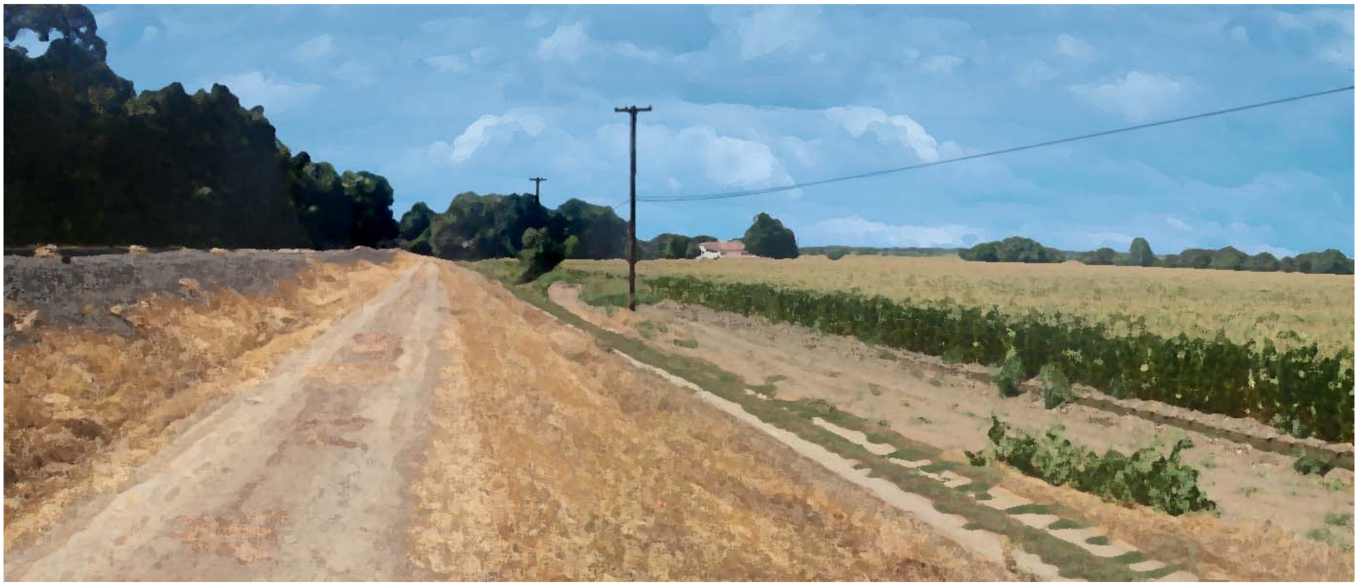
Public Draft

Supplement to the Environmental Impact Report on the

Natomas Levee Improvement Program Landside Improvements Project—Phase 2 Project



State Clearinghouse # 2007062016

Prepared for:

SAFCA
Sacramento Area Flood Control Agency

November 2008

EDAW | AECOM

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Natomas Levee Improvement Program Landside Improvements Project—Phase 2 Project

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EXHIBITS

TABLES

ACRONYMS AND ABBREVIATIONS

2007 Landside EIR	*Environmental Impact Report on the Natomas Levee Improvement Program, Landside Improvements Project*
afy	acre-feet per year
Airport	Sacramento International Airport
APE	area of potential effects
BMP	best management practices
CEQA	California Environmental Quality Act
CNEL	community noise equivalent level
CRHR	California Register of Historical Resources
dBA	A-weighted decibel scale
DWR	California Department of Water Resources
EIR	environmental impact report
HAER	Historic American Engineering Record
HPTP	Historic Preservation and Treatment Plan
L_{dn}	day-night average noise level
LSCE	Luhdorff & Scalmanini Consulting Engineers
MLD	Most Likely Descendant
MMRP	mitigation monitoring and reporting plan
NAHC	Native American Heritage Commission
NBHCP	Natomas Basin Habitat Conservation Plan
NCC	Natomas Cross Canal
NHPA	National Historic Preservation Act
NLIP	Natomas Levee Improvement Program
NOP	notice of preparation
NPDES	National Pollutant Discharge Elimination System Permits
NRHP	National Register of Historic Places
PA	programmatic agreement
Phase 2 Project SEIR	Landside Improvements Project EIR for the Phase 2 Project
PRC	Public Resources Code
RD	Reclamation District
SAFCA	Sacramento Area Flood Control Agency
SHPO	State Historic Preservation Officer
SRFCP	Sacramento River Flood Control Project
TNBC	The Natomas Basin Conservancy
VELB	valley elderberry longhorn beetle

EXECUTIVE SUMMARY

INTRODUCTION

The Sacramento Area Flood Control Agency (SAFCA) is proposing modifications to Phase 2 of the Natomas Levee Improvement Program (NLIP), Landside Improvements Project previously addressed in the *Environmental Impact Report on the Natomas Levee Improvement Program, Landside Improvements Project* ("2007 Landside EIR," State Clearinghouse No. 2007062016), certified in November 2007. As the lead agency for complying with the California Environmental Quality Act (CEQA), SAFCA has determined that the proposed modifications to the Phase 2 Project may have significant effects on the environment. Because the proposed modifications are minor, SAFCA has determined that a supplemental document is the appropriate CEQA document to make the previous 2007 Landside EIR adequately apply to the project in the changed situation. This *Supplement to the Natomas Levee Improvement Project Landside Improvement Project Environmental Impact Report* (Phase 2 Project SEIR, or SEIR) focuses on the significant effects on the environment that would potentially result from the project modifications not previously addressed in the 2007 Landside EIR.

This SEIR does not address changes in the remaining phases of the NLIP Landside Improvements Project (e.g., Phases 3 and 4) that have occurred since the certification of the 2007 Landside EIR. Any such changes will be addressed in the project-level environmental review for the Phase 3 and Phase 4 Projects. A joint EIS/EIR is being prepared for the Phase 3 Project. An additional joint EIS/EIR will be prepared in early 2009, when the site-specific details of the Phase 4 Project are available.

SUMMARY DESCRIPTION OF THE PROPOSED PROJECT

The 2007 Landside EIR provides a full description of the Phase 2 Project, which consists of the following components:

- levee raising and seepage remediation: Natomas Cross Canal (NCC) south levee;
- levee raising and seepage remediation: Sacramento River east levee, Reach 1 through 4B;
- improvements to major irrigation and drainage infrastructure; and
- right-of-way acquisition.

This SEIR analyzes the following modifications to the Phase 2 Project:

- construction of cutoff walls in place of seepage berms for several areas between Reaches 1 through 4A along the Sacramento River east levee;
- cutoff wall construction on a 24-hours-per-day, 7-days-per-week ("24/7") basis;
- a change in the baseline at the Sacramento International Airport north bufferlands from active rice cultivation to idle conditions;
- additional details regarding construction of new collection facilities for storm drainage to convey surface water beneath Garden Highway to the Sacramento River; and
- the addition of 90 acres of high-quality foraging habitat that would be created or preserved by acquisition and reclamation of land used for borrow materials.

Although the Notice of Preparation for the SEIR discussed the potential use of the Dunmore and Sutter Pointe borrow sites, these sites have since been eliminated from the proposed Phase 2 Project modifications and are not analyzed in this SEIR.

MAJOR CONCLUSIONS OF THE ENVIRONMENTAL ANALYSIS

SUMMARY OF IMPACTS AND MITIGATION MEASURES

The proposed Phase 2 project modifications could result in significant environmental effects on several resources, but all of these effects were evaluated and mitigation measures were identified, where feasible, in the 2007 Landside EIR for similar project features. The majority of the impacts due to the proposed Phase 2 Project modifications would be temporary, construction-related effects that would be less than significant or would be reduced to less-than-significant levels through the application of mitigation. Overall, there are no new significant environmental effects that were not identified in the 2007 Landside EIR, or any substantial increase in the severity of previously identified significant effects in the 2007 Landside EIR.

Table ES-1, included at the end of this Executive Summary, summarizes the proposed project's environmental impacts, the level of significance of each impact before implementation of mitigation, recommended mitigation measures, and the level of significance of each impact after mitigation.

SIGNIFICANT AND UNAVOIDABLE IMPACTS

The proposed project modifications would result in the following significant and unavoidable impacts, all of which were identified in the 2007 Landside EIR and mitigated to the degree feasible:

- Potential Construction Impacts on CA-SAC-485/H
- Damage to or Destruction of Other Identified Prehistoric Cultural Resources
- Generation of Temporary, Short-Term Construction Noise

Where feasible mitigation exists, it has been included to partially reduce these impacts; however, the mitigation would not be sufficient to reduce the impacts to a less-than-significant level.

PUBLIC INVOLVEMENT AND NEXT STEPS

This SEIR will be used by the SAFCA Board of Directors (Board) when considering approval of the proposed project modifications.

In accordance with CEQA review requirements, this Draft SEIR is being distributed for public and agency review and comment for a 45-day period, which ends on January 2, 2009. SAFCA will hold one or more public meetings during the comment period—including a meeting to be held during the regular December 11, 2008, meeting of the SAFCA Board—at which it will receive input from agencies and the public on the Draft SEIR. In addition, written comments from the public, reviewing agencies, and stakeholders will be accepted throughout the public comment period.

Following consideration of these comments, SAFCA will prepare written responses to comments on significant environmental issues, and prepare a final SEIR (Final SEIR) that will describe the disposition of any significant environmental issues raised in the comments on the Draft SEIR. Written responses must be provided to public agencies on comments made by those agencies at least 10 days before the SEIR can be certified. Following this 10-day period, the SAFCA Board will consider certifying that the Final SEIR has been prepared in compliance with CEQA, and will rely on the certified Final SEIR when considering project approval (i.e., approval of the project modifications).

In accordance with the requirements of CEQA, if the SAFCA Board decides to approve the proposed project modifications analyzed in this SEIR, it will make written findings with respect to each significant environmental effect identified in the SEIR. In addition, if the SAFCA Board decides to approve the project but determines that it would have significant unavoidable environmental effects, the Board will adopt a "Statement of Overriding Considerations" that explains why the benefits of the project outweigh its significant effects on the environment, based on information in the SEIR and other information in the project record.

At the time of project approval, the SAFCA Board must also adopt a mitigation monitoring and reporting program for those measures that it has adopted and incorporated into the project to mitigate or avoid significant effects on the environment. Following project approval, a notice of determination documenting the decision will be issued.

Table ES-1
Summary of Impacts and Mitigation Measures

Issue Area Impact	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
Hydrology and Water Quality			
Impact 3.2-a. Possible Effects on Water Quality from Stormwater Runoff from Garden Highway Drainage Outlets to the Sacramento River	Significant	Mitigation Measure 3.2-a: Implement Standard Best Management Practices and Comply with NPDES Permit Conditions	Less than significant
Impact 3.2-b. Possible Effects on Groundwater	Less than significant	No mitigation is required	Less than significant
Impact 3.2-c. Cumulative Effects on Groundwater	Less than significant	No mitigation is required	Less than significant
Terrestrial Biological Resources			
Impact 3.3-a. Loss of Sensitive Habitats	Significant	Mitigation Measure 3.3-a: Minimize Effects on Sensitive Habitats, Develop a Habitat Management Plan to Ensure Compensation for Unavoidable Adverse Effects, and Comply with Section 404, Section 401, and Section 1602 Permit Processes	Less than significant
Impact 3.3-b. Disturbance and Loss of Giant Garter Snake Habitat	Significant	Mitigation Measure 3.3-b: The following mitigation measure from the 2007 Landside EIR would be applied: *Mitigation Measure 3.7-d: Minimize the Potential for Direct Loss of Giant Garter Snake Individuals, Develop a Management Plan in Consultation with the U.S. Fish and Wildlife Service (USFWS) and the California Department of Fish and Game (DFG), and Obtain Incidental Take Authorization*	Less than significant
Impact 3.3-c. Loss of Swainson's Hawk Habitat and Potential Disturbance of Nests	Significant	Mitigation Measure 3.3-c: The following mitigation measure from the 2007 Landside EIR would be applied: *Mitigation Measure 3.7-f: Minimize Potential Impacts on Swainson's Hawk, Monitor Active Nests during Construction, Develop a Management Plan in Consultation with DFG, and Obtain Incidental Take Authorization*	Less than significant

Table ES-1
Summary of Impacts and Mitigation Measures

Issue Area Impact	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
Cultural Resources			
Impact 3.4-a. Changes to Elements of Reclamation District (RD) 1000	Significant	Mitigation Measure 3.4-a: Incorporate Mitigation Measures to Documents Regarding Any Elements Contributing to RD 1000 and Distribute the Information to the Appropriate Repositories	Less than significant
Impact 3.4-b. Potential Construction Impacts on CA-SAC-485H	Significant	Mitigation Measure 3.4-b: Avoid Ground Disturbance near Known Prehistoric Archaeological Site CA-SAC-485/H to the Extent Feasible and Prepare and Implement a Historic Properties Treatment Plan	Significant and unavoidable
Impact 3.4-c. Damage to or Destruction of Other Identified Prehistoric Cultural Resources	Potentially Significant	Mitigation Measure 3.4-c: Evaluate NLIP-7 and NLIP-22. If the Resources are Eligible, Avoid Disturbance to the Extent Feasible, and Prepare and Implement a Historic Properties Treatment Plan	Significant and unavoidable
Impact 3.4-d. Damage to or Destruction of Previously Undiscovered Cultural Resources	Potentially Significant	Mitigation Measure 3.4-d: Conduct Additional Backhoe and Canine Forensic Investigations As Appropriate	Significant and unavoidable
Impact 3.4-e. Damage to or Destruction of Previously Undiscovered Interred Human Remains	Significant	Mitigation Measure 3.4-e: The following mitigation measure from the 2007 Landside EIR would be applied: *Mitigation Measure 3.8-e: Halt Work Within 50 Feet of the Find, Notify the County Coroner and Most Likely Descendant, and Implement Appropriate Treatment of Remains*	Significant and unavoidable
Noise			
Impact 3.5-a. Generation of Temporary, Short-Term Construction Noise	Significant	Mitigation Measure 3.5-a: The following mitigation measure from the 2007 Landside EIR would be applied: *Mitigation Measure 3.12-a: Implement Noise-Reducing Construction Practices, Prepare a Noise Control Plan, and Monitor and Record Construction Noise Near Sensitive Receptors*	Significant and unavoidable

1 INTRODUCTION

This chapter explains the background and purpose of this *Supplement to the Natomas Levee Improvement Program* (NLIP) *Landside Improvement Project Environmental Impact Report* (EIR) for the Phase 2 Project (the “Phase 2 Project SEIR). The Sacramento Area Flood Control Agency (SAFCA) is the lead agency for the proposed NLIP Landside Improvement Project for purposes of environmental review under the California Environmental Quality Act (CEQA) (Public Resources Code [PRC] Section 21000 et seq.) “Lead agency” is defined by Section 21067 of CEQA as “the public agency which has the principal responsibility for carrying out or approving a project which may have a significant effect upon the environment.”

1.1 BACKGROUND AND PURPOSE OF THE SEIR

1.1.1 PURPOSE OF THE SEIR

CEQA requires a public agency to prepare an EIR for any project that it proposes to carry out or approve that may have a significant direct or indirect effect on the environment. An EIR is an informational document that is intended to inform public agency decision makers and the general public of the significant adverse physical environmental effects of a project, identify feasible mitigation measures that would avoid or reduce those effects to less-than-significant levels, and describe a range of reasonable alternatives to the project that would feasibly attain most of the basic project objectives but would avoid or substantially lessen the project’s significant environmental effects. If all significant effects of the proposed project cannot be reduced to a less-than-significant level, CEQA requires decision makers to balance the benefits of a project against its significant and unavoidable environmental effects in deciding whether to carry out the project. The purpose of an EIR is not to recommend either approval or denial of a project.

The CEQA statute and guidelines require preparation of a subsequent EIR if changes are proposed to the project that would create new significant environmental effects or a substantial increase in the severity of previously identified significant effects and would require a major revision of the previous EIR (PRC Section 21166, and State CEQA Guidelines Section 15162). CEQA allows preparation of a supplement to an EIR when conditions that require preparation of a subsequent EIR are met and *only minor additions or changes would be necessary to make the previous EIR adequately apply to the project in the changed situation* (State CEQA Guidelines Section 15163). A notice of preparation (NOP) was publically released on October 2, 2008 to prepare a subsequent EIR for the proposed project modifications because two new potential sources of borrow material were to be included in the proposed project modifications. Since the NOP was published, SAFCA has determined that these two new potential sources of borrow material for the Phase 2 Project are no longer needed. Consequently, SAFCA is not proposing new potential sources of borrow material for the Phase 2 Project, and the remaining project changes, referred to in this SEIR as “modifications,” are considered to be minor, allowing for preparation of a supplement to the EIR. This SEIR focuses on those modifications to the project and the new environmental effects and mitigation measures related to those modifications, as required under CEQA. The purposes of this SEIR are to:

- address impacts on environmental resources related to modifications to the Phase 2 Project;
- recommend mitigation measures to avoid any new significant impacts or reduce them to a less-than-significant level; and
- update impact analysis and mitigation measures where conditions have changed since the publication of the *Environmental Impact Report on the Natomas Levee Improvement Program, Landside Improvements Project* (2007 Landside EIR) to assist responsible agencies with issuing permits for the Phase 2 Project.

As the lead agency, SAFCA will consider the information presented in this SEIR, comments received on this SEIR, and responses to those comments, along with other information, when determining whether to approve the proposed project (modifications to the Phase 2 Project). This draft SEIR has been prepared in accordance with the requirements of CEQA and the State CEQA Guidelines (California Code of Regulations Title 14, Section 15000 et seq.). The SEIR process is described further in Section 1.5, "Draft SEIR Review and Public Comment."

1.1.2 PROJECT BACKGROUND

In November 2007, the SAFCA Board certified the 2007 Landside EIR, State Clearinghouse Number 2007062016. That EIR was tiered from the program-level Environmental Impact Report on Local Funding Mechanisms for Comprehensive Flood Control Improvements for the Sacramento Area (Local Funding EIR, State Clearinghouse No. 2006072098) (February 2007) that analyzed the significant effects on the environment associated with the program of flood control improvements and related environmental mitigation that will be funded, in part, by SAFCA Consolidated Capital Assessment District and SAFCA development fees. The NLIP and Landside Improvements Project consist of improvements to the levee system in the Natomas Basin and related landscape modifications and drainage and infrastructure improvements. This document addresses modification to the second of four phases within the NLIP (the "Phase 2 Project"). On October 2, 2008, SAFCA issued an NOP of a draft subsequent EIR and filed the NOP with the State Clearinghouse (State Clearinghouse No. 2007062016). However, changes in the proposed modifications to the Phase 2 Project resulted in SAFCA determining that a supplement to the EIR, rather than a subsequent EIR, would be the appropriate type of document to address changes to the project.

Since certification of the 2007 Landside EIR, SAFCA has changed the nomenclature used to describe the various phases of the NLIP. While the certified 2007 Landside EIR uses years (2008, 2009, and 2010) to identify project features, this SEIR uses phase numbers. As such, 2008 construction is now referred to as the Phase 2 Project, 2009 construction is now referred to as the Phase 3 Project, and 2010 construction is now referred to as the Phase 4 Project. The Phase 1 Project, previously called 2007 construction, has been completed. The 2007 Landside EIR provides a full description of the Phase 2 Project, which consists of the following components:

- levee raising and seepage remediation: Natomas Cross Canal (NCC) south levee;
- levee raising and seepage remediation: Sacramento River east levee, Reaches 1 through 4B;
- improvements to major irrigation and drainage infrastructure; and
- right-of-way acquisition.

This SEIR analyzes the following modifications to the Phase 2 Project:

- construction of cutoff walls in place of seepage berms in several areas between Reaches 1 through 4A along the Sacramento River east levee;
- cutoff wall construction on a 24-hours-per-day, 7-days-per-week basis;
- a change in the baseline at the Airport north bufferlands from active rice cultivation to idle conditions;
- additional details regarding construction of new collection facilities for storm drainage to convey surface water beneath Garden Highway to the Sacramento River; and
- the addition of 90 acres of high-quality foraging habitat that would be created or preserved by acquisition and reclamation of land used for borrow materials.

Although the NOP discussed the potential use of the Dunmore and Sutter Pointe borrow sites, these sites have since been eliminated from the Phase 2 Project modifications and are not analyzed in this SEIR.

1.2 SCOPE OF THE DRAFT SEIR

This document supplements the 2007 Landside EIR already prepared for the Phase 2 Project to address project modifications, changed circumstances, or new information that was not known and could not have been known with the exercise of reasonable diligence at the time the prior document was certified. The purpose of an SEIR is to provide the additional information necessary to make the previous EIR adequately apply to the project as modified. Accordingly, pursuant to CEQA Guidelines Section 15163, the SEIR need contain only the information necessary to analyze the project changes, changed circumstances, or new information that triggered the need for additional environmental review. When information and analysis within the 2007 Landside EIR or Local Funding Mechanisms EIR is relevant to the changed projects components, it is briefly summarized or briefly described rather than repeated, as described in Section 1.4, "Documents Incorporated by Reference."

Issue areas addressed in this SEIR were established based on discussion in the NOP, public agency input, and verbal and written comments received during the NOP review period (Appendix A):

- hydrology and water quality;
- terrestrial biological resources;
- cultural resources; and
- noise.

1.3 DRAFT SEIR CONTENTS AND ORGANIZATION

This draft SEIR is organized as follows:

- "Executive Summary" summarizes the proposed project, significant environmental effects that would result from project implementation, and mitigation measures proposed to eliminate or reduce those impacts to less-than-significant levels.

- Chapter 1, "Introduction," describes the purpose of this SEIR, its relationship to the 2007 Landside EIR, its scope, and the organization of the draft SEIR.

- Chapter 2, "Project Description," describes the project objectives, location, and components of project modifications.

- Chapter 3, "Environmental Setting, Impacts, and Mitigation Measures," describes, by environmental issue area, the existing environmental setting (i.e., baseline or existing conditions); discusses the potential environmental impacts of the proposed project modifications (including any cumulative impacts); and identifies feasible mitigation measures where available to avoid or substantially lessen any significant environmental effects.

- Chapter 4, "References," contains a comprehensive listing of the sources of information used in the preparation of the draft SEIR, including agencies or individuals consulted.

- Chapter 5, "List of Preparers," identifies the preparers of this draft SEIR.

- The appendices support the SEIR conclusions or form the basis of the analyses.

1.4 DOCUMENTS INCORPORATED BY REFERENCE

The State CEQA Guidelines encourage incorporation by reference of previously analyzed and publicly circulated information (State CEQA Guidelines Section 15150). Because this SEIR is focused on proposed modifications to the Phase 2 Project and associated impacts relative to the 2007 Landside EIR (State Clearinghouse No. 2007062016), which is tiered from the Local Funding Mechanisms EIR (State Clearinghouse No. 2006072098), relevant portions of both documents are incorporated by reference. Where material is incorporated by reference, the relationship of the referenced material to analysis in this document is explained. Referenced material includes regulatory and environmental setting information and unchanged mitigation measures. Where appropriate, new environmental setting information is provided to evaluate new environmental impacts. The 2007 Landside EIR (State Clearinghouse No. 2007062016) and the Local Funding Mechanisms EIR (State Clearinghouse No. 2006072098) are available in electronic format on SAFCA's Web site and in hard copy at SAFCA's office, located at 1007 7th Street, 7th Floor, Sacramento, California 95814. Interested parties may review these documents online or at SAFCA's office during normal business hours.

1.5 DRAFT SEIR REVIEW AND PUBLIC COMMENT

On October 2, 2008, SAFCA issued an NOP for a draft subsequent EIR and filed the NOP with the State Clearinghouse (State Clearinghouse No. 2007062016). The public comment period on the NOP ended on November 3, 2008. A scoping meeting was held on October 22, 2008, from 4 p.m. to 7 p.m. at the Teal Bend Golf Club, 7200 Garden Highway, Sacramento, California, to solicit input on the scope of the draft subsequent EIR from interested agencies, individuals, and organizations. The NOP and copies of the comments provided to SAFCA are included in Appendix A. As explained above, refinements to the Phase 2 Project modifications resulted in preparation of a supplemental EIR rather than a subsequent EIR.

In accordance with CEQA review requirements, this draft SEIR is being distributed for public and agency review and comment for a 45-day period, which begins on November 18, 2008, and ends on January 2, 2009. This public review period and draft SEIR distribution ensures that interested parties have an opportunity to express their views regarding the significant environmental effects of the Phase 2 Project as revised by this document (State CEQA Guidelines Section 15163[e]), and to ensure that information pertinent to permits and approvals is provided to the decision makers for SAFCA and the CEQA responsible and trustee agencies. This document is available for review, along with the Environmental Impact Report on Local Funding Mechanisms for Comprehensive Flood Control Improvements for the Sacramento Area (Local Funding EIR) and 2007 Landside EIR, by the public during normal business hours at the SAFCA office at 1007 7th Street, 7th Floor, Sacramento, California.

SAFCA will hold a public meeting during the regular December 11, 2008, meeting of the SAFCA Board—at which time it will receive input from agencies and the public on the SEIR. In addition, written comments from the public, reviewing agencies, and stakeholders will be accepted throughout the public comment period. Comments must be received by SAFCA by 5:00 p.m. on January 2, 2009, at the following address, fax number, or e-mail address:

> Attn: John Bassett/NLIP Landside Phase 2 Draft SEIR Comments
> Sacramento Area Flood Control Agency
> 1007 7th Street, 7th Floor
> Sacramento, CA 95814
> Fax number: (916) 874-8289
> E-mail address: BassettJ@SacCounty.net

If comments are provided via e-mail, please *include the project title in the subject line, attach comments in MS Word format, and include the commenter's U.S. Postal Service mailing address*.

Following consideration of these comments, SAFCA will prepare written responses to comments on environmental issues, and prepare a final SEIR that will describe the disposition of any significant environmental issues raised in the comments on the draft SEIR. Written responses must be provided to public agencies on comments made by those agencies at least 10 days before the SEIR can be certified. Following this 10-day period, the SAFCA Board will consider certifying the final SEIR if it is determined to be in compliance with CEQA and will rely on the certified final SEIR when considering project approval.

In accordance with the requirements of CEQA, if the SAFCA Board decides to approve the proposed project analyzed in this SEIR, it will make one or more of the following written findings with respect to each significant environmental effect identified in the SEIR:

- Changes or alterations have been incorporated into the project that mitigate or avoid the significant effects on the environment.
- Such changes or alterations are within the responsibility and jurisdiction of another public agency and have been adopted, or can and should be adopted, by such other agency.
- Specific economic, legal, social, technological, or other considerations render the mitigation measures identified in the final SEIR infeasible.

In addition, if the SAFCA Board decides to approve the project but determines that it would have significant and unavoidable environmental effects, the board will adopt a “Statement of Overriding Considerations” that explains why the benefits of the project outweigh its significant effects on the environment, based on information in the SEIR and other information in the project record.

At the time of project approval, the SAFCA Board must also adopt a mitigation monitoring and reporting plan (MMRP), in compliance with CEQA for those measures that it has adopted and incorporated into the project to mitigate or avoid significant effects on the environment. The MMRP will be designed to ensure compliance during project implementation. The MMRP will monitor implementation of all Phase 2 Project mitigation measures from this SEIR and any applicable mitigation measure from the Local Funding EIR and 2007 Landside EIR.

Following SEIR certification and project approval, a notice of determination documenting the decision will be issued.

2 PROJECT DESCRIPTION

This chapter describes the proposed changes to the Natomas Levee Improvement Program (NLIP) Landside Improvements Phase 2 Project (Phase 2 Project) since certification of the NLIP Landside Improvements Project Environmental Impact Report (EIR) in November 2007 (2007 Landside EIR). The original project need, objectives, location, and existing environmental setting are presented in detail in the 2007 Landside EIR, have not changed substantially, and are briefly summarized below. This supplemental environmental impact report (SEIR) focuses on the modifications to the Phase 2 Project that could result in potentially significant environmental impacts on the physical environment that were not analyzed in the 2007 Landside EIR and that could require new mitigation not identified in the 2007 Landside EIR.

2.1 PROJECT BACKGROUND, NEED, AND OBJECTIVES

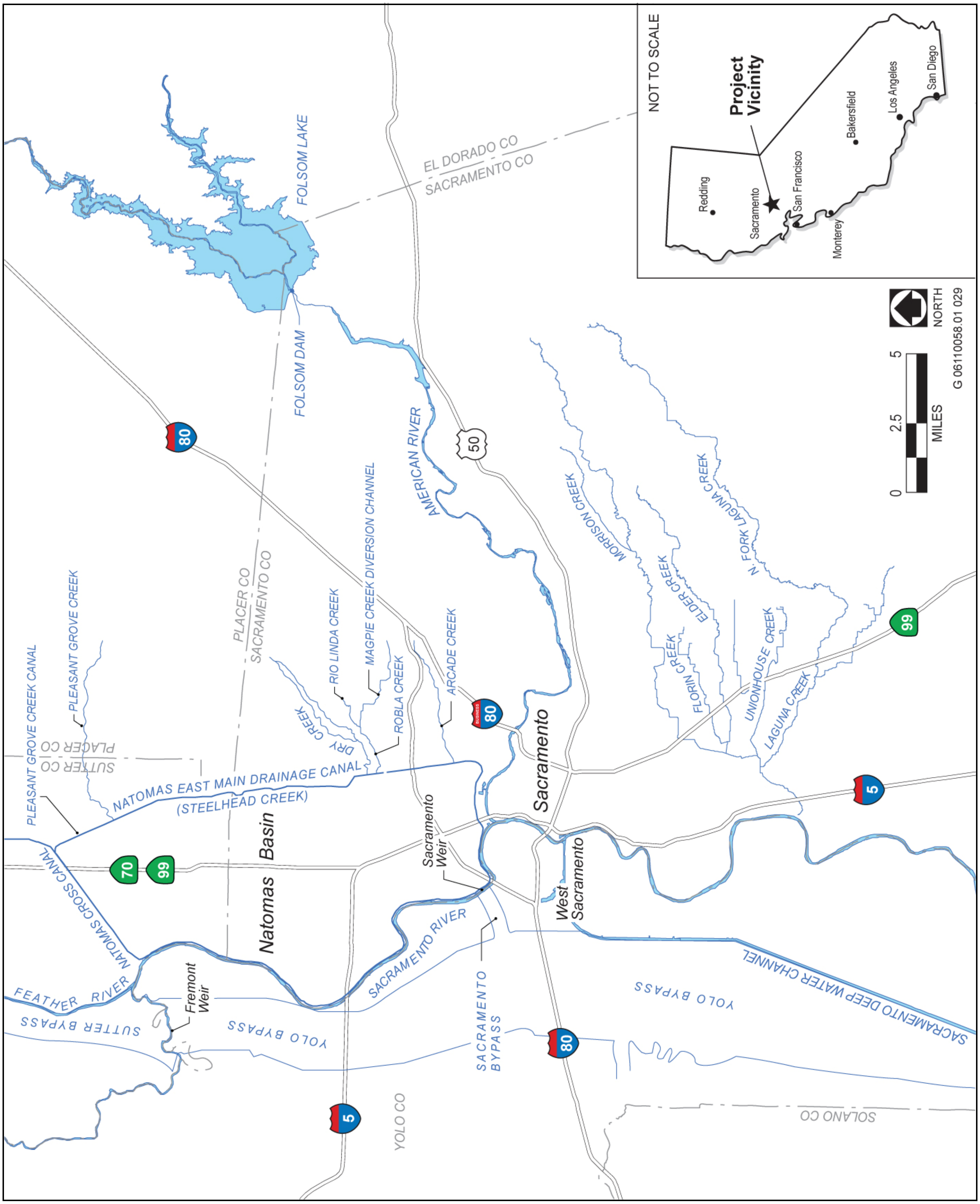
Phase 2 is one of four phases of the NLIP, which is a major component of the flood control improvements analyzed in the Sacramento Area Flood Control Agency's (SAFCA's) *Environmental Impact Report on Local Funding Mechanisms for Comprehensive Flood Control Improvements for the Sacramento Area* (Local Funding EIR) (February 2007), from which the 2007 Landside EIR (November 2007) is tiered pursuant to the California Environmental Quality Act Guidelines Section 15152. The NLIP involves improving the levee system that provides flood protection for the 53,000-acre Natomas Basin in northern Sacramento and southern Sutter Counties, California, including a portion of the city of Sacramento (Exhibit 2-1). The Natomas Basin is generally bounded by leveed reaches of the Natomas Cross Canal (NCC) on the north, the Sacramento River on the west, the American River on the south, and the Pleasant Grove Creek Canal (PGCC) and Natomas East Main Drainage Canal (NEMDC)/Steelhead Creek on the east (Exhibit 2-2).

SAFCA's overall objectives are to provide the Natomas Basin with at least a 100-year level of flood protection by the end of 2010 and a "200-year" level of protection by the end of 2012. Achievement of these objectives would significantly reduce the risk of an uncontrolled flood in the Natomas Basin that could result in a catastrophic loss of property (estimated at $7 billion) and a prolonged interruption of commercial activity, including the operation of the Sacramento International Airport (Airport) and closure of Interstate 5 and State Route (SR) 99/70.

2.1.1 DEFICIENCIES OF THE NATOMAS LEVEE SYSTEM

Chapter 2 in the Local Funding EIR provides comprehensive information about the flood risk to Sacramento, SAFCA's role in flood control, and the history of regional flood control improvements. Chapter 3 of the Local Funding EIR provides an overview of the need for the NLIP. As described in that chapter, SAFCA and the U.S. Army Corps of Engineers (USACE), Sacramento District, in cooperation with the California Department of Water Resources and the Central Valley Flood Protection Board, together referred to as "State," have conducted engineering studies that show the Natomas Basin to be vulnerable to uncontrolled flooding as a result of levee overtopping, levee seepage that could threaten levee stability, and riverbank erosion. USACE determined in 2006 that the Natomas Basin has less than a 100-year level of protection against levee failure. This led to a proposal for remapping of the Natomas Basin floodplain by the Federal Emergency Management Agency, which will show the Basin within the 100-year floodplain.

Most of the 42 miles of the levee surrounding the Natomas Basin require one or more forms of remediation to address the potential for failure in a 100-year or "200-year" flood event (Exhibit 2-3). SAFCA is designing the NLIP in coordination with the federal and state flood control project sponsors, USACE and the Central Valley Flood Protection Board, to address the deficiencies in the Natomas levee system with a focus on achieving a 100-year level of protection by 2010. This will require improving the following conditions:



Source: CaSil, adapted by EDAW for SAFCA 2007

Project Location **Exhibit 2-1**

Source: Aerial image SACOG 2006, adapted by EDAW 2008

Natomas Basin Levee System **Exhibit 2-2**

- Inadequate levee height—The NCC south levee, portions of the Sacramento River east levee, and the PGCC west levee are not high enough to provide at least 3 feet of levee height above the 100-year water surface profile, and several reaches do not provide 3 feet of levee height above the "200-year" design water surface profile.

