolstering natural channel banks). Text was revised to clarify that the work in the 1900s was a substantial improvement/effort.	Response accepted, comment closed Actually, the hydraulic fill that makes up the SREL in Natomas was constructed in 1911. Whatever was constructed before was likely totally replaced.	Noted.	
115	ULDC 7.1, Page 9	Remove "*NLIP DWSE and* " from "*The computed* ~~*NLIP DWSE and*~~ *ULDC DWSE for the ...*" at the top of the page.	Text corrected.	Response accepted, comment closed		
116	1.0	1. 1.0 Natomas Levee System, Sacramento River East Levee, NCC To Powerline Road, page 4. States "Many fences, gates, and other appurtenances.....are located on the levee itself." These are riverward of the theoretical levee prism and really not in what is now the levee.	Text was revised to clarify that these items are on the embankment most, outside the levee prism	Response accepted, comment closed		
117	page 5, NEMDC	States, "Past performances issues are primarily related to seepage." Is this underseepage or through or both?	Unknown. We're trying to track this down and will include if able to locate.	Response accepted, close comment.		
118	7.4.2, page 18	states that a minimum FOS of 1.2 is required for rapid drawdown, but this section actually states, "As per USACE guidance, a factor of safety for stability of 1.0 to 1.2 is required, depending on the extent to which the DWSE may have saturated the waterside levee slope."	Section was revised per other IPE comments to clarify which FOS were applied where.	Response accepted, comment closed		
119	7.5, page 20	This paragraph reports that "(average exit gradient) be no greater than 0.5.....". California is used to using this phrase, "average exit gradient", but technically it is not a correct statement. The gradient of 0.5 (or any other USACE/DWR required gradient is the gradient acting across the blanket thickness. It is not "the average" so the term "average" should be removed. Note: The term average is not in any USACE or DWR documents.	Term average was removed.	Response accepted, comment closed		

Attachment 2:

Resumes for Members of the Independent Panel of Experts

Leslie Harder

Senior Technical Advisor

Dr. Harder serves as a Senior Water Resources Technical Advisor for HDR and its clients. He both manages and provides technical support for the planning and design of a full range of water resources and environmental restoration related projects. Prior to joining HDR, Dr. Harder was the Deputy Director for Public Safety for the California Department of Water Resources (DWR). During his 30-year tenure with DWR, Dr. Harder was extensively involved with engineering projects on the State Water Project and the Central Valley Flood Protection Project. Les played a key role in the development of FloodSAFE and the Early Implementation Project Program, and served on the California Levee Vegetation Roundtable. He authored the section on vegetation management in the recently published International Handbook on Levees.

EDUCATION

Doctor of Philosophy, Civil Engineering, University of California at Berkeley, 1988

Master of Science, Civil Engineering, University of California Davis, 1977

Bachelor of Science, Civil Engineering, University of California Davis, 1975

REGISTRATIONS

Professional Engineer - Civil, California, No. C 30472

Professional Engineer - Geo Technical, California, No. GE 000378

PROFESSIONAL MEMBERSHIPS

American Society of Civil Engineers (ASCE), Member

Association of State Dam Safety Officials, Member
ASTM International, Member

Earthquake Engineering and Research Institute, Member

International Society for Soil Mechanics and Geotechnical Engineering, Member

United States Society on Dams (USSD), formerly USCOLD, Member

RELEVANT EXPERIENCE

County of Riverside Flood Control & Water Conservation District, West Cathedral Canyon East Levee Certification, Riverside, CA. HDR worked with the Riverside County Flood Control & Water Conservation District to complete the evaluation and certification for the West Cathedral Canyon Channel East Levee (approximately 1.7 miles) to meet Federal Emergency Management Agency's (FEMAs) regulatory requirements as identified in Title 44 of the CFR, Section 65.10. The evaluation and certification of levees is based on design criteria (freeboard, closures, embankment protection, embankment and foundation stability, settlement and interior drainage), operation plans and criteria (for closures and interior drainage), maintenance plans and criteria and the actual certification requirements (i.e. as-builts, forms, documentation and data).

FEMA requested the district to provide the necessary documentation to continue showing the existing levee as providing protection from the base flood on the new countywide Digital FIRM (DFIRM). All certification requirements have been outlined in FEMA Procedural Memorandum 34 - Draft Certification Procedures and Plan, dated August 22, 2005, and must be followed. The HDR team completed the engineering and geotechnical analyses to address the design criteria as required by 44 Code of Federal Regulations (CFR) 65.10, as well as the O&M and as-built requirements. The certification package was completed and submitted to FEMA in 2008.

San Bernardino City Flood Control District, FEMA Levee Certification Project Phase II, San Bernardino, CA. HDR assisted with evaluating and certifying existing levees within San Bernardino County based on FEMA regulatory requirements as identified in Title 44 of the CFR, Section 65.10. The evaluation and certification of levees is based on design criteria, operation plans and criteria, maintenance plans and criteria, and the actual certification requirements (i.e. as-builts, forms, documentation, and data).

City of Council Bluffs, 2011 Flood Assistance, Council Bluffs, IA. Geotechnical Engineer. Provided expert levee engineering support to the City of Council Bluffs during the 2011 flood fight. Support included patrolling levees looking for distress, assessing distress reported by others, and then developing flood-fight measures to combat levee deterioration. Work also included developing the official requests by

the City of Council Bluffs for federal assistance through the state of Iowa and the US Army Corps of Engineers (USACE). Once federal assistance was secured, coordinated with the USACE to prepare advance and emergency levee repairs and specific recommendations for improvements to pump stations, roads and temporary pumping.

City of Oroville, Levee Evaluation, Oroville, CA. HDR provided an initial assessment of whether the levee on the south bank of the Feather River is eligible for accreditation by FEMA under the National Flood Insurance Program.

West Sacramento Implementation Design, City of West Sacramento, CA. Provided preliminary geotechnical services for evaluation of underseepage, slope stability and erosion assessment for a portion of the levee system surrounding West Sacramento. Also performed problem identification and alternatives analysis as a preliminary level investigation of possible improvements to the levee system.

Natomas Levee Improvement Program, Sacramento Area Flood Control Agency (SAFCA), CA. Chair, Board of Senior Advisors. Led the group of senior technical advisors who provided oversight of this levee repair project that includes a drainage study, pre-design, design, environmental documentation, permitting assistance, bid period, and construction support services on approximately 4 miles of levees on the lower Sacramento and American Rivers. Levee repairs were needed to retain FEMA certification and achieve a 200-year level of flood protection, and included levee crown raising for all four reaches, seepage berms (2 and 5A), and cutoff walls (4B). Redesign of the Garden Highway was required along the project reaches, as well as relocation of utilities and other infrastructure. Dr. Harder's specific area of oversight was geotechnical engineering.

Nevada Countywide Digital Flood Insurance Rate Map (DFIRM) Production, Levee Certification Reviews, and El Dorado County Restudy, FEMA, NV. The purpose of this Task Order is to assist FEMA Region IX with scoping activities and the production of a DFIRM and Flood Insurance Study text for Elko County, Nevada. HDR will assist in coordinating and conducting a kickoff meeting with the community representatives to discuss the National Flood Insurance Program and Map Modernization Initiative. Once the Preliminary DFIRMs have been completed, the HDR shall mail copies of the preliminary map panels to affected community for a 30-day comment period. HDR will assist in coordinating and conducting a final meeting with community representatives to discuss the revised maps. HDR will then finalize all maps, incorporating recent Letters of Map Change and minor refinements identified during the comment periods that were not previously incorporated. Once finalized, digital files in the format required by FEMA will be prepared and final deliverables will be submitted to the Map Service Center.

Feather River West Levee Rehabilitation Early Implementation Project, Sutter Butte Flood Control Agency, Sutter and Butte Counties, CA. Strategic/Technical Advisor. Dr. Harder is leading a group of strategic/technical advisors who are providing engineering oversight of this levee project that involves the rehabilitation, restoration and necessary improvements to 44 miles of the west levee of the Feather River. The goal of the project is two-fold: 1) to rehabilitate the levee so that segments 1-7 can be accredited as meeting FEMA standards for providing protection against the 100-year flood event, and 2) to rehabilitate the levee so that segments 1-6 meet the new state standard of 200-year flood protection for urban areas. A major role is to negotiate with various State and Federal agencies regarding the financing and technical requirements for the project. Major interactions

and negotiations are involved with the DWR, the Central Valley Flood Protection Board, and USACE.