- Underseepage and through-seepage vulnerability—Most of the reaches in the NCC south levee, Sacramento River east levee, PGCC west levee, NEMDC west levee, and American River north levee do not meet recently adopted federal criteria for safely containing underseepage and through-seepage when the water surface in the adjacent channel reaches the 100-year elevation or, in some cases, the "200-year" elevation. Exhibit 2-4 shows a schematic of these two failure mechanisms.

- Erosion—Because of ongoing erosion, several sites along the Sacramento River east levee do not meet current federal criteria for waterside levee stability and integrity. One area along the NCC south levee may also require erosion protection.

2.1.2 PROJECT OBJECTIVES

As stated in the Local Funding EIR, the overall project objectives of SAFCA's flood control improvement program, including the NLIP, are to:

(1) complete the projects necessary to provide 100-year flood protection for developed areas in the major floodplains of the Sacramento metropolitan area (Sacramento) as quickly as possible,

(2) provide urban-standard ("200-year") flood protection for developed areas in Sacramento's major floodplains over time, and

(3) ensure that new development in the undeveloped areas of Sacramento's major floodplains does not substantially increase the expected damage of an uncontrolled flood.

Additional project objectives that informed SAFCA's project design are to:

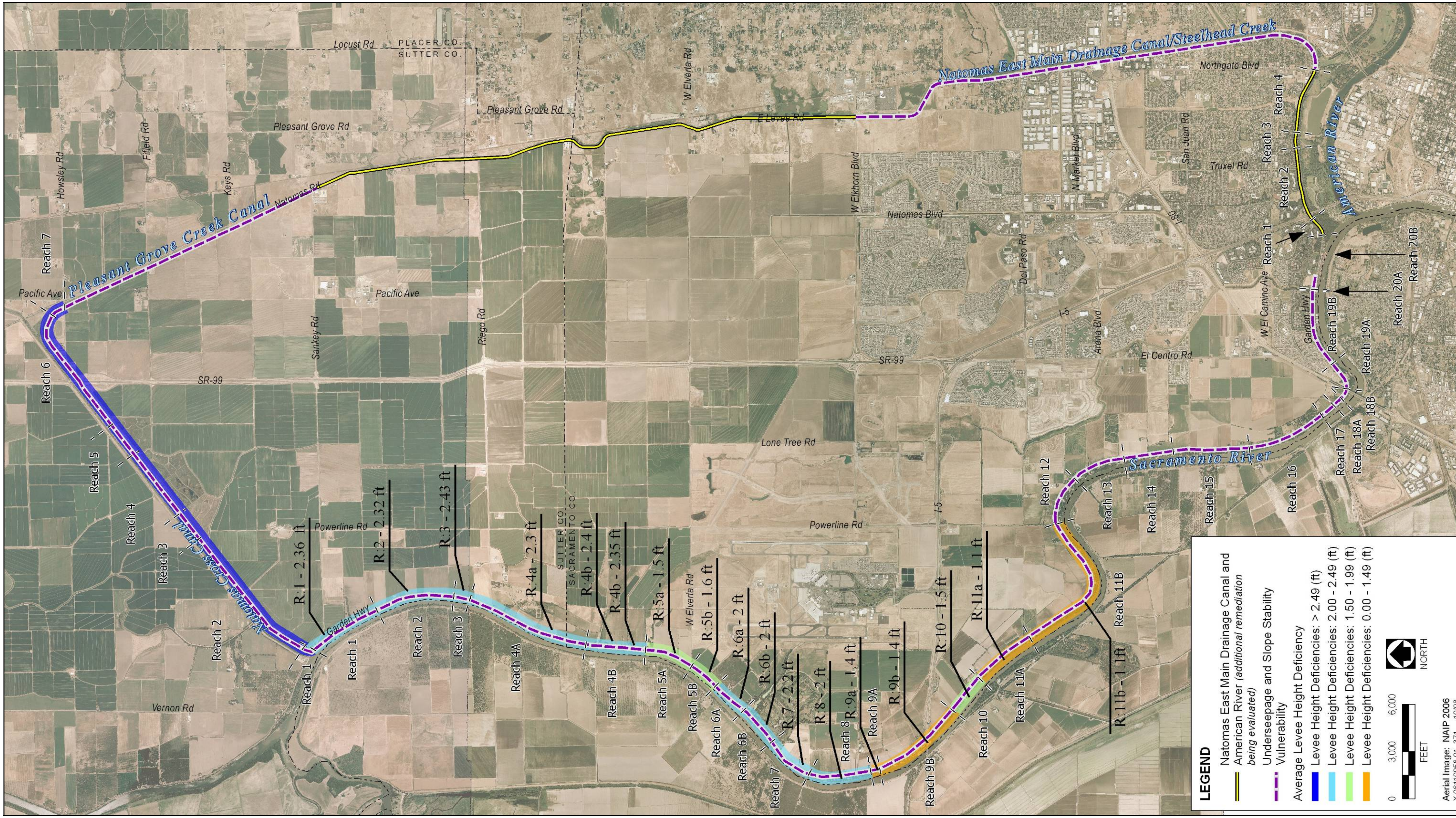
(1) use flood control projects in the vicinity of the Airport to manage Airport lands in accordance with the Airport's Wildlife Hazard Management Plan; and

(2) use flood control projects to increase the extent and connectivity of the lands in the Natomas Basin being managed to provide habitat for giant garter snake, Swainson's hawk, and other special-status species.

2.2 SUMMARY DESCRIPTION OF THE PHASE 2 PROJECT ANALYZED IN THE 2007 LANDSIDE EIR

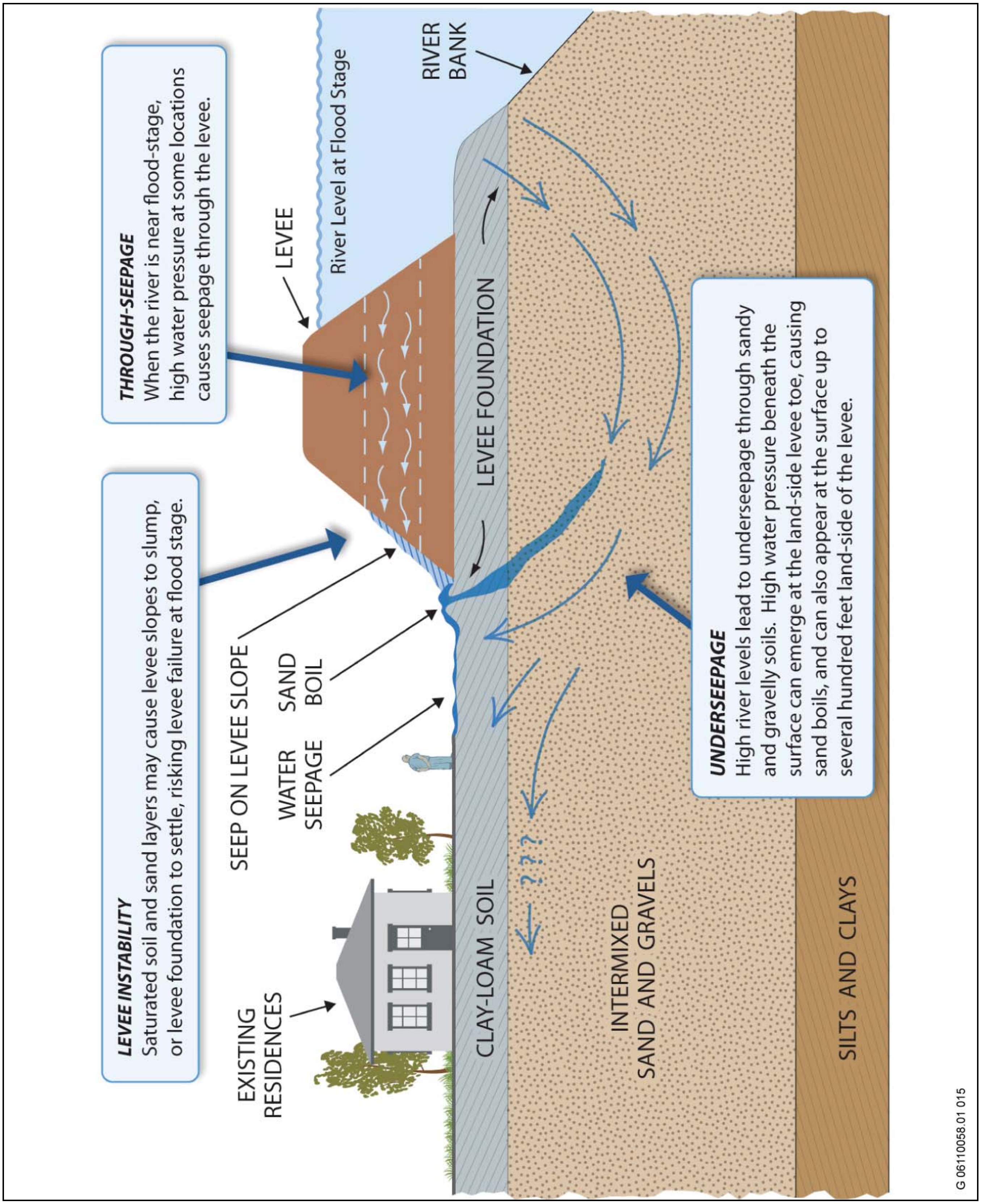
The Phase 2 Project was described and analyzed in the 2007 Landside EIR at a project level of detail, and the Phase 3 and Phase 4 Projects were described and analyzed at a general, program level of detail. The Phase 3 and Phase 4 Projects will be evaluated in future, project-specific EIRs. The general elements of the Phase 2 Project proposed and analyzed in the 2007 Landside EIR and updated based on current plans are shown in Exhibit 2-5 and summarized as follows (a detailed project description is provided in the 2007 Landside EIR):

- **Levee raising and seepage remediation: NCC south levee**—Raise and realign the NCC south levee to provide additional levee height and more stable waterside and landside slopes and to reduce the need for removal of waterside vegetation. Construct a seepage cutoff wall through the levee crown in Reaches 3 through 7.



Sources: Aerial image SACOG 2006, adapted by EDAW 2008 based on data from HDR 2007, Wood Rodgers 2007

Levee Segments Requiring Seepage Remediation and Levee Height Increases **Exhibit 2-3**



Source: SAFCA 2007 – Illustration prepared by Jones & Stokes

Underseepage and Through-Seepage Levee Risks **Exhibit 2-4**

- **Levee raising and seepage remediation: Sacramento River east levee**—Construct an adjacent setback levee from the NCC to the downstream end of Sacramento River east levee Reach 4B, raised where needed to provide adequate levee height, with a combination of cutoff walls, seepage berms, and relief wells for seepage remediation where required.

- **Improvements to major irrigation and drainage infrastructure**—These improvements are described below.

  - Relocate a portion of the existing highline Elkhorn Main Irrigation Canal north of the Natomas Central Mutual Water Company's Elkhorn Reservoir. ("Highline" canals are water conveyances with bottom elevations roughly equal to the surrounding ground elevation.)

  - Construct a new canal designed to provide drainage and associated giant garter snake habitat (the "GGS/Drainage Canal") between the North Drainage Canal and the Elkhorn Reservoir to improve associated giant garter snake habitat. (These features are intended to offset project impacts on giant garter snake canal and ditch habitat.)

  - Remove a deep culvert at the location of Reclamation District 1000 Pumping Plant No. 2 on the Sacramento River east levee, and reconstruct Pumping Plant No. 2.

- **Right-of-way acquisition**—Acquire right-of-way through fee title or easement interest within the footprint of the project features and at the borrow sites to prevent encroachments into the flood control system.

The levee raise along the Sacramento River involves construction of an "adjacent setback levee," consisting of a new levee crown and embankment adjoining the land side of the existing levee. As illustrated in Exhibit 2-6, construction of an adjacent setback levee would shift the jurisdictional levee landward, thereby providing more flexibility with respect to the management of structures and vegetation on the waterside slope compared with raising the levee in place. The adjacent setback levee would be constructed to provide the required levee height and would include seepage remediation where required.

The seepage remediation would use a combination of seepage berms, cutoff walls, and relief wells, as illustrated in Exhibits 2-7, 2-8, and 2-9. SAFCA would acquire additional rights-of-way to construct the improvements and to prevent encroachment into the flood control system. These improvements would include recontouring the levee slopes where necessary to provide at least a 3:1 horizontal-to-vertical (3H:1V) waterside slope and a 3H:1V (preferred) or 2H:1V (maximum) landside slope.

Soil material for Phase 2 Project construction would be excavated and hauled to construction sites from the borrow sites shown in Exhibit 2-10, which also shows the routes haul trucks would use.

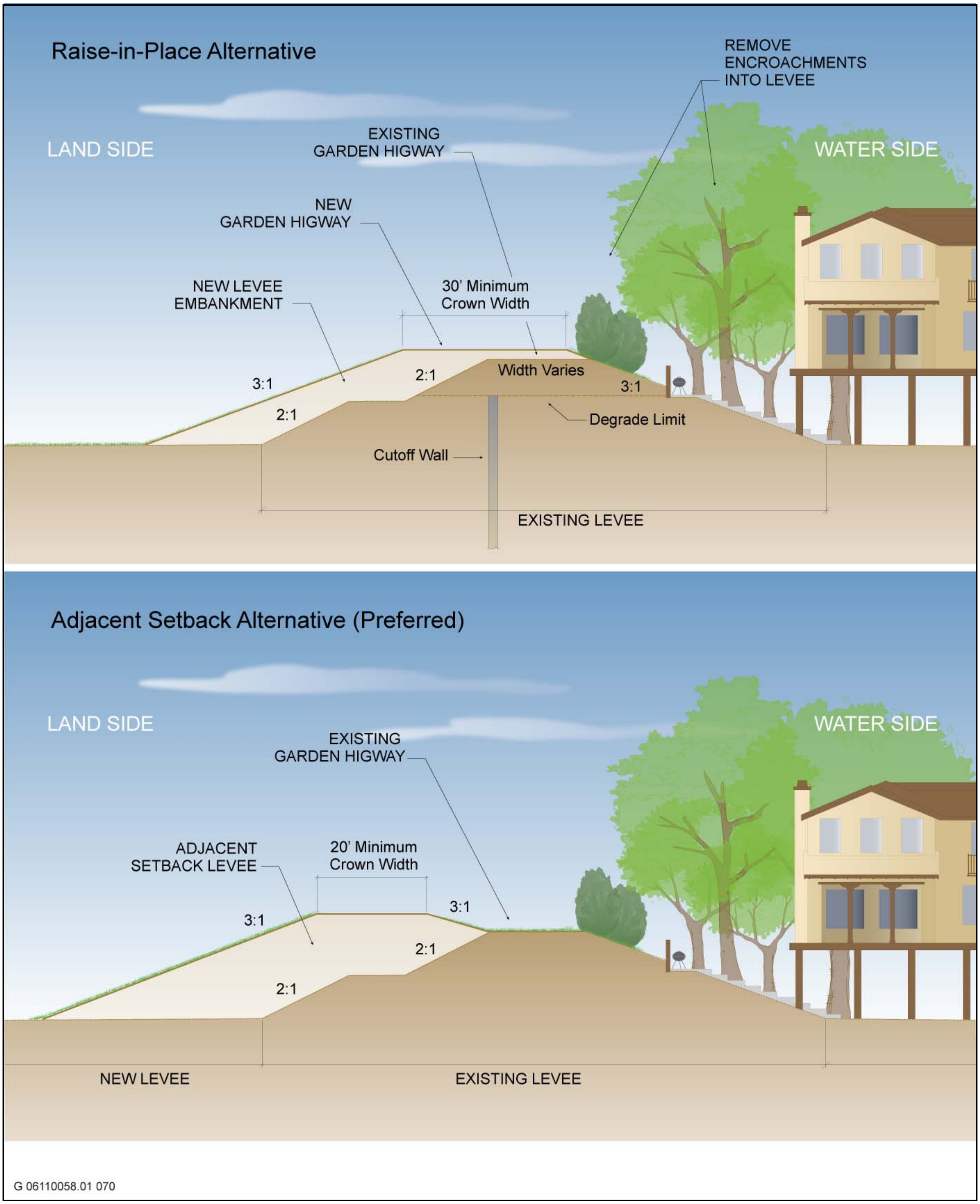
2.3 MODIFICATIONS TO THE PHASE 2 PROJECT SINCE CERTIFICATION OF 2007 LANDSIDE EIR

Since certification of the 2007 Landside EIR in November 2007, SAFCA has continued to finalize the design and refine the features of the proposed Phase 2 Project, resulting in modifications to the project description, as follows:

- **"24/7" Construction of Cutoff Walls.** To complete construction of cutoff walls before the flood season while providing sufficient drying and curing time to ensure high-quality cutoff walls, SAFCA would likely conduct cutoff wall construction on a 24-hours-per-day, 7-days-per-week ("24/7") basis.

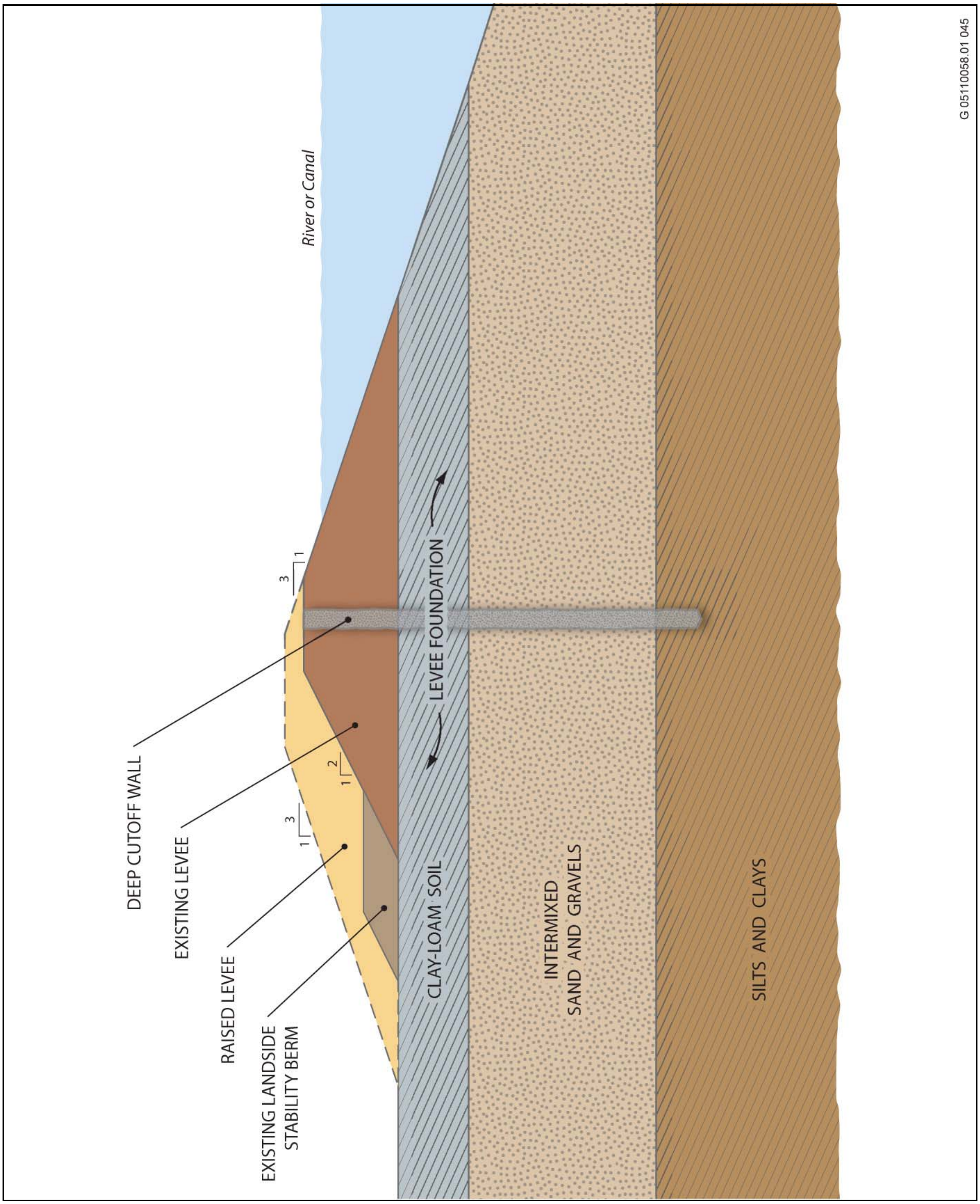
Source: HDR 2008, Wood Rodgers 2007, Mead & Hunt 2008

Overview of the Proposed Phase 2 Project Features **Exhibit 2-5**



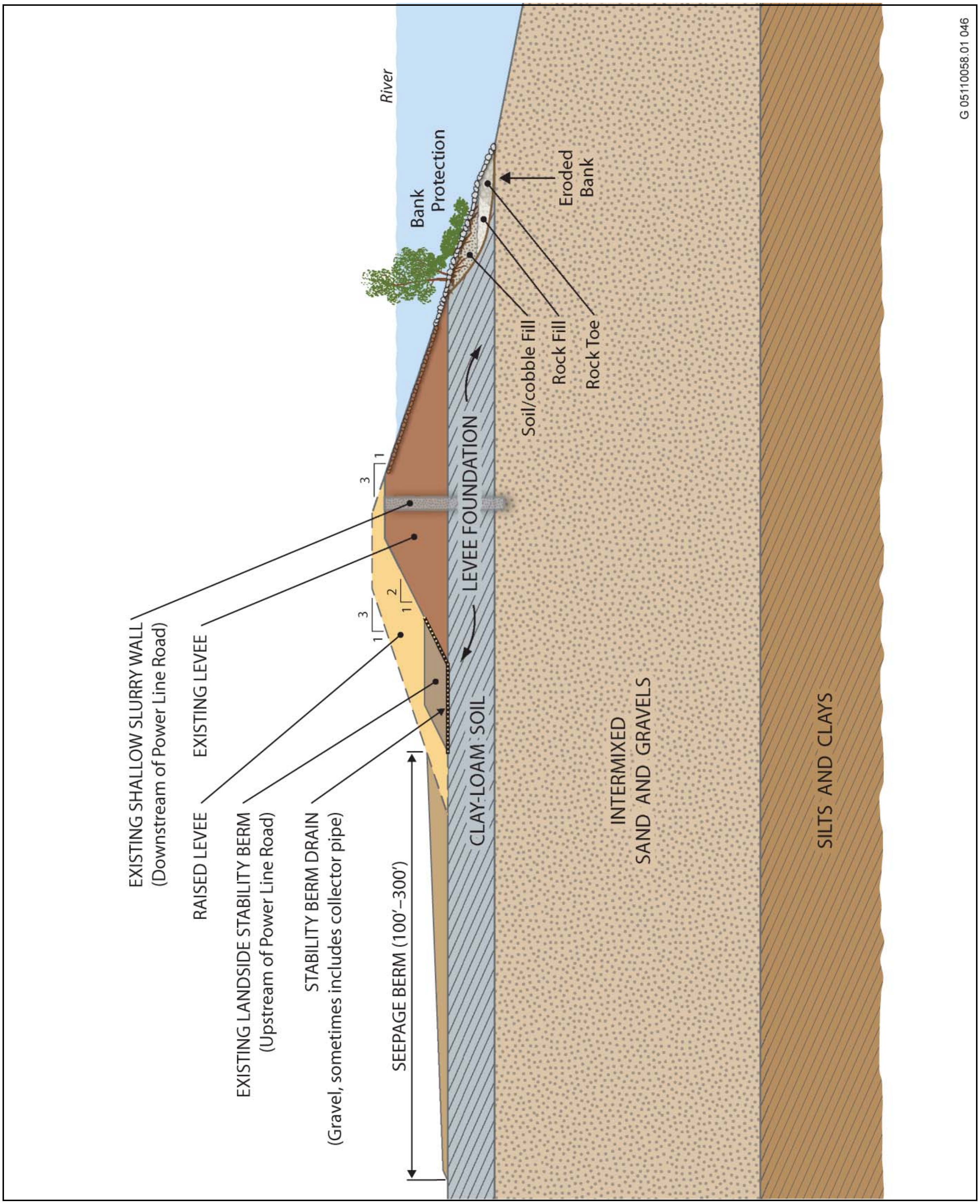
Sources: HDR 2007, adapted by EDAW in 2008

Alternative Methods for Increasing Levee Height **Exhibit 2-6**



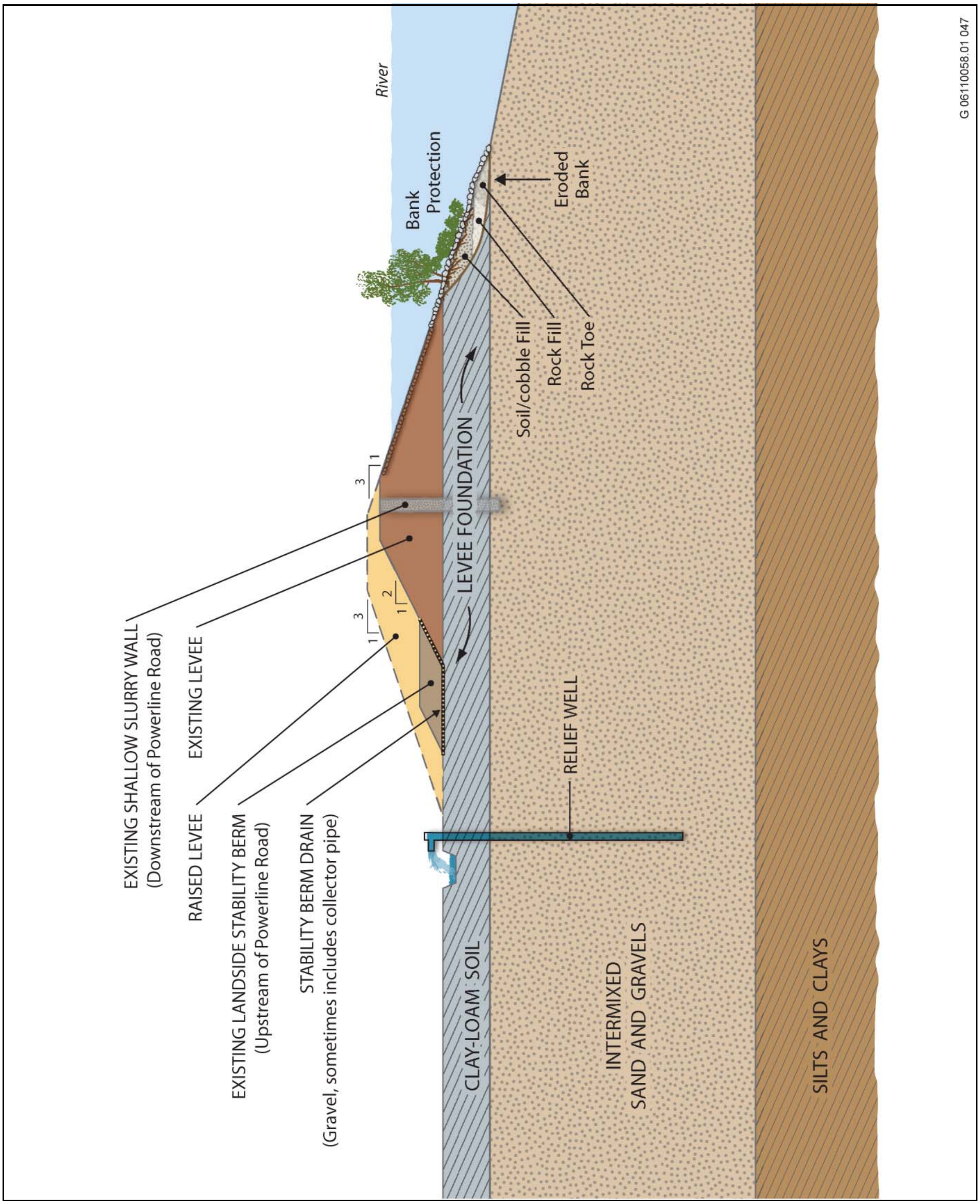
Source: SAFCA 2007, Illustration prepared by Jones & Stokes

Typical Levee Raise, Flattening of landside Levee Slope, and Seepage Cutoff Wall **Exhibit 2-7**



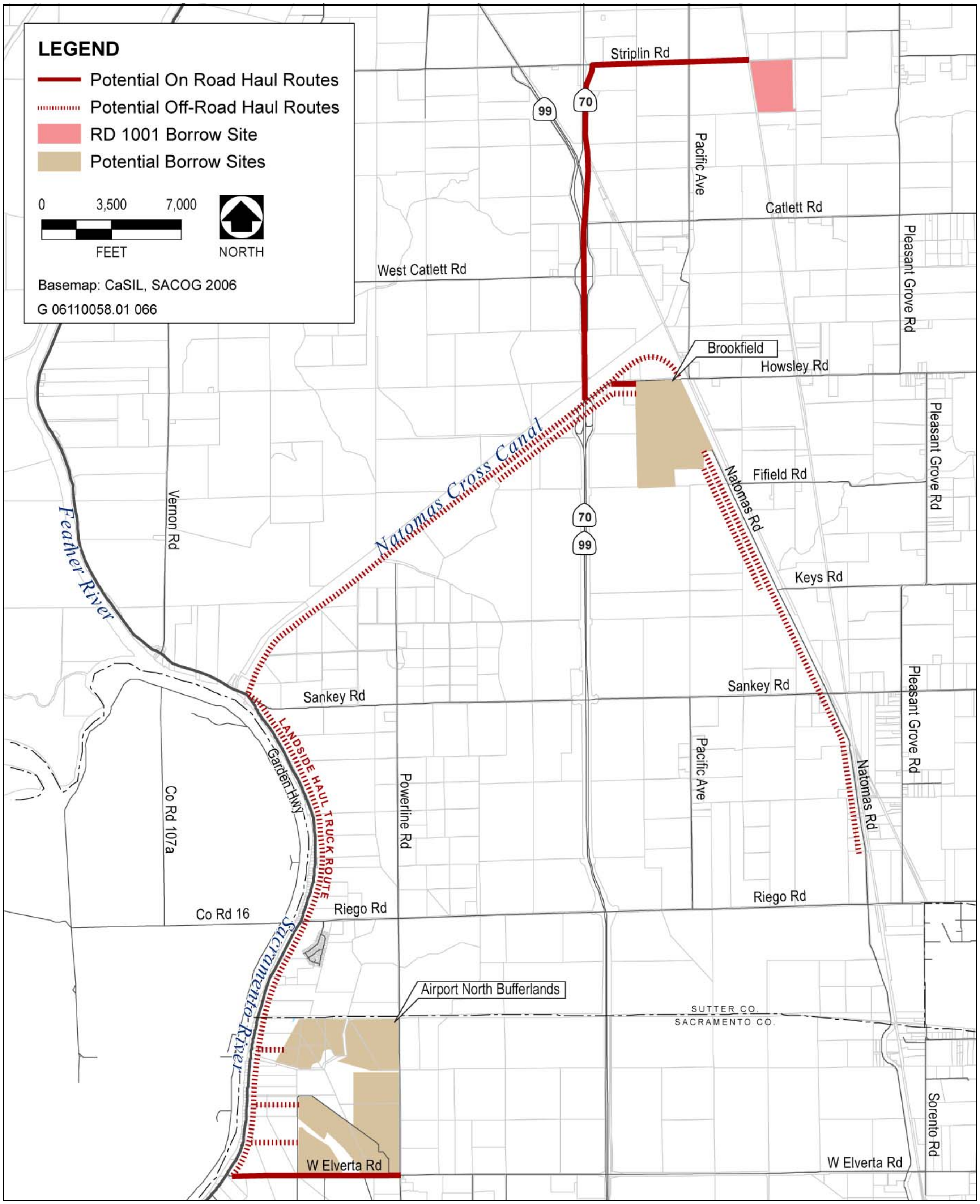
Source: SAFCA 2007, Illustration prepared by Jones & Stokes

Typical Seepage Berm **Exhibit 2-8**



Source: SAFCA 2007, Illustration prepared by Jones & Stokes

Typical Relief Well **Exhibit 2-9**



Source: Prepared by EDAW 2008

Borrow Sites and Anticipated Haul Routes **Exhibit 2-10**

- **Replacement of Seepage Berms with Cutoff Walls in Sacramento River East Levee.** In Reaches 2 and 3 of the Sacramento River east levee, seepage berms would be replaced by approximately 6,200 feet of cutoff walls up to 65 feet deep from existing landside toe elevation. In Reach 1, approximately 4,500 feet of cutoff wall up to 25 feet deep and 300 feet of cutoff wall up to 65 feet deep would be constructed. In Reach 4A, 200 feet of cutoff wall up to 60 feet deep would be constructed.

- **Enlargement of Seepage Berm in Reach 4B of the Sacramento River East Levee.** In Reach 4B of the Sacramento River east levee, the seepage berm footprint would be extended farther (500 feet as opposed to 300 feet) from the setback levee for approximately 1,200 feet to accommodate a known cultural resources site. No relief wells would be installed, as was assumed in the 2007 Landside EIR. Any necessary monitoring wells would be located outside of the extended berm footprint. The enlarged berm would provide a protective cap over much of an area known to contain sensitive cultural resources.

- **Change in Airport North Bufferlands Baseline—Active Rice to Idle.** The existing conditions at the Airport north bufferlands borrow sites changed from “active rice cultivation,” which existed on June 4, 2007, the time of publication of the notice of preparation (NOP) for the 2007 Landside EIR, to “idle” because the agricultural leases for these lands expired on December 31, 2007. The Sacramento County Airport System has indicated that it will not be bringing these lands back into rice production. The NOP issued for the SEIR (October 2, 2008) acknowledges that these current, existing physical conditions constitute the baseline for this SEIR, i.e., the baseline for these lands are no longer in active rice, but idle. These lands are no longer considered giant garter snake habitat, and SAFCA has revised its borrow site reclamation plan to preplant all of the sites used for borrow sites to idle grassland. Previously, the site now called Grassland 4 was to be converted into a managed marsh after excavation of borrow material. The reclamation of all of the Airport north bufferlands borrow sites to idle grasslands will reduce potential impacts to aviation safety.