Upper Yuba River Levee Improvement Project, Three Rivers Levee Improvement Authority, CA. Provided engineering analyses and design services to identify problems and provide corrective information and documents (PIRs, TMs, PS&E and environmental documentation) to support the repair of a reach along the Yuba River South Levee (from SR70 to Yuba Gold Fields) in order to achieve FEMA certification. Specifically, services include: geotechnical investigations and lab testing, topographic data acquisition, preliminary engineering and alternatives analyses, preparation of Technical Memos, preparation of a Problem Identification Report, development of final construction documents (plans, specifications, and construction cost estimate); preparation of Basis of Design documents, construction permit application preparation, environmental analyses and documentation, preparation of DWR EIP project documentation, and preparation of FEMA Levee Certification documents (as required).

American River Common Features WRDA96 Remaining Sites, USACE, Sacramento, CA. Lead Geotechnical Engineer. Directed the geotechnical portion of this project by providing evaluation and design of levee improvements for the 10 sites along the American River. Most of the levee system along the American River was remediated with slurry cutoff walls and the sites under this SOW are located between areas of non-remediated segments of the levee. Two of the sites (L8 & R8) were geotechnically-evaluated (seepage and stability) and designed by HDR in 2009, and constructed (summer of 2010). The third site (L9A) is slated for jet-grouting and was geotechnically-evaluated and designed to 95% plans and specifications during the work and additional geotechnical exploration is necessary due to the cobble materials below the levee. HDR was also tasked to perform exploration and laboratory testing, evaluate potential underseepage, through seepage, and slope stability for the gaps in the existing remediated levee alignment for seven remaining sites known as Phase 2. The result of the HDR analysis was that only five of the seven remaining sites needed remediation, however they recommended the two sites not needing remediation for further exploration and evaluation. The analysis results were included in the Draft Remediation Methods Report, November 2010. HDR will design these five sites as well.

Marysville Ring Levee, USACE, Sacramento District, CA. Geotechnical Engineer. Directing geotechnical tasks related to the design of levee improvements that meet FEMA requirements for levee accreditation under the National Flood Insurance Program.

Simi Arroyo Levee Improvements, Moorpark, Ventura County, CA. HDR prepared a retaining wall and flood wall designs for the County of Ventura. Scope of work included designing a three-foot high retaining wall that provides access to the existing sewer manholes at two locations along the stretch of Simi Arroyo that is adjacent to the Science Drive and north of Los Angeles Avenue in Moorpark, CA.

Southport EIP TO #4, Sacramento, West Sacramento Area Flood Control Agency (WSAFCA), CA. HDR provided engineering services to WSAFCA for initiation of 60% design work on the preferred levee improvements for Segments A, C, D, E, and G of the Southport EIP. This fourth phase in the project involved preparation of contract documents, including final construction plans, specifications, estimates, and general and special provisions; an environmental impact statement for public release; and associated project permit applications.

California Levee Vegetation Research Program/Vegetation Assessment Working Group, DWR and SAFCA, CA. Dr. Harder has served for several years as a technical advisor to DWR and SAFCA in developing science and applying both science and engineering in the development of programs for the management of vegetation on levees. He has been a Principal Investigator in research projects for several years and has published technical papers on the subject. He has also provided guidance and review to DWR and SAFCA with regard to research investigations conducted by others including notably the USACE. He is currently providing expert guidance to DWR as a member of the Vegetation Assessment Working Group in the development of a levee vegetation management plan and screening tool for managing woody vegetation on state-federal levees in the Central Valley.

NON-HDR EXPERIENCE

DWR, Civil Engineering Branch, Division of Engineering, CA. Principal Engineer and Chief. Duties included directing the activities of more than 100 civil engineers, architects, geologists, and technicians in preparing preliminary and final designs for various civil engineering structures. Major design projects included the new intake for the San Bernardino Tunnel and design support for the Coastal Aqueduct Phase II Project. Also headed the Restructuring Subcommittee tasked with reorganizing the Division of Engineering.

DWR, Civil Engineering Branch, Division of Engineering, CA. Principal Engineer and Chief. Duties included directing the activities of more than 50 civil engineers and technicians in preparing preliminary and final designs for various civil engineering structures. Major activities included preliminary designs of South Delta facilities and Los Banos Grandes Dam.

DWR, Division of Flood Management, CA. CEA and Chief. Duties included directing the work of 200+ engineering and floodplain professionals responsible for flood management activities across California. Flood management responsibilities included the maintenance of more than 300 miles of levees in the Central Valley, inspecting more than 1,600 miles of State-federal project levees, floodplain management and mapping, local assistance programs for the Sacramento-San Joaquin Delta, emergency preparation and emergency response during flood events. As Chief of this division, he worked closely with the State Reclamation Board, the U.S. Army Corps of Engineers, and local flood control agencies. During his tenure, the Division was reorganized, the Departments White Paper on Californias flood crisis was published, and the Delta Risk Management Strategy was initiated.

DWR, Division of Flood Management, CA. CEA and Chief. Duties included directing the work of up to 300+ engineering professionals and technicians responsible for performing engineering services for the Department of Water Resources. Engineering services include preparing preliminary and final designs, preparing construction contract documents and cost estimates, bidding and awarding of construction contracts, administration and inspection of construction work, and resolution of construction claims. Major projects worked on during this time included the Coastal Branch Aqueduct Phase II, East Branch Extension Project, San Bernardino Tunnel Intake, Hyatt Power Plant Turbine Refurbishment, South Bay Aqueduct Refurbishment, South Delta Temporary and Permanent Barriers, Jones Tract Breach/Dewatering and Levee Repairs, and numerous emergency canal repairs. After 2003, was also responsible for leading the staff formerly within the Division of Land and Right of Way and responsible for providing real estate and surveying services to the Department and to the Reclamation Board.

DWR, Public Safety and Business Operations, CA. Deputy Director. Responsibilities include the public safety programs of the Division of Flood Management, Division of Safety of Dams, and the Department Security program, and the administrative programs of the Division of Technology Services and the Internal Audits Office. Specific activities included working on new legislation and bond measures related to flood control reform, developing the FloodSAFE California program, developing flood bond expenditure plans and strategic vision for improving flood protection in California. He helped coordinate emergency responses to the flood events of January and April 2006. In addition, Dr. Harder worked closely with the Governors Office on policy issues, testified in several legislative hearings, served on numerous public workshops and conference panels related to flood policy, and gave several briefings to Congressional representatives, Senator Feinstein, and Governor Schwarzenegger.

George Sills Geotechnical
Engineering Consultant, LLC
470 Dogwood Lake Drive
Vicksburg, MS 39183
Office: 601-638-0436
Cell: 601-529-3407

Qualifications for George L. Sills, PE

EDUCATION

- Advanced graduate work, Civil Engineering, Louisiana State University, toward Ph.D.
- ME, Civil Engineering, Texas A & M University. 1981
- BS, Civil Engineering, Mississippi State University, 1975

REGISTRATION

Professional Engineer: MS, TX, LA

AWARDS

- Tau Beta Pi Member
- Selected by National Society of Professional Engineers as USACE National Engineer of the year and one of the Top 10 Federal Engineers of the Year-1999
- Award for Outstanding Team Effort for planning and testing of temporary, barrier-type flood-fighting technologies. Award-May 2008
- Commander's Award for Superior Civilian Service, 2007-for service to ERDC
- Commander's Award for Superior Civilian Service, 2007- for service to IPET Team
- Certificate of Appreciation from Sacramento District, U.S. Army Corps of Engineers for leading the Levee Seepage Task Force for developing criteria for flood protection – 2003
- Commander's Award for Civilian Service-1995, 1999
- Commander's Award for Community Service-1994, 1999

- Appointed to MS State University National Board of Directors and recipient of the Distinguished Service Award-1994

- Commander's Award for Civilian Service-1994. During the 1993 Midwest flood, George served as technical advisor for the USACE St. Louis District to answer seepage related questions in the field during the flood event.