- **Design Details for Garden Highway Drainage Outfalls.** The surface drainage outlets across Garden Highway were discussed in the 2007 Landside EIR. However, SAFCA has since developed additional design and construction details. Between the Sacramento River adjacent setback levee and the Garden Highway pavement in Reaches 1 through 4B, new storm drainage collection facilities would be constructed to convey surface water beneath Garden Highway and toward the Sacramento River. A surface collection system (grassed drainage swale) would convey runoff water to drop inlets, and new pipe laterals would convey the water beneath Garden Highway to new outfalls in the berm along the east bank of the Sacramento River. In most locations, the outfalls would be placed above the ordinary high-water mark (2-year) water surface elevation. The location of the cross culverts would be selected to minimize impacts on existing residential properties and vegetation. These discharge pipes would require minor landscape improvements to control erosion and ensure that applicable water quality standards are met. Excavation of a trench across Garden Highway would be required, and those segments where excavation occurs would have to be reconstructed. Single-lane traffic controls and through-traffic detours would be required during this phase of construction. This work would be conducted in two headings (work sites) simultaneously.

- **Additional Preservation of High-Quality Foraging Habitat.** To mitigate the permanent loss of (high quality) foraging habitat within the foraging range of potentially impacted Swainson’s hawk nest locations, SAFCA would create or preserve in perpetuity approximately 90 acres of high-quality foraging habitat. This would be primarily achieved by the acquisition and reclamation of land used for borrow material, including a combination of the South Sutter (Thornton), Bianchi, and Novak borrow sites and approximately 14 acres of land acquired in Reach 2 of the Sacramento River east levee.

3 ENVIRONMENTAL SETTING, IMPACTS, AND MITIGATION MEASURES

This chapter describes the general approach to the environmental analysis, relevant environmental and regulatory setting information, and the results of the analysis of direct and indirect significant environmental impacts of the proposed project (project modifications). Section 3.1 discusses the general approach to the environmental impact analysis. The remainder of the chapter, Sections 3.2 through 3.5, describes by issue area the regulatory and environmental setting, significance criteria, and impacts and mitigation measures.

3.1 APPROACH TO THE ENVIRONMENTAL ANALYSIS

This SEIR supplements and makes adequate the information provided in the 2007 Landside EIR for purposes of consideration by the SAFCA Board of proposed modifications to the Phase 2 Project. As discussed in Section 1.4, “Documents Incorporated by Reference,” the California Environmental Quality Act Guidelines (State CEQA Guidelines) encourage incorporation by reference of previously analyzed and publicly circulated information (State CEQA Guidelines Section 15150). Where material is incorporated by reference, the relationship of the referenced material to the analyses in this document is explained. New environmental setting information is provided to evaluate new environmental impacts or to support updates of previously analyzed impacts due to proposed modifications to the Phase 2 Project. The documents incorporated by reference in this SEIR, the Local Funding EIR (State Clearinghouse Number 2006072098) and the 2007 Landside EIR (State Clearinghouse Number 2007062016), are available in electronic format on SAFCA’s web site and in hard copy at SAFCA’s office, located at 1007 7th Street, 7th Floor, Sacramento, California 95814. Interested parties may review these documents online or at SAFCA’s office during normal business hours.

In accordance with Sections 15126.2 and 15163 of the State CEQA Guidelines, this SEIR identifies and focuses on the significant direct and indirect environmental effects on the physical environment of the proposed modifications to the Phase 2 Project, giving due consideration to both its short-term (temporary) and its long-term effects. Short-term effects are generally temporary and associated with construction of the project. Long-term effects, or permanent effects, are generally associated with operation of flood control facilities. Updates to setting, impact, and mitigation discussions are provided only where information or project components have been modified and where discussion of these changes is necessary to provide sufficient analysis of impacts.

This chapter addresses the following issue areas:

- Section 3.2, “Hydrology and Water Quality”
- Section 3.3, “Terrestrial Biological Resources”
- Section 3.4, “Cultural Resources”
- Section 3.5, “Noise”

Sections 3.2 through 3.5 follow the same general format:

“Regulatory Setting” identifies the federal, state, regional, and local plans, policies, laws, regulations, and ordinances that are relevant to each issue area.

“Environmental Setting” provides, in accordance with State CEQA Guidelines Section 15125, a description of the existing physical conditions in the project area at the time the notice of preparation (NOP) was published (October 2, 2008) that could be affected by implementation of the proposed project (e.g., modifications to the Phase 2 Project).

“Environmental Impacts and Mitigation Measures” lists the significance criteria used in the impact analysis and identifies the direct and indirect impacts of the proposed project on the environment, in accordance with State

CEQA Guidelines Sections 15126, 15126.2, and 15143. The significance criteria (sometimes called "thresholds of significance") used in this SEIR are based on the checklist presented in Appendix G of the State CEQA Guidelines, best available data, professional judgment, and/or regulatory standards of federal, state, regional, and local agencies. The level of each impact is determined by comparing the effects of the proposed project to the existing physical conditions (the environmental setting) at the time the NOP for the SEIR was published.

The SEIR must describe any feasible measures that could avoid, minimize, rectify, reduce, or compensate for significant adverse impacts on the physical environment, and the measures are to be fully enforceable through incorporation into the project (Public Resources Code Section 21081.6[b]). Mitigation measures are not required for effects that are found to be less than significant. Where feasible mitigation for a significant impact is available, it is described following the impact. Each identified mitigation measure is labeled numerically to correspond with the number of the impact that would be mitigated by the measure. Where sufficient feasible mitigation is not available to reduce impacts to a less-than-significant level, the impacts are identified as "significant and unavoidable."

3.2 HYDROLOGY AND WATER QUALITY

This section evaluates the potential for the proposed modifications to cause adverse effects to water quality, groundwater, and current flood conditions. This section combines the "Water Quality" and "Hydrology and Hydraulics" issue areas that were discussed in separate sections in the 2007 Landside EIR.

3.2.1 REGULATORY SETTING

The "Regulatory Setting" in the 2007 Landside EIR has remained unchanged and is hereby incorporated by reference. The 2007 Landside EIR addressed the federal, state, regional, and local regulations, laws, and ordinances listed below.

FEDERAL

- Clean Water Act
- Sacramento River Flood Control Project
- National Flood Insurance Program

STATE

- Porter-Cologne Water Quality Control Act
- Water Quality Control Plan for the Sacramento and San Joaquin River Basins
- Clean Water Act, Section 303(d)
- Clean Water Act, Section 401
- California Toxics Rule and State Implementation Policy
- Waste Discharge Requirements and National Pollutant Discharge Elimination System Permits (NPDES)
- California Fish and Game Code Section 1602
- Central Valley Flood Protection Board
- Sacramento-San Joaquin River Basins, California, Comprehensive Study

LOCAL

- Reclamation District 1000

3.2.2 ENVIRONMENTAL SETTING

The "Environmental Setting" in the 2007 Landside EIR is hereby incorporated by reference. The 2007 Landside EIR described existing conditions for surface water quality, groundwater quality, surface water hydrology, and groundwater hydrology. Updated information concerning the setting for groundwater hydrology is provided below.

GROUNDWATER HYDROLOGY

Basin and Aquifer Description

The Natomas Basin lies in the North American Subbasin within the Sacramento Groundwater Basin. The North American Subbasin is bounded on the north by the Bear River, on the west by the Feather and Sacramento Rivers, and on the south by the Sacramento River in the west and the American River in the east. The eastern boundary is a north-south line extending from the Bear River south to Folsom Lake, which passes about 2 miles east of the city of Lincoln. The eastern boundary represents the approximate edge of the alluvial basin, where little or no groundwater flows into or out of the groundwater basin from the rock of the Sierra Nevada (DWR 1997). The eastern portion of the subbasin is characterized by low, rolling dissected uplands. The western portion is nearly a flat flood basin for the Bear, Feather, Sacramento and American Rivers, and several small east side tributaries. The general direction of drainage is west-southwest at an average grade of about 5% (DWR 2003).

California Department of Water Resources (DWR) Bulletin 118 (DWR 2003) describes the aquifer system in the subbasin as heterogeneous and consisting of many discontinuous beds of clay, silt, sand, and gravel. The water-bearing materials of the subbasin are dominated by unconsolidated continental deposits of Late Tertiary and Quaternary age deposits that include Miocene/Pliocene volcanics, older alluvium, and younger alluvium. Younger alluvium consisting of alluvial flood basin and stream channel deposits is present in the upper 100 feet in areas along and adjacent to the Sacramento and American Rivers. Sand and gravel zones, along with dredger tailings that are found sporadically along the American River, are highly permeable and yield significant quantities of water to wells. Older alluvium, deposited during Pliocene and Pleistocene times and occurring over the area between the Sierra foothills and the valley axis, consists of loosely to moderately compacted sand, silt, and gravel. Permeability varies considerably in these alluvial deposits (Valley Springs, Laguna, and Fair Oaks formations), which occupy the upper 200 to 300 feet of the aquifer system. Groundwater in the older alluvium is typically unconfined, although semiconfined conditions exist on localized levels. The Mehrten and older geologic units can be characterized as composing the lower aquifer system, which is generally deeper than 300 feet toward the west side of the subbasin. Typically, the level of confinement increases with depth. The cumulative thickness of these deposits increases from a few hundred feet near the Sierra Nevada foothills on the east to over 2,000 feet along the western margin of the subbasin. Most of the groundwater is produced in the northern portion of the subbasin. (DWR 2003.)

Groundwater Recharge and Local Levels

Major recharge to the local aquifer system generally occurs along active river and stream channels where extensive sand and gravel deposits exist, particularly in the American River and Sacramento River channels (SGA 2002). Where surface water is hydrologically disconnected from groundwater, it percolates through the unsaturated zone beneath the streambed to the groundwater and is a function of the underlying aquifer materials and water levels in the stream. Some evidence suggests this occurs in parts of the Sacramento River in northern Sacramento County (SGA 2003). In Western Placer County (northeast section of the subbasin), the rivers adjacent to the subbasin, including the Sacramento and Bear Rivers, and the major streams, ravines, and creeks that cross the valley floor are the main sources of recharge (Placer County Water Agency 2003). Other sources of recharge within the system include inflow of groundwater generally from the northeast; subsurface recharge from fractured geologic formations to the east; and deep percolation from applied surface water, precipitation, and small streams. The extensive agricultural operations in the Natomas Basin have also contributed to recharge there, with the portion of applied irrigation water in excess of crop demands becoming recharge water through deep percolation (SGA 2003).

Groundwater levels average 10 to 25 feet below ground surface in the Natomas Basin (MWH 2001). According to the Sacramento Groundwater Authority, hydrographs for wells in the western part of the North American Subbasin show groundwater levels varying between -5 and 20 feet mean spring groundwater level between wells.

Groundwater Storage

DWR's Bulletin 118 assumes a specific yield of 7% and an aquifer thickness of 200 feet for 200,000 acres within the North American Subbasin. Storage capacity can be estimated for the North American Subbasin by applying the same assumptions as previous DWR studies (DWR 1997), which indicated a specific yield of 7% and an assumed thickness of 200 feet over the entire 351,000-acre subbasin. The result is an estimated storage capacity of approximately 4.9 million acre-feet (DWR 2003).

Groundwater Budget

Luhdorff & Scalmanini Consulting Engineers (LSCE) prepared a report in August 2008 evaluating the potential groundwater impacts of the Natomas Levee Improvement Program (NLIP) (see Appendix B2). The report includes a groundwater budget for existing conditions (without SAFCA construction activities) in the Natomas Basin based on the final water year of the 1970–2004 calibration period for the Sacramento County Integrated Groundwater and Surface Water Model. The model results for 2004, shown in Table 3.2-1, are grouped into inflow and outflow components, with the change in storage representing the difference between the inflow and the outflow. The simulated change in storage shows a decline of almost 5,000 acre-feet per year (afy). Divided by the area of the Natomas Basin, this represents a small decrease in storage on a per-acre basis of less than 0.1 acre-foot per acre per year.

Table 3.2-1
Simulated Groundwater Budget for Natomas Basin—Existing Conditions

	Water Budget Component	2004 Simulation (AFY)
Inflow	Deep Percolation (Including Canal Seepage)	31,429
	Recharge from Sacramento River	6,469
	Recharge from American River	1,086
	Boundary Inflow from West	10,365
	Subsurface Inflow from North and South	2,955
	Total Inflow	**52,304**
Outflow	Groundwater Pumping	35,537
	Subsurface Outflow to East	21,738
	Subsurface Outflow to South	0
	Total Outflow	**57,275**
Inflow minus Outflow	**Change in Storage**	**-4,971**

Note: AFY = acre-feet per year
Source: Data adapted from Luhdorff & Scalmanini Consulting Engineers in 2008

3.2.3 Environmental Impacts and Mitigation Measures

Hydrologic impacts associated with the proposed modifications to the Phase 2 Project were evaluated based on changes in drainage, runoff, or groundwater storage. Water quality impacts that could result from project construction activities associated with the proposed modifications were evaluated based on the construction practices and materials used, the location and duration of the construction activities, and the potential for degradation of water quality or beneficial uses of project area waterways.

3.2.3.1 Significance Criteria

The thresholds for determining the significance of impacts for this analysis are based on the environmental checklist in Appendix G of the California Environmental Quality Act Guidelines. The proposed project was determined to result in a significant effect on water quality, drainage, or groundwater if it would:

- violate any water quality standards or waste discharge requirements or otherwise substantially degrade water quality.
- substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level;

- create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff;

- place housing within a 100-year flood hazard area or place within a 100-year flood hazard area structures that would impede or redirect flood flows;

- expose people or structures to a significant risk of loss, injury, or death involving flooding; or

- substantially alter the existing drainage pattern of a site or an area, or substantially increase the rate or amount of surface runoff in a manner that would result in flooding on-site or off-site.

The 2007 Landside EIR noted that the Phase 2 Project would not cause substantial increases in amounts of runoff or place housing or other structures, with the exception of flood control facilities, in a 100-year flood hazard area. Rather, the Phase 2 Project would result in substantial benefits by reducing flood risk. That discussion from the 2007 Landside EIR is hereby incorporated by reference, and these significance criteria are not further discussed in this SEIR.

The 2007 Landside EIR addressed temporary effects on water quality from stormwater runoff, erosion, and spills associated with construction; that analysis is hereby incorporated by reference. The proposed modifications to the Phase 2 Project would not change the types of construction activities and would not create new sources of stormwater runoff, erosion, and spills associated with their construction. This impact is not further discussed in this SEIR.

The 2007 Landside EIR addressed alteration of local drainage through relocation of drainage and irrigation canals and ditches, and that analysis is hereby incorporated by reference. The proposed project modifications would not involve design changes that would alter locatal drainage compared to what was previously analyzed. This impact is not further discussed in this SEIR. Impact 3.2a below provides additional analysis of the possible water quality effects from stormwater runoff from Garden Highway Drainage Outlets that were discussed in the 2007 Landside EIR.

The 2007 Landside EIR addressed the effects on water quality from groundwater discharged by relief wells, and that analysis is hereby incorporated by reference. The proposed modifications to the Phase 2 Project would not create new sources of potential groundwater contamination, and this impact is not further discussed in this SEIR.

In determining whether a proposed project would expose people or structures to a significant risk as a result of flooding, SAFCA uses the following thresholds:

- Would the proposed project cause encroachment on the Sacramento River Flood Control Project (SRFCP) design levee freeboard outside the project area?

- Would the proposed project cause a significant increase in flooding, defined as an increase of 0.1 foot or more, in an area that is outside the protection of the SRFCP?

- The 2007 Landside EIR addressed the potential hydraulic impacts of the Phase 2 Project, and that analysis is hereby incorporated by reference. The proposed modifications to the Phase 2 Project would not increase 100-year or “200-year” water surface elevations, and therefore would not expose people or structures to a significant risk as a result of flooding. This threshold is not further discussed in this SEIR.

3.2.3.2 IMPACT ANALYSIS

IMPACT 3.2-a	Possible Effects on Water Quality from Stormwater Runoff from Garden Highway Drainage Outlets to the Sacramento River. *Drainage outlets would convey surface water toward the Sacramento River through subsurface laterals and waterside drainage outfalls. Stormwater runoff from Garden Highway could degrade the water quality of the Sacramento River by discharging contaminants through the proposed drainage outlets. This potential impact would be* ***significant****.*

The proposed project modifications would involve construction of a new drainage system along Garden Highway in Reaches 1–4B to collect surface water from the drainage area between the existing highway and the new adjacent levee and convey it beneath Garden Highway and toward the Sacramento River. The surface water would collect in drainage swales between Garden Highway and the adjacent setback levee and drain through pipe laterals under Garden Highway to outfalls in the berm along the east bank of the Sacramento River. Without treatment, stormwater runoff from Garden Highway could degrade the water quality of the Sacramento River by discharging water containing metals, oil and grease, solvents, phosphates, hydrocarbons, break-lining dust, and suspended solids through the proposed drainage outlets. This impact would be significant.

Mitigation Measure 3.2-a: Implement Standard Best Management Practices and Comply with NPDES Permit Conditions.

SAFCA and its engineering consultants shall implement a suite of stormwater quality best management practices (BMPs) designed to remove contaminants from water discharging through the Garden Highway outlets. These BMPs shall be based on the *Stormwater Quality Design Manual for Sacramento and South Placer Regions* (May 2007), meet “maximum extent practicable” and “best conventional technology/best available technology” requirements, and comply with NPDES permit conditions.

Implementing this mitigation measure would reduce the potential impact on water quality from stormwater runoff associated with drainage from Garden Highway caused by the Phase 2 Project modifications to a **less-than-significant** level.

IMPACT 3.2-b	Possible Effects on Groundwater. *Installation of the proposed cutoff walls along the Sacramento River east levee could potentially increase or decrease localized near-surface groundwater levels in areas immediately east and west of the cutoff wall. A significant drop in groundwater levels could decrease the yields of nearby wells or increase pumping costs.. Modeling of these potential effects found no measurable decrease in groundwater levels or well yields. This impact would be* ***less than significant****.*

The proposed modifications include installation of approximately 11,700 feet of cutoff walls ranging in depth from 35 feet to 80 feet deep in the adjacent setback levee in Reaches 1–4 B of the Sacramento River. The presence of cutoff walls could restrict the movement of groundwater in either direction (away from or toward the Sacramento River), potentially increasing or decreasing localized near-surface groundwater levels in areas immediately east and west of the cutoff wall. A significant drop in groundwater levels could decrease the yields of nearby wells or increase the pumping costs of those wells.

Kleinfelder (Appendix B1) estimated the water-level changes caused by the cutoff walls along the Sacramento east levee using the SEEP/W groundwater model. On the river side of the levee, the predicted effect of the cutoff wall is negligible at the low stage, and there would be a slight increase in groundwater levels (less than 1 foot) at the high stage. On the land side of the levee, the simulated groundwater levels would be slightly lower (typically 0.25 to 0.5 foot) because of the cutoff wall. In both cases, any impacts would be small enough to be considered negligible even for the shallowest domestic wells (less than 100 feet deep), because the project modifications would not significantly decrease groundwater levels or well yields or cause an increase pumping costs; therefore, this impact would be less than significant.

Mitigation Measure: No mitigation is required.

IMPACT 3.2-c	**Cumulative Effects on Groundwater.** *Implementation of all phases of the NLIP in combination with existing and projected land and water use changes in the Natomas Basin could adversely affect the groundwater budget for the Natomas Basin. Modeling found a negligible cumulative effect on both the groundwater budget for the Natomas Basin and on outflow to adjacent areas. The project modifications would not contribute considerably to a significant cumulative effect. This impact would be* ***less than significant****.*

The evaluation of potential groundwater impacts prepared by LSCE investigated the impacts of the proposed project, in combination with existing and projected land and water use changes in the Natomas Basin, on the basin's groundwater budget (see Appendix B2 in this SEIR for the full report). The estimated groundwater budget for existing conditions was modeled using historical data through the year 2004. The water budget for future conditions is based on a simulation conducted by Water Resources and Information Management Engineering, Inc., to estimate the effect of proposed land and water use changes caused by the proposed developments in the North American Subbasin on groundwater conditions in 2030.

The impacts of the proposed project modifications would include reduced irrigated lands covered by the footprint of the proposed levee improvements, increased recharge from the proposed canal improvements, and changed land use and irrigation practices following excavation of soil and reclamation of the potential borrow sites. These impacts are summarized in Tables 5-3 and 5-4 of the LSCE report in Appendix B2. The report also evaluated the potential impacts on subsurface flows to and from the Natomas Basin as a result of the installation of cutoff walls in levees.

Without the proposed project, the 2004 simulation results show a reduction in groundwater storage of 4,971 afy in the Natomas Basin. With the proposed project, the decrease in groundwater storage would be slightly smaller (4,248 afy). Subsurface outflow from the Natomas Basin to the east would decrease slightly (from 21,738 to 21,118 afy) as a result of the proposed project. Overall, the proposed project would have a small positive impact on groundwater supplies in the Natomas Basin and a small negative impact on groundwater east of the Natomas Basin, based on existing conditions.

The results of the 2030 simulation without the proposed project show a positive change in groundwater storage in the Natomas Basin of 1,572 afy. With the proposed project, this positive change would be reduced slightly to 1,527 afy. The proposed cutoff walls would cause a small increase in groundwater outflow (from 1,200 to 1,238 afy). Overall, the cumulative impact of the proposed project on future groundwater conditions is predicted to be negligible.

The project modifications would not contribute considerably to a significant cumulative effect. Therefore, this impact is less than significant.

Mitigation Measure: No mitigation is required.

3.3 TERRESTRIAL BIOLOGICAL RESOURCES

This section addresses terrestrial biological resources that could be affected by implementation of proposed modifications to the Phase 2 Project. The information presented is based on field surveys and a review of existing documentation, some of which has been updated since certification of the 2007 Landside EIR. Existing information reviewed for preparation of this section includes documents that discuss biological resources in the region, such as the *Natomas Basin Habitat Conservation Plan* (NBHCP) (City of Sacramento, Sutter County, and The Natomas Basin Conservancy 2003) and annual monitoring reports of The Natomas Basin Conservancy (TNBC).

This section also updates impact analyses based on ongoing negotiations with the U.S. Fish and Wildlife Service (USFWS) and California Department of Fish and Game (DFG) for special-status species (giant garter snake and Swainson's hawk). The Section 7 consultation with USFWS resulted in issuance of a programmatic biological opinion (BO) in October 2008 for the Phase 2, Phase 3, and Phase 4 Projects of the NLIP, with incidental take authorization for the Phase 2 Project only. The BO analyzed both program-level and project-level impacts and mitigation based on available information, some of which has changed since certification of the 2007 Landside EIR. In addition, ongoing coordination with DFG has resulted in an overall program-level plan to mitigate impacts on Swainson's hawk nesting and foraging habitat for the Phase 2, Phase 3, and Phase 4 Projects. Finally, the proposed modifications to the Phase 2 Project related to special-species habitat would changes acreage calculations for the entire program, including habitat that would compensate for impacts of both the Phase 3 and Phase 4 Projects. Therefore, this section provides both project-level and program-level impact analysis for special-status species.

3.3.1 REGULATORY SETTING

The "Regulatory Setting" in the 2007 Landside EIR has remained unchanged and is hereby incorporated by reference. The 2007 Landside EIR addressed the federal, state, regional, and local regulations, laws, and ordinances listed below.

Federal

- Federal Endangered Species Act
- Clean Water Act (CWA)
- Migratory Bird Treaty Act

State

- California Endangered Species Act
- California Fish and Game Code Sections 3503 and 3503.5—Protection of Bird Nests and Raptors
- California Fish and Game Code—Fully Protected Species
- California Fish and Game Code Section 1602—Streambed Alteration
- Porter-Cologne Water Quality Control Act—California Water Code Section 13000 et seq.

Local

- Natomas Basin Habitat Conservation Plan
- County and City Policies and Ordinances

3.3.2 ENVIRONMENTAL SETTING

With the exception of Sensitive Habitats, the "Environmental Setting" in the 2007 Landside EIR has remained unchanged for the topics listed below and is hereby incorporated by reference. The 2007 Landside EIR described land use and vegetation, wildlife, sensitive biological resources, and special-status species. The environmental setting associated with the project modifications is briefly described below under each impact statement.

- Land Use and Vegetation
- Wildlife
- Sensitive Biological Resources
- Special-Status Species

Sensitive Habitats

Sensitive habitats are habitats that are of special concern to resource agencies or that are afforded specific consideration through CEQA, Section 1602 of the California Fish and Game Code, and/or Section 404 of the Clean Water Act, as discussed above in Section 3.7.1, "Regulatory Setting," of the 2007 Landside EIR.

Irrigation/drainage canals and ditches in the project area are anticipated to be considered waters of the United States and subject to regulation under CWA Section 404. Other permanently and/or seasonally wet habitats, such as freshwater marsh and seasonal wetland, could qualify as wetlands subject to Section 404 regulation if they are adjacent or connected to waters of the United States. Wetland delineations have been completed and verified for the Natomas Cross Canal (NCC) portion of the project area (verified by the U.S. Army Corps of Engineers [USACE] on November 7, 2006), the Sacramento River east levee portion of the project area, and the Airport north bufferlands and Brookfield borrow sites (verified by USACE on July 24, 2008). The NCC delineation concluded that the NCC and irrigation/drainage ditches and seasonal wetlands south of the levee are under USACE jurisdiction; this delineation was verified by USACE on November 7, 2006. The verified delineation report covering the anticipated Sacramento River east levee, Airport north bufferlands, and Brookfield borrow site footprint for Phase 2 Project elements (levee improvements and canal relocations, including borrow operations at the Airport north bufferlands and Brookfield sites) identifies the following features as potentially jurisdictional: irrigation and drainage ditches and canals along the toe of the levee, lateral ditches that connect with these, seasonal wetlands and irrigated wetlands within the Airport north bufferlands and the rice fields of the Brookfield borrow areas, and patches of freshwater marsh and slough north of the Teal Bend Golf Club. In addition, some of the discharge pipes conveying filtered stormwater drainage from the east levee to the east bank of the Sacramento River might extend to areas within CWA and/or Rivers and Harbors Act jurisdiction.

All of these aquatic habitats are also anticipated to qualify as waters of the state and regulation under the Porter-Cologne Water Quality Control Act. In addition, waterways and associated riparian habitats are likely subject to regulation under Section 1600 et seq. of the California Fish and Game Code.

The functional quality and value of an aquatic resource is considered by USACE as part of the CWA Section 404 regulatory process. Functions may be generally categorized as low, moderate, or high, defined for the purposes of this SEIR as follows:

- **High:** Natural structure and function of biotic community exists, with minimal changes in structure or function evident—i.e., zero to low levels of human disturbance (e.g., natural plant communities intact, no artificial structures present, sensitive plant and/or wildlife species utilization);

- **Moderate:** Moderate levels of disturbance (e.g., natural plant communities intact with some evidence of nonnative vegetation, low-intensity developments such as trails, selective vegetation management for flood control purposes); or

- **Low:** High levels of disturbance (e.g., vegetation disking for fire clearance purposes, dominance of monotypic stands of nonnative vegetation, presence of human-made structures).

The Phase 2 Project features with one or more of the functional qualities identified above are generally irrigation canals and irrigation/drainage ditches (low); seasonal wetlands near the toe of the NCC south levee and in the

Airport north bufferlands area (moderate); and slough, freshwater marsh, NCC, and Sacramento River bank (moderate to high).

Other habitats considered sensitive by DFG include those identified as “rare and worthy of consideration” in natural communities recognized by the California Natural Diversity Database (CNDDB). These sensitive communities provide essential habitat to special-status species that are often restricted in distribution or decreasing throughout their range. Some woodland patches within the project area could be categorized as Great Valley cottonwood riparian forest, which is a natural community documented in the CNDDB.

The existing conditions at the Airport north bufferlands borrow sites changed from “active rice cultivation,” which existed on June 4, 2007, the time of publication of the notice of preparation (NOP) for the 2007 Landside EIR, to “idle” because the agricultural leases for these lands expired on December 31, 2007. The Sacramento County Airport System has indicated that it will not be bringing these lands back into rice production. These lands are no longer considered giant garter snake aquatic habitat, and SAFCA has revised its reclamation plan to convert all of the sites used for borrow sites to managed grassland. Previously, the site now called Grassland 4 was to be converted into a managed marsh after excavation of borrow material.

3.3.3 Environmental Impacts and Mitigation Measures

3.3.3.1 Significance Criteria

The thresholds for determining the significance of impacts for this analysis are based on the environmental checklist in Appendix G of the State CEQA Guidelines. The proposed project modifications were determined to result in a significant effect related to terrestrial biological resources if they would:

- have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by DFG or USFWS;
- have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in any local or regional plans, policies, or regulations, or by DFG or USFWS;
- have a substantial adverse effect on federally protected waters of the United States, including wetlands, as defined by Section 404 of the CWA (including but not limited to marshes, vernal pools, rivers) through direct removal, filling, hydrological interruption, or other means;
- interfere substantially with the movement of any native resident or migratory wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites;
- conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance; or
- conflict with the provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved local, regional, or state habitat conservation plan.

The 2007 Landside EIR addressed the impacts caused by the disturbance and loss of special-status plant habitat, loss of potential habitat for valley elderberry longhorn beetle (VELB), disturbance and loss of northwestern pond turtle habitat, loss and disturbance of habitat for other special-status birds, loss and/or disturbance of wildlife corridors, and consistency with the NBHCP. No significant changes in the project description have occurred that would affect the severity of the above-mentioned impacts or mitigation for those impacts and that analysis is hereby incorporated by reference. Impacts that have been affected by the proposed Phase 2 Project modifications are discussed below.

3.3.4 IMPACT ANALYSIS

Consistent with the overall approach to this document and for purposes of CEQA compliance, the analysis presented below addresses effects from the proposed project modifications.

IMPACT 3.3-a	Loss of Sensitive Habitats. *The proposed modifications to the Phase 2 Project include construction of new drainage outfalls in Reaches 1–4B of the Sacramento River east levee. Placement of these outfalls would result in fill of waters of the United States and potential removal of some riparian vegetation. This impact would be **significant**.*

In Reaches 1 through 4B of the Sacramento River east levee, where the adjacent levee would be constructed and would be higher than the existing levee, runoff filtered through a grass-lined swale would be conveyed in pipes from the swale between the existing levee and the new adjacent levee in approximately 23 new drainage outfalls in the berm along the east bank of the Sacramento River. Although most of the outfalls would be placed above the ordinary high-water mark and are not expected to result in filling of waters of the United States, some of the outfalls are anticipated to result in filling of 0.02 acre of waters of the United States. In addition, construction of these outfalls could result in removal of some minor amounts of riparian vegetation. This impact would be significant.

Mitigation Measure 3.3-a: Minimize Effects on Sensitive Habitats; Develop and Implement a Habitat Management Plan to Ensure Compensation for Unavoidable Adverse Effects; Comply with Section 404, Section 401, and Section 1602 Permit Processes; and Implement all Permit Conditions.

Mitigation Measure 3.7-a from the 2007 Landside EIR, which remains unchanged, is copied below.

SAFCA and its primary contractors for engineering design and construction shall ensure that the following measures are implemented to avoid, minimize, and compensate for potential project effects on sensitive habitats.

Areas of sensitive habitat shall be identified and the primary engineering and construction contractors shall ensure, through coordination with a qualified biologist retained by SAFCA, that staging areas and access routes are designed to minimize disturbance of canals and ditches, seasonal wetlands, and woodland patches. Trees within the Sacramento County portion of the project area that qualify as Native Oaks or Heritage Trees under Sacramento County's tree preservation ordinance shall be identified. All sensitive habitats and protected trees that are located adjacent to construction areas, but can be avoided, shall be protected by temporary fencing during construction.

SAFCA shall develop and implement a habitat management plan to address establishment and management of aquatic (i.e., GGS/Drainage Canal and marsh/seasonal wetland habitat) and woodland habitats that are created as part of the proposed project in order to ensure that the performance standard of no net loss of sensitive habitat is met. The plan shall, at a minimum, establish specific requirements for habitat creation (e.g., acreage of specific habitats to be created and number and species of trees to be planted), success criteria for habitat creation (e.g., tree survival requirements), specify remedial measures to be undertaken if success criteria are not met (e.g., supplementary plantings and additional monitoring), and describe short- and long-term maintenance and management of the features. Long-term protection of the created features, and funding for their management, shall be provided through appropriate mechanisms to be determined by SAFCA, in consultation with the regulatory agencies and other entities cooperating in implementation of the proposed project. The management plan for the habitat creation components of the proposed project shall be reviewed and approved by the appropriate resource agencies before project implementation.

Applicable permits, including a Section 404 permit from the USACE, Section 401 certification from the Central Valley RWQCB, and a Section 1602 streambed alteration agreement from DFG, shall be obtained before any impact on the relevant resources occurs. All measures adopted through these permitting processes shall be implemented.

Implementation of the project modifications and the measures contained in previously adopted Mitigation Measure 3.7-a of the 2007 Landside EIR would ensure that adverse effects on sensitive habitats are minimized and an overall performance criterion of no net loss in acreage, function, and value of sensitive habitats is met. This would reduce the impact on sensitive habitats to a **less-than-significant** level.

IMPACT 3.3-b	Disturbance and Loss of Giant Garter Snake Habitat. *Implementation of the Phase 2 Project with proposed modifications would result in disturbance and loss of aquatic and upland habitat for giant garter snake. The project would also result in creation of habitat for the snake, but specific requirements have not been established to ensure that appropriate habitat conditions are provided to adequately replace the habitat values that would be lost. Project construction also has the potential to result in direct take of giant garter snake individuals. This impact would be* ***significant****.*

Ongoing formal consultation and coordination with USFWS, DFG, and USACE have resulted in a change in the environmental baseline for giant garter snake aquatic and upland habitat values. Since certification of the 2007 Landside EIR, the Sacramento County Airport System (Airport) has allowed the agricultural leases for rice cultivation to expire on all the Airport bufferlands, including the Airport north bufferland sites to be used for borrow material for work on the Sacramento River east levee. Because the Airport north bufferlands will no longer be cultivated for rice, these are no longer considered giant garter snake aquatic habitat. To account for this change, the analysis of impacts on giant garter snake aquatic habitat (and associated compensation through Section 7 of the ESA) has been modified as follows.

Irrigation and drainage ditches, rice fields, managed marsh, and remnant marsh within the Natomas Basin provide critically important aquatic habitat for the basin's giant garter snake population. Suitable upland adjacent to these aquatic habitats is very limited and, in some areas, is provided almost exclusively by agricultural field boundaries and levee slopes and maintenance corridors. In general, recent occurrences of giant garter snake have been concentrated in the central and northern portions of the basin and opportunities for exchange of individuals between key populations in the northern concentration of TNBC reserves and the population at Fisherman's Lake in the south are limited (TNBC 2007). The project area provides habitat of varying quality for giant garter snake, depending on the location. In general, irrigation ditches on the far western side of the Natomas Basin, along the toe of the Sacramento River east levee, are of poor habitat quality. Sections of these ditches are concrete lined, and in the southern portion of the basin they are bordered by development. In contrast, rice fields, canals, and TNBC lands within and adjacent to the northern portion of the project area provide high-quality habitat and support a known population.

The proposed project would result in permanent loss and disturbance of potential giant garter snake habitat. However, it also includes components that would result in creation, enhancement, and preservation of habitat, including the Giant Garter Snake (GGS)/Drainage Canal (created in previously unsuitable habitat), managed marsh (created on certain rice and other agricultural fields that are used for borrow), and rice land preserved in rice production. Table 3.3-1 summarizes the changes in giant garter snake habitat that would result from the proposed project, including habitat loss, creation, enhancement, and preservation. This table provides data for the Phase 2, Phase 3, and Phase 4 Projects, and has been updated since certification of the 2007 Landside EIR.

Habitat loss and disturbance could adversely affect giant garter snake populations in the Natomas Basin if the snakes rely on the affected areas. This is unlikely to be the case for irrigation ditches along the toe of the Sacramento River east levee, but snakes are likely to use rice fields in the northern portion of the basin that would be used for borrow. Fill, temporary dewatering, and other construction disturbances would adversely affect snakes using the affected habitats. Project construction activities in areas of potentially suitable habitat could also result in direct disturbance and loss of individual giant garter snakes. Despite the habitat creation components of the

Table 3.3-1 Permanent Effects of the NLIP on Giant Garter Snake Habitat	
Location	Effects
Phase 2 Project Habitat Effects	
Canal Habitat Near Natomas Cross Canal (NCC) South Levee	0.7 acre
Rice Near NCC South Levee and Sacramento River East Levee	25 acres
Canal/Ditch Habitat Near Sacramento River East Levee	1.1 acres
Phase 3 and Phase 4 Habitat Effects	
Canal/Ditch and Elkhorn Reservoir Habitat Near Sacramento River East Levee	15 acres
Canal Habitat Near the Airport West Ditch	5 acres
Canal Habitat Near Pleasant Grove Creek Canal (PGCC) West Levee	0.5 acre
Rice Near PGCC West Levee	45 acres
Rice in Riverside Canal footprint	2.73 acres
Rice in Reclamation District 1000 Pumping Plant No. 2 footprint	0.25 acre
Rice in Fisherman's Lake Area (conversion to managed marsh)	55 acres
Total of Permanent Effects	**22.3 acres canal/ditch 127.98 acres rice**
Habitat Creation in Project Design	
Canal Habitat	105 acres
Marsh Habitat	72.98 acres
Preserved Rice	175 acres
Source: Data compiled by EDAW in 2008	

project, there would be some temporal loss in potential habitat while the created habitat develops into a suitable state. This temporal loss would be minimized by constructing the replacement irrigation and GGS/Drainage Canal before most of the fill of existing ditches and canals occurs, providing some time for habitat development before the loss. In addition, marsh habitat creation would occur as soon after borrow extraction as possible.

Adverse effects on giant garter snake habitat within the Phase 2 Project footprint would occur along the NCC south levee and Reaches 1 and 4B of the Sacramento River east levee. Most of the work along the NCC south levee would occur within 200 feet of suitable aquatic habitat for giant garter snake provided by irrigation/drainage canals near the landside toe of the levee. Therefore, potentially suitable uplands adjacent to this aquatic habitat would be disturbed during construction. The limited amount of waterside levee expansion in Reaches 6 and 7 would not result in loss of aquatic habitat typically present during the snake's active season. In addition, the NCC provides poor-quality habitat for giant garter snake and there is little evidence to suggest the species regularly occurs in the NCC. On the land side of the NCC south levee, less than 1 acre of irrigation/drainage canal (where the ends of the canals approach the levee toe) would be filled or realigned to eliminate excavated areas near the levee. This is anticipated to result in permanent loss of less that 0.7 acre of canal habitat.

Approximately 25 acres of rice field in Reach 1 of the NCC south levee and Reach 1 of the Sacramento River east levee, and 0.5 acre of a minor irrigation ditch in Reach 1 and 0.5 acre of irrigation canal in Reach 4B of the Sacramento River east levee, would be filled to accommodate levee expansion and construction of the adjacent levee. Temporary disturbance of approximately 0.5 acre of aquatic habitat would occur where the Elkhorn Main Irrigation Canal (Elkhorn Canal) and the GGS/Drainage Canal connect to existing lateral canals. Borrow material for construction is anticipated to come from a combination of the Brookfield borrow site (up to 190 acres assumed for the Phase 2 Project) and the Airport north bufferlands (up to 225 acres assumed for the Phase 2 Project). The Brookfield borrow area would be returned to rice production after borrow extraction, and the Airport borrow area would be reclaimed as grassland. (The Sacramento County Airport System has chosen not to renew agricultural leases, which expired December 31, 2007, on its lands north of the Airport, and has allowed these lands to become idle.) The RD 1001 borrow site (120 acres) north of the Natomas Basin also could be used during Phase 2 Project construction, in place of the Brookfield site.

The nature of adverse effects on giant garter snakes and their habitat in the Phase 3 and Phase 4 Projects would be similar to those described for the Phase 2 Project, but the acreages of impact would be greater. Sacramento River east levee improvements in the Phase 3 Project would result in permanent fill of approximately 12 acres of irrigation canal and 1 acre of Elkhorn Reservoir along the landside toe of the levee. The existing irrigation canals along the levee toe generally provide poor-quality habitat, and no giant garter snakes have been documented in them. However, the canals represent potential habitat for giant garter snake and are a component of the overall area of habitat available in the Natomas Basin and addressed in the NBHCP. Approximately 2 additional acres of lateral irrigation/drainage ditch segments within the levee improvement footprint, and between the new levee features and replacement irrigation canals and the GGS/Drainage Canal, would be filled. The Airport West Ditch, which supports approximately 6.5 acres of potential giant garter snake aquatic habitat, would be dewatered as part of the irrigation and drainage infrastructure reconfiguration. Finally, approximately 2 acres of irrigation/drainage canal along the toe of the Pleasant Grove Creek Canal (PGCC) levee would require relocation to accommodate the levee raise and seepage remediation in 2010, and portions of rice fields adjacent to the levee could be lost if seepage berms are constructed. Based on a 100-foot-wide seepage berm that could be required in portions of these reaches, approximately 23 acres of rice fields could be lost. Borrow material for the Phase 3 and Phase 4 Projects is anticipated to come from a combination of the Brookfield, Krumenacher, Pacific Terrace, Bianchi, and South Sutter (Thornton) properties, private property in Sacramento River east levee reaches 7–9B, and/or agricultural fields in the vicinity of Fisherman’s Lake. Approximately 160 acres of land which would potentially include rice fields would be used for the PGCC work, and approximately 500 acres of mixed agricultural land (rice and/or field/row crops/fallow crop) would be used for the Sacramento River east levee improvements.

The loss and disturbance of giant garter snake habitat would be offset by the habitat creation and preservation components of the project. In the Phase 2 Project, giant garter snake habitat creation would include approximately 33 acres of aquatic habitat in the new GGS/Drainage Canal and new Elkhorn Canal. Up to 175 acres of existing privately owned rice fields in the northern portion of the basin would also be acquired and preserved either in public ownership or under the control of the TNBC. In the Phase 3 and Phase 4 Projects, an additional 72 acres of aquatic and associated upland habitat would be created in the new GGS/Drainage Canal, enhancement of the existing Western Drainage Canal, and the new Elkhorn and Riverside canals. An additional approximately 73 acres of managed marsh habitat would be created in the vicinity of Fisherman’s Lake.

The habitat quality of the GGS/Drainage Canal and West Drainage Canal is anticipated to eventually be substantially higher than the canal habitat that would be lost. Creation and enhancement of these canals would include a number of features designed to maximize the amount and quality of habitat, as well as minimize the need for maintenance activities that temporarily reduce habitat quality and can result in injury and mortality of giant garter snakes. In addition, the configuration and design of the GGS/Drainage Canal and West Drainage Canal enhancement were specifically formulated based on the goal of providing a functional travel corridor between giant garter snake populations in the northern and southern portions of the Natomas Basin. Loss and deterioration in the quality of existing travel corridors has been identified as a primary concern in maintaining a genetic connection between these two snake populations. Although the primary function of the replacement Elkhorn and Riverside Canals would be irrigation supply, they are anticipated to provide habitat comparable to that of the irrigation canals that would be filled as a result of the proposed project. They have also been designed to minimize maintenance and resulting habitat degradation and snake injury and mortality.

Although rice fields are an important component of giant garter snake habitat, the habitat value and quality of the created marsh habitat is anticipated to be of higher than that of the rice it would replace. The marsh areas would include uplands, which are a very important component of snake habitat that is nearly lacking in rice fields. Managed marsh also would provide habitat consistently from one year to the next, while rice fields can periodically sit fallow and fail to provide aquatic habitat during key periods. The marsh areas would also be managed in a manner that minimizes potential for snake injury and mortality that can result from typical farming practices. In addition, the preserved rice fields would be cultivated in a manner that maximizes habitat suitability and minimizes potential for injury and mortality.

Although the habitat loss would be compensated for by habitat creation and preservation, a plan has not yet been prepared specifying how canals and marsh that are designed to provide giant garter snake habitat would be managed to ensure that the appropriate habitat conditions are provided. Creation of replacement habitat that does not provide the essential components, and is not managed in a way that maximizes habitat quality and minimizes potential adverse effects on giant garter snake, could also result in a substantial adverse effect on the species. In addition, loss of individual giant garter snakes during construction could result in a substantial adverse effect on the species. These potential impacts would be significant.

Mitigation Measure 3.3-b: Minimize the Potential for Direct Loss of Giant Garter Snake Individuals, Develop and Implement a Management Plan in Consultation with USFWS and DFG, and Obtain Incidental Take Authorization.

Mitigation Measure 3.7-d from the 2007 Landside EIR, which remains unchanged, is copied below.

SAFCA and its primary contractors for engineering design and construction shall ensure that the following measures are implemented to avoid, minimize, and compensate for potential project effects on giant garter snakes.

The primary engineering and construction contractors shall ensure, through coordination with a qualified biologist retained by SAFCA, that staging areas and access routes are designed to minimize disturbance of giant garter snake habitat. All aquatic and adjacent upland habitat that is located adjacent to construction areas, but which can be avoided, shall be protected by temporary fencing during construction.

Additional measures consistent with the goals and objectives of the NBHCP shall be implemented to minimize the potential for direct injury or mortality of individual giant garter snakes during project construction. Such measures shall be finalized in consultation with DFG and USFWS, and are likely to include conducting worker awareness training, timing initial ground disturbance to correspond with the snake's active season (as feasible in combination with minimizing disturbance of nesting Swainson's hawks), dewatering aquatic habitat before fill, conducting preconstruction surveys, and conducting biological monitoring during construction.

SAFCA shall develop and implement a plan to address management of aquatic (i.e., GGS/Drainage Canal and marsh/seasonal wetland habitat) and adjacent upland habitats that are created and rice fields that are preserved as part of the project in order to ensure that the performance standard of no net loss in function and value of giant garter snake habitat is met. The management plan shall, at a minimum, establish specific success criteria for habitat creation, specify remedial measures to be undertaken if success criteria are not met (e.g., adaptive management, physical adjustments to created habitat, additional monitoring), and describe short- and long-term maintenance and management of the features. Long-term protection of the created features and funding for their management shall be provided through appropriate mechanisms to be determined by SAFCA, the regulatory agencies, and other entities cooperating in implementation of the proposed project.

The management plan for the giant garter snake habitat creation and preservation components of the project shall be reviewed and approved by USFWS and DFG before project implementation. Authorization for take of giant garter snake under ESA and CESA shall be obtained. All measures subsequently adopted through the permitting process shall be implemented.

Implementation of previously adopted Mitigation Measure 3.7-d from the 2007 Landside EIR would ensure that adverse effects from proposed modifications to giant garter snake are minimized and an overall performance criterion of no net loss in function and value of giant garter snake habitat is met. This would reduce the impact on giant garter snake to a **less-than-significant** level.

IMPACT 3.3-c — **Loss of Swainson's Hawk Habitat and Potential Disturbance of Nests.** *Implementation of the proposed project, including proposed modifications, would result in loss of suitable foraging and potential nesting habitat. Creation of suitable foraging and nesting habitat would also occur, but specific requirements have not been established to ensure that appropriate habitat conditions are provided to adequately replace the habitat values that would be lost. Project construction could also result in disturbance and potential failure of active nests for Swainson's hawk. This impact would be* ***significant.***

Ongoing coordination with DFG since certification of the 2007 Landside EIR has resulted in a reanalysis of effects and impacts on Swainson's hawk foraging habitat as a result of changes in land cover types. The impact discussion of foraging habitat quality and quantity has been modified to reflect those changes and potential impacts associated with those changes. As described in Section 2.2.2 of the SEIR, additional agricultural land to mitigate impacts on high-quality foraging habitat has been identified as part of the project and is included in the analysis below.

The project area is within a densely populated and critical component of the Central Valley Swainson's hawk population. Nesting pairs in the Natomas Basin may represent as much as 10% of the Swainson's hawks that are found in the Central Valley. Most nest sites are located in trees along the western portion of the basin along the waterside slopes of the Sacramento River; several nests are also typically scattered along the NCC and PGCC. Nesting habitat includes riparian and non-riparian woodlands. In addition to these nest sites adjacent to the project area, there are agricultural fields and grassland habitats (including levee and canal maintenance zones) throughout the project area that provide suitable foraging habitat for Swainson's hawk.

The proposed project would result in permanent loss and disturbance of Swainson's hawk foraging and nesting habitat. However, it also includes components that would result in creation and/or preservation of native perennial and annual grasslands and woodlands anticipated to provide suitable foraging and nesting habitat. Tables 3.3-2 and 3.3-3 provide a summary of changes in Swainson's hawk habitat that would result from the proposed project.

Table 3.3-2
Permanent Effects of the Project on Swainson's Hawk Foraging Habitat (in acres)

	Affected Cropland	Created/ Preserved Cropland*	Net Cropland	Impacted Grassland	Created Grassland	Net Grassland	Total Loss	Total Increase	Total Net
Phase 2	-236	152	-84	-152	316	164	-388	468	80
Phase 3	-139	60	-79	-71	235	163	-210	295	85
Phase 4	-177	0	-177	-45	290	245	-222	290	68
	-552	**212**	**-340**	**-267**	**840**	**573**	**-819**	**1,052**	**233**

Source: Data compiled by EDAW in 2008

* This includes 62 acres of croplands in two parcels that will become fallow due to their proximity to Phase 2 Project elements (the new GGS/Drainage Canal and relocated Elkhorn Canal). These parcels may be used for borrow in the Phase 3 Project and then reclaimed.

The conversion of foraging and nesting habitat for Swainson's hawk would occur from construction of levees, berms, and operation, maintenance, and utility corridors along the Sacramento River, PGCC, NCC, and Natomas East Main Drainage Canal; the construction of the new GGS/Drainage and realigned Elkhorn Canals; and the creation of woodland corridors. These activities would also impact some land types that do not support foraging or nesting habitat for Swainson's hawks, including developed areas, orchards, rice crops, and irrigation canals and ditches. However, the majority of the land conversion is from field crops into grasslands. The plan to offset impacts on foraging and nesting habitat includes preserving approximately 150 acres of high quality foraging habitat (field crops which include an alfalfa crop rotation) and 62 acres of fallow agricultural land, creating 840 acres of native perennial and annual grasslands, and creating 125 acres and preserving 10–20 acres of woodland corridors along the landside of the Sacramento River east levee.

Table 3.3-3
Permanent Effects of the Project on Swainson's Hawk Nesting Habitat (in acres)

	Affected Woodlands	Created/Preserved Woodlands	Net Woodlands
Phase 2	-17	63	**46**
Phase 3	-25	32	**7**
Phase 4	-40	45	**5**
	-82	**140**	**58**

Source: Data compiled by EDAW in 2008

Alfalfa and other irrigated field crops can generally provide higher quality foraging habitat than uncultivated annual grasslands and ruderal areas due to prey abundance and availability. The crops can provide abundant cover and food for prey populations. Further, periodic disturbances, such as harvesting, tilling, and flooding, can increase prey availability. Certain crops provide better foraging than others due to crop height and disturbance regime. Generally, alfalfa crops are considered the highest value foraging habitat for Swainson's hawk. Next, in order of preference, is grass hay, fallow crops, row and grain crops, and finally grasslands (Estep 2007, Woodbridge 1998). Alfalfa crops are typically managed by rotating in other crops such as tomatoes or beets or allowing the field to fallow in some years. These alfalfa croplands will be referred to as high-quality foraging habitat for this section of this SEIR. Although agricultural crops provide higher-quality foraging habitat for Swainson's hawks at particular times in the cultivation cycle, grassland habitat also provides valuable foraging habitat because its availability is consistent throughout the period when Swainson's hawks are present in the Natomas Basin. However, the value of common annual grassland may be less than that of the high-quality agricultural crops, such as alfalfa, at their peak of foraging quality (i.e., during irrigation and harvest).

SUMMARY OF EFFECTS ON SWAINSON'S HAWK HABITAT

The total amount of foraging habitat that would be lost (819 acres) is less than the amount that would be created (1052 acres). However, the habitat types and foraging values involved vary substantially. Approximately 74% of the croplands and grasslands being affected would be converted or reclaimed into native perennial grasslands and the remainder would be converted into woodlands and aquatic habitat. Of the 552 acres of croplands being affected, about 32% (approximately 174 acres) are high quality foraging habitat. The other crop types being affected, in order of foraging value, include grass hay (18%), fallow crops (20%), and row and grain crops (30%).

In total, SAFCA would create and preserve in perpetuity approximately 150 acres of high quality foraging habitat (field crops which include an alfalfa crop rotation) to mitigate the permanent loss of this habitat. This would be achieved primarily by acquiring, reclaiming, and preserving land used for borrow material from a combination of the following sites: the South Sutter (Thornton), Bianchi, and Novak borrow sites (which would be used for the Phase 3 and 4 projects), and approximately 14 acres of private land acquired along Reach 2 of the Sacramento River east levee. In addition 62 acres of croplands will become fallow due to their proximity to Phase 2 Project activities and will be maintained as foraging habitat. The borrow sites would be temporarily affected by project activities and then returned to their prior conditions within approximately 2 years. The estimated acres of foraging habitat temporarily affected in these borrow sites for the Phases 2, 3, and 4 Projects are 320, 672, and 286 acres, respectively. The majority of these affected acres are fallow crops (51%), with croplands accounting for 35% and grasslands for 14% of the acreage.

The majority of grasslands being affected are nonnative annual grasslands and ruderal areas, which are generally the least preferred foraging habitat for Swainson's hawks. Grasslands would be created along new or realigned levee slopes and canal berms by drill seeding with native perennial grasses. They would be managed by mowing or grazing with an emphasis on creating appropriate stubble height to optimize the value of these areas for foraging hawks to the extent possible. These perennial grasslands would provide moderately suitable foraging habitat. The primary purpose of levee maintenance is to maintain effective flood control, which may constrain managing grasslands on levee slopes to optimize foraging habitat.

To mitigate the loss of potential nesting habitat in landside woodlands, the proposed project includes planting a series of woodland corridors and larger woodland nodes alongside existing woodland habitats that would be preserved as potential nesting habitat. In areas where trees would be removed under the Sacramento River east levee footprint, a number of existing trees, especially valley oaks under 8–10 inches diameter at breast height, would be transplanted into the new woodland corridors or nodes.

Phase 2 Project

The Phase 2 Project would result in the net loss of 84 acres of croplands and a net increase of 164 acres of native perennial and annual grasslands, which would increase the amount of foraging habitat in the project area by 80 acres. However, the composition of this habitat would shift from 61% croplands to 67% grasslands, which may result in a decrease in the quality of foraging habitat for the Swainson's hawk. Approximately 90 acres (40%) of the croplands being affected are high quality foraging habitat (field crops which include alfalfa in the crop rotation). To offset this impact to high quality foraging habitat, SAFCA would preserve approximately 90 acres of high quality foraging habitat within reclaimed borrow sites (on properties that SAFCA would acquire in Phase 2 that could be used for borrow operations as part of the Phase 3 and/or 4 projects). This would reduce the impact on foraging habitat by ensuring the preservation of field crops with high foraging value. In addition the 62 acres of fallow crops on the two potential borrow sites will continue to provide foraging habitat. The total amount of croplands being affected in the Phase 2 Project is only 1% of the estimated agricultural lands in the basin and, therefore, is not a substantial reduction of foraging habitat in the basin overall.

The vast majority of Swainson's hawk nests in the basin are within the mature riparian forest along the waterside of the Sacramento River's levees. The adjacent setback levee design of the Sacramento River east levee avoids the need to remove waterside forest, which would otherwise be required if the Garden Highway levee were being rebuilt and upgraded in place. The 17 acres of woodlands that would be affected in the Phase 2 Project are along the landside of the Sacramento River east levee where no nests have been documented since 2001. Nests that have been documented on the landside of the east levee are within substantial riparian corridors along ditches, sloughs, and canals toward the interior of the basin. Approximately 63 acres of woodlands would be created or preserved during the Phase 2 Project, resulting in a net increase of 46 acres of potential nesting habitat.

The woodland mitigation plan would include transplanting suitable trees from the flood control footprint, where feasible, as well as planting a variety of native tree species that could become suitable nesting habitat for Swainson's hawks. There would be a temporal loss of 17 acres of woodlands in the project area as these plantings mature and provide potential nesting habitat within 10 to 15 years. This temporal loss represents a small proportion (<3%) of the available nesting habitat in the basin. Ultimately, the planting of woodland corridors in the Phase 2 Project would increase potential nesting habitat by 8% in the basin. The temporal loss of potential nesting trees would affect a small proportion of the available trees in the basin, and there would be an increase in potential nesting habitat following mitigation associated with the Phase 2 Project. Therefore, the Phase 2 Project would not have a substantial adverse effect on the ability of Swainson's hawks to nest in the basin.

Project construction during the proposed project would occur during the Swainson's hawk nesting season and could result in disruption of nesting behavior. If project construction is already underway when pairs return to their nesting territories, project activity could render previously occupied territories unsuitable. If active nests are present near construction areas when construction begins, the nesting pairs could be disturbed, potentially resulting in nest abandonment and loss of eggs or young.

These potential impacts on foraging habitat and nesting pairs occurring in the Phase 2 Project would be significant.

Phase 2, Phase 3, and Phase 4 Projects

Land conversion due to all remaining phases of the NLIP Landside Project would result in a net loss of 340 acres of croplands and a net increase of 573 acres of native perennial and annual grasslands. This would increase the amount of foraging habitat in the project are by 233 acres. However, the composition of foraging habitat across the entire project footprint would shift from 69% croplands to 82% grasslands, leading to a potential decrease in the quality of foraging habitat for Swainson's hawks. The majority of the high-quality foraging habitat converted (174 acres of alfalfa) would be partially offset by preserving 150 acres of high quality foraging habitat (field crops which include an alfalfa crop rotation) within sites (already acquired by SAFCA) which may be used for borrow material extraction. Therefore, the net loss of alfalfa crops in the basin would be reduced to 24 acres or only 2 % of the estimated alfalfa in the basin. The amount of all crops converted by the Phase 2, Phase 3, and Phase 4 Projects would be a small portion (4%) of the total croplands within the basin, and the majority of these are not considered high-quality foraging habitat for Swainson's hawk. Project activities would also result in the reduction of 82 acres of nesting habitat and the creation and preservation of 140 acres of nesting habitat, resulting in an increase of 58 acres of potential nesting habitat for Swainson's hawks.

The main impact on foraging habitat from the proposed project is a conversion from higher quality croplands to somewhat lower quality grasslands. This replacement of croplands with grasslands would decrease the quality of foraging habitat for the Swainson's hawk. This could force hawks to forage farther from the nest or increase competition for prey with other hawks in the area. This impact would be offset by a net increase of 233 acres of native perennial and annual grassland foraging habitat, the creation or preservation of high-quality foraging habitat by preserving specific crop types (crop rotations including alfalfa) in reclaimed borrow areas, and the small percentage (4%) of cropland foraging habitat being affected in the basin overall. A plan is being prepared to specify how the grasslands would be managed to ensure the appropriate habitat conditions.

While there would be a temporal loss of 82 acres of nesting habitat until the created woodland corridors mature, these woodlands planted in the project area would ultimately increase potential nesting habitat in the basin by 10%.

Project construction could result in potential displacement from nesting territories and disturbance and failure of active nests, which would represent substantial adverse effects on Swainson's hawks.

Creation of replacement habitat that does not provide the essential components (e.g., an adequate prey base or adequate nesting habitat) and is not managed in a way that maximizes habitat quality could result in a substantial adverse effect on the species, which would be a significant impact.

These potential impacts on foraging habitat and nesting pairs occurring through the Phase 2, 3, and 4 Projects would be significant.

Mitigation Measure 3.3-c: Minimize Potential Impacts on Swainson's Hawk, Monitor Active Nests during Construction, Develop and Implement a Management Plan in Consultation with DFG, and Obtain Incidental Take Authorization.

Mitigation Measure 3.7-f from the 2007 Landside EIR, which remains unchanged, is copied below.

SAFCA and its primary contractors for engineering design and construction shall ensure that the following measures are implemented to avoid, minimize, and compensate for potential project effects on Swainson's hawks.

The primary engineering and construction contractors shall ensure, through coordination with a qualified biologist retained by SAFCA, that staging areas and access routes are designed to minimize disturbance of known Swainson's hawk nesting territories. The biologist shall conduct preconstruction surveys to identify active nests within 0.25 mile of construction areas, in accordance with DFG guidelines. Surveys shall be conducted in accordance with NBHCP requirements and *Recommended Timing and Methodology for Swainson's Hawk Nesting Surveys in California's Central Valley* (Swainson's Hawk Technical Advisory Committee 2000). If an active nest is found, an appropriate buffer that minimizes the potential for disturbance of the nest shall be determined by the biologist, in coordination with DFG. No project activities shall commence within the buffer area until a qualified biologist confirms that the nest is no longer active or the birds are not dependent on it. Monitoring shall be conducted by a qualified biologist to determine whether project activity results in detectable adverse effects on the nesting pair or their young. The size of the buffer may vary, depending on the nest location, nest stage, construction activity, and monitoring results. If implementation of the buffer becomes infeasible or construction activities result in an unanticipated nest disturbance, DFG shall be consulted to determine the appropriate course of action.

SAFCA shall develop and implement a plan to address management of grassland habitats that are created as part of the proposed project in order to ensure that the performance standard of no net loss of sensitive habitat is met. The management plan shall, at a minimum, establish specific success criteria for habitat creation, specify remedial measures to be undertaken if success criteria are not met (e.g., supplementary plantings and additional monitoring), and describe short- and long-term maintenance and management of the features. Long-term protection of the created features and funding for their management shall be provided through appropriate mechanisms to be determined by SAFCA, DFG, and other entities cooperating in implementation of the proposed project.

The management plan for the grassland habitat creation components of the project shall be reviewed and approved by USFWS and DFG before project implementation. Authorization for take of Swainson's hawk under CESA shall be obtained. All measures subsequently adopted through the permitting process shall be implemented.

Implementation of Mitigation Measure 3.7-f from the 2007 Landside EIR and the project as modified would ensure that adverse effects on Swainson's hawk are minimized and an overall performance criterion of no net loss in acreage, function, and value of Swainson's hawk foraging habitat is met. This would reduce the impact on Swainson's hawk to a **less-than-significant** level.

3.4 CULTURAL RESOURCES

This section evaluates potential impacts of the proposed modifications to the Phase 2 Project on cultural resources. Cultural resources include archaeological traces such as Native American occupation sites and artifacts, historic-era buildings and structures, and places used for traditional Native American practices or other properties with special cultural significance. The modifications evaluated include slight changes to anticipated impacts and mitigation for some identified resources. This section also identifies new resources and the management status of these resources, which were discovered after the certification of the 2007 Landside EIR.

As a result of proposed modifications to the Phase 2 Project, two resources, Reclamation District (RD) 1000 (a historic landscape district) and CA-SAC-485/H (a prehistoric site), would be subject to slightly different impacts and mitigation than previously described. Two newly identified prehistoric resources, identified as Natomas Levee Improvement Program (NLIP) 7 and NLIP-22, would require further management as discussed below in Impact 3.4-c. Several newly identified historic and prehistoric resources (NLIP-8, NLIP-9, NLIP-10, NLIP-11, and NLIP-21) are evaluated by SAFCA in this SEIR. SAFCA recommends that these resources are ineligible for listing on the National Register of Historic Places (NRHP) and the California Register of Historical Resources (CRHR). These resources will also be documented and evaluated in inventory reports as required under the Programmatic Agreement (PA) executed as part of Section 106 and the reports will be sent to the U.S. Army Corps of Engineers (USACE) and State Historic Preservation Officer (SHPO) for concurrence.

3.4.1 REGULATORY SETTING

The 2007 Landside EIR provides a complete regulatory setting, which is hereby incorporated by reference. This section describes the PA executed for the NLIP.

3.4.1.1 FEDERAL

Management Framework for Historic Properties: The Programmatic Agreement

The NLIP is subject to the requirements of Section 106 of the National Historic Preservation Act (NHPA) as described in the 2007 Landside EIR (DEIR, page 3.8-2). Section 106 is triggered because USACE must provide permits for SAFCA to fill jurisdictional waters under the Clean Water Act and authorization for SAFCA to modify levees and to construct any structure in or over any navigable water of the United States under Section 408 of the Rivers and Harbors Act.

Normally, the Section 106 process is performed as four sequential steps. In this process, the federal agency responsible for satisfying Section 106 initiates consultation with the SHPO, identifies historic properties, assesses effects, and then resolves adverse effects, if any. These steps are defined at Title 36 of the Code of Federal Regulations (CFR), Part 800 et seq. However, because the proposed project involves large areas of land that require inventory and evaluation of historic properties in phases, USACE and SAFCA, in consultation with the SHPO and other consulting parties, developed and executed a PA (Appendix C), which establishes an alternative, expedited process that replaces the process provided in Part 800, while incorporating relevant standards and definitions from Part 800 by reference. The process in the PA fulfills the requirements of Section 106 of the NHPA.

The PA requires SAFCA to define the area of potential effects (APE) and complete an inventory of cultural resources before each phase of project construction begins, subject to review and written approval by USACE and SHPO (Stipulations III[C] and IV[A]). The inventory will include a map of the APE for each project phase (Stipulation III[C]). Identified resources will be evaluated for National Register of Historic Places (NRHP) eligibility, and SAFCA will make a finding of effect, in consultation with USACE and the SHPO (Stipulation IV[A]). If historic properties are identified, either in the Stipulation V(A) inventory or during construction, that would be adversely affected by the NLIP Landside Project, SAFCA must prepare an HPTP per Stipulation V(A) of the PA. The HPTP specifies actions SAFCA will take to resolve adverse effects on a historic property or a set of historic properties (Stipulation V[A]). The PA also requires SAFCA to prepare and obtain the approval of USACE, before construction begins, a plan to respond to inadvertent discoveries (Stipulation V[B][1]). EDAW has prepared a construction monitoring and inadvertent discovery plan, and SAFCA will submit this document to USACE as part of pending inventory reports. The plan describes the protocols and methods for monitoring construction and the protection of cultural resources discovered during construction. Relevant sections include stipulations for preconstruction training of equipment operators, locations subject to monitoring, treatment of inadvertent discoveries, and treatment of inadvertently discovered human remains. Together, the PA and the monitoring and inadvertent discovery plan provide part of the management framework for historic properties that may be affected by the proposed project. Identified resources will also be evaluated for eligibility for listing on the California Register of Historical Resources (CRHR).

While SAFCA is a signatory to the PA, Section 106 requires consultation between the federal signatory to the PA and other consulting parties. USACE and the SHPO must concur on major management decisions such as how adverse effects will be resolved (Stipulation V), and USACE has the ultimate responsibility for satisfying Section 106 (36 CFR Part 800.1[a]). Therefore while this section of the SEIR identifies what SAFCA believes are all feasible methods of mitigating impacts on cultural resources, USACE and the other consulting parties under Section 106 must agree to SAFCA's mitigation plan.

3.4.2 ENVIRONMENTAL SETTING

The environmental (cultural resource) setting, including the environmental characteristics and prehistoric historic human use of the region, is provided in the 2007 Landside EIR (DEIR, pages 3.8-4 to 3.8-11) and is hereby incorporated by reference. That setting describes the results of record searches conducted for the entire Natomas Basin at the North Central and the Northeast Information Centers of the California Historical Resources Information System (DEIR, pages 3.8-12 to 3.8-28). Section 3.4.3.1 below provides information on resources that may be affected by the proposed modifications to the Phase 2 Project, or which were identified after certification of the 2007 Landside EIR.

3.4.3 METHODOLOGY

EDAW consulted with Native American individuals and organizations included on a list provided by the California Native American Heritage Commission and conducted a pedestrian survey of the project area in 2007 as described in the 2007 Landside EIR (DEIR, pages 3.8-11 and 3.8-16). The field investigation included limited shovel testing (DEIR, page 3.8-16). The discussion in this SEIR focuses on investigations that are relevant to proposed project modifications that drive the need for preparation and circulation of this SEIR.

Phase 2 Project fieldwork in 2008 focused on completing a cultural resource inventory of the Phase 2 Project footprint and an evaluation of identified resources. The inventory effort included pedestrian surveys of the project footprint and shovel testing. Shovel testing provided an important means of identifying resources that were not visible or were only slightly visible on the surface. Shovel testing was conducted along the levee toe at 30 meter intervals, and at the same interval 30 meters east of the levee toe. Shovel test pits measured approximately 0.5 meters on a side and were excavated to a depth of 1.0 meters on average. To increase the depth of the sample, cultural resources specialists also conducted hand auger investigations in the same units, sampling at the same interval described above. Hand auger units reached on average approximately 2 meters (6.5 feet) in depth. Because this sample interval (30 meters) is smaller than the average size of identified archaeological deposits in the region, it provides a very good proxy for the presence or absence of cultural resources under the adjacent levee down to a depth of approximately 6 feet. This inventory has been completed for the majority of the reaches along the Sacramento River east levee (Reaches 2 through 4A), where there is the highest probability of encountering archaeological deposits. Pedestrian surveys have also been completed along the NCC where deep cutoff walls will be constructed in Reaches 4 through 7. The remaining portion of the Phase 2 Project footprint that requires inventory (approximately 5%) will be completed prior to construction. The additional inventory stipulated in

Mitigation Measure 3.8-d from the 2007 Landside EIR (DEIR, page 3.8-31) is incorporated by reference under Impact 3.4-d below. Additional resources that may be identified, if any, would be subject to Mitigation Measure 3.4-c below.