PROFESSIONAL SUMMARY

George currently serves as manager of his private consultant company, George Sills Geotechnical Engineering Consultant, LLC, which he opened in 2008. George is retired from the U.S. Army Corps of Engineers (Corps) where he worked for over 36 years. He was employed by the Vicksburg District for 32 of those years and the Engineer Research & Development Center (ERDC) for 4 years. He has extensive experience in the evaluation, design, and construction of dams, design and drivability of piles, levees, and flood fighting. George has lead several investigations into the causes and mechanisms of seepage distress along levees and dams, and has helped the Corps develop a comprehensive understanding of these issues. He has lectured and published numerous technical papers on levee seepage distress and levee design.

While at ERDC, George led the joint Corps and Bureau of Reclamation (Reclamation) team that developed a toolbox for use in performing Probabilistic Risk Assessments (PRAs) on Corps and Reclamation dams with regard to seepage and piping distress. Much of this effort involved leading a diverse group to resolve complex and conflicting guidance criteria to create useable tools for practitioners from different agencies. The original guidance contained in the current USACE "Internal Erosion Toolbox A Method for Estimating probabilities of Failure of Embankment Dams due to Internal Erosion Best Practices Guidance Document" was developed by George's team. The document was originally published as, "A Unified Method for Estimating Probabilities of Failure of Embankment Dams by Internal Erosion and Piping" Delta Version, Issue 2, dated August 2008. George also served on the Corps' National Levee Safety Program to help set policy/methodology for Corps levee assessments in the future. George also led the team assigned to rewrite the Corps Levee Design Engineering Manual, which instructs engineers in proper design procedures for levee underseepage. This document is currently in draft form and undergoing review.

George served on a team from 2006 through 2007 to provide Independent Technical Review of the design for repairs to the Herbert Hoover Dike in Florida. This 145-mile-long dam/dike was constructed over peat and limestone which created seepage problems. Currently, George was a member of the Independent Consulting Board reviewing the ongoing design work for urban and non-urban levees in the Central Valley of California from 2006 through March 2013. He also serves on numerous Independent External Peer Review Boards: he is member of the Senior Board of Consultants for the review of levee designs for the Natomas Levee Improvement Program for the Sacramento Area Flood Control Agency. He also serves on a similar Board of Senior Consultants for the Cities of

West Sacramento, CA, Sutter-Butte, CA, and Dallas, TX. He has also performed IEPR review for the Whitewater and Walnut Rivers Levee Project in Augusta, KS and for the Turkey Creek Restored Channel Project in Kansas City, KS. During 2008, George was selected and served as a member of the National Levee Safety Committee Review Team which reviewed the new levee proposals made to Congress.

George is currently a sub-consultant supporting the GEI/HDR Design Team as a member of the Value Engineering, Constructability Reviews, Cost Estimating (VCC) Panel. As a member, he participated in Alternatives Identification workshops, assisted in determining design criteria, reviews and provides feedback to geotechnical analyses performed by the GEI team, reviews preliminary design details and supports the GEI team with evaluations for construction sequencing and site access constraints, provides constructability reviews, and cost estimating reviews. The goal of this design approach is to provide a project with the highest degree of public safety at the lowest cost.

In 2005, George was selected to serve on the Corps' Interagency Performance Evaluation Task Force (IPET) following Hurricane Katrina as a member of the Perishable Data Team and also as a member of the Performance Analysis Team. He made major contributions to these efforts and to the IPET document that summarized the team's findings. He has also testified in court about their efforts on this study.

During 2003, George was selected to lead the Sacramento District (SPK) Levee Seepage Task Force. The Task Force consisted of six levee experts: two from the federal government, one from the State of California, one private consultant, and two consultants from universities. George led this diverse team to accomplish their mission within budget and within schedule. George later took the information from this study and wrote an Engineering Technical Letter to change procedures currently used by USACE for their nationwide approach to seepage design.

While at the Vicksburg District, Mr. Sills led a study to determine the effects on area groundwater along the Red River which might occur from impounding the pools for navigation on the Red River.

Mr. Sills has been performing structural and foundation inspections, evaluations, and assessments for residential and commercial buildings from 1985 until present. These assessments have dealt with all aspects of issues relating to foundation problems as well as poor construction techniques.

RELEVANT EXPERIENCE

1994-2003

While working at the Vicksburg District George performed the following as a Geotechnical Coordinating Specialist: George assisted the Branch Chief with the overall management, direction, control, administration, planning, and review of the engineers and design functions of the Geotechnical Branch of the Vicksburg District (MVK). He evaluated technical staffing and performance and made recommendations on the most economical, efficient, and feasible methods and/or manner to accomplish work. He also established schedules and priorities. He served as Technical Expert and Consultant for

guidance and recommendations to MVK, other Corps Districts, A-E firms, and higher Corps echelons. During this period, George led the design effort for the soil nailing of the Natchez Bluffs.

July 1994-December 1994
Served as a Project Engineer in the Programs and Project Management Division, managing the $1.8 billion Red River Basin Project. Daily, he coordinated all District functions concerning District policies and procedures. He served as major liaison between the project sponsor and Corps. He also worked closely with Congressional staff in order to meet project milestones. He used innovative problem solving techniques to enable the District to begin pool impoundments as scheduled.

December 1994-December 1995
Supervisory Civil Engineer, GS-0810-13, Acting Chief of the Analytical Section with the responsibility of supervising twelve engineers and professionals. This responsibility included personnel and administrative matters as well as scheduling and programming funds. During this period, the Section met or exceeded all schedule requirements and operated within budget requirements.

December 1989-July 1994
Geotechnical Specialist responsible for the designs and reviews of all geotechnical work associated with the Red River Project. This work included designing the foundations for the locks and dams, dewatering requirements, and all other Geotechnical requirements. During this project, George invented a method of slide repair reported in ASCE and currently used by private and government sectors.

January 1991-November 1991
Served as a professional specialist in Project Management, CEMVD General Management Branch. Responsibilities included executing the project management function for Engineering Division by furnishing staff assistance and managerial and technical advice to Districts and MVD staff. He also coordinated the review of reports and studies, monitored District schedules, identified potential slippages, and took corrective action when necessary.

January 1981-December 1989
Served as Project Engineer in the Analytical Section where George was responsible for geotechnical design of complex multimillion dollar projects, as well as supervision of as many as 20 engineers and professionals in the execution of field testing operations. These field tests included the pile load test at John H. Overton Lock and Dam for a period of 8 months, as well as field pumping tests at Locks and Dams No. 4 and 5 on the Red River. He was also responsible for programming funds for the entire Red River in CEMVK-ED-G. George was the primary point of contact for design and/or construction problems for Locks and Dams No. 2, 3, 4, and 5 on the Red River.

CONCRETE LOCKS AND DAMS

- Served as Geotechnical Project Engineer for the Red River Waterway Project and was responsible for designing and reviewing all Geotechnical designs of this $1.8 billion dollar project. This design work included the foundations for the locks and dams, dewatering requirements, and all other Geotechnical requirements.
- Geotechnical Project Engineer for the Joe D. Waggoner, Jr. L&D (Lock & Dam No. 5) on the J. Bennett Johnston Waterway Project (Red River Waterway). His design and construction experience on this project included a slurry trench design and dewatering wells to unwater the excavation. He also led a field pumping test at this site.
- Geotechnical Project Engineer for the design and construction of the Russell B. Long L&D (Lock & Dam No. 4) on the Red River Waterway, this design included a slurry trench, dewatering wells, and excavation through a rock formation. He also led a field pumping test at this site.
- Geotechnical Project Manager for Lock & Dam No. 3 for the design and construction which also included a field pump test.
- Geotechnical Project Manager for John H. Overton L&D (Lock & Dam No. 2) for the construction phase which included the redesign of the field pile load test program. The pile test program was modified using a method never tried before. Because of these changes, the modified program was able to collect more useable data while saving the Government a sum of $450,000.
- Geotechnical Project Manager for the construction of Lindy C. Boggs L&D (Lock & Dam No. 1) where he answered all geotechnical related questions during construction.
- Geotechnical Engineer performing all phases of geotechnical design for the foundation of Felsenthal L&D and T.K. Thatcher L&D (Calion L&D) on the Ouachita-Black Navigation Project.

DAMS AND LEVEES

- Served on a group to provide Independent Technical Review for the Herbert Hoover Dike in Florida. This 145 mile long dam/dike was constructed over peat and limestone which has created seepage problems. This review team was responsible for assuring the safety of the design repair.
- He led a diverse team of Corps, State of California personnel, and leading academic experts to review the Sacramento Districts practices of levee construction. Results from this study have led to major changes in the procedures the Corps used nationwide in levee design.

- Geotechnical Engineer managing the geotechnical designs of the Sicily Island Levee system. This project included numerous drainage structures, several large pumping plants, and approximately 70 miles of levees.
- Geotechnical Engineer designing numerous miles of mainline Mississippi River Levee enlargements that included stability berms, seepage berms, and relief well designs.
- Geotechnical Engineer designing and providing construction design support for the Swan Lake levee project. This project was constructed over very soft soils with shear strengths less than 100 psf.

  Geotechnical Project Manager for the geotechnical design for the earthen closures at Locks & Dams 2, 3, 4, and 5 on the Red River. All these closures were constructed in the wet.

OTHER EXPERIENCE

- George has worked on numerous deep slurry trenches and has been heavily involved both in design and in the oversight of construction. He is widely known as an expert in several fields of Geotechnical Engineering.
- Publication and expertise in long-term behavior of soils and slope stability, pile design and driving.
- Experience in dewatering, slope stability, slurry trench design and construction, ground water movements, seepage, and foundation design.
- Ameristar Casino (Vicksburg) – review of cofferdam cell keyed into limestone that was sliding – including the development of recommendations to stabilize (for Sverdrup).
- Served as lead geotechnical designer for the $1.8 billion Red River Waterway project that included five locks and dams. Work included pile design, cofferdam cells, dewatering, slope stability, etc.
- Invented a method of slide repair using stone filled trenches that was later published by the American Society of Civil Engineers.
- Responsible geotechnical engineer for the Natchez Bluff Stabilization Project which used "soil nailing".

Expert Witness for Litigation

- Prepared an expert report and assisted in mediation in connection with the Appeal of Nicholson Construction Co., ASBCA Nos. 58145, 58182, 58183, and 58184 December 2012, Washington, DC.

- Prepared an expert report and testified in Court Deposition in case: John Douglas Coots, et ux.v. James Terrell Machen, et al, Number 44284 Div: D, 18th Judicial

Court Parish of Pointe Coupee, State of Louisiana, File #5356.135, for Kyle Law Firm, Baton Rouge, LA, December 2012.

- Retained as expert witness in a case of Miller v. KCP & L. In this case the power company of Kansas City Power and Light had refused to allow the local levee district to raise the levee during a flood event within their property and they also refused to raise it when it only need approximately one foot of raise to prevent it from overtopping. I performed a deposition on 9/8/11 and gave testimony to the fact that there was no engineering reason not to raise the levee. After deposition, KCP&L settled the dispute.

- 2006 testified on IPET forensic work for New Orleans in: Colleen Berthelot, et al., v. BOH Brothers Construction Co., LLC, et al., Civil Action No. 05-4182, May 4, 2006, United States District Court, E.D. Louisiana.

- Calion Lock and Dam - dewatering and differing site condition construction claim - a second claim for rock in the outlet channel.

- Felsenthal Lock and Dam - dewatering construction claim
- John H. Overton Lock and Dam - access road construction claim differing site conditions
- Lock and Dam No. 3 - access road claim - differing site conditions construction claim
- Lock and Dam No. 4 - differing site conditions construction claim - rock in the inlet channel evaluation of difficult driving of sheep pile in rock
- Provided technical assistance to EPA in trial conducted in Texas (1995).
- Provided testimony and assistance concerning “sudden drawdown failures” in lawsuit defended by the Red River Waterway Commission
- Provided numerous depositions in the above listed cases and disputes.

PUBLICATIONS

- Singh, V. P., Ojha, C. S. P., Adrian, D. D., Ozkan, S. and Sills, G.L., (2002), "Role of Sand Boil Formation in Levee Failure," Proceedings of XXIX International Association for Hydraulic Research Congress: Forecasting and Mitigation of Water-Related Disasters, Edited by G. Li, pp. 226-231, Beijing, China
- Sills, G. L, Harder, L. F., Duncan, J. M., Groves, C. B., Wolff, T. F., Al-Hussaini, M., Hess, J. R.(2003), Recommendations for Seepage Design Criteria, Evaluation and Design Practices,” Report prepared for the Sacramento District, (USACE), July.
- Hess, J. R. and Sills, G. L. (2004), “A Review of Corps of Engineers Levee Seepage Practices in the Central California Flood Control System”, USSD, 24th USSD Annual Meeting and Conference Proceedings.

- Dunbar, J. B., and Sills, G., 2004. "Geotechnical Investigation Work Plan of Selected Areas, Lower Rio Grande Valley Flood Control Project, South Texas," Open-File Report, Engineer Research and Development Center, Waterways Experiment Station, Vicksburg, MS
- Dunbar, J. B., and Sills, G., 2004. "Geotechnical Assessment of Presidio Levees, Presidio, Texas," Letter Report, Engineer Research and Development Center, Waterways Experiment Station, Vicksburg, MS
- Sills, G., Dunbar, J. B., (2005). Letter Report: "Geotechnical Inspection of US IBWC Levees at Presidio, TX", Engineer Research Development Center, Waterways Experiment Station, Geotechnical and Structures Laboratory, Vicksburg, MS, February 8-9. 2005.
- Sills, G. L. (2005), Published new USACE ETL, "Engineering and Design, Design Guidance for Levee Underseepage", Engineer Technical Letter (ETL), ETL 1110-2-569, Dated May 05
- Hess, J.R., Sills, G.L., Costa, R., and Shewbridge, S.E. (2005) "Fixing California's Levees" The Military Engineer, Society of Military Engineers, Nov/Dec 2005, Vol. 97, #638
- Shewbridge, S. E., Hess, J.R., Sills, G.L., Costa, R., (2006) "The Evolving Approach to Fixing California's Levees" Journal of Dam Safety, Association of State Dam Safety Officials, Vol. 4, Issue 4, Fall, 2006, p28-35.
- Shewbridge, S. E., Hess, J.R., Sills, G.L., Costa, R., (2006) "The Evolving Approach to Fixing California's Levees" Geo-Strata, Geo-Institute, Vol.7, Issue 6, p24-28.
- Wibowo, J., Pinkard, F., Sills, G., Ward, D., Taylor, P. (2006), "Testing of Flood Fighting Structures", ASCE Journal of Hydraulic Engineering.
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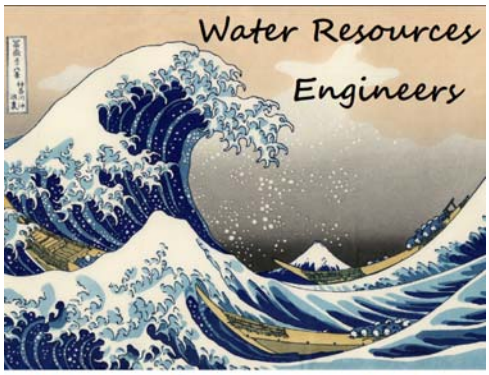

DTW and Associates, LLC

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Education

Ph.D., Civil Engineering, Colorado State University
M.S., Civil Engineering, University of California, Davis
B.S., Civil Engineering, University of California, Davis

Registrations

Professional Engineer (Civil) license number and date:

Arizona 24349, 1990
Colorado 42353, 2008
Louisiana, 34075, 2009
New Mexico 12187, 1993
Texas 80003, 1994
Missouri 2012015265, 2011
California 57020, 1997
Hawaii 7796, 1993
Mississippi 08242, 1981
Oregon 16963, 1993
Washington 27190, 1990

Registered Professional Hydrologist (PH: 96-H-1146)
Certified Professional, Erosion and Sediment Control (CPESC: #703)
Certified Floodplain Manager (CFM; US-08-03224)

Work History

2011 – 2012: Director of Water Resources, NV5, Centennial, CO

2008 – Present; President, David T. Williams and Associates, Engineers, LLC, Fort Collins, CO