At identified prehistoric sites that suggest the potential to be eligible for listing on the NRHP or CRHR, such as NLIP-22, a prehistoric resource located along the Sacramento River east levee, EDAW also conducted canine forensic investigations. During this process, dogs that are trained to alert upon detection of buried human remains were used to inspect the site. This investigation failed to reveal interred human remains at NLIP-22.

Evaluation of the deposits identified in field work focused on collecting additional data and applying NRHP and CRHR listing criteria.

3.4.3.1 Identified Resources

This section identifies the resources that are located in the footprint associated with the proposed project modifications to the Phase 2 Project, or resources that may be subject to a greater degree of impact because of these modifications (see Table 3.4-1).

Table 3.4-1
Identified Cultural Resources In the Phase 2 Project Modification Footprint

Trinomial or P-Number	Temporary Designation or Common Name	Resource Type	Eligibility Recommendation or Management Status
	RD 1000	Historic Landscape District	Previously recommended eligible, may require updates, see 2007 Landside EIR at 3.8-8
P-51-000135	NLIP-1	Historic resource	Recommended ineligible, see 2007 Landside EIR at page 3.8-29*
	NLIP-2	Historic resource	Recommended ineligible, see 2007 Landside EIR at page 3.8-29*
P-51000136/ CA-SUT-136H	NLIP-3	Historic resource	Recommended ineligible, see 2007 Landside EIR at page 3.8-29*
P-51000137/ CA-SUT-137H	NLIP-4	Historic resource	Recommended ineligible, see 2007 Landside EIR at page 3.8-29*
P-51-000138/ CA-SUT-138H	NLIP-5	Historic resource	Recommended ineligible, see 2007 Landside EIR at page 3.8-29*
P-51-000139/ CA-SUT-139H	NLIP-6	Historic resource	Recommended ineligible, see 2007 Landside EIR at page 3.8-29*
	NLIP-7	Prehistoric site, buried	Requires testing/evaluation
	NLIP-8	Prehistoric resource	Recommended ineligible
	NLIP-9	Prehistoric resource	Recommended ineligible
P-61-000153	NLIP-10	Historic concrete feature	Recommended ineligible
	NLIP-11	Debris, non-cultural	Recommended ineligible
	NLIP-21	Historic site, partially buried	Recommended ineligible
	NLIP-22	Buried prehistoric site	Requires testing/evaluation
CA-SAC-485/H			Recommended eligible

Notes: NLIP = Natomas Levee Improvement Program; RD = Reclamation District.
*Documented in pending 2008 *Draft Historic Era Cultural Resources Eligibility Assessment Report*, not discussed in site descriptions below.
All eligibility and ineligibility recommendations are subject to USACE and the SHPO concurrence. For all eligible or listed resources, SAFCA will determine the effect of the undertaking, subject to USACE and the SHPO review. If adverse effects are found, SAFCA would prepare and implement an HPTP in consultation with USACE and the SHPO.
Source: Data compiled by EDAW in 2008

CA-SAC-485/H

Investigations during summer 2008 focused on characterizing the boundaries and nature of the deposit at CA-SAC-485/H. This investigation was conducted through excavation of control units with limited use of a backhoe at the edges of the site and beyond the site boundaries (to confirm the site boundaries). Based on the records and investigation to date, it appears that CA-SAC-485/H was a habitation site with structures and numerous interments. The assemblage on-site contains a rich deposit of flaked stone, faunal bone, skeletal remains and grave goods, hearth features, and utilitarian artifacts. Test excavation in 2008 recovered numerous burials, grave goods, and other cultural constituents from the assemblage.

This site will be recommended eligible in an inventory report prepared by SAFCA and submitted to USACE and the SHPO, as required in the PA. This report will also make a finding of effect, which is anticipated to be adverse (subject to treatment to minimize impacts). Further consultation with SAFCA, USACE, the SHPO, and Native American individuals and organizations is required to define appropriate treatment. Through this consultation process, SAFCA will prepare an HPTP that defines how impacts on the site will be minimized. SAFCA is currently consulting with these entities to determine whether placement of a wide seepage berm over the site will meet the combined goals of reducing flood risks and minimizing adverse effects. The most likely descendant (MLD), designated pursuant to California Public Resources Code Section 5097.98, has also expressed the desire to reinter all removed human skeletal remains without analysis.

Newly Identified Prehistoric Resources Recommended as Ineligible: NLIP-8, NLIP-9, and NLIP-11

These prehistoric resources consist of sparse manifestations of burned soil and clay, with charcoal and occasional instances of cultural debris such as debitage. During 2008 fieldwork, EDAW tested excavations of these resources to determine if the deposits contain any substantial deposits that could offer useful data for prehistoric research questions. The sites contain only the sparsest manifestation of cultural debris with no features, human interments, or rich assemblages that could be used for important research questions. Because these resources offer no important data for prehistoric research, SAFCA will recommend that NLIP-8, NLIP-9 and NLIP-11 are ineligible for listing on the NRHP and CRHR. SAFCA will submit these findings and recommendations to USACE and the SHPO for review and consultation. If USACE and the SHPO concur in this recommendation, no further management is required.

Newly Identified Historic Resources Recommended as Ineligible: NLIP-10 and NLIP-21

The resource NLIP-10 consists of a concrete structure built parallel to the northern slope of the NCC, with a central poured concrete abutment and flanking concrete wings with broken edges and top. This concrete structure is entirely unremarkable and lacks integrity because the original pump that the structure supported is gone. SAFCA will recommend that NLIP-10 is ineligible for listing on the NRHP and the CRHR.

NLIP-21 contains a sparse scatter of historic trash that has largely been burned and intermingled with surrounding soil matrix. Any discernible association with a larger deposit or structure is gone. The incineration of the debris also has reduced any data potential for historical research. Because the feature lacks both integrity and identifiable association with significant historic themes, SAFCA will recommend that NLIP-21 is ineligible for listing on the CRHR and the NRHP.

Newly Identified Prehistoric Resources that Require Further Management: NLIP-7 and NLIP-22

These resources consist of prehistoric deposits that offer no surface manifestation but instead are buried beneath the current A-horizon of soil. Identified deposits include debitage, burnt clay, and midden. Further investigation is required to make recommendations regarding the eligibility of these resources for listing on the NRHP or CRHR.

NLIP-7 consists of a prehistoric cultural deposit identified in core bores at a depth of approximately 10 to 12 feet underground. Core bores revealed soil consistent with prehistoric midden, charcoal, and spiral fractured faunal bone.

NLIP-22 consists of a prehistoric site that contains midden, charcoal, baked clay, and debitage, occurring at least 2 feet underground.

3.4.4 ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

3.4.4.1 SIGNIFICANCE CRITERIA

The thresholds for determining the significance of impacts for this analysis are based on the environmental checklist in Appendix G of the California Environmental Quality Act Guidelines (State CEQA Guidelines) and Section 106 of the NHPA. The proposed project was determined to result in a significant effect on cultural resources if it would:

- cause a substantial adverse change in the significance of a unique archaeological resource as defined in California Public Resources Code Section 21083.2(g) or a historical resource as defined in California Public Resources Code Section 21084.1 (see also Section 15064.5 of the State CEQA Guidelines);

- disturb any human remains, including those interred outside of formal cemeteries; or

- result in an adverse effect, after treatment, to a historic property, subject to Section 106 of the NHPA, as defined at 36 CFR Part 800.5(a)(1).

A substantial adverse change in the significance of a historical resource means "physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of the historical resource would be materially impaired" (State CEQA Guidelines Section 15064.5[b][1]). An adverse effect under Section 106 means that the project would "alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association" (36 CFR Part 800.5[a][1]).

Modified Phase 2 Project impacts on undiscovered cultural resources and undiscovered interred human remains are anticipated to be the same as the impacts identified in the 2007 Landside EIR (DEIR, pages 3.8-31 and 3.8-32). If such resources are discovered during construction, and management other than avoidance is required, such management would occur, in part, under HPTPs as described in Section 3.4.1.1 above. Discoveries of human remains are subject to the notifications required under State law identified in the 2007 Landside EIR (DEIR, pages 3.8-32 and 3.-33). These impacts are not discussed further in this SEIR.

3.4.4.2 IMPACT ANALYSIS

Project construction would involve a range of soil-disturbing impacts in a region that is highly sensitive for cultural resources, particularly prehistoric archaeological sites and would alter structures and landscapes associated with RD 1000.

IMPACT 3.4-a **Changes to Elements of RD 1000, which Consists of a Rural Historic Landscape District That is Eligible for Listing on the NRHP.** *This district consists of the levees, drainage features, roads, and large-scale patterns of land use that form a distinct rural landscape surrounding and including the physical features of RD 1000 flood control infrastructure. Activities associated with several of the Phase 2 Project modifications, including construction of drainage infrastructure under Garden Highway and expansion of a seepage berm in Reach 4B of the Sacrament River east levee, could disturb contributing elements of RD 1000. These impacts would be* ***significant****.*

As described in the 2007 Landside EIR (DEIR, pages 3.8-8 to 3.8-11), RD 1000 was evaluated both to determine the NRHP eligibility of the district and to evaluate whether flood control projects (levee modifications) planned and subsequently implemented by USACE as part of the American River Watershed Project (DEIR, page 3.8-8) would significantly affect the district. That analysis is hereby incorporated by reference. RD 1000 was identified as eligible for inclusion in the NRHP as a Rural Historic Landscape District. The "determination of effects" statement concluded that the USACE projects would adversely affect both contributing and noncontributing elements of RD 1000 by allowing for greater development to occur in the region. As a result, mitigation measures were adopted and incorporated into USACE's project. These consisted of Historic American Engineering Record (HAER) documentation, which was prepared by Peak & Associates (1997); videotapes of historic properties; and a list of repositories where copies of the information would be made available to the public (DEIR, page 3.8-8).

Activities associated with several of the Phase 2 Project modifications, including construction of drainage infrastructure under Garden Highway and expansion of a seepage berm in Reach 4B of the Sacrament River east levee, could disturb contributing elements of RD 1000. These modifications may be consistent with the current land use pattern and the long-term operation of a levee system and rural irrigation and drainage system. As such, project features would be consistent with the character-defining elements of the district. It is also possible that changes to the setting, including urban development, may have diminished the integrity of the elements of the district affected by the proposed project. If the contributing elements in the project footprint no longer retain integrity, no further management is required. If affected elements retain integrity and still can convey their significance, then activities associated with the proposed modifications to the Phase 2 Project might diminish this integrity. These impacts would be **significant**.

Mitigation Measure 3.4-a: Incorporate Mitigation Measures to Documents Regarding Any Elements Contributing to RD 1000 and Distribute the Information to the Appropriate Repositories.

Mitigation Measure 3.8-a from the 2007 Landside EIR has been updated as follows:

The management of the cultural resources that constitute the contributing elements of RD 1000 are governed by the PA (Appendix C). Because the elements of the RD 1000 historic landscape district have already been recorded, a new inventory of these resources is not required under Stipulation IV(A) of the PA. After an APE has been determined per Stipulation III(C), a qualified architectural historian shall determine if contributing elements of the district are present in the APE. If contributing elements are present, the architectural historian shall update records for these resources and evaluate those elements to determine if they still retain integrity. Because much of the Natomas Basin has been developed, it is possible that changes to the setting have diminished the integrity and thus eligibility of contributing elements in the APE. If the elements in the APE retain eligibility, the architectural historian shall make a finding of effect.

If there is an adverse effect to a contributing element (under Section 106) or a significant impact on the resource's integrity as an historical resource (under CEQA) the architectural historian shall review existing HAER documentation and determine whether any augmentation of this documentation is needed. The original documentation for the American River Watershed Project, completed in 1997 contemplated changes to the setting of the district and thus provided comprehensive documentation to record the district before urbanization (Peak & Associates 1997). It is possible that this original documentation adequately recorded and preserved records of the elements that may be affected. If this documentation is not sufficient for adversely affected and contributing elements, SAFCA will prepare an HPTP stipulating additional HAER documentation, or other similar treatment as required under Stipulation V(A). After consultation with USACE and the SHPO, SAFCA shall implement the required documentation. Any additional documentation that is needed shall be prepared and distributed to appropriate public repositories.

Implementing Mitigation Measure 3.4-a would reduce the impact on contributing elements of RD 1000 to a **less-than-significant** level, as discussed in the 2007 Landside EIR.

IMPACT 3.4-b — Potential Construction Impacts on CA-SAC-485/H. *This prehistoric resource consists of an extremely rich deposit that contains midden, features, debitage, faunal bone and bone tools, habitation structures, and numerous human interments. The site occurs just east of the Sacramento River east levee Reach 4B. This reach has an existing, serious risk of underseepage and levee failure. SAFCA proposes construction of a seepage berm that could abut the Sacramento River east levee and would cover this resource. The width of this berm has been expanded compared to the original design; therefore, the impact of placing the berm on CA-SAC-485/H was not analyzed in the 2007 Landside EIR. This impact would be* ***significant****.*

As described above, EDAW has conducted an extensive program of testing at CA-SAC-485/H. Although the first 16 inches of this deposit have been disturbed by agricultural operations, the site contains an extremely rich assemblage below 16 inches. The 2007 Landside EIR identified the potential for construction of the Giant Garter Snake (GGS)/Drainage Canal and Elkhorn Main Irrigation Canal to affect this resource (DEIR, page 3.8-29) and evaluated these impacts. After preparation of the 2007 Landside EIR, SAFCA re-evaluated the options available for addressing seepage remediation along the adjacent reach of the Sacramento River east levee. These options include relief wells, cutoff walls, and seepage berms. As a result of investigations in 2008, EDAW identified the boundaries of the deposit at CA-SAC-485/H and determined that an extremely rich and significant deposit remains at the site. SAFCA then determined that construction of cutoff walls alone was infeasible due to the depth of the clay layer in the foundation soils under the levee and construction of a partially penetrating cutoff wall or a seepage berm in combination with relief wells along the adjacent Sacrament River east levee could potentially intrude into the site and adversely affect the resource. This disturbance would affect both the utility of the deposit for archaeological research and the cultural and religious values for Native Americans.

To minimize the risk of direct impacts on this resource, SAFCA is proposing to replace all relief wells and cutoff walls with a 500-foot-wide seepage berm for the portion of Reach 4B that abuts CA-SAC-485/H. This wider berm would address the risk of underseepage while minimizing or avoiding direct intrusion into the site. Nonetheless, using heavy equipment to construct the seepage berm could crush some remaining portions of the assemblage at CA-SAC-485/H because of the weight of the machinery typically utilized in construction. Furthermore the weight of the berm itself could compress the site, which could damage the remaining assemblage. The potential for this kind of impact on CA-SAC-485/H was not analyzed in the 2007 Landside EIR; thus, it is analyzed here. This impact would be **significant**.

Mitigation Measure 3.4-b: Avoid Ground Disturbance near Known Prehistoric Archaeological Site CA-Sac-485/H to the Extent Feasible and Prepare and Implement a Historic Properties Treatment Plan.

SAFCA shall implement the following measures required by the PA (Appendix C) to address potential significant impacts on CA-SAC-485/H associated with Phase 2 Project construction impacts:

- Prior to start of construction, SAFCA shall prepare an HPTP as required under the PA (Stipulation V[A]).
- The HPTP shall address the effect of construction of a seepage berm on CA-SAC-485/H, including the effects of operating heavy equipment on the site during construction and of the placement of a seepage berm over the resource.

- To the extent possible, SAFCA shall minimize or avoid direct impacts on the site by carefully selecting equipment with consideration given to the pressure the construction equipment will place on the site and the capability of the assemblage to withstand these impacts. SAFCA shall also minimize the impact of the weight of the berm on the site through engineering and design to the maximum extent possible.

- The HPTP shall recommend an appropriate program of research and analysis for any portion of the assemblage removed from the site during test excavations. SAFCA shall then consult with USACE, the SHPO, and appropriate Native American individuals and entities regarding the recommendations of the HPTP.

- Upon concurrence from USACE and the SHPO, SAFCA shall implement the HPTP. The HPTP shall account for and incorporate the concerns of all consulting parties, to the extent possible, given project goals, as required under Section 106.

- During construction, SAFCA shall monitor construction at this location and within an appropriate radius. This monitoring shall be governed by a plan for monitoring and response to inadvertent discoveries that has been approved by USACE, as required in the PA (Stipulation V[B]).

The construction of a wide seepage berm and preparation and execution of an HPTP shall minimize impacts on this resource by avoiding or reducing disturbance and conducting research on the excavated portions of the assemblage. The HPTP shall minimize these impacts to the maximum extent possible and disclose the projected magnitude of these impacts. Nonetheless, construction of a seepage berm may affect the site through operation of equipment and construction of a massive feature over the site. Therefore, this impact would be **significant and unavoidable** with implementation of mitigation.

IMPACT 3.4-c **Damage to or Destruction of Other Identified Prehistoric Cultural Resources.** *Two prehistoric resources, NLIP-7 and NLIP-22, were identified within the project footprint after preparation of the 2007 Landside EIR. Construction of the seepage berm in Reaches 4A and 4B has the potential to affect these resources. This potential impact would be **potentially significant**.*

Prehistoric resources NLIP-7 and NLIP-22 are located in the footprint of the proposed seepage berm along the Sacramento River east levee in Reaches 4B and 4A, respectively. These resources were not identified as being within the project footprint until after preparation of the 2007 Landside EIR These resources require further test investigations and evaluation to determine whether they are eligible for listing in the NRHP or CRHR. The evaluation of eligibility and determination of effects on all recommended eligible sites would be made in consultation with USACE and the SHPO. These sites may be significant both for their data potential and their importance to local Native American groups and may have the integrity to convey this significance.

It is possible that construction of the seepage berm over these resources in the Phase 2 Project may, absent mitigation or treatment, directly affect these resources. Impacts could include excavation required to prepare the landform for the berm and crushing of the prehistoric deposit caused by operation of heavy machinery during berm construction and the weight of the berm itself. This impact is considered **potentially significant**.

Mitigation Measure 3.4-c: Evaluate NLIP-7 and NLIP-22. If the Resources are Eligible, Avoid Disturbance to the Extent Feasible, and Prepare and Implement a Historic Properties Treatment Plan.

The following mitigation measure addresses potentially significant impacts on NLIP-7 and NLIP-22, which are two new resources found after certification of the 2007 Landside EIR.

SAFCA shall implement the following measures prior to start of construction:

- Complete an evaluation of NLIP-7 and NLIP-22 resources, and determine the effect of Phase 2 work on all eligible or listed resources in accordance with Stipulation IV(A) of the PA.

- Consult with USACE, the SHPO, and other consulting parties such as Native American individuals and organizations, to develop appropriate treatment or mitigation in an HPTP, as required by Stipulation V(A) of the PA, if the project would result in adverse effects on eligible resources.

- If the resources are deemed to be eligible, document the sites and avoid or reduce adverse effects by minimizing disturbance from construction of the berm. Where physical impacts cannot be avoided and such physical impacts could damage the data these sites may contain, further excavation would be required. Such excavation would be required to support of documentation of the resource as required under Section 110(b) of the NHPA, or data recovery excavations to retrieve those values and mortuary assemblages that contain significance for archaeology and Native American culture after consultation with and the agreement of the Native American MLD tribe.

- Monitor all construction in the vicinity of documented and eligible resources, as required under the pending construction monitoring and inadvertent discovery plan.

Implementation of these management steps would lead to a determination as to the eligibility of these resources, and if eligible, minimize impacts on qualities that make these resources significant. While data recovery excavation is usually performed in instances where significant resources may be affected by a project, consultation under Section 106 may require alternate treatment, such as minimal investigation other than documentation. Minimization of any disturbance is an expressed desire of the Native American individuals and organizations that were consulted. To the extent possible, SAFCA shall minimize the impact of operating equipment over the resources and the impact caused by placement of a berm on these sites, through engineering and equipment selection. Nonetheless, it may not be possible to avoid all impacts to the deposits at these resources. Therefore, these impacts would be **significant and unavoidable**.

IMPACT 3.4-d	Damage to or Destruction of Previously Undiscovered Cultural Resources. *Previously unknown cultural resources could be present in areas that would be subject to construction disturbance and could be damaged or destroyed by project construction. This potential impact would be* ***potentially significant****.*

This impact was previously analyzed in the 2007 Landside EIR as Impact 3.8-d, Mitigation Measure 3.8-d was adopted by the SAFCA Board and incorporated into the project, and the significance conclusion is unchanged. As described in the 2007 Landside EIR and summarized herein, construction of improvements such as deep cutoff walls and associated inspection trenches has the potential to impact previously undiscovered cultural resources (DEIR at 3.8-32). The proposed modifications to the Phase 2 Project include construction of deep cutoff walls in Reach 2 and Reach 3 of the Sacramento River east levee. Seepage berms are proposed for Reach 4A and Reach 4B of the Sacramento River east levee. These features (cutoff walls and seepage berms) will also require excavation of an inspection trench adjacent to the levee toe, underneath the existing levee prism. Thus during construction the existing stability berm will be removed, and contractors will excavate an approximately six feet deep inspection trench to prepare the underlying strata to provide a suitable base for the proposed improvements. Both of these activities have the potential to damage or destroy previously undiscovered resources. This impact remains **potentially significant**; however, SAFCA has identified an additional, feasible mitigation measure.

As described above, SAFCA has performed both pedestrian surveys and subsurface testing along the majority of the Sacramento River east levee reaches where Phase 2 construction will take place. The land along and under the Sacramento River east levee may contain buried and previously unidentified cultural resources. Although the surface and subsurface investigations conducted to date provide a good proxy for surface and near-surface resources that extend under or occur under the existing levee, these investigations are less useful for identifying buried sites below a depth of six feet.

Mitigation Measure 3.4-d: Conduct Additional Backhoe and Canine Forensic Investigations As Appropriate

To increase the data set for identifying buried sites under the existing levee, SAFCA shall recommend that the following additional mitigation measures be adopted by USACE during Section 106 consultation:

- Additional inventory should be conducted at appropriate intervals along the Sacramento River east levee for the Phase 2 Project, using a backhoe excavator, to increase the sample of information at depths below six feet, which cannot be reached with conventional shovel test methods.

- Where this process or additional inventory efforts reveal other resources, SAFCA recommends the use of canine forensic investigations as a way of identifying interred human remains with minimal disturbance, and for further refinement of and understanding of the constituents of identified resources.

- If previously undiscovered resources are encountered during excavation of the inspection trench they will be treated in accordance with Mitigation Measure 3.4-c.

Because SAFCA does not control the final selection of inventory and treatment methods under Section 106, SAFCA can only suggest these methods to USACE and other consulting parties to the Section 106 process. Furthermore, because these methods will result in a sample data set rather than an exhaustive excavation of the entire footprint of ground disturbing work, the possibility remains that previously undiscovered cultural resources will be inadvertently damaged or destroyed during construction. Therefore, this impact remains potentially **significant and unavoidable**.

IMPACT 3.4-e	Damage to or Destruction of Previously Undiscovered Interred Human Remains. *Previously undiscovered interred human remains could be present in areas that would be subject to construction disturbance and could be damaged or destroyed by project construction. This impact would be* ***significant.***

This impact was previously analyzed in the 2007 Landside EIR as Impact 3.8-e (DEIR, page 3.8-32). Mitigation Measure 3.8-e was adopted by the SAFCA Board and incorporated into the project, and the significance conclusion is unchanged. Prehistoric human remains have been found at several prehistoric sites in the project area. Previously unknown buried human remains located beyond the depth of practical archeological excavation may be unearthed, damaged, or destroyed during excavation activities associated with construction of cutoff walls. Damage to or destruction of human remains would be a **significant impact**.

SAFCA will implement Mitigation Measure 3.8-e as described in the 2007 Landside EIR, and recited below, if such remains are encountered during construction (DEIR at 3.8-32). Furthermore SAFCA is recommending the additional efforts to identify these remains and associated archaeological deposits described above in Mitigation Measure 3.4-d. Despite these efforts the potential will remain that previously undiscovered interred human remains could be inadvertently damaged or destroyed during construction. Therefore, this impact is **potentially significant and unavoidable**.

Mitigation Measure 3.4-e: Halt Work Within 50 Feet of the Find, Notify the County Coroner and Most Likely Descendant, and Implement Appropriate Treatment of Remains

Mitigation Measure 3.8-e from the 2007 Landside EIR, which remains unchanged, is copied below.

SAFCA and its primary construction contractors shall ensure that the following measures are implemented to address the potential discovery of human remains during construction.

- If human remains are uncovered during ground-disturbing activities, all ground-disturbing activities shall cease within a 50-foot radius of the find, and SAFCA or its designated representative shall be notified. In accordance with the California Health and Safety Code, if human remains are uncovered during ground-disturbing activities, SAFCA and/or the contractor shall notify the county coroner of the county in which the remains are uncovered (Sutter or Sacramento) and a professional archaeologist to determine the nature of the remains. The coroner is required to examine all discoveries of human remains within 48 hours of receiving notice of a discovery on private or state lands (Health and Safety Code Section 7050.5[b]). If the coroner determines that the remains are those of a Native American, he or she must contact the NAHC by phone within 24 hours of making that determination (Health and Safety Code Section 7050[c]). The NAHC will designate a Most Likely Descendant (MLD) to dispose of the remains with appropriate dignity.

- After a determination that the remains are of prehistoric Native American origin, SAFCA shall coordinate with the MLD for reburial of the remains and associated grave goods in an appropriate location. If the MLD fails to make a recommendation or reinter the remains, further treatment will conform to PRC Section 5097 et seq. and other appropriate authorities.

- The discovery of prehistoric burials often reveals locations sensitive for the occurrence of additional archaeological material. After the initial discovery and management of human remains, a professional archaeologist working on behalf of SAFCA shall record the site with the NAHC and the appropriate Information Center and, if possible, use project features to protect the site from future disturbance.

Even though measures would be implemented to avoid human remains or, if found, to dispose of the remains with appropriate dignity, future disturbance to additional archaeological material at the site could still occur after the initial discovery and management of human remains. Therefore, this potential impact would remain **significant and unavoidable** with implementation of mitigation.

3.5 NOISE

This section describes regulations that apply to noise, noise-sensitive land uses, and existing noise sources in the project area and describes the potential noise impacts on the human environment from proposed project modifications involving construction and operation. Noise-sensitive land uses generally include those uses for which exposure to noise would result in significant adverse effects and uses where quiet is essential to the intended purpose of the land uses. Noise-sensitive uses include residences, schools, hospitals, community centers, and places of worship. Noise effects are evaluated according to the standards of the jurisdiction in which they are generated, regardless of where they are perceived. The 2007 Landside EIR "Environmental Setting" provided an overview of acoustic fundamentals, including definitions of noise terminology used in this section and an explanation of the A-weighted decibel scale (dBA) scale (DEIR, Section 3.12.2). That information is hereby incorporated by reference.

3.5.1 REGULATORY SETTING

The "Regulatory Setting" in the 2007 Landside EIR has remained unchanged and is hereby incorporated by reference. The 2007 Landside EIR addressed the federal, state, and local regulations, laws, and ordinances listed below.

FEDERAL

- U.S. Environmental Protection Agency
- U.S. Department of Transportation

STATE

- Governor's Office of Planning and Research
- California Code of Regulations
- California Department of Transportation

LOCAL

- Sutter County
- Sacramento County
- City of Sacramento
- Sacramento County Noise Control
- City of Sacramento Noise Control Code

3.5.2 ENVIRONMENTAL SETTING

The "Environmental Setting" in the 2007 Landside EIR has remained unchanged and is hereby incorporated by reference. The 2007 Landside EIR described sound and the human ear, sound propagation, noise descriptors, existing noise conditions, and noise-sensitive land uses in the project area and the construction area. As necessary, the setting associated with the changes to the project is detailed below under "Impact Analysis."

3.5.3 ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

3.5.3.1 SIGNIFICANCE CRITERIA

The thresholds for determining the significance of impacts for this analysis are based on the environmental checklist in Appendix G of the CEQA Guidelines. The proposed project was determined to result in a significant effect on the noise environment if it would:

- result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project;
- expose people residing or working in the project area to excessive noise levels;
- expose persons to or generate excessive groundborne vibration or groundborne noise levels;
- for a project located within an airport land use plan or, where such a plan has not been adopted, within 2 miles of a public airport or public use airport, expose people residing or working in the project area to excessive noise levels; or
- for a project within the vicinity of a private airstrip, expose people residing or working in the project area to excessive noise levels.

The 2007 Landside EIR addressed exposure of construction workers to excessive noise levels from Sacramento International Airport (Airport) operations, and that analysis is hereby incorporated by reference. The proposed modifications would not change this exposure from what has already been analyzed; therefore, the fourth threshold is not discussed further in this SEIR.

The 2007 Landside EIR noted that the project area contains no private airstrips, and that discussion is hereby incorporated by reference. The last significance threshold is not discussed further in this SEIR.

The following considerations apply to the first three significance thresholds:

- **Temporary and short-term construction noise impacts:** Temporary and short-term construction noise impacts would be significant if construction-generated noise levels exceed the levels shown in Table 3.12-1 (DEIR, page 3.12-3) at nearby noise-sensitive land uses.
- **Noise impacts from haul truck traffic:** For all affected residential land uses, noise generated by haul trucks associated with the project would be significant if it would cause the overall exterior noise level to exceed the "normally acceptable" exterior land use compatibility noise standard of 60 dB day-night average noise level/community noise equivalent level (L_{dn}/CNEL) for residential land uses or would exceed the interior noise standard of 45 dB L_{dn}/CNEL in any inhabitable residence (Table 3.12-2, DEIR, page 3.12-3).
- **Exposure of sensitive receptors to or generation of excessive vibration levels.** Temporary, short-, and long-term vibration impacts would be significant if construction or operation of the proposed project would result in the exposure of sensitive receptors to, or would generate, vibration levels that exceed the California Department of Transportation's recommended standard of 0.2 inches per second peak particle velocity concerning the prevention of structural damage for normal buildings (Caltrans 2002) or the Federal Transit Administration's maximum acceptable vibration standard of 80 vibration decibels concerning human response for residential uses (i.e., annoyance) (FTA 2006) at any nearby existing sensitive land uses.

The 2007 Landside EIR addressed the exposure of sensitive receptors to or generation of excessive groundborne vibration or noise, long-term increases in noise, and exposure of construction workers to excessive noise level from Airport operations. That analysis is hereby incorporated by reference. The proposed modifications would not increase the use of pile-driving that could cause groundborne vibrations; therefore, the third threshold is not discussed further in this SEIR.

The 2007 Landside EIR addressed exposure of residents to increased traffic noise levels from hauling activity, and that analysis is hereby incorporated by reference. The proposed modifications would eliminate certain borrow sites and shift most borrow material hauling to off-road routes, thus reducing the potential exposure of residents to increased traffic noise levels from hauling activity. This impact is not discussed further in this SEIR.

The proposed project modifications would not change the types of construction activities, add new long-term noise sources, or increase exposure of construction workers to Airport noise sources. Consequently, these impacts are not discussed further in this SEIR.

3.5.2 IMPACT ANALYSIS

IMPACT 3.5-a	Generation of Temporary, Short-Term Construction Noise. *Construction of proposed cutoff walls on a 24-hours-per-day, 7-days-per-week basis could generate noise levels that exceed the local noise standards for stationary sources at nearby sensitive receptors. In addition, because this construction would occur during the noise-sensitive evening and nighttime hours, it would have the potential to cause sleep disturbance at nearby residential land uses. This impact would be* ***significant****.*

The 2007 Landside EIR addressed a variety of construction activities that could generate noise levels that exceed the local noise standards for stationary sources at nearby sensitive receptors. That analysis is hereby incorporated by reference. The proposed modifications would not change the types of construction activities in the Phase 2 Project. However, as noted in Section 2.2.2 of this SEIR, SAFCA may conduct cutoff wall construction on a 24-hours-per-day, 7-days-per-week basis in order to complete construction of cutoff walls before the flood season while providing sufficient drying and curing time to ensure high-quality cutoff walls. The 2007 Landside EIR disclosed that noise may be generated by construction equipment operating near homes during the more noise-sensitive early morning and nighttime hours and could result in increased annoyance and/or sleep disruption to occupants of residential dwellings and other sensitive receptors. It also disclosed that cutoff wall construction along the Natomas Cross Canal (NCC) south levee (Reaches 3–7) could occur 24 hours a day. With the proposed project modifications, this activity could occur on a 7-days-per-week schedule. In addition, 24-hours-per-day, 7-days-per-week construction also could occur in Reaches 1–4B of the Sacramento River east levee, where cutoff walls would be installed in the new adjacent setback levee. The 2007 Landside EIR established that major construction activities would exceed the hourly thresholds for daytime, evening, and nighttime periods for both Sutter and Sacramento Counties, even after implementation of mitigation. The Phase 2 Project construction noise impact with the proposed project modifications would be significant.

Mitigation Measure 3.5-a: Implement Noise-Reducing Construction Practices, Prepare and Implement a Noise Control Plan, and Monitor and Record Construction Noise Near Sensitive Receptors.

Mitigation Measure 3.12-a from the 2007 Landside EIR, which remains unchanged, is copied below.

SAFCA and its primary contractors for engineering design and construction shall ensure that the following measures are implemented at each work site in any year of project construction to avoid and minimize construction noise effects on sensitive receptors. These measures are consistent with SAFCA's standard contract specifications for noise control.

The primary construction contractors shall employ noise-reducing construction practices. Measures that shall be used to limit noise shall include the following:

- Equipment shall be used as far away as practical from noise-sensitive uses.

- All construction equipment shall be equipped with noise-reduction devices such as mufflers to minimize construction noise and all internal combustion engines shall be equipped with exhaust and intake silencers in accordance with manufacturers' specifications.

- Equipment that is quieter than standard equipment shall be used, including electrically powered equipment instead of internal combustion equipment where use of such equipment is a readily available substitute that accomplishes project tasks in the same manner as internal combustion equipment.

- Construction site and haul road speed limits shall be established and enforced.

- The use of bells, whistles, alarms, and horns shall be restricted to safety warning purposes only.

- Noise-reducing enclosures shall be used around stationary noise-generating equipment (e.g., compressors and generators).

- Fixed construction equipment (e.g., compressors and generators), construction staging and stockpiling areas, and construction vehicle routes shall be located at the most distant point feasible from noise-sensitive receptors.

- When noise sensitive uses are within close proximity and subject to prolonged construction noise, noise-attenuating buffers such as structures, truck trailers, or soil piles shall be located between noise generation sources and sensitive receptors.