2005 - 2008; National Technical Director for Water Resources, PBS&J, Fort Collins, CO

2002 - 2005; National Director for Hydrology and Hydraulics, HDR Engineering, San Diego, CA

1988 - 2002; President and co-founder of WEST Consultants, a premier water resources engineering firm

1979 - 1988; Research Hydraulic Engineer, Hydraulics Lab, Engineering and Research Development Center (formerly Waterways Experiment Station), Vicksburg, MS

1983 - 1984; Acting Chief, Hydrology and Hydraulics Section, Baltimore District Corps of Engineers

1977 - 1979; Civil Engineer, Hydrology Branch, Nashville District Corps of Engineers

1975 - 1977; Research Hydraulic Engineer, Planning Branch and Research Branch, Hydrologic Engineering Center (HEC), Davis, CA

1972 - 1975; Infantry Platoon Officer and Combat Engineering Unit Officer, 7th Special Forces Group, Fort Bragg, NC

Professional Affiliations

American Society of Civil Engineers
American Academy of Water Resources Engineers
International Erosion Control Association (IECA – past president)
American Society of Testing and Materials (ASTM)
American Institute of Hydrology (Chair, Board of Registration and Executive Committee Board member)

Honors and Awards

Fellow and Life Member, American Society of Civil Engineers
Founding Diplomate, American Academy of Water Resources Engineers
Hogg-Owen Award for Meritorious Achievement, Floodplain Management Association
Sustained Contributor Award, IECA
Small Business Person of the Year, Chamber of Commerce, Carlsbad, California, 1993
Sustained Superior Performance, USACE
Special Act Award, USACE
U.S. Army Commendation Medal
U.S. Army Commendation Medal with Oak Leaf Cluster

Summary

David T. Williams and Associates (DTW) is a certified MBE, SBE, DBE and Disabled Veteran owned business. Dr. David Williams, the president of DTW, has over 35 years of experience in the water resources industry and is known nationally and internationally for his contributions to the industry. He served as Principal-in-Charge for several FEMA flood insurance studies in San Diego and Orange counties. He has written the new HEC-6 User Manual for the U.S. Corps of Engineers Hydrologic Engineering Center, performed HEC-6 and local scour analysis of pipeline crossings in Arizona and New Mexico, headed the Keene Ranch groundwater modeling study and the Nile River sedimentation evaluations for the World Bank. He is well versed in the computer programs HEC-1, HEC-HMS, HEC-2, HEC-RAS, HEC-6, STORM, and WQRRS. Dr. Williams is also a nationally recognized expert in sedimentation engineering and in developing innovative solutions to difficult hydraulic and hydrologic design problems in rivers and estuaries.

Dr. Williams previously served as a two time President of the International Erosion Control Association. He has served as chair of the ASCE Task Committee on Analysis of Laboratory and Field Sediment Data Accuracy and Availability. He is also a past chair of the ASCE Sedimentation Committee as well as the Computational Hydraulics Committee and currently serves on the ASCE River Restoration Committee. He served as a committee member of ASTM A05.12 (Wire specifications), where he helped develop the standards for both welded and twisted (woven) gabions. He also served on ASTM D18.25 (Erosion Control Products), where he helped develop a variety of standards related to erosion control. While chair of the Federal Interagency Technical Committee on Sedimentation when Dr. Williams was with the U.S. Army Corps of Engineers, he worked with hydraulic and sedimentation experts from the Federal Highway Administration, Bureau of Reclamation, U.S. Geological Survey, Bureau of Land Management, Forest Service, TVA, Bureau of Land Management and the Agricultural Research Service. His work with the Committee involved developing sediment sampling equipment and sediment data collection methods. He is the author of more than 100 technical papers and reports on hydraulics and sedimentation. Dr. Williams was formerly an Associate Editor of the ASCE Journal of Hydraulic Engineering, as well as a reviewer. He was selected the 1993 Small Business Person of the Year by the Carlsbad, California Chamber of Commerce, and served as chair of the Carlsbad Beach Erosion Committee.

His professional experience includes more than eighteen years as a hydraulic engineer with the U.S. Army Corps of Engineers at the Waterways Experiment Station (WES) in Vicksburg, Mississippi, both the Nashville and Baltimore Districts, and the Hydrologic Engineering Center (HEC) in Davis, California. While at WES, Dr. Williams worked on research applications of sediment transport in rivers and reservoirs and the solution of unusual hydraulic and sediment related problems using computer models and other state-of-the-art techniques. He also worked on the development of the cohesive and network versions of the HEC-6 sediment transport computer model and wrote the Reservoir

Sedimentation Chapter in the U.S. Corps of Engineering Manual on Sedimentation Investigations. At the Nashville District, Dr. Williams performed erosion control and sedimentation studies for the Tennessee-Tombigbee Waterway Project and also conducted sedimentation and floodplain information studies of proposed flood control projects. He was acting Chief of the Hydrology and Hydraulics Section at the Baltimore District Corps of Engineers. During the mid 1970's, Dr. Williams worked at HEC, helping in the development of spatial data management techniques, evaluation of the economic benefits of flood control projects, and sedimentation in rivers and reservoirs.

Dr. Williams has been a frequent short course instructor for ASCE, Federal and State Agencies for computer training workshops on using HEC-2, HEC-RAS, HEC-HMS and HEC-6. In addition, he has taught short courses on channel bed scour for toe protection design, sediment transport, bridge scour and streambank protection.

Selected Projects

Expert and Independent Technical Review Panels

Member of 4 Board of Senior Consultants/Safety Assurance Review Panel – The Sacramento Area Flood Control Agency (SAFCA), the West Sacramento Area Flood Control Agency (WSAFCA), and the Three Rivers Levee Improvement Authority (TRLIA) are each upgrading their levee systems in the northern California to the 200 year protection level and the City of Dallas (Trinity River Watershed Protection) to the 100 year flood level. After the devastation brought on by Hurricane Katrina, the U.S. Army Corps of Engineers required that all new or upgraded flood control projects that received federal cost sharing funding are to have an Independent External Technical Review (IETR) comprised of national experts in the appropriate disciplines. In response to this edict, these agencies appointed Dr. Williams as a member of the Board of Senior Consultants (BOSC) for their 4 project to review and provide expert advice on the risk and uncertainty analysis, plan formulations, erosion control, sediment transport analyses, fluvial geomorphology, hydrology and hydraulic aspects of the project.

Member, FEMA’s Scientific Resolution Panel (SRP), Washington DC - The Federal Emergency Management Agency makes available an independent scientific body referred to as the Scientific Resolution Panel (SRP) that can be convened when deemed necessary by FEMA or upon a joint agreement between FEMA and a community. SRPs are independent panels of experts organized, administered, and managed by the National Institute of Building Sciences. They are established for the purpose of reviewing and resolving conflicting scientific and technical data submitted by a community challenging FEMA's proposed flood elevations. Dr. Williams is on a pre-qualified roster of national experts on FEMA regulations and procedures and was recently appointed to a Panel for a dispute in Texas.

NCHRP 24 – 34, Risk Based Approach for Bridge Scour Prediction. For the U.S Department of Transportation, Transportation Research Board, Dr. Williams is on the

technical advisory committee for this research. The project objective is to develop a risk-based methodology that can be used in calculating bridge pier, abutment, and contraction scour at waterway crossings so that scour estimates can be linked to a probability. The developed probabilistic procedures would be consistent with LRFD approaches used by structural and geotechnical engineers.

EPA Selection Panel, Washington D.C. – Dr. Williams has served on 3 EPA selection panels in the areas of climate change, ecological indicators and thresholds. The panel evaluated research proposals from universities and non-profit organizations and made recommendations to EPA on which proposals to approve. The panels were comprised of experts in the engineering and naturals sciences. Dr. Williams was the only private consultant on each panel, which was composed of academic and government personnel.

Flood Control and FEMA Mapping

FEMA Studies of 27 Streams in the Unincorporated Areas of San Diego County, California – Dr. Williams was the principal-in-charge for this project for FEMA. He also took on some of the studies are the project manager. The studies involved over 50 miles of streams using FEMA standards for surveying, hydraulic modeling and floodplain and floodway delineations which and resulted in new and updated FIRM maps.

Approximate Floodplain Study for Orange County, California - Dr. Williams and his team prepared an approximate floodplain study for the Orange County Flood Control District to delineate 100-year floodplains for the East Garden Grove - Wintersburg Channel (C05), the Ocean View Channel (C06), and seven tributaries to the C05 channel. This project was undertaken by the District to facilitate lifting of the Santa Ana River floodplain (zone A99) after the completion of the Santa Ana River flood protection project by the U.S. Army Corps of Engineers (Corps). The Corps project has controlled breakout flows from the Santa Ana River (SAR), but the flooding from other sources underlying the SAR floodplain, needed to be delineated before the A99 zone was lifted by FEMA. The study area is located in the Cities of Huntington Beach, Fountain Valley, Westminster, Santa Ana, Garden Grove, Anaheim, and Orange, in Orange County, California. The C05 and C06 channel system consists of a complex network of leveed channels, storm drains, and detention basins that convey stormwater runoff from highly urbanized low-lying interior areas to the Pacific Ocean. About 16 miles of flood control channels were analyzed using an approximate hydraulic analysis with the Corps HEC-RAS program. The C05 channel laterals were analyzed using various computer programs including the Corps HEC-RAS program and the HEC-2 program with the split-flow option, and the Los Angeles County Flood Control Districts WSPG program. To obtain a model for an approximate level of analysis, all levees, bridges, and culverts, were removed from the cross-sections. Engineering judgment was used to interpret the model results based on output that appeared reasonable in accordance with field observations. Field observations were used to verify flow directions, track flow paths, and evaluate the effect of floodplain features such as elevated highway embankments. Approximate studies in urban environments can be especially challenging because of the need to make

appropriate assumptions in order to simplify complex hydrologic and hydraulic phenomena. A Zone A approximate 100-year floodplain was delineated. The results of the study satisfied FEMA requirements and were subsequently published for the benefit of the community. Dr. Williams was the Project Manager and Principal in Charge.

St. Tammany Flood Control Analysis, U.S. Army Corps of Engineers, New Orleans District, New Orleans, Louisiana - Dr. Williams and his engineers developed a conceptual flood management plan for St. Tammany Parish in southeast Louisiana. Flood management in St. Tammany Parish was a unique challenge, with 100 square miles drained by a complex network of natural bayous and man-made canals. Hydrologic and hydraulic models were needed to evaluate existing conditions and compare flood management alternatives. The results of the hydrologic models provided the input for hydraulic modeling to the New Orleans District Corps of Engineers with useful answers about their proposed flood management plan, allowing the District and the citizens of St. Tammany Parish to make informed decisions about their watershed.

Dam Breach Analyses for San Diego County Water Authority (SDCWA) – As principal in charge, Dr. Williams also acted as the technical advisor for this series of contracts to analyse numerous dam breach projects for SDCWA. This contact involved using the NWS DAMBreak model for FERC re-authorization of existing hydroelectric dams as well as for scenarios of raising dams to obtain additional storage and power. The results, which included numerous breach scenarios, output hydrographs and resulting inundation areas for FEMA flood mapping, were used to create new or revise Emergency Action Plans.

Hydraulics and Hydrology

Reservoir Sedimentation Analysis for FERC relicensing, Alcoa Power Generating Inc. – Dr. Williams was in charge of this reservoir sedimentation study for the High Rock Dam in North Carolina. The client needed this information for the application for relicensing of the dam. The sediment transport model was used to evaluate the effects of the dam on sedimentation that had a potential to adversely affect adjacent infrastructure.

Examination of Hydraulic Rollers at Run of the River Dams, Illinios Dept. of Natural Resources, Springfield, IL – As technical advisor to this project, Dr. Williams provided technical guidance in developing solutions to the hydraulic roller problem at the downstream portion of the weir at Geneva Dam. The temporary solution was the placement of rock riprap at this location and its design based upon high turbulence conditions.

Eastern Arkansas Water Supply Study - Study included extensive model application and model calibration to analyze the effect of in-basin water transfers on surface water flow magnitude, frequency, and duration in the La Grue Bayou stream network using Corps of Engineers' programs HEC-1, HEC-2, HEC-DSS, and HEC-FFA. A unique feature to this study was the application of the Memphis District's program HUXRAIN to develop long

term (50 years) synthetic discharge hydrographs using calibrated antecedent precipitation index coefficients, a long term rainfall data base, and computed unit hydrographs for the sub-basins. Another component of this work was an interior hydrology study for the city of Clarendon, Arkansas. Several scenarios were analyzed using HEC-IFH for continuous simulation with 50 years of data.

IDIQ for Los Angeles District Corps of Engineers - During this IDIQ contract for hydrology and hydraulics with the Los Angeles District, Dr. Williams and his team completed multiple work orders. A spillway inundation study was conducted for Carbon Canyon simulating dam break using HEC-RAS. A two-dimensional link node model was applied to Mission Creek in Santa Barbara to evaluate flooding due to overspilling of the channels to lower elevations and connector streams. In the Santa Margarita river watershed study, HEC-1, HEC-2 and HEC-6 were used to evaluate flooding extents and sedimentation problems in the river. Two channel restoration and environmental enhancement plans were developed in Phoenix area for the Tres Rios and Rio Salado projects. Tres Rios involved HEC-6 modeling and Rio Salado had both HEC-RAS and HEC-6 models developed for the Salt River. A major flood map revision study and levee analysis report was conducted for the Los Angeles River and Compton Creek, resulting in hundreds of thousands people taken out of the 100 year regulatory floodplain. During this study, numerous HEC-2 models were modified to reflect levee system changes made by the Los Angeles District. Overbank models were also modified to analyze split flow conditions.

Lindo Lake Park Water Quality Study, Lakeside, California - Dr. Williams conducted detailed study of water quality conditions, to evaluate lake rehabilitation alternatives, and to develop a restoration plan to improve water quality conditions and to support a wide array of beneficial uses, including active recreation for Lindo Lake Park. Lindo Lake Park Water Quality Study. The Lindo Lake Park Water Quality Study was comprised of five major tasks: 1) public meetings; 2) report on inventory, bibliography and proposed methodology; 3) Quality Assurance Project Plan according to EPA guidelines; 4) Water quality study and associated technical report; and 5) Implementation plan.

Minnesota and Red River CWMS Watershed Modeling, U.S. Army Corps of Engineers, St. Paul District - To establish a flood forecasting system and reduce future flood damage in the Red River of the North basin (4,010 square miles) and Minnesota River basin (1,770 square miles), Dr. Williams, along with his staff and the U.S. Army Corps of Engineers, St. Paul District (the Corps), developed a Corps Water Management System (CWMS) model to assist in real time operation of the reservoirs to regulate reservoir outflows. Dr. Williams' team developed snow process, hydrologic, water control, and hydraulic models that will be incorporated by the Corps into CWMS as model components. The modeling work included development, calibration, and verification of the Distributed Snow Process Model (DSPM), HEC-HMS, HEC-ResSim, and HEC-RAS models.

Wellhead Protection Plan for the Los Angeles Corps of Engineers, Planning Division, San Luis, Arizona - The components included the delineation of wellhead protection

areas, the compilation of a contaminant source inventory, the development of management tools to protect the groundwater and the formulation of a contingency plan for both short and long term losses of one or more wells.

Two-Dimensional Study of the Missouri River, Chamois Reach, USACE, Kansas City District IDC - Dr. Williams was Principal in Charge for a 2-D study of the Missouri River called the Chamois reach between RM 116.5 and RM 113.5. The model used was RMA2, which is a part of the WMS system. It was used to identify low and medium flow habitat areas and the depths and velocities associated with those areas. The results were used to determine opportunities for habitat enhancements.

West Tennessee Tributaries Project Limited Evaluation Study, Tennessee - A reconnaissance level analysis was conducted to evaluate the proposed restoration of old river meanders that were cut off from the Middle Fork Forked Deer River by historical channelization projects. This study included an extensive combination of hydrological, hydraulic, and sediment transport simulations, using historical rainfall and runoff records, current field data, and calibration to 1960 and 1979 channel geometry survey data. In addition to Corps of Engineers' programs HEC-1, HEC-2, HEC-DSS, HEC-FFA, and HUXRAIN for surface water flow modeling and standard computer program HEC-6 for sediment transport analysis, the newer HEC-6T, "Sedimentation in Stream Networks", developed by William A. (Tony) Thomas, was used to evaluate the sediment transport of flow converging and diverging at the junctions of the main channel and the old meanders. A sediment-weighted histogram generator modified by WEST Consultants was used to generate the hydrology input for the HEC-6 programs. Designs for rock riprap diversion weirs and bridge protection, and an in-line sediment trap were developed in this study.