- Before construction activity begins within 500 feet of one or more residences, written notification shall be provided to the potentially affected residents, identifying the type, duration, and frequency of construction activities. Notification materials shall also identify a mechanism for residents to register complaints with the appropriate jurisdiction if construction noise levels are overly intrusive. The distance of 500 feet is based on the 60-dBA contour of the loudest anticipated construction activity other than pile driving (as listed in Table 3.12-4).

- If noise-generating activities are conducted within 100 feet of noise-sensitive receptors (the 70-dBA noise contour of construction noise), the primary contractor shall continuously measure and record sound generated as a result of the proposed work activities. Sound monitoring equipment shall be calibrated before taking measurements and shall have a resolution within 2 dBA. Monitoring shall take place at each activity operation adjacent to sensitive receptors. The recorded noise monitoring results shall be furnished weekly to SAFCA.

- The primary contractor shall prepare a detailed noise control plan based on the construction methods proposed. This plan shall identify specific measures to ensure compliance with the noise limits specified above. The noise control plan shall be submitted to and approved by SAFCA before any noise-generating construction activity begins.

These measures would reduce interior and exterior noise levels at noise-sensitive receptors located near construction sites. However, standards applicable to local exterior noises would not be reduced to a less-than-significant level at every nearby receptor. Therefore, the impact of temporary, short-term construction noise on sensitive receptors would be **significant and unavoidable**.

4 REFERENCES

CHAPTER 1, INTRODUCTION

The information sources referenced in the 2007 Landside EIR are hereby incorporated by reference. No new sources are referenced for this SEIR.

CHAPTER 2, PROJECT DESCRIPTION

The information sources referenced in the 2007 Landside EIR are hereby incorporated by reference. The following information sources are referenced in this SEIR.

Sacramento Area Flood Control Agency. 2007 (February). *Environmental Impact Report on Local Funding Mechanisms for Comprehensive Flood Control Improvements for the Sacramento Area*. Sacramento, CA.

SAFCA. *See* Sacramento Area Flood Control Agency.

SECTION 3.1, APPROACH TO THE ENVIRONMENTAL ANALYSIS

No references cited.

SECTION 3.2, HYDROLOGY AND WATER QUALITY

The information sources referenced in the 2007 Landside EIR are hereby incorporated by reference. The following information sources are referenced in this SEIR.

California Department of Water Resources. 1997. *Feasibility Report – American Basin Conjunctive Use Project*. Sacramento, CA.

————. 2003. Bulletin 118—Description of the North American Subbasin. Available: <http://www.dpla2.water.ca.gov/publications/groundwater/bulletin118/basins/pdfs_desc/5-21.64.pdf>. Accessed January 31, 2008.

DWR. *See* California Department of Water Resources.

MWH. 2001. *Sacramento River Watershed Project (Common Features), CA: Sacramento River East-Side Levee Strengthening Project Cut-Off Wall Evaluation*. Prepared by Mary Paasch; submitted by Sergio Jimenez to Barry Jarvis, Civil Engineer, U.S. Army Corps of Engineers. Sacramento, CA.

Placer County Water Agency. 2003. *West Placer Groundwater Management Plan*. Adopted October 6, 1998; updated November 6, 2003.

Sacramento Groundwater Authority. 2002. *State of the Basin Report 2002*. Citrus Heights, CA.

———. 2003 (December). *Sacramento Groundwater Authority Groundwater Management Plan*. Citrus Heights, CA.

SGA. *See* Sacramento Groundwater Authority.

SECTION 3.3, TERRESTRIAL BIOLOGICAL RESOURCES

The information sources referenced in the 2007 Landside EIR are hereby incorporated by reference. The following information source is referenced in this SEIR.

City of Sacramento, Sutter County, and The Natomas Basin Conservancy. 2003. *Final Natomas Basin Habitat Conservation Plan*. Sacramento, CA.

Estep, Jim. Estep Environmental Consulting, Sacramento, CA. July 20 and August 16, 2007—personal communication with Leo Edson and Anne King of EDAW regarding the value of types of foraging habitat.

The Natomas Basin Conservancy. 2007. *Biological Effectiveness Monitoring for the Natomas Basin Habitat Conservation Plan Area 2006 Annual Survey Results*. Sacramento, CA.

TNBC. *See* The Natomas Basin Conservancy.

Woodbridge, B. 1998. Swainson's Hawk (*Buteo swainsoni*). In *The Riparian Bird Conservation Plan: A Strategy for Reversing the Decline of Riparian-Associated Birds in California. California Partners in Flight*. Available: <http://www.prbo.org/calpif/htmldocs/riparian_v-2.html>.

SECTION 3.4, CULTURAL RESOURCES

The information sources referenced in the 2007 Landside EIR are hereby incorporated by reference. The following information source is referenced in this SEIR.

Peak & Associates. 1997. Historic American Engineering Record Reclamation District 1000 HAER No. CA-187. Prepared for Sacramento Area Flood Control Agency.

SECTION 3.5, NOISE

The information sources referenced in the 2007 Landside EIR are hereby incorporated by reference. The following information sources are referenced in this SEIR.

California Department of Transportation. 2002 (February 20). *Transportation Related Earthborne Vibrations*. Sacramento, CA.

Caltrans. *See* California Department of Transportation.

Federal Transit Administration. 2006 (May). *Transit Noise and Vibration Impact Assessment*. Washington, DC.

FTA. *See* Federal Transit Administration.

5 LIST OF PREPARERS

Following is a list of the individuals who prepared sections of the SEIR, provided significant background materials, or participated in preparing the SEIR.

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APPENDIX A

Public Outreach

A1. Notice of Preparation

Sacramento Area Flood Control Agency

NOTICE OF PREPARATION

To: Governor's Office of Planning and Research/State Clearinghouse Unit, Responsible Agencies, Trustee Agencies, and Interested Parties

From: Sacramento Area Flood Control Agency

Date: October 2, 2008

Subject: **Notice of Preparation of a Subsequent Environmental Impact Report on the Natomas Levee Improvement Program Landside Improvements Project Phase 2**

The Sacramento Area Flood Control Agency (SAFCA) is preparing a subsequent environmental impact report (SEIR) for the Natomas Levee Improvement Program (NLIP) Landside Improvements Project (hereafter referred to as the Phase 2 Project). SAFCA certified the Phase 2 Project EIR (State Clearinghouse #2007062016) in November 2007 and is the lead agency under the California Environmental Quality Act (CEQA) for the SEIR. In accordance with Section 15082 of the State CEQA Guidelines, SAFCA has prepared this notice of preparation (NOP) to inform all responsible and trustee agencies, federal agencies, and interested parties that an SEIR will be prepared. The purpose of an NOP is to provide sufficient information about the proposed project and its potential environmental effects to allow the Office of Planning and Research (OPR), and responsible and trustee agencies and interested parties, with the opportunity to provide a meaningful response related to the scope and content of the SEIR, including any significant environmental issues, mitigation measures, or reasonable alternatives (State CEQA Guidelines, Section 15082).

The SEIR will be subsequent to the Phase 2 Project EIR. A lead or responsible agency may choose to prepare an SEIR pursuant to State CEQA Guidelines Section 15162. In this instance, the provision that triggers the need for additional environmental review is State CEQA Guidelines Section 15162(a)(1): "Substantial changes are proposed in the project which require major revisions of the previous EIR due to the involvement of new significant environmental effects or a substantial increase in the severity of previously identified environmental effects…." The proposed project modifications described herein meet the criteria for preparing an SEIR.

The Landside Improvements Project (the Phase 2 Project) is part of SAFCA's efforts to complete comprehensive flood control improvements to provide an urban-standard of "200-year" flood protection (i.e., protection from a flood of a magnitude that would happen once every 200 years) for the Sacramento area and is part of the NLIP evaluated in SAFCA's programmatic EIR on Local Funding Mechanisms for Comprehensive Flood Control Improvements for the Sacramento Area (Local Funding EIR) (State Clearinghouse #2006072098). Pursuant to State CEQA Guidelines Section 15152 on tiering, the Phase 2 Project EIR and the SEIR are "tiered" from the broader analyses provided in the Local Funding EIR.

The Landside Improvements Project and the overall NLIP are also subject to additional documentation pursuant to the Federal National Environmental Policy Act (NEPA). An environmental impact statement (EIS) pursuant to NEPA has been prepared and released by the U.S. Army Corps of Engineers (USACE), Sacramento District, for development and permitting of the Phase 2 Project. In addition, a joint EIS/EIR is being prepared for what is referred to as the Phase 3 Project. An EIS/EIR for the Phase 4 Project will be prepared in early 2009, when the site-specific details of the Phase 4 Project are available.

The project location, project description, and probable environmental effects that will be addressed in the SEIR are presented below. The SEIR will also include any additional, feasible mitigation measures that are necessary to avoid or substantially reduce the proposed project's significant adverse environmental effects.

A public scoping meeting will be held during the 30-day NOP public review period to provide public agencies and interested parties with an opportunity to provide comments on the scope and content of the SEIR. The scoping meeting will satisfy the meeting requirement for projects of statewide, regional, or areawide significance (State CEQA Guidelines, Section 15082).

SCOPING MEETING

Date and Time: October 22, 2008, 4pm-7pm

Location: Teal Bend Golf Club
7200 Garden Highway
Sacramento 95837

Comments and suggestions are invited from all public agencies and interested parties. All comments must include the commenter's full name and address. Written comments or questions concerning the SEIR should be directed to SAFCA's project manager at the following address within 30 days from receipt of this notice, and no later than 5:00 p.m. on November 3, 2008:

Mr. John Bassett, P.E., Director of Engineering
Sacramento Area Flood Control Agency
1007 Seventh Street, Seventh Floor
Sacramento, CA 95814
Telephone: (916) 874-7606
Fax: (916) 874-8289
E-mail: bassettj@saccounty.net

PURPOSE OF THE NOTICE OF PREPARATION

The purposes of this NOP are to:

1. provide background information, briefly describe the proposed project changes requiring the need for an SEIR, and summarize the probable potentially significant environmental effects associated with implementing these project changes and

2. solicit input by November 3, 2008, from public agencies and interested parties, regarding the scope and content of the SEIR, including alternatives to be considered, potentially significant environmental effects, and identification of responsible and/or trustee agencies.

PROJECT BACKGROUND

SAFCA's project purpose is to provide the Natomas Basin in Sacramento and Sutter Counties with at least 100-year flood protection as quickly as possible, while laying the groundwork to achieve at least 200-year flood protection over time. Improvements necessary to meet this purpose would substantially reduce the risk of an uncontrolled flood in the Natomas Basin that would result in a catastrophic loss of property (estimated at $7 billion) and a prolonged interruption of commercial activity, including the operation of Sacramento International Airport (Airport) and closure of Interstate 5 (I-5), I-80, and State Route 99/70 (SR 99/70).

PROJECT DESCRIPTION

The proposed project includes the Phase 2 Project evaluated in the original 2007 Phase 2 Project EIR (November 2007) and the project modifications addressed in the SEIR. The project entails improving the levee system that protects the 53,000-acre Natomas Basin in northern Sacramento County and southern Sutter County, California, including a portion of the city of Sacramento The Natomas Basin is generally bounded by leveed reaches of the Natomas Cross Canal (NCC) on the north, the Sacramento River on the west, the American River on the south, and the Pleasant Grove Creek Canal (PGCC) and Natomas East Main Drainage Canal (NEMDC)/Steelhead Creek on the east. Exhibit 1showns the regional location, Exhibit 2).

Summary Description of Project Analyzed in 2007 Phase 2 Project EIR

The Phase 2 Project was described and analyzed in the 2007 Phase 2 Project EIR at a project level of detail, and the Phase 3 and 4 Projects were described and analyzed at a general, program level of detail. The Phase 3 and 4 Projects as described in the 2007 Phase 2 Project EIR are not being modified at this time and, therefore, will not be addressed in the SEIR. The Phase 3 and Phase 4 Projects will be evaluated in future project-specific EIRs. The general elements of the Phase 2 Project proposed and analyzed in the 2007 Phase 2 Project EIR are summarized as follows (a detailed project description is provided in the 2007 EIR):

- **Levee raising and seepage remediation: NCC south levee**—Raise and realign the NCC south levee to provide additional levee height and more stable waterside and landside slopes and to reduce the need for removal of waterside vegetation. Construct a seepage cutoff wall through the levee crown in Reaches 3 through 7.

- **Levee raising and seepage remediation: Sacramento River east levee**—Construct an adjacent setback levee from the NCC to the downstream end of Sacramento River east levee Reach 4B, raised where needed to provide adequate levee height, with a combination of cutoff walls, seepage berms, and relief wells for seepage remediation where required.

- **Improvements to major irrigation and drainage infrastructure**—These improvements are as follows:

  - Relocate a portion of the existing highline Elkhorn Main Irrigation Canal (Elkhorn Canal) north of the Natomas Central Mutual Water Company's Elkhorn Reservoir. ("Highline" canals are water conveyances with bottoms roughly equal to the surrounding ground elevation.)

  - Construct a new canal designed to provide drainage and associated giant garter snake (GGS) habitat (the "GGS/Drainage Canal") between the North Drainage Canal and the Elkhorn Reservoir to improve associated GGS habitat. (These features are intended to offset project impacts on GGS canal and ditch habitat.)

  - Remove a deep culvert at the location of Reclamation District (RD) 1000 Pumping Plant No. 2 on the Sacramento River east levee, and reconstruct Pumping Plant No. 2.

- **Right-of-way acquisition**—Acquire right-of-way through fee title or easement interest within the footprint of the project features and at the borrow sites to prevent encroachments into the flood control system.

Description of Proposed Changes to the Phase 2 Project Description

Since certification of the Phase 2 Project EIR in November 2007, SAFCA has continued to design and refine the features of the proposed Phase 2 Project, resulting in changes to the project description, as described below:

Borrow Sites and Haul Routes

- Three potential borrow sites—the Vestal, Spangler, and Nestor properties—have been removed from consideration. Two new borrow sites have been added as potential sources of soil material for work on the Sacramento River east levee (Reaches 1 through 4B):

  - **The Sutter Pointe borrow site.** Located at the southwest corner of Sankey Road and SR 99/70, this 817-acre private property is currently in rice cultivation. After the removal of borrow material, the land would be returned to rice production.

  - **Dunmore (formerly known as Stone) borrow site.** Located north of Elverta Road, east of Lone Tree Road, and west of SR 99/70, this 160-acre property is owned by SAFCA and is currently in rice production. It could be excavated for borrow material for the Sacramento River east levee, reclaimed, and returned to rice production.

- The Brookfield borrow site has been switched from potential to preferred for construction of the NCC improvements, whereas the RD 1001 borrow site has been retained as a backup site.

- The North Airport Bufferlands have been designated as a preferred borrow site for the Phase 2 Project construction along the Sacramento River east levee. It has been divided into six separate sites: Grassland Sites 1, 2, 3, 4, 5, and 6. This division was made to assist planning and engineering for specific reclamation and postproject land use targets. The division also provides flexibility for assigning borrow material to different phases of work along the Sacramento River east levee to avoid conflict between construction crews that may be working on different phases at the same time. Grassland Sites 1 and 2 are planned to be used for Phase 2 Project work:

  - **Grassland Site 1:** Grassland Site 1 is approximately 156 acres bordered on the west by the North Drainage Canal and on the south by the Pullman Irrigation Canal. Prichard Lake Road forms the boundary between Grassland Sites 1 and 2. The western half of Grassland Site 1 is located on Sacramento County Assessor's Parcel Number (APN) 201-0010-015, and the southern half is located on Sacramento County APN 201-0020-018. Grassland Site 1 would be sloped downward toward a shallow drainage ditch along the western edge of the excavation limits. The drainage ditch would be sloped to the south and to the north, converging at a field drain near the southwest corner of the excavation limits. The field drain would connect the drainage ditch to the North Drainage Canal. The overall site is designed with a finish grade at a standard irrigation ground slope, which would also provide for efficient stormwater runoff. The existing drainage ditch that bisects Grassland Site 1 would be relocated to the eastern edge of the site and would flow south through a gate into the Pullman Irrigation Canal.

  - **Grassland Site 2:** Grassland Site 2 is approximately 175 acres south of Prichard Lake Road, east of the Airport Mitigation Site, north of the Central Main Flume, and west of Powerline Road. The northern half of Grassland Site 2 is located on Sacramento County APN 201-0010-015, and the southern half is located on Sacramento County APN 201-0130-032. An underground telephone line runs along the east side of Grassland Site 2, and an overhead electrical line runs along the north side of the site. These utility facilities would not be affected by the proposed grading activities.

- Sankey Road, Pacific Avenue, and Powerline Road have been eliminated as haul routes. The haul route on West Elverta Road has been extended eastward approximately 1 mile to provide access to and from the Dunmore borrow site.

- The amount of borrow soil needed for the project has increased, as detailed below.

- Most truck hauling would be rerouted to off-road haul routes of the Sacramento River east levee (Reaches 1–4B).

Levee Design, Seepage Remediation, and Drainage

- A limited portion of the NCC east of SR 99/70 would be modified through the installation of a partial waterside levee raise so as to limit the extent of the landside footprint of the project and reduce the need to relocate Howsley Road. An analysis of the hydraulic effects of this modification indicated that it would not diminish the NCC's conveyance capacity.

- The width of the seepage berm located between Sacramento River east levee Stations 57+00 and 85+00 would be extended from 100 feet to 300 feet. This modification would extend the feature farther eastward into the adjacent agricultural cropland so as to more effectively contain underseepage through a relatively shallow but lengthy layer of levee foundation sand and gravel material.

- In Reaches 1 and 2 of the NCC, in addition to being raised, the south levee would be widened to the land side to shift the levee prism away from the canal to reduce the need to remove waterside vegetation. The previous design would have potentially required a greater amount of vegetation removal in conformance with USACE design criteria. This design modification requires an increase in imported soil borrow of 285,000 cubic yards, from 400,000 to 685,000 cubic yards.

- The cutoff wall portion of the NCC south levee design has also been modified. It is now assumed that none of the excavated material would be suitable for the Soil-Bentonite (SB) mix, compared with the previous assumption that 25% of the excavated material would be suitable. Therefore, 100% of the soil material for the cutoff wall would have to be imported. The removal of the top portion of the levee required to install the cutoff wall has been increased from one-third of the levee height to one-half of the levee height. The removed soil is assumed to not be suitable for use in replacing the levee height. The combination of these two modifications has increased the imported soil borrow quantity requirement for construction of the cutoff wall from 42,000 cubic yards to approximately 195,000 cubic yards.

- The design of the Sacramento River adjacent setback levee has been modified to flatten the landside slope from an angle of 3H:1V to 5H:1V in Reaches 1, 4A, and 4B. The slopes in Reach 2 and Reach 3 would remain 3H:1V. The environmental impacts of the footprint of an adjacent setback levee with a slope of 5H:1V were analyzed in the 2007 EIR. These design changes have increased the requirement for soil borrow amounts by approximately 761,000 cubic yards, from 1,161,000 cubic yards to 1,922,000 cubic yards. Combined with the additions from the design modifications on the NCC, this increase in borrow material pushes the total borrow material required for the Phase 2 Project construction from approximately 1.6 million cubic yards to 2.8 million yards.

- In Reaches 2 and 3 of the Sacramento River east levee, seepage berms would be replaced by approximately 5,400 feet of cutoff walls up to 80 feet deep in the proposed adjacent setback levee. In Reach 1, approximately 4,800 feet of cutoff wall up to 35 feet deep would be constructed. In Reach 4B, approximately 1,500 feet of cutoff wall up to 80 feet deep would be constructed at RD 1000 Pumping Plant 2.

- The Sacramento River seepage berm footprint would be extended farther (500 feet as opposed to 200 feet) from the setback levee to accommodate a documented cultural resources site. No relief wells would be installed. Any necessary monitoring wells or trenches would be located outside of the extended berm footprint. The enlarged berm would provide a protective cap over much of an area known to contain sensitive cultural resources.

- In Reach 4B of the Sacramento River east levee, the 300-foot seepage berm has been extended through an area occupied by a small grove of trees that is approximately located between Station 214+00 and 218+00. This area occupies about 1.3 acres and is subject to deep and extensive underseepage. Approximately 11 relief wells were originally proposed to temporarily retain these trees near the seepage berm until trees planted in the woodland corridor had reached a sufficient level of maturity. However, further analysis raised concerns that this design might not offer consistent resistance to underseepage, particularly along the seams between the wells and the berms. Additional geotechnical data have indicated that temporary retention of these trees is not recommended.

- Additional design and construction details have been developed for surface drainage outlets across the Garden Highway. Between the Sacramento River adjacent setback levee and the Garden Highway pavement, new storm drainage collection facilities would be constructed to convey surface water beneath the Garden Highway and toward the Sacramento River. A surface collection system (drainage swale) would convey runoff water to drop inlets, and new pipe laterals would convey the water beneath the Garden Highway to new outfalls in the berm along the east bank of the Sacramento River. In most locations, the outfalls would be placed above the 2-year water surface elevation. The location of the cross culverts would be selected to minimize impacts on existing residential properties. These discharge pipes would require minor landscape improvements to prevent erosion and ensure that applicable water quality standards are met. Excavation of a trench across the Garden Highway would be required, and those segments where excavation occurs would have to be reconstructed. Single-lane traffic controls and through-traffic detours would be required during this phase of construction. This work would be conducted in two headings (work sites) simultaneously.

- The alignment of the proposed Elkhorn Canal-GGS/Drainage Canal in Reaches 4B through 6A would be modified to remove several bends. The total footprint of the Phase 2 Project canal work would remain the same.

- The NCC south levee would be widened on the land side to avoid removing waterside vegetation in conformance with USACE design criteria.

- The Sacramento River east levee improvement would be extended approximately 14,000 feet from Station 214+00 to approximately Station 228+00

Construction Phasing and Timing

- The limit of Phase 2 Project construction on the Sacramento River east levee has been shifted approximately 14,000 feet south within Reach 4B from station 214+00 to approximately station 228+00.

- The start of Phase 2 Project construction has been delayed 1 year, from May 2008 until at least May 2009. It is highly possible that the Phase 2 Project construction may overlap with the Phase 3 Project construction during 2009.

- To complete construction of cutoff walls before the flood season while providing sufficient drying and curing time to ensure high-quality cutoff walls, SAFCA may conduct cutoff wall construction on a 24-hours-per-day, 7-days-per-week basis.

Land Use and Habitat

- As noted above, the existing conditions at the Airport North Bufferlands borrow sites changed from "active rice cultivation," which existed at the time the NOP for the Phase 2 Project EIR was issued, to "fallow field" because the agricultural leases for these lands have expired. To comply with Federal Aviation Administration requirements, SCAS has indicated that it will not be bringing these lands back into rice production.

- SAFCA no longer proposes to create managed marsh on 118 acres of the Airport North Bufferlands.

- The Novak property at Powerline Road and the Sacramento River east levee would be used for mitigation for loss of field crops.

POTENTIALLY NEW SIGNIFICANT ENVIRONMENTAL EFFECTS

The SEIR will evaluate any new direct or indirect significant environmental effects of the proposed project modifications. The SEIR also will evaluate the cumulative effects of the proposed project modifications when considered in conjunction with other related past, present, and probable future projects, including other SAFCA projects. Consistent with State CEQA Guidelines Section 15163, the environmental analysis in the SEIR will be subsequent the 2007 Phase 2 Project EIR. The SEIR will incorporate by reference general discussions from the 2007 Phase 2 Project EIR and will focus on the project changes and new potentially significant effects resulting from modifications to the 2007 EIR's project description.

On the basis of preliminary evaluation, SAFCA has determined that the proposed project modifications that will be evaluated in the SEIR may have the significant environmental effects described below. The SEIR will identify feasible mitigation measures to reduce significant environmental impacts, where appropriate.

- **Agriculture.** The SEIR will address conversion of farmland to temporary and permanent nonagricultural use. Because of the change in status of the Airport land from rice production to fallow, the total acreage of this impact may decline.

- **Air Quality.** The SEIR will address temporary increases in pollutant emissions associated with construction activities. The changes to the project description that could affect air quality include cutoff wall construction and the potential for the Phase 2 and Phase 3 Project construction to occur simultaneously. The potential for increases in emissions and dust will be evaluated in the SEIR.

- **Noise and Vibration.** The SEIR will address temporary increases in noise and vibration levels near sensitive receptors during construction. The changes to the project description that could affect noise include cutoff wall construction and the potential for the Phase 2 and Phase 3 Project construction to occur simultaneously. The resulting increase in noise will be evaluated in the SEIR.

- **Transportation and Circulation.** The SEIR will address temporary disruption of traffic circulation during construction. The changes to the project description that could affect traffic include cutoff wall construction and the potential for the Phase 2 and Phase 3 Project construction to occur simultaneously. The resulting increase in traffic will be evaluated in the SEIR.

- **Fisheries and Aquatic Resources.** The SEIR will address disturbance or loss of sensitive natural communities or special-status species habitats, as well as disturbance or take of special-status aquatic species, from the proposed project modifications.

- **Terrestrial Biological Resources.** The SEIR will address disturbance or loss of riparian vegetation, woodland vegetation, waters of the United States, other sensitive natural communities, or special-status species habitats, as well as construction disturbance or take of special-status terrestrial species from the proposed project modifications. Impacts on the Natomas Basin Habitat Conservation Plan and two of its covered species, the Swainson's hawk and GGS, will be addressed.

- **Cultural Resources.** The SEIR will address disturbance of known and unknown historic or archaeological resources from the proposed project modifications. Portions of the Phase 2 footprint have been specifically redesigned to avoid impacts on known sensitive cultural resources.

- **Water Resources.** The SEIR will address temporary effects on water quality during construction and long-term effects on groundwater associated with the cutoff walls and water quality issues associated with stormwater outfall locations.

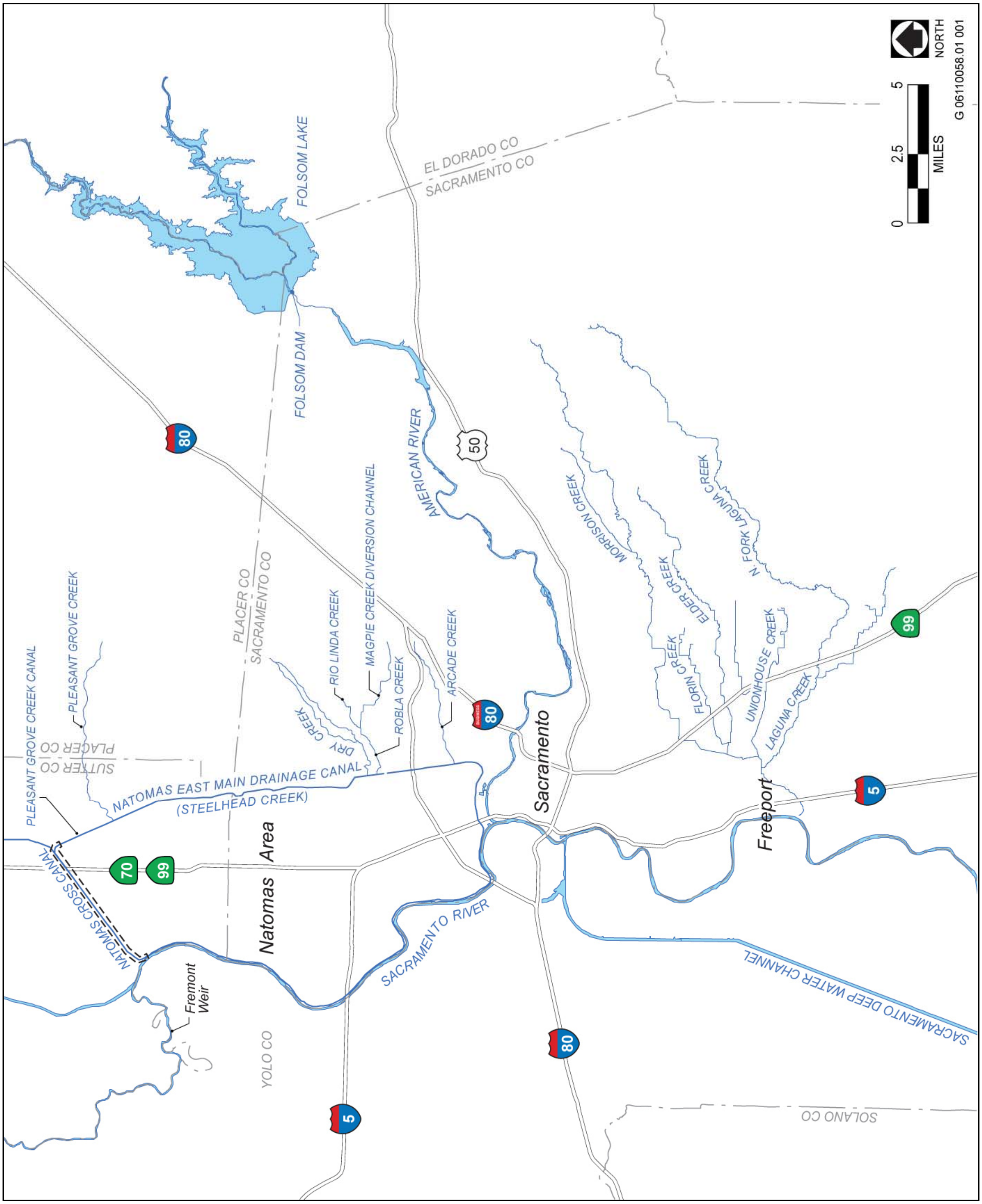
- **Geology and Soils.** The SEIR will address effects on geology and soils from the proposed project modifications.
- **Hazards.** The potential for encountering contaminated soils or groundwater at the new borrow sites will be addressed in the SEIR. Potential changes to aviation hazards attributable to potential bird strikes because of changes to the Airport Bufferlands, and/or public health and safety because of changes to the haul routes, will be analyzed in the SEIR.
- **Cumulative Impacts.** The SEIR will address cumulative impacts associated with any increase or decrease in the severity of impacts as a result of proposed project modifications.
- **Significant and Unavoidable Impacts/Significant Irreversible Impacts.** The SEIR will address the extent to which changes in the severity of impacts triggers the unavoidable or irreversible thresholds, as a result of the proposed project modifications.

ISSUE AREAS REMOVED FROM FURTHER CONSIDERATION

The SEIR will likely not address the following issue areas because they are not expected to be significantly affected by the proposed project modifications. These issue areas were analyzed in detail in the 2007 Phase 2 Project EIR, and all effects were found to be less than significant: paleontological resources, visual resources, recreation, utilities and service systems, and growth-inducing effects.

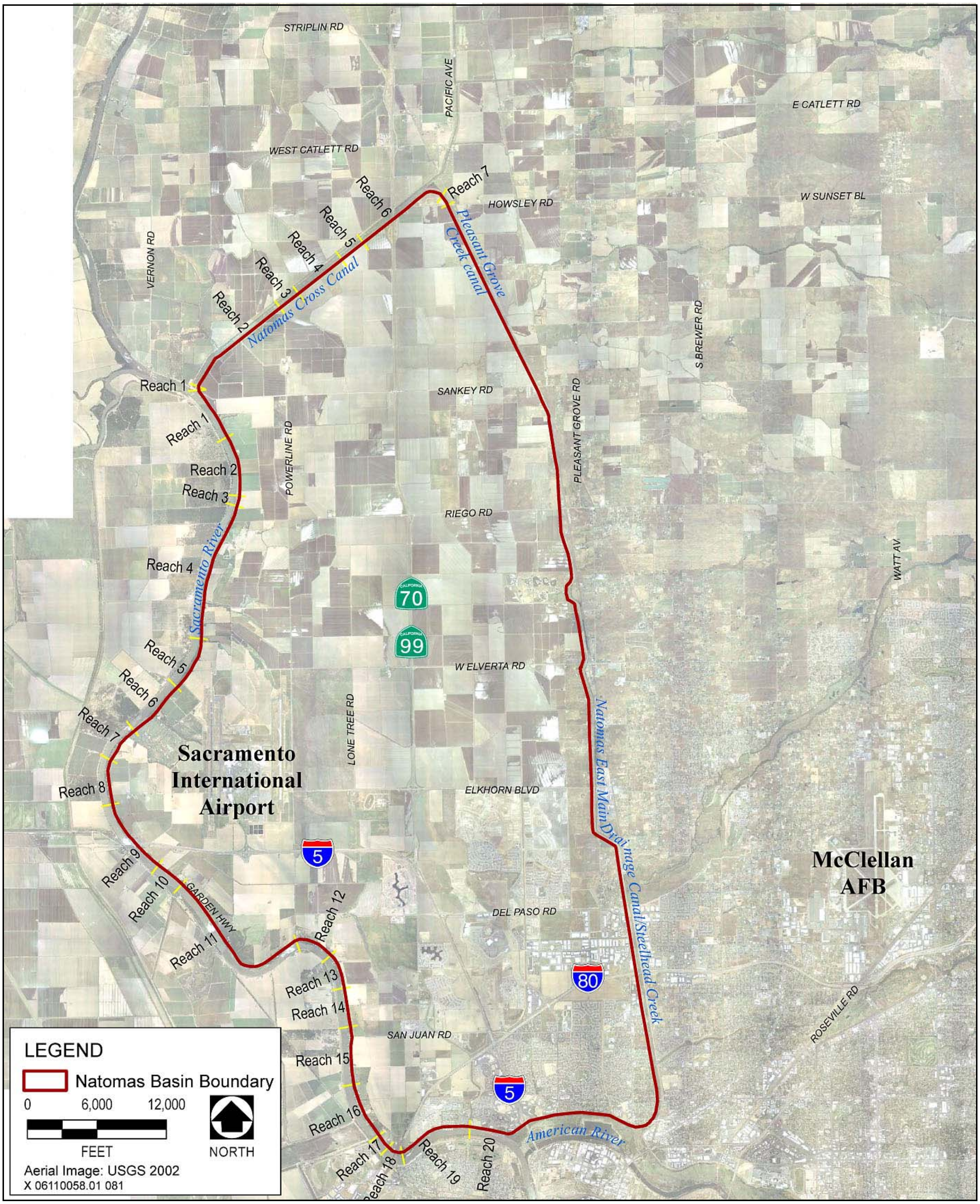
SUBMISSION OF COMMENTS

To ensure that the full range of project issues of interest to responsible and trustee agencies and the public are addressed, comments and suggestions are invited from all interested parties. Written comments or questions concerning the SEIR should be directed to John Bassett at the address provided on the first page of this NOP **no later than 5 p.m. on November 3, 2008.** Please provide the name and address of a contact person who should receive future correspondence regarding the project.



Source: Casil: EDAW 2006

Project Area for Comprehensive Sacramento Area Flood Protection **Exhibit 1**



Natomas Levee Improvement Program Area **Exhibit 2**

Comments Received

Sacramento Area Bicycle Advocates
SABA
Making Sacramento a cycling capital

909 12th Street Ste 114 Sacramento, CA 95814 (916) 444-6600 www.sacbike.org

October 3, 2008

Mr. John Bassett, P.E., Director of Engineering
Sacramento Area Flood Control Agency
1007 Seventh Street, Seventh Floor
Sacramento, California 95814

Re: Notice of Preparation, Natomas Levee Improvement Program Landside Improvements Project Phase 2 Subsequent Environmental Impact Report

Dear Mr. Bassett:

Thank you for the opportunity to comment.

It was difficult to understand the project phasing and description without a detailed map. Maybe I'll be able to attend your scoping meeting.

The transportation and circulation section should address bicycle circulation.

Aesthetic impacts should be addressed.

As mitigation for the air quality, traffic and circulation and aesthetic impacts, bicycle improvements should be considered. Bicycle improvements include bike paths on or alongside levees, alongside canals, added access points to bike paths, and improved directional signage.

We have very specific recommendations for mitigations for the NEMDC/Steelhead Creek levee. That levee does not appear to be affected by this phase, although the following mitigations might still be appropriate for the overall project.

The NEMDC/Steelhead Creek levee mitigations are:

Use NEMDC levee work to gain additional access points.
Add access points to north and south ends of Natoma Way (at south end from Natoma Way to Gardenland Park access trail)
Add access from Rosin Court

Add access from North Market Blvd.
Add undercrossing of West El Camino Avenue Bridge
Make trail access to south side of West El Camino Avenue meet Caltrans Highway Design Manual standards.

Any bike paths that are disturbed by the project should be restored to pre-project conditions or better as far as pavement quality and smoothness.

The project may present an opportunity to replace non-standard gates and bollards at bike path access points and to build additional bike facilities in bicycle master plans. These opportunities should be explored with the city of Sacramento.

SABA is a nonprofit corporation with more than 1,400 members. We represent bicyclists. Our aim is more and safer trips by bike. We're working for a future in which bicycling for everyday transportation is common because it is safe, convenient and desirable. Bicycling is the healthiest, cleanest, cheapest, quietest, most energy efficient and least congesting form of transportation.

Yours truly,

Walt Seifert
Executive Director

cc: Ed Cox, city of Sacramento Bicycle and Pedestrian Coordinator

U.S. Department of Homeland Security
FEMA Region IX
1111 Broadway, Suite 1200
Oakland, CA. 94607-4052

FEMA

October 8, 2008

John Bassett, P. E., Director of Engineering
Sacramento Area Flood Control Agency
1007 Seventh Street, Seventh Floor
Sacramento, California 9814

Dear Mr. Bassett:

This is in response to your request for comments on the Notice of Preparation of a Subsequent Environmental Impact Report on the Natomas Levee Improvement Program Landside Improvements Project Phase 2.

Please review the current effective Flood Insurance Rate Maps (FIRMs) for the Counties of Sacramento (Community Number 060262), Maps revised July 6, 1998 and Sutter (Community 060394), Maps revised December 2, 2008. New Revised Maps for the County of Sacramento will also be effective December 2, 2008. Please note that the Counties of Sacramento and Sutter, California are participants in the National Flood Insurance Program (NFIP). The minimum, basic NFIP floodplain management building requirements are described in Vol. 44 Code of Federal Regulations (44 CFR), Sections 59 through 65.

A summary of these NFIP floodplain management building requirements are as follows:

- All buildings constructed within a riverine floodplain, (i.e., Flood Zones A, AO, AH, AE, and A1 through A30 as delineated on the FIRM), must be elevated so that the lowest floor is at or above the Base Flood Elevation level in accordance with the effective Flood Insurance Rate Map.

- If the area of construction is located within a Regulatory Floodway as delineated on the FIRM, any ***development*** must not increase base flood elevation levels. **The term *development* means any man-made change to improved or unimproved real estate, including but not limited to buildings, other structures, mining, dredging, filling, grading, paving, excavation or drilling operations, and storage of equipment or materials.** A hydrologic and hydraulic analysis must be performed *prior* to the start of development, and must demonstrate that the development would not cause any rise in base flood levels. No rise is permitted within regulatory floodways.

- Upon completion of any development that changes existing Special Flood Hazard Areas, the NFIP directs all participating communities to submit the appropriate hydrologic and hydraulic data to FEMA for a FIRM revision. In accordance with 44 CFR, Section 65.3, as soon as practicable, but not later than six months after such data becomes available, a community shall notify FEMA of the changes by submitting technical data for a flood map revision. To obtain copies of FEMA's Flood Map Revision Application Packages, please refer to the FEMA website at http://www.fema.gov/business/nfip/forms.shtm.

Please Note:

Many NFIP participating communities have adopted floodplain management building requirements which are more restrictive than the minimum federal standards described in 44 CFR. Please contact the local community's floodplain manager for more information on local floodplain management building requirements. The Sacramento County floodplain manager can be reached by calling George H. Booth, Senior Civil Engineer, at (916) 874-6851. The Sutter County floodplain manager can be reached by calling Douglas R. Gault, Director of Department of Public Works, at (530) 822-7450.

If you have any questions or concerns, please do not hesitate to call Cynthia McKenzie (Sacramento County) at (510) 627-7190 and/or Marshall Marik (Sutter County) at (510) 627-7057 of the Mitigation staff.

Sincerely,

Gregor Blackburn, CFM, Branch Chief
Floodplain Management and Insurance Branch

cc:
George H. Booth, Senior Civil Engineer, Sacramento County
Douglas R. Gault, Director, Department of Public Works, Sutter County
Ray Lee, State of California, Department of Water Resources, Central District
Cynthia McKenzie, Senior Floodplanner, CFM, DHS/FEMA Region IX
Marshall Marik, Floodplanner, CFM, DHS/FEMA Region IX
Alessandro Amaglio, Environmental Officer, DHS/FEMA Region IX

CALIFORNIA STATE LANDS COMMISSION
100 Howe Avenue, Suite 100-South
Sacramento, CA 95825-8202

PAUL D. THAYER, *Executive Officer*
(916) 574-1800 FAX (916) 574-1810
Relay Service From TDD Phone **1-800-735-2929**
from Voice Phone **1-800-735-2922**

Contact Phone: **(916) 574-1900**
Contact FAX: **(916) 574-1885**

October 20, 2008

File Ref: SCH# 2007062016

Sacramento Area Flood Control Agency
Attn: John A. Bassett
1007 7th Street, 7th Floor
Sacramento, Ca 95814

Subject: Natomas Levee Improvement Program Landside Improvements Project Subsequent EIR

Dear Mr. Bassett:

The California State Lands Commission (CSLC) staff has reviewed the Notice of Preparation (NOP) for the Natomas Levee Improvement Program Landside Improvements Project Subsequent EIR. For this project, the CSLC is potentially both a trustee agency and a responsible agency under the California Environmental Quality Act (CEQA).

By way of background, the State of California acquired sovereign ownership of all tidelands and submerged lands and beds of navigable waterways upon its admission to the United States in 1850. The State holds these lands for the benefit of all people of the State for statewide Public Trust purposes, which include waterborne commerce, navigation, fisheries, water-related recreation, habitat preservation and open space. The boundaries of these State-owned lands generally are based upon the last naturally occurring location of the ordinary high or low water marks prior to artificial influences which may have altered or modified the river or shoreline characteristics. On tidal waterways, the State's sovereign fee ownership extends landward to the ordinary high water mark as it last naturally existed. On navigable non-tidal waterways, the State holds fee ownership of the bed landward to the ordinary low water mark and a Public Trust easement landward to the ordinary high water mark, as they last naturally existed. Such boundaries may not be readily apparent from present day site inspections. The State's sovereign interests are under the leasing jurisdiction of the CSLC.

Based on a review of the NOP, the CSLC recommends that the following be included as a part of the Draft Subsequent Environmental Impact Report (DSEIR):

- Greenhouse gas emissions information consistent with the California Global Warming Solutions Act (AB 32) should be included in the DSEIR. This would include a determination of the greenhouse gases that will be emitted as a result of construction and ongoing operations and maintenance, a determination of the significance of the impacts, and mitigation measures to reduce impacts.

We appreciate receiving the Notice of Preparation for the DSEIR and look forward to review of that CEQA document.

If you have any jurisdictional questions, please contact Mary Hays, Public Land Manager, at (916) 574-1812 or by e-mail at haysm@slc.ca.gov. If you have any questions on the environmental review, please contact Crystal Spurr at (916) 574-0748 or by e-mail at spurrc@slc.ca.gov

Sincerely,

Gail Newton, Chief
Division of Environmental Planning
and Management

cc: Office of Planning and Research
State Clearinghouse

Crystal Spurr, CSLC
Mary Hays, CSLC

SAFCA

Sacramento
Area Flood
Control
Agency

**Natomas Levee Improvement Program:
Landside Improvements Project Phase 2**

Public Scoping Meeting
Comment Sheet

Comments may be submitted at the Public Scoping Meeting on October 22, 2008 or provided to the Sacramento Area Flood Control Agency **no later than 5:00 p.m. on November 3, 2008**. If sending comments, please address to:

Mr. John Bassett, Director of Engineering
Sacramento Area Flood Control Agency
1007 Seventh Street, 7th Floor
Sacramento, CA 95814
Fax: (916) 874-8289
E-mail: bassettj@saccounty.net

Name: Frances Tennant
Organization:
Mailing Address: 2196 GARDEN HW
SAC CA 95833
E-mail:
francestenn@yahoo.com

Comment:
SAFCA has threatened for 7 a yr to take my house by eminent domain – my health has deteriorated, I now take blood pressure & anti anxiety med)

I have lived in this area for 55 yrs (my brother owns the house next door)

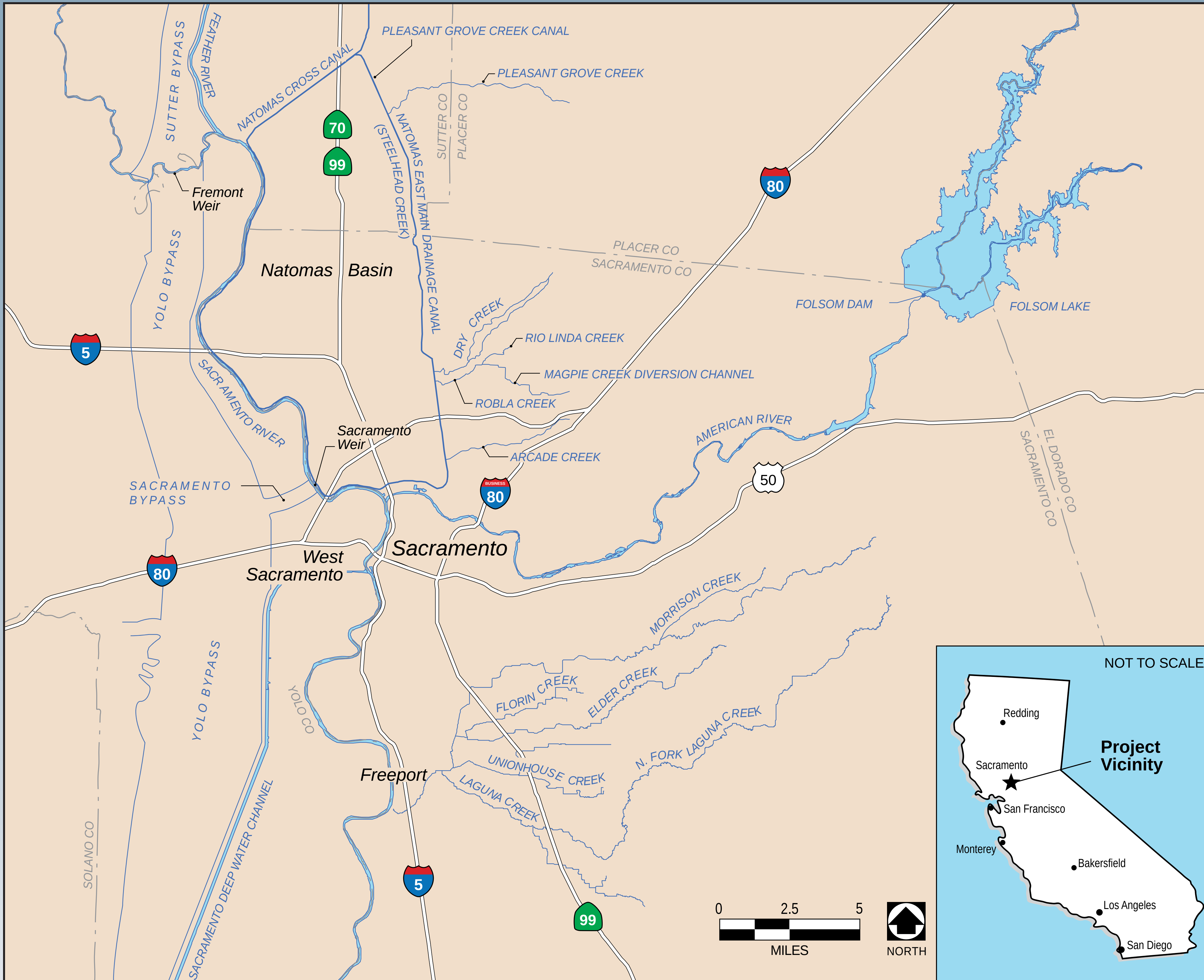
SAFCA plans to take my house & my brothers & give us "fair market value" when the housing market is bottomed out & the economy is in the Toilet –

They also do not intend to take houses in housing developments very near to mine that are closer to the levee than mine – I want equal rights to theirs

Please use reverse side of page or use additional sheets as needed

A2. Public Outreach Materials for October 22, 2008 Scoping Meeting

Station 1 – Project Location



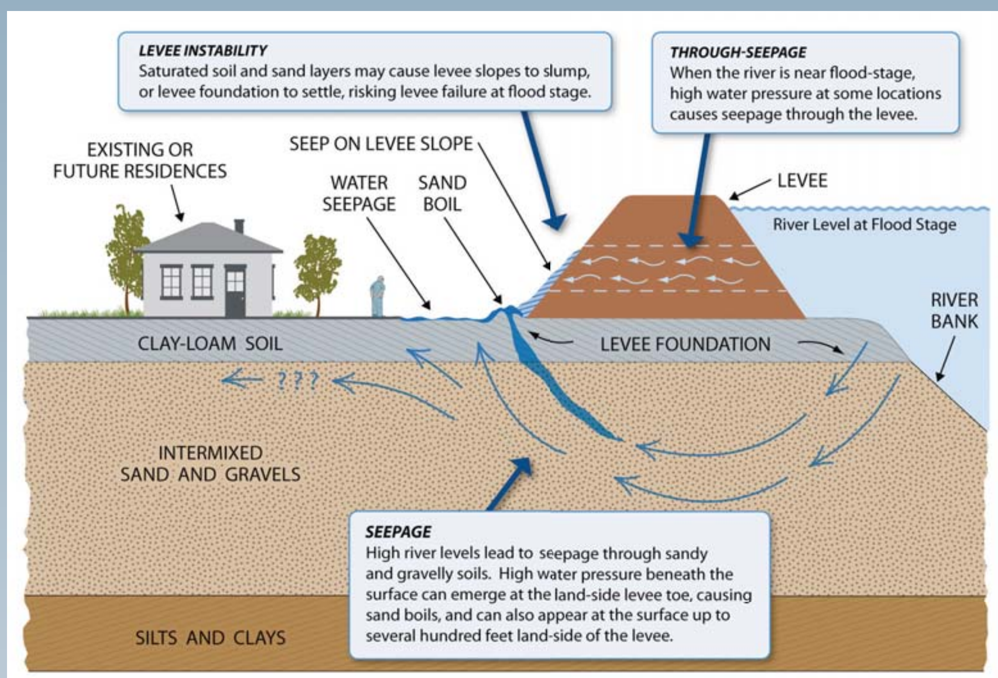
Station 2 – Project Purpose and Need

SAFCA's Project Purpose

Provide at least 100-year flood protection as quickly as possible while laying the groundwork to achieve at least "200-year" flood protection over time

Project Need: Levee Problems

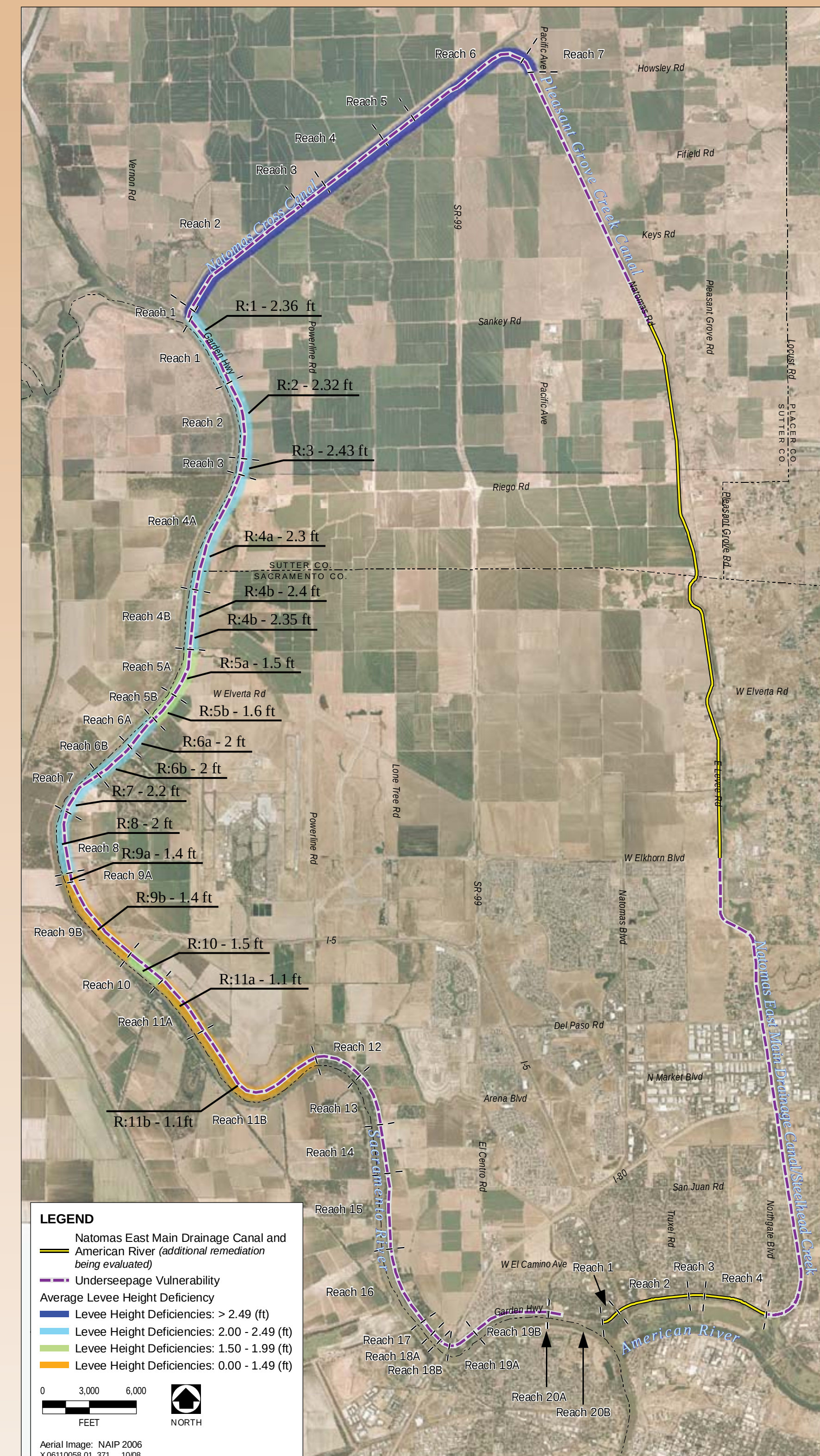
Seepage: Geotechnical studies have identified seepage beneath and through segments of the Natomas levee system as a significant risk to the stability and reliability of the system.



Height Deficiency: Much of the Natomas levee system is not high enough to meet the FEMA criteria for the National Flood Insurance Program and the Urban Level of Flood Protection required by state law.

Encroachments: USACE levee guidance requires the removal of vegetation greater than 2 inches in diameter on the levee slopes and within 15 feet of the waterside and land-side levee toes. Other encroachments that penetrate the levee and limit access on the land side and the water side (e.g., fences, retaining walls and driveways) may also be subject to removal.

Levee Segments Requiring Seepage Remediation and Levee Height Increases



Source: HDR 2007, Wood Rodgers 2007, SACOG 2006, EDAW 2007

Station 4

Summary of NLIP Phase 2 Modifications

Soil Borrow and Haul Routes

- Two potential borrow sites—Sutter Pointe and Dunmore—have been added to the construction plan. The Brookfield and Airport North Borrow sites have been designated as preferred, while the RD 1001 site would remain as a back-up. The Vestal, Spangler, Nestor, and Bolen South sites have been dropped from consideration.
- Design changes have increased the soil borrow requirement from 1.6 million to 2.8 million cubic yards.
- Sankey Road, Pacific Avenue, Powerline Road, and a portion of Riego Road have been eliminated as haul routes. Several off-road routes have been added at the Airport North Bufferlands. The haul route on West Elverta Road has been extended eastward approximately 1 mile to provide access to and from the Dunmore borrow site.

Construction Phasing and Timing

- The limit of the Phase 2 construction footprint along the Sacramento River East Levee has shifted 14,000 feet south to the end of reach 4B.
- Phase 2 levee construction start has been delayed to May 2009 and may overlap with Phase 3 construction.
- Construction of cutoff walls on a 24-hours-per-day, 7-days-per-week basis will take place as needed to complete work prior to the flood season.

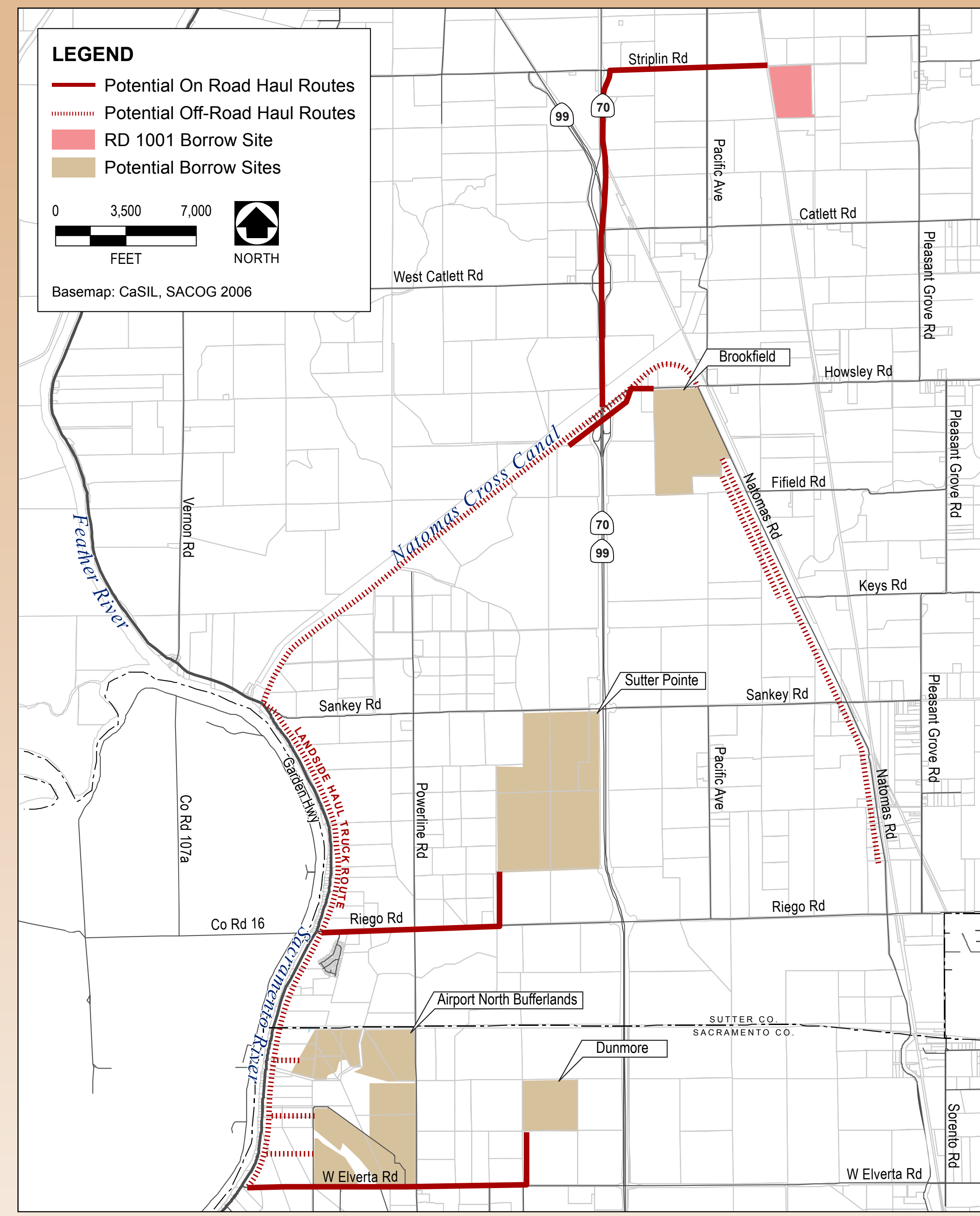
Levee Design and Seepage Remediation

- The design of the NCC south levee raise in Reaches 1 and 2 has been widened to the land side to reduce the need for vegetation removal on the water side.
- Seepage remediation measures in the Sacramento River east levee (Reaches 1-4B) have been modified as follows:
  - cutoff walls would be added for Reach 1, and cutoff walls would replace seepage berms in used in Reaches 2 and 3
  - seepage berms have been widened in several locations in Reach 4B.
- Sacramento River adjacent setback levee slope has been flattened from 3H:1V to 5H:1V in Reaches 1, 4A, and 4B.
- A portion of the seepage berm in Reach 4B of the Sacramento River east levee would be widened to 500 feet, reducing the need for relief wells, to help minimize impacts to cultural resources.

Land Use and Habitat

- The existing condition at the Airport North Bufferlands (NOP baseline) has changed from "active rice cultivation" to "fallow field."
- A planned 118-acre marsh at Airport North Bufferlands has been eliminated.
- Compensation for alfalfa "foraging habitat" that may be lost as a result of Phase 2 construction has been added to the habitat plan.

Borrow Sites and Anticipated Haul Routes



Source: Mead & Hunt 2007, EDAW 2007

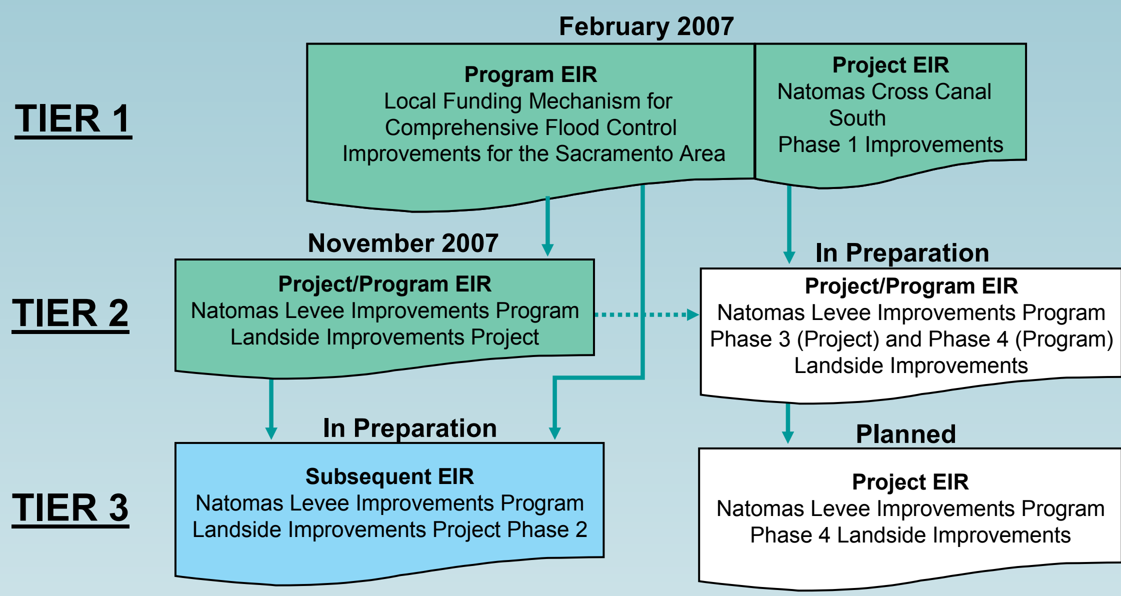
Station 3

SAFCA EIR Documents and Relationships

This Subsequent EIR will focus on changes to the Phase 2 (formally called the 2008 phase of construction) Project and new significant environmental effects driven by those modifications, as required under CEQA.

The Phase 2 Project consists of levee upgrades and seepage remediation for the Natomas Cross Canal south levee and Sacramento River east levee (Reaches 1-4B), relocation of the northern portion of the Elkhorn Canal, and creation of the first section of a new GGS/Drainage Canal. This phase was originally analyzed in the Natomas Levee Improvement Program Landside Improvements Project EIR, which the SAFCA Board of Directors certified in November 2007.

CEQA Lead Agency - SAFCA



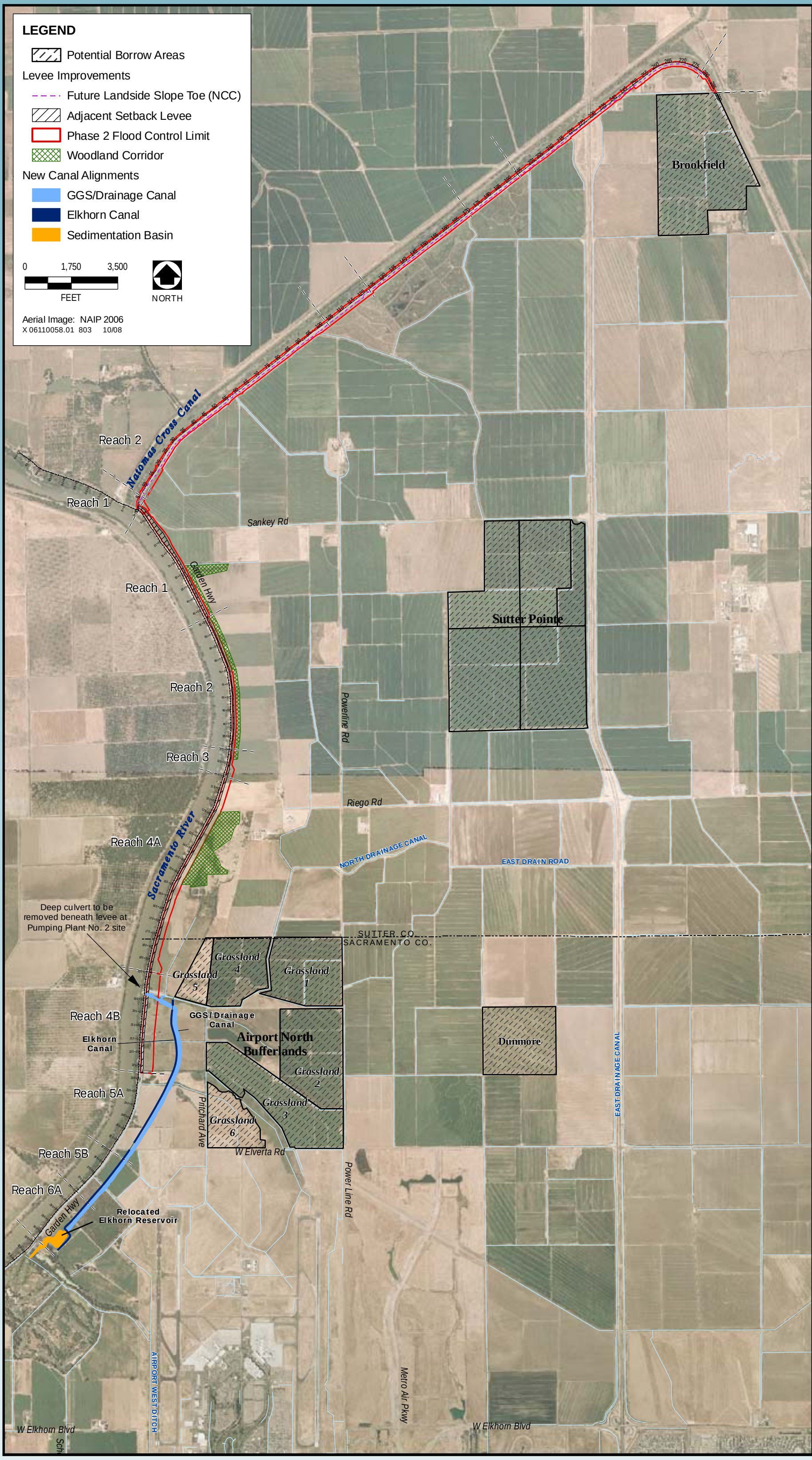
EIR Process Timeline

Subsequent EIR for Phase 2 Project

October 2, 2008	Issue NOP
November 3, 2008	Close of scoping period
November 18, 2008	Release Public Draft SEIR
January 2, 2009	Close of public comment period
January 27, 2009	Issue Final SEIR
February 19, 2009	Certify Final SEIR and file Notice of Determination

Station 5

Overview of Phase 2 Project Features



Source: HDR 2008, Wood Rodgers 2007, Mead & Hunt 2008, SACOG 2006, SCAS 2008

APPENDIX B

Hydrology and Water Quality

B1. Evaluation of Cutoff Walls Impact on Groundwater Recharge Sacramento River East Levee (December 2007)

December 19, 2007
File No.: 72834

Mr. Timothy Washburn
SAFCA
1007 7th Street, 7th Floor
Sacramento, CA 95814

Subject: Evaluation of Cutoff Walls Impact on Groundwater Recharge
Sacramento River East Levee
Natomas Levee Improvement Project
Sacramento and Sutter Counties, California

Dear Mr. Washburn:

One of the design alternatives considered for remediation of the Sacramento River East Levee from Reach 1 to Reach 20 includes construction of cutoff walls through an adjacent levee. These soil-bentonite (SB) walls are proposed to mitigate underseepage concerns and reduce exit seepage gradients to the acceptable levels, according to the established project criteria. Based on the design recommendations provided by Kleinfelder, the SB wall material should have permeability of $5x10^{-7}$ cm/sec or lower and extend at least 5 feet into a fine grained layer underneath the permeable foundation layer. To account for the variability of the slurry and the potential for construction defects, for this study the SB wall was modeled with and average overall permeability of $1x10^{-6}$ cm/sec.