White River Unsteady Flow Model, Arkansas - An unsteady flow model using the computer program UNET was developed for 70 miles of the White River in eastern Arkansas. Model parameters were calibrated to historical stage and flow records before executing two 47 year simulations. Simulations were run for existing conditions and conditions after installation of an inlet canal and pumping station for an irrigation scheme. Results were provided to the District to help them evaluate effects of the irrigation project on the river. A second part of this project involved evaluation of the irrigation canals for sediment transport and scour/deposition. The computer program SAM was used to help determine stable channel parameters and the amount of scour/deposition that could be expected with the District's design geometry and slope.

Expert Testimony and Support

Expert Consultant: Flooding of property by US Army Corps of Engineers, Missouri, for private party

Expert Consultant: Stream restoration design and construction defects, North Carolina, for private party

Expert Testimony: Flooding death, for Metropolitan St. Louis Sewer District

Expert Testimony: Gabion technical claims dispute, for Terra Aqua Gabions

Expert Consultant: Subdivision Flooding, for City of Reno, NV

Expert Consultant: Analysis of Milltown Dam Removal and Potential Deposition at Thompson Falls Reservoir, Montana, for Pennsylvania Power and Light

Expert Consultant: FERC relicensing, North Carolina, for Alcoa Power Generating Corporation

Expert Consultant: Scour Evaluation of Grading Plan Changes for Cyrus Wash, for Kern County, CA

Expert Consultant: Baker River FERC relicensing, WA, for Puget Sound Energy

Expert Consultant: Blackfoot and Clark Fork River Restoration Plan, Montana for unnamed client

Expert Consultant: Agua Fria River Streambank Scour Analyses, Phoenix, AZ, for Flood Control District of Maricopa Co., AZ

Expert Consultant: Erosion and Drainage, Newport Beach, California, for private client

Expert Consultant: Subdivision Flooding Problems and Floodplain Mapping Procedures, Dayton, Ohio, for private client

Expert Consultant: Flooding Problems, Unnamed creek, Los Angeles, California, for private client

Expert Testimony: Murrieta Creek Flooding, Riverside County, California, for Riverside Co. Flood Control District

Expert Testimony: Flooding Potential and Analysis of Coconut Grove, Kailua, Oahu, Hawaii, for private client

Expert Consultant: Subdivision Flooding Problems, Waialae Iki V, Oahu, Hawaii, for private client

Expert Testimony: Flood Problems at Carlton Oaks Country Club, Santee, California, for private client

Expert Consultant: Alpine Mobile Home Park Flooding, Alpine, California, for private client

Expert Consultant: River Effects of Sand Mining Operations, San Luis Rey River, California, for private client

Expert Testimony: Pecos Road Pipeline Scour, Phoenix, Arizona, for El Paso Natural Gas Company

Expert Consultant: San Diego Creek Revetment Failure, Irvine, California, for private client

Expert Consultant: San Luis Obispo Creek Flooding, San Luis Obispo, California, for private client

Expert Consultant: Kern River Ordinary Highwater Litigation, Bakersfield, California, for private client

Misc. Floodplain Hydraulics and Flood Protection

Reconnaissance Study Report and Project Management Plan for the Tijuana River Watershed Study – USACE, Los Angeles District

Spillway, Outlet, and Stilling Basin Design for Reelfoot Lake Sedimentation Basin – USACE, Memphis District
FEMA Studies of River System near Huntington Beach, Orange County, California
River System Studies near Huntington Beach for Orange County for Submittal to FEMA, Orange County, California
FEMA Studies of 27 Streams in the Unincorporated Areas of San Diego County, California
Hydraulic Analysis and Levee Elevation Design of West Williamson, West Virginia, Flood Control Project, for USACE, Huntington District
Flood Information Study of Pineville, Kentucky, for USACE, Nashville District
Murrieta Creek Flood Control and Environmental Restoration Project – USACE, Los Angeles District
Hydraulic Design of Supercritical and Subcritical Flood Control Channels for the Rio Puerto Nuevo Flood Control Project, San Juan, Puerto Rico, for USACE, Jacksonville District
Flood Control Channel Design, Buena Vista Creek, Vista, California, City of Vista, CA
Forest Falls Community Flood Warning System – USACE, Los Angeles District

Publications (abbreviated)

Professional Papers

Wu, Weiming, Williams, David T., et.al, "Earthen Embankment Breaching, "Earthen Embankment Breaching," *J. Hydraul. Eng.*, 137(12), 1549–1564, 2011

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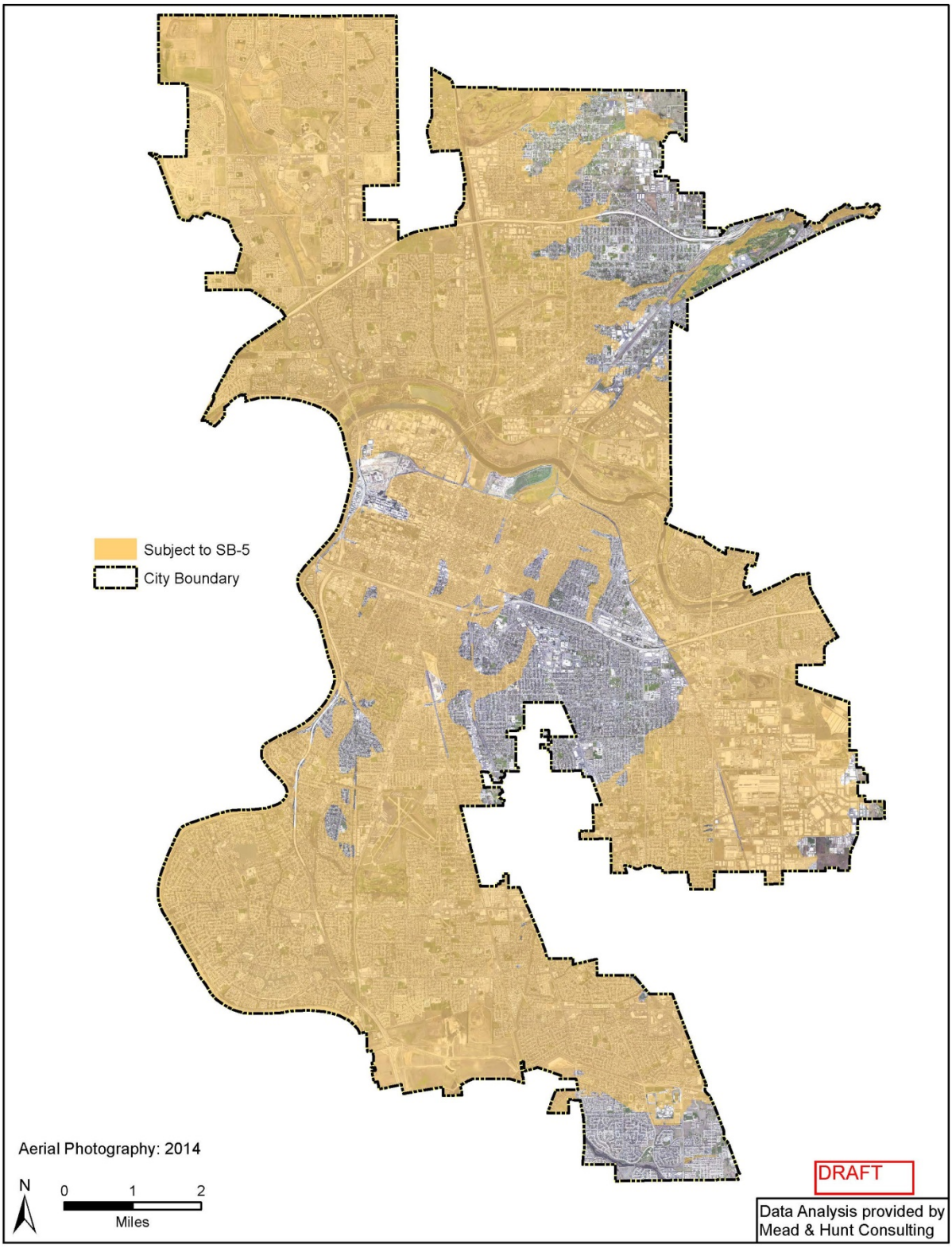
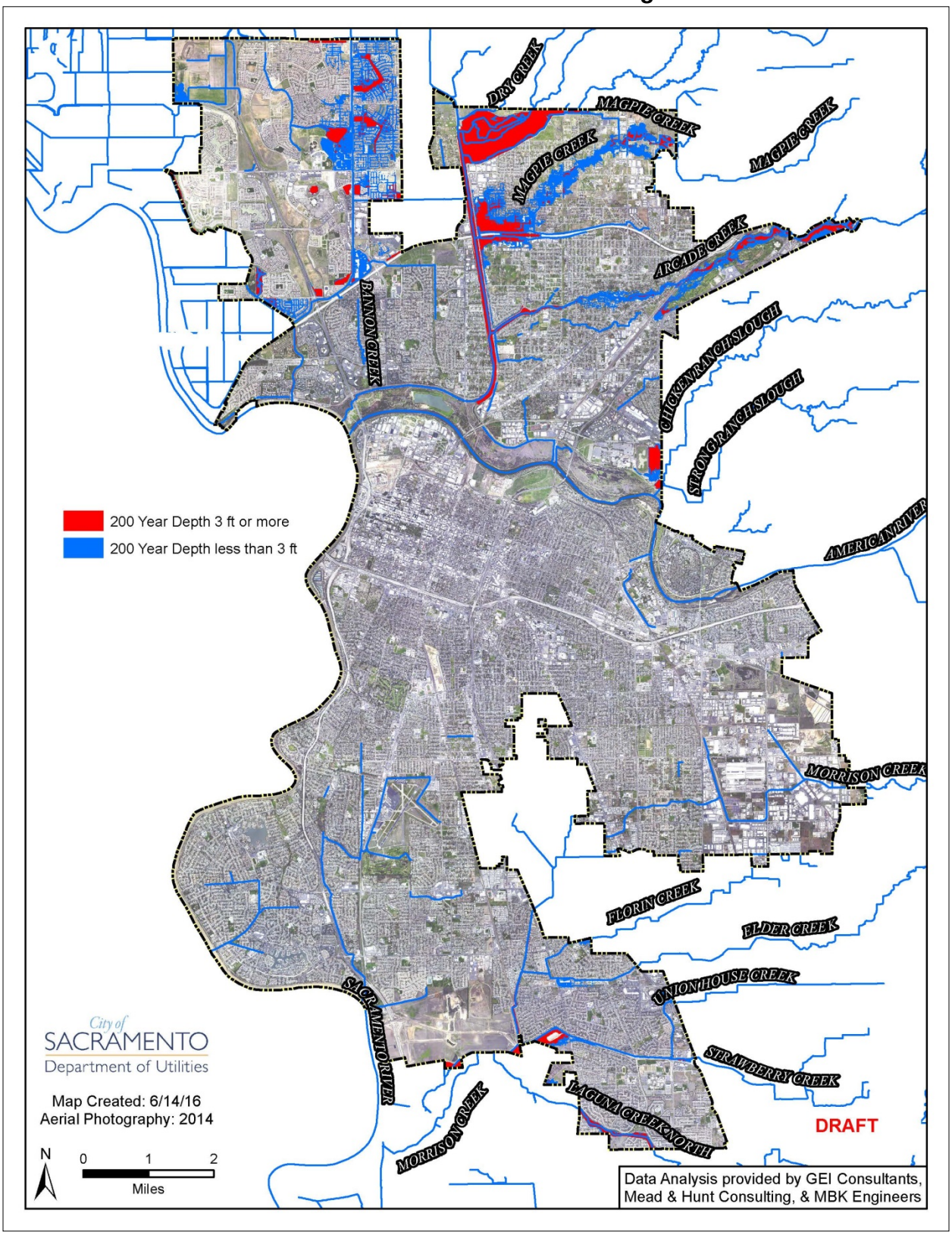
Area Covered by SAFCA's Improvements to the State Plan of Flood Control System



Areas of Non-Riverine Flooding



RESOLUTION NO. 2016-

Adopted by the Sacramento City Council
Date Adopted

ACCEPTING THE SACRAMENTO AREA FLOOD CONTROL AGENCY URBAN LEVEL OF FLOOD PROTECTION PLAN AND ADEQUATE PROGRESS BASELINE REPORT AND THE SACRAMENTO AREA FLOOD CONTROL AGENCY ADEQUATE PROGRESS TOWARDS AN URBAN LEVEL OF FLOOD PROTECTION ENGINEER'S REPORT

BACKGROUND

A. The Central Valley Flood Protection Act of 2008 (the "Act") prohibits cities and counties, beginning July 1, 2016, from entering into development agreements, approving discretionary permits or ministerial permits that would result in the construction of a new residence, or approving tentative or parcel maps for areas located within a flood hazard zone unless the city or county makes one of the findings set forth in the legislation. (See Government Code sections 65865.5, 65962, and 66474.5.)

B. On March 1, 2016, the city council adopted Ordinance No. 2016-0012, which makes various changes to the city code to conform to the Act.

C. One of the Act's required findings—the "adequate-progress finding"—allows development to proceed within a flood hazard zone if the city or county finds the local flood management agency has made adequate progress (as defined in Government Code section 65007) on the construction of a flood protection system that will result in flood protection equal to or greater than the urban level of flood protection ("ULOP") in urban or urbanizing areas or the national Federal Emergency Management Agency ("FEMA") standard of flood protection in non-urbanized areas intended to be protected by the system.

D. The California Department of Water Resources has declared that the adequate-progress finding must be based on the following: a report prepared by the applicable local flood management agency demonstrating adequate progress; a report prepared by a professional civil engineer that documents the data and analysis for demonstrating the property, development project, or subdivision will have an urban level of flood protection at the time when the flood protection system is completed; a report by an independent panel of experts on the review of the report prepared by the professional civil engineer; a response by the professional civil engineer to the comments from the independent panel of experts; the most recent annual report prepared by local flood management agency that was submitted to the Central Valley Protection Board documenting the efforts in working toward completion of the flood protection system; and any additional data and information that cities or counties use to make the finding. (See California Department of Water Resources, Urban Level of Flood Protection Criteria, page 2-10.)

E. Consistent with these mandates, the City of Sacramento's ("City") local flood management agency—the Sacramento Area Flood Control Agency (SAFCA)—has prepared the following documents to support the adequate-progress finding: the Urban Level of Flood Protection Plan and Adequate Progress Baseline Report ("ULOP Plan") and the SAFCA Adequate Progress Towards an Urban Level of Flood Protection Engineer's Report ("Engineer's Report"), which includes the reports of the professional civil engineer and independent panel of experts and a response by the professional civil engineer. These documents conclude that the levees that protect much of the City do not currently meet ULOP requirements, but the documents also lay out a plan for SAFCA to demonstrate adequate progress towards achieving ULOP in urban or urbanizing areas or the national Federal Emergency Management Agency standard of flood protection in nonurbanized areas for property located within a flood hazard zone, intended to be protected by the system, by 2025.

F. On June 16, 2016, the SAFCA Board of Directors approved the ULOP Plan and the Engineer's Report for distribution to and use by the City and other agencies.

BASED ON THE FACTS SET FORTH IN THE BACKGROUND, THE CITY COUNCIL RESOLVES AS FOLLOWS:

Section 1. The city council accepts SAFCA's ULOP Plan and the Engineer's Report.

Section 2. When considering development within a flood hazard zone, the City may rely on the ULOP Plan and the Engineer's Report as substantial evidence that SAFCA has made adequate progress (as defined in Government Code section 65007) on the construction of a flood protection system that will result in flood protection equal to or greater than the urban level of flood protection in urban or urbanizing areas or the national FEMA standard of flood protection in nonurbanized areas for property located within a flood hazard zone, intended to be protected by the system.