A concern has been raised that the SB walls could potentially impede seepage from the river through the levee foundation and adversely impact groundwater recharge landward of the levee. To address these concerns, we have performed simplified seepage analyses to estimate seepage flow from the river into the aquifer under both existing conditions and with cutoff walls in place.

In addition, we have evaluated potential seepage loss from the proposed Giant Garter Snake ditch. This new 2 mile long unlined canal will be located approximately 500 to 1,000 feet landward of the levee toe and will follow the existing levee alignment between Stations 200+00 and 305+00. In general, the canal will be filled with water during summer month and will be dry during the winter months. During periods of time when the canal is filled with water, seepage through its bottom and side slopes may temporarily affect the groundwater table in the area.

General Assumptions

- Indealized stratigraphic models at Stations 27+00, 70+00, 217+00, and 353+00 were selected to represent the range of subsurface conditions along the

Sacramento River East Levee. Analyses at Station 217+00 are based on the stratigraphy model developed by URS, as presented in the URS "Draft Subsurface Investigation Report for Sacramento River East Levee, Natomas General Reevaluation Report" prepared for US Army Corps of Engineers, Sacramento District, dated 18 July 2007. Analyses at Stations 27+00, 70+00, and 353+00 are based on the models developed by Kleinfelder as presented in the Draft Basis of Design Report (Kleinfelder, 2007).

- Total length and location of the SB wall were estimated based on the information provided in the Final Draft Basis of Design Report dated December 18, 2007 and in the Alternatives Analysis Report for Seepage Mitigation Revision 1 dated September 24, 2007. Two representative cross-sections (Stations 70+00 and 353+00) have been selected to represent the proposed wall locations and depths.
- Seepage analyses were completed using steady state and transient analysis procedures with the finite element program SEEP/W version 6.17, provided with the GeoStudio 2004 package. These analyses do not account for 3-D effects, such as flow around the cutoff wall.
- All elevations are assumed to be NGVD29 datum unless otherwise noted.
- Typical seasonal river level fluctuations were estimated based on the information provided by the Department of Water Resources, Division of Flood Management (http://cdec.water.ca.gov/queryStation.html) for the Sacramento River gage at Verona. River stage data recorded at Verona from 11/26/1995 to 11/26/2007 are presented on Plates 1 through 5. Please note that river elevations on Plates 1 through 6 are reported in United States Engineering Datum (USED). In the Sacramento and San Joaquin River Basins, the adjustment from USED to NGVD varies from gaging station to gaging station within a range of 2.48 feet to 3.2 feet. The commonly used adjustment, when not otherwise known, is 3.0 feet. Elevation reported in USED is approximately 3 feet higher than elevation reported in NGVD29.
- Elevation of the groundwater table landward of the levee was estimated based on piezometer data obtained from "Final Observation Wells Report II: for Reaches North and South of Powerline Road", prepared by URS.
- A summary of permeability values used in the seepage analyses is presented on each of the Plates 6 through 10. Seepage parameters selected for this study are consistent with those presented in the Basis of Design Report.
- Only recharge due to seepage from the river was considered. The model does not account for flow into or out of the system due to precipitation, pumping or groundwater flow in a direction parallel to the levee axis.

Analysis Approach

We have performed simplified seepage analyses to estimate seepage flow from the river into the aquifer under both existing conditions and with cutoff walls in place and to evaluate the impact of the proposed canal construction based on the methodology outlined below. The following sections of this memo discuss analysis assumptions and details and present the results.

1. Review available historical data and develop representative seasonal river level and ground water table hydrographs.
2. Perform series of steady state seepage analyses at four representative cross-sections to estimate seepage through levee foundation under the existing conditions as a function of river elevation. Estimate seepage quantities in one foot increment of the water surface elevation for river levels between Elevations 15 and 32. Boundary conditions used in steady state seepage modeling simulations are defined below. Fixed-head boundary conditions set to the water surface elevations were applied along the boundary nodes of the upstream slope, river bottom, and the upstream (riverside) vertical edge of the model. Nodes along the bottom of the model were modeled as no flow boundary (zero total flux boundary condition). Infinite elements with fixed-head boundary conditions were used along the right vertical edge of the model. The total head along the vertical edge was set to an estimated groundwater table elevation landward of the levee. The landside slope of the levee and the ground surface were modeled as potential seepage exit surfaces.
3. Using results from Steps 1 and 2 for each representative cross-section estimate seepage flow under the existing conditions over a typical year report seepage quantities in acre-feet per year per 1,000 feet of levee.
4. Using results from Step 3 and subsurface condition profiles at the landside toe of the levee, estimate seepage flow under the existing conditions over the entire length of the levee. Report seepage quantities in acre-feet per year.
5. Perform series steady state seepage analyses at two representative cross-sections (Stations 70+00 and 353+00) to estimate seepage through levee foundation with a cutoff wall in place as a function of river elevation. Estimate seepage quantities in one foot increments of the water surface elevation for river levels between Elevations 15 and 32.
6. Using results from Steps 1 and 5, for Stations 70+00 and 353+00 estimate seepage flow with a cutoff wall in place over a typical year. Report seepage quantities in acre-feet per year per 1,000 feet of levee.
7. Using results from Steps 4 and 6, calculate reduction in seepage quantities at Stations 70+00 and 353+00 due to the cutoff wall.
8. Using river and groundwater table hydrographs from Step 1, perform transient seepage analyses at Station 70+00 with and without the cutoff wall. The purpose of this analysis is two-fold: 1) better understand the impact of the cutoff wall on the recharge of the aquifer throughout the year; 2) verify percent reduction estimated based on the steady state analysis.
9. Using results from Steps 4 and 7 and subsurface condition profiles at the landside toe of the levee, estimate impact of the cutoff wall construction over the entire length of the levee. Report seepage quantities in acre-feet per year.
10. Perform transient analysis at Station 70+00 with the cutoff wall and canal to estimate seepage from the canal during a typical year.

Analysis Results

Step1

Historical data recorded by the Sacramento River gage station at Verona from 11/26/1995 to 11/26/2007 are plotted on Plates 1 through 5. We have estimated typical number of days per year river level remains at a given elevation as presented on Plate 6. We have also developed a representative annual river hydrograph (river level as a function of time) as shown graphically on Plate 7 and in tabular format on Plate 8. Transient seepage analyses utilized this hydrograph as a time-dependent boundary condition on the river side of the model.

Data from piezometer 2F-01-15N located north of Powerline Road indicates that the ground water elevation varies throughout the year from about 5 to 15 feet below ground level, see Attachment A. Based on the piezometer data, we have developed a representative groundwater table hydrograph as shown on Plate 7. Transient seepage analyses utilized this hydrograph as a time-dependent boundary condition on the landside of the model. For our steady state analyses we have set the groundwater table at 7 feet below ground surface, or Elevation 15. Our assumption of Elevation 15 is also supported by the groundwater contour maps from County of Sacramento, Department of Water Resources for the spring and fall. The groundwater contours immediately landward of the levee near Reach 4B indicate groundwater elevations greater than 10 feet but generally less than 20.

Steps 2 and 3

Estimated seepage quantities through the levee foundation as a function of river elevation under the existing conditions (no cutoff wall) at Stations 27+00, 70+00, 217+00, and 353+00 are summarized in Table 1 and presented on Plate 9. Seepage analyses results for WSE at Elevation 32 are presented graphically on Plates 10 through 13. As shown in this table and graphically on Plate 9, the seepage quantities increase two orders of magnitude as the river level rises from Elevations 15 to 32. These results also indicate Station 217+00 provides the greatest contribution to the aquifer recharge landward of the levee. For a given river stage, estimated seepage quantities at Station 217+00 are approximately 100 times greater than the estimated quantities at the other three stations. Seepage quantities at Stations 27+00, 70+00, and 353+00 are approximately the same order of magnitude. The higher seepage quantities at Station 217+00 are primarily due to the presence of thick highly permeably sand and gravel layers in the foundation.

The second result worth noting is the aquifer only recharges when the river level is above the groundwater elevation. When the river elevation is below the groundwater table (Elevation 15), the direction of the seepage flow in the model is reversed, indicating flow out of the aquifer.

Table 1
Estimated Seepage Quantities Versus River Stage
Existing Conditions

Elevation	27+00 Flow Existing Conditions	70+00 Flow Existing Conditions	217+00 Flow Existing Conditions	353+00 Flow Existing Conditions
15	-4.98E-11	8.61E-03	1.51E+00	-3.69E-12
16	8.53E-02	4.31E-02	6.06E+00	3.89E-01
17	1.71E-01	7.75E-02	1.21E+01	7.78E-01
18	2.56E-01	1.12E-01	1.82E+01	1.17E+00
19	3.41E-01	1.46E-01	2.42E+01	1.56E+00
20	4.26E-01	1.81E-01	3.03E+01	1.96E+00
21	5.13E-01	2.15E-01	3.63E+01	2.35E+00
22	5.99E-01	2.50E-01	4.24E+01	2.74E+00
23	6.84E-01	2.85E-01	4.85E+01	3.14E+00
24	7.70E-01	3.19E-01	5.45E+01	3.53E+00
25	9.24E-01	3.54E-01	6.07E+01	3.92E+00
26	1.08E+00	3.89E-01	6.68E+01	4.87E+00
27	1.43E+00	5.17E-01	7.33E+01	6.09E+00
28	1.93E+00	8.47E-01	7.97E+01	7.47E+00
29	2.60E+00	1.40E+00	8.62E+01	9.05E+00
30	3.26E+00	2.10E+00	9.28E+01	1.08E+01
31	4.08E+00	2.99E+00	9.95E+01	1.28E+01
32	5.07E+00	4.21E+00	1.06E+02	1.51E+01
Total Flux Acre ft/yr/1000ft	3.9	2.6	129	13.4

Note: All fluxes in ft^3/day/ft unless noted otherwise and elevations are reported in ft (NGVD29)

Step 4

The total length of the Sacramento River East Levee between Station 0+00 (Reach 1) and Station 960+00 (Reach 20) is approximately 18.1 miles. The general profile for the subsurface conditions along the levee crown/landside toe was is provided in Attachment B. In general, the subsurface conditions profile is comprised of five units. These strata listed in order of increasing depth include: existing levee, surficial clay/fine grain soil blanket, silty and clayey sand layer, clean sand layer, gravel layer, and a lower clay/lower permeability soil region. As shown in Table 2, conditions at Station 27+00 are representative of approximately 1.8 miles or 11 percent of the entire length of the Sacramento River East Levee. Conditions at Station 70+00 are representative of approximately 4 miles or 23 percent of the entire length of the Sacramento River East Levee. Conditions at Station 217+00 are representative of approximately 7.6 miles or 42 percent of the entire length of the Sacramento River East Levee. Conditions at Station 353+00 are representative of approximately 4.7 miles or 24 percent of the entire length of the Sacramento River East Levee. Accordingly, the total estimated flow from the Sacramento River through the levee foundation between Station 0+00 and Station 960+00 is approximately 5,650 acre-feet per year.

Table 2
Estimated Seepage Quantities, Entire East Levee
Existing Conditions

Reach	Stations	Representative Station	Length of Stretch (ft)	Seepage without Cutoff Wall (ac-ft/yr)
1	00+00 to 48+00	27+00	4,800	19
2	48+00 to 100+00	70+00	5,200	14
3	100+00 to 110+00	70+00	1,000	3
4a	110+00 to 120+00	70+00	1,000	3
4a	120+00 to 190+00	353+00	7,000	95
4b	190+00 to 228+00	217+00	3,800	490
5a	228+00 to 263+00	70+00	3,500	10
5b	263+00 to 280+00	27+00	1,700	6
6	280+00 to 330+00	217+00	5,000	650
7	330+00 to 345+00	353+00	1,500	20
7	345+00 to 362+00	353+00	1,700	23
8	362+00 to 402+00	353+00	4,000	55
9a	402+00 to 430+00	353+00	2,800	38
9b	430+00 to 468+10	353+00	3,810	50
10	468+10 to 495+00	217+00	2,690	350
11	495+00 to 635+00	217+00	14,000	1810
12	635+00 to 640+00	217+00	500	65
12	640+00 to 667+00	70+00	2,700	7
13	667+00 to 700+00	353+00	3,300	45
14	700+00 to 732+00	70+00	3,200	8
15	732+00 to 780+00	217+00	4,800	620
16	780+00 to 832+00	217+00	5,200	675
17	832+00 to 842+00	217+00	1,000	130
18	842+00 to 857+00	217+00	1,500	195
19a	857+00 to 875+00	217+00	1,800	235
19b	875+00 to 925+00	70+00	5,000	15
20a	925+00 to 925+50	27+00	50	.2
20b	925+50 to 960+00	27+00	3,450	13
Total Seepage ac-ft/year				**5,650**

Steps 5 and 6

Cutoff soil-bentonite (SB) walls are currently proposed at thirteen locations along the east levee, as summarized in Table 3. The total length of the proposed SB walls is approximately 8 miles. The proposed depth of the wall varies from location to location based on the subsurface conditions and the required underseepage mitigation. Idealized cross-sections at Stations 70+00 and 353+00 are selected to represent the range of conditions at the proposed cutoff wall locations. At Station 70+00 where the surficial clay blanket is relatively thin and the underlying permeable layer is relatively shallow, the wall would completely penetrate the sand layer and key into the clay layer beneath. On the other hand at Station 353+00, only a partially penetrating cutoff wall is required. Proposed depth of the wall relative to the estimated bottom of the permeable layer at each location is presented in Table 3.

Table 3
Proposed Cutoff Wall Locations

Reach	Stations	Length of Stretch	Proposed depth of wall, Elevation	Depth of Sand layer, Elevation	Representative station for wall impact evaluation
2	48+00 to 100+00	5,200	-25	-25	70+00
3	100+00 to110+00	1,000	-25	-10	70+00
6	280+00 to 330+00	5,000	-70	-65	70+00
7	330+00 to 362+00	3,200	-60	-50	70+00
8	362+00 to 402+00	4,000	-60	-50	70+00
9	430+00 to 468+00	3,800	-70	-45	70+00
10	468+10 to 495+00	2,690	-25	-70	353+00
13	667+00 to 700+00	3,300	-20	-100	353+00
15	732+00 to 780+00	4,800	-10	-100	353+00
17	832+00 to 842+00	1,000	-25	-100	353+00
18	842+00 to 857+00	1,500	-25	-100	353+00
19a	857+00 to 875+00	1,800	-25	-100	353+00
19b	875+00 to 925+00	5,000	-25	-40	353+00

We have performed a series of steady state seepage analyses to estimate seepage quantities through the levee foundation with an SB wall in place. The analyses results for Stations 70+00 and 353+00 with WSE at Elevation 32 are presented on Plates 14 and 15. Total flow through a flux section located immediately landward of the SB wall was calculated with and without the cutoff wall in place. The two results were compared to estimate the groundwater recharge effects of the cutoff wall. Seepage quantities as a function of river stage are summarized in Table 4.

Table 4
Estimated Seepage Quantities versus River Stage
With and Without Cutoff Wall

Elevation	70+00 Flow Existing Conditions	70+00 Flow With Cutoff Wall	353+00 Flow Existing Conditions	353+00 Flow With Cutoff Wall
15	8.61E-03	4.56E-03	-3.69E-12	-5.97E-13
16	4.31E-02	2.29E-02	3.89E-01	3.90E-01
17	7.75E-02	4.14E-02	7.78E-01	7.80E-01
18	1.12E-01	6.00E-02	1.17E+00	1.17E+00
19	1.46E-01	7.87E-02	1.56E+00	1.56E+00
20	1.81E-01	9.75E-02	1.96E+00	1.96E+00
21	2.15E-01	1.16E-01	2.35E+00	2.35E+00

Table 4 (Cont.)

Elevation	70+00 Flow Existing Conditions	70+00 Flow With Cutoff Wall	353+00 Flow Existing Conditions	353+00 Flow With Cutoff Wall
22	2.50E-01	1.36E-01	2.74E+00	2.74E+00
23	2.85E-01	1.55E-01	3.14E+00	3.13E+00
24	3.19E-01	1.74E-01	3.53E+00	3.52E+00
25	3.54E-01	1.93E-01	3.92E+00	3.92E+00
26	3.89E-01	2.13E-01	4.87E+00	4.31E+00
27	5.17E-01	2.33E-01	6.09E+00	4.70E+00
28	8.47E-01	2.54E-01	7.47E+00	5.12E+00
29	1.40E+00	2.75E-01	9.05E+00	5.59E+00
30	2.10E+00	2.95E-01	1.08E+01	6.06E+00
31	2.99E+00	3.16E-01	1.28E+01	6.54E+00
32	4.21E+00	3.37E-01	1.51E+01	7.02E+00
Total Flux Acre ft/yr/1000ft	2.6	0.4	13.4	8.4

Note: Flows in ft^3/day/ft unless noted otherwise and elevations are reported in ft (NGVD29)

<u>Step 7</u>

Based on the results of steady state seepage analyses presented in Table 4, the cutoff wall could potentially reduce seepage through the foundation by 40 to 85 percent depending on the subsurface conditions and the proposed depth of the wall. At the locations where the wall fully penetrates the permeable sand layer (Station 70+00) seepage quantities could be reduced by approximately 85 percent. At the locations, where the cutoff is shallow and only partially penetrates the sand layer (Station 353+00), the reduction would be approximately 40 percent.

<u>Step 8</u>

To verify and validate steady state seepage analyses described above, we have performed transient seepage analyses for Station 70+00. The purpose of these analyses was to better understand effects of seasonal groundwater table fluctuations on the estimated seepage quantities with and without the cutoff wall and more accurately model typical river conditions throughout the year. Time-dependent boundary conditions assigned to the riverside and the landside of the model as shown on Plate 16 and summarized in a tabular form on Plate 8 were used in these analyses. Seepage quantity computations were performed at 34 time steps, starting in February and ending a year later.

Transient seepage analyses results are presented on Plates 17 through 20. Existing seepage flow regime during typical winter and summer conditions is illustrated on Plates 17 and 18 respectively. Seepage conditions with the cutoff wall in place are shown on

Plates 19 and 20. The plates show calculated seepage velocity vectors which illustrate the direction and the amount of flow - the larger the arrow, the higher the velocity and the larger the flow. A consistent scale was used on all four plates for easier visual comparison. The results indicate seepage occurs primarily through the permeable foundation sand layer and the existing sand levee. The flow is significantly higher during the elevated river stages (winter). Further, conditions may exist during the year when the river water surface is lower than the groundwater table. During these periods of time, the direction of the flow is reversed indicating seepage flow toward the river as illustrated on Plate 18.

Seepage quantities through levee foundation with and without the cutoff wall as a function of time are presented on Plate 21. Positive seepage quantities indicate flow from the river landward of the levee while the negative sign indicates flow in the opposite direction. As shown on Plate 21, construction of the cutoff wall impedes flow in both direction and as a result may prevent flow into the river during the summer months.

Based on the transient seepage analyses, flow through the levee foundation at Station 70+00 without the wall is estimated at 8 acre-ft/year per 1,000 feet of the levee. Seepage through the levee foundation with the wall in place is approximately 1.7 acre-ft/year per 1,000 feet. Compared to the steady state analyses results for the same station, the transient seepage analyses estimate higher seepage quantities. However, the estimated reduction in flow due to the wall is comparable in both analyses. Based on the transient analysis, the seepage quantities would be reduced by about 80% compared to 85% estimated from the steady-state seepage analyses. Accordingly, we conclude the steady state seepage analyses should reasonably well approximate the effect of the cutoff walls.

<u>Step 9</u>

The overall effect of the cutoff wall construction can be estimated based on the information presented in Table 5. Based on our evaluations, construction of the SB wall could potentially reduce the inflow to the aquifer by approximately 1,300 acre-feet per year.

Table 5
Estimated Seepage Quantities through Levee Foundation
Reaches 1 through 20

Reach	Stations	Representative Station	Stretch Length (ft)	Seepage without Cutoff Wall (ac-ft/yr)	Percent reduction based on cross section	Seepage with Cutoff Wall (ac-ft/yr)	Is Cutoff Wall Proposed at this Location?
1	00+00 to 48+00	27+00	4,800	19	0	19	N
2	48+00 to 100+00	70+00	5,200	14	85	2	Y
3	100+00 to 110+00	70+00	1,000	3	85	.4	Y
4a	110+00 to 120+00	70+00	1,000	3	0	3	N

Table 5 (Cont.)

Reach	Stations	Representative Station	Stretch Length (ft)	Seepage without Cutoff Wall (ac-ft/yr)	Percent reduction based on cross section	Seepage with Cutoff Wall (ac-ft/yr)	Is Cutoff Wall Proposed at this Location?
4a	120+00 to 190+00	353+00	7,000	95	0	95	N
4b	190+00 to 228+00	217+00	3,800	490	0	490	N
5a	228+00 to 263+00	70+00	3,500	10	0	10	N
5b	263+00 to 280+00	27+00	1,700	6	0	6	N
6	280+00 to 330+00	217+00	5,000	650	85	100	Y
7a	330+00 to 345+00	353+00	1,500	20	85	3	Y
7b	345+00 to 362+00	353+00	1,700	23	85	3	Y
8	362+00 to 402+00	353+00	4,000	55	85	8	Y
9	402+00 to 430+00	353+00	2,800	38		38	N
9	430+00 to 468+10	353+00	3,800	50	85	8	Y
10	468+10 to 495+00	217+00	2,690	350	40	210	Y
11	495+00 to 635+00	217+00	14,000	1810	0	1810	N
12	635+00 to 640+00	217+00	500	65	0	65	N
12	640+00 to 667+00	70+00	2,700	7	0	7	N
13	667+00 to 700+00	353+00	3,300	45	40	30	Y
14	700+00 to 732+00	70+00	3,200	8	0	8	N
15	732+00 to 780+00	217+00	4,800	620	40	375	Y
16	780+00 to 832+00	217+00	5,200	675	0	675	N
17	832+00 to 842+00	217+00	1,000	130	40	80	Y
18	842+00 to 857+00	217+00	1,500	195	40	120	Y
19a	857+00 to 875+00	217+00	1,800	235	40	140	Y
19b	875+00 to 925+00	70+00	5,000	15	40	8	Y
20a	925+00 to 925+50	27+00	50	.2	0	.2	N
20b	925+50 to 960+00	27+00	3,550	13	0	13	N
Total Seepage				**5,650**		**4,330**	

The results of this study indicate the construction of cutoff walls could potentially impede the groundwater aquifer recharge landward of the levee by approximately 20-25% of its current recharge rate. Seepage through the levee foundation without the wall is estimated at 5,650 acre-feet per year. Seepage with the SB cutoff wall in place is approximately 4,350 acre-feet per year. The resulting impact to the groundwater recharge is approximately 1,300 acre-feet per year. In our opinion, these results are likely conservative and represent the upper-bound estimate. The actual impact is likely lower, due to 3-D effects but cannot be assessed with the existing modeling.

Step 10

A new 2 mile long canal will be constructed along the east levee between Stations 200+00 and 305+00. This canal, shown in plan in Attachment C, will be located approximately 500 to 1,000 feet landward of the levee toe and will follow the existing levee alignment. In general, the canal will be filled with water during summer months and will be dry during the winter months.

We have evaluated the impact of the canal operation on the groundwater conditions in the area. Transient analyses were performed to estimate seepage quantities from and into the canal at various times throughout the year. The analyses were performed for Station 70+00 with a cutoff wall in place. The canal cross-section was incorporated into the transient analysis model described in Step 8 above as a 8 feet deep and 10 feet wide ditch with 3H:1V side slopes positioned 1,000 ft landward of the levee. The canal was assumed to be filled with up to 5 feet of water from May through November and was allowed to seep in the winter, modeled as a free seepage discharge face. The canal operation was modeled as another time-dependent boundary condition applied, as shown on Plate 22. The canal will be excavated through the surficial clay blanket which consists primarily of CL with some CH and ML soils with percent fines between 50 and 70 percent. The permeability of this layer is estimated at 10^{-5} cm/sec. This permeability was assigned to the surface layer to represent base-case conditions. Clay blanket thickness varies across the site and excavation of the canal may result in a complete removal of the surficial clay at some locations. To account for variability in subsurface conditions and the possibility of a complete removal of the clay blanket, we have conducted a sensitivity analysis with permeability of the surface layer increased by one order of magnitude (10^{-4} cm/sec). The results of this analysis provide an upper bound estimate of seepage losses from the canal.

Seepage quantities were calculated using a flux line placed along the perimeter of canal cross-section. Positive and negative quantities indicate flow from and into the ditch, respectively. The estimated seepage quantities as a function of time are shown on Plate 23. Based on the results of the transient analyses, seepage loss is estimated at 1.4 acre-ft/year per 1,000 feet of the canal for base-case conditions. Only positive flow (flow from the canal) was considered in these computations. Seepage loss over the entire length of the canal is estimated at 15 acre-ft per year. The upper bound estimate is approximately 90 acre-ft per year.

We have also evaluated the combined impact of the cutoff wall construction and the canal operation on the groundwater table in the vicinity of the levee. This evaluation was performed based on the transient seepage analysis results from Steps 8 and 10. The groundwater table elevation was estimated as a function of time at the location halfway between the existing levee and the proposed canal. The results, provided on Plate 24, indicate minimal impact during winter months. However, during summer months groundwater table elevation in the immediate vicinity of the proposed wall locations could increase by as much as 3 feet. This increase is likely due to the combined effect of the cutoff wall preventing backflow into the river and the additional inflow from the canal.

Conclusions

The key findings and conclusions presented in this memorandum are as follows:

- Under the existing conditions seepage from the Sacramento River through the levee foundation along Sacramento River East Levee between Stations 00+00 and 960+00 is estimated at 5,650 acre-ft/year.
- At the proposed wall locations seepage flow could be reduced locally by up 85 percent, depending on stratigraphy and proposed wall depth.
- The overall impact of the proposed cutoff walls is estimated at approximately 1,300 acre-ft/year (20 percent reduction of the total recharge rate)
- The cutoff wall could impede seepage flow towards the river in the summer months when the river level is low.
- Construction of an irrigation canal may increase aquifer recharge by approximately 15 to 90 acre-ft per year.
- Construction of the cutoff wall and the canal may locally increase the groundwater level up to 3 feet in the summer months.

Due to the limitations of the model, the analyses can only provide an order-of-magnitude estimate of the seepage quantities. Additional analyses with a three-dimensional model such as MODFLOW are recommended to properly characterize groundwater flow regime in the area and quantify the impact of the proposed SB cutoff wall on the aquifer recharge.

If you have questions regarding this design or require additional information, please contact either Elena Sossenkina at (303) 237-6601 or the undersigned.

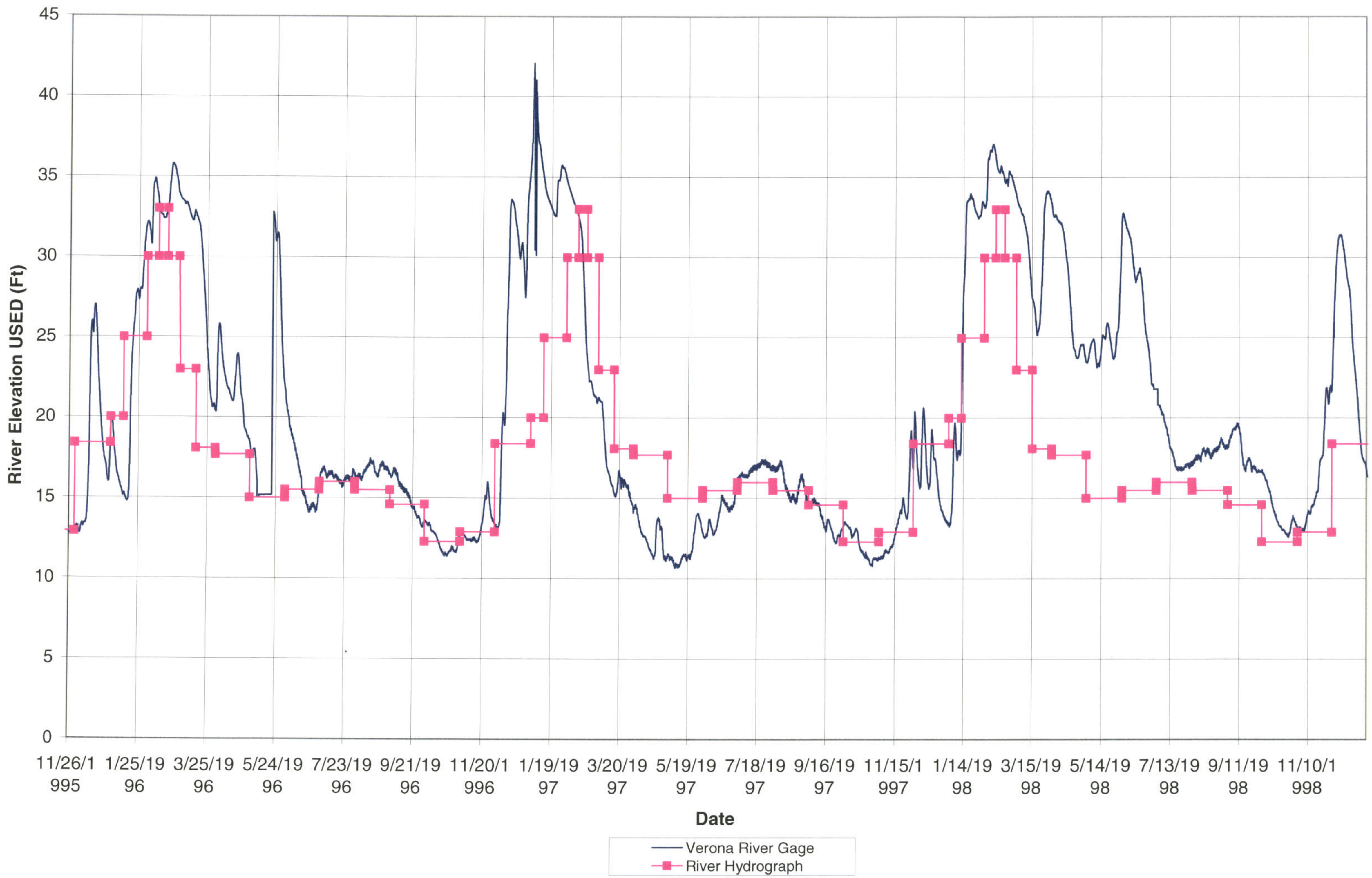
Sincerely,

KLEINFELDER WEST, INC.

Keith A. Ferguson, PE
Principal Engineer

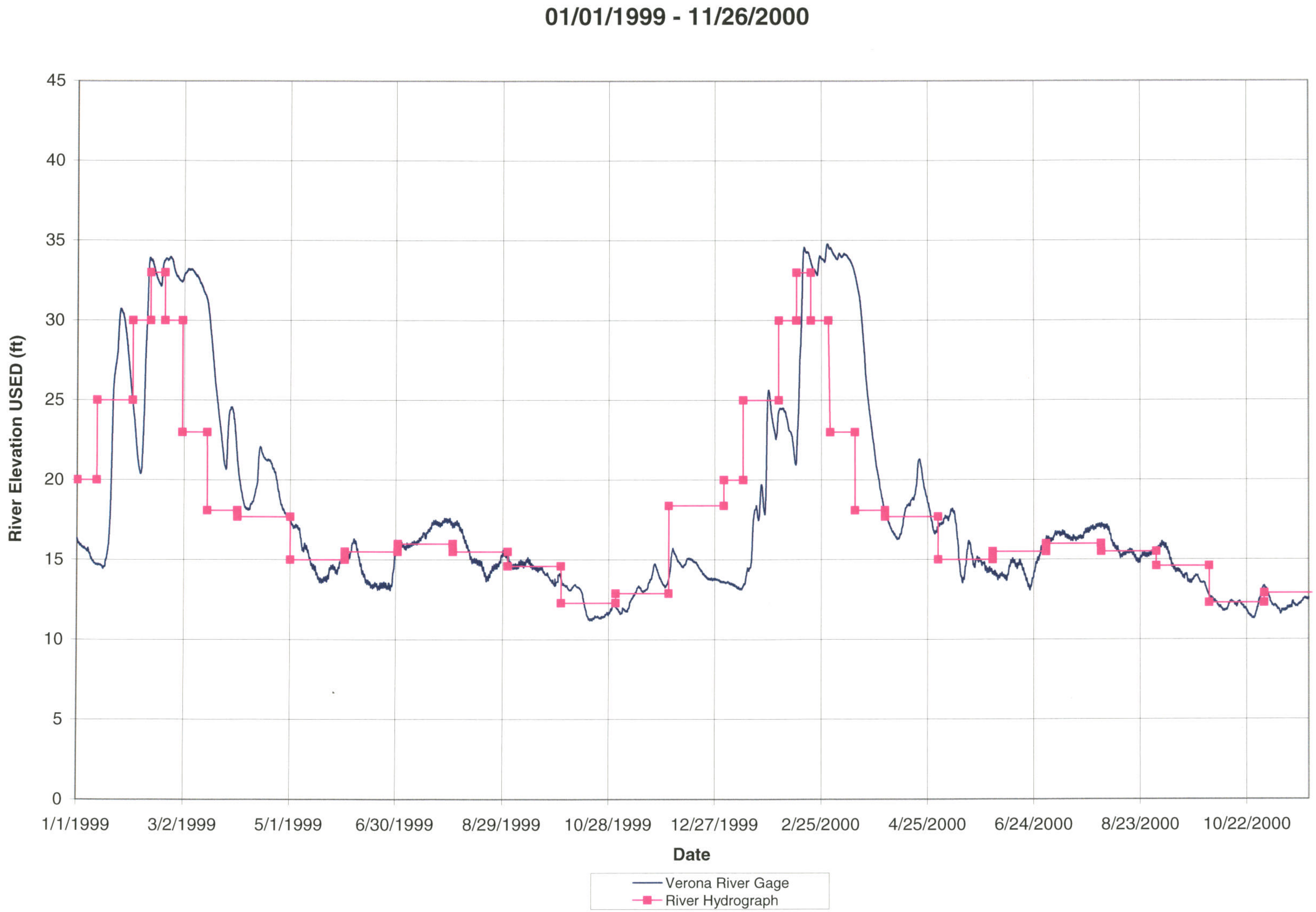
PLATES

11/26/1995 - 12/31/1998



KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 1
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		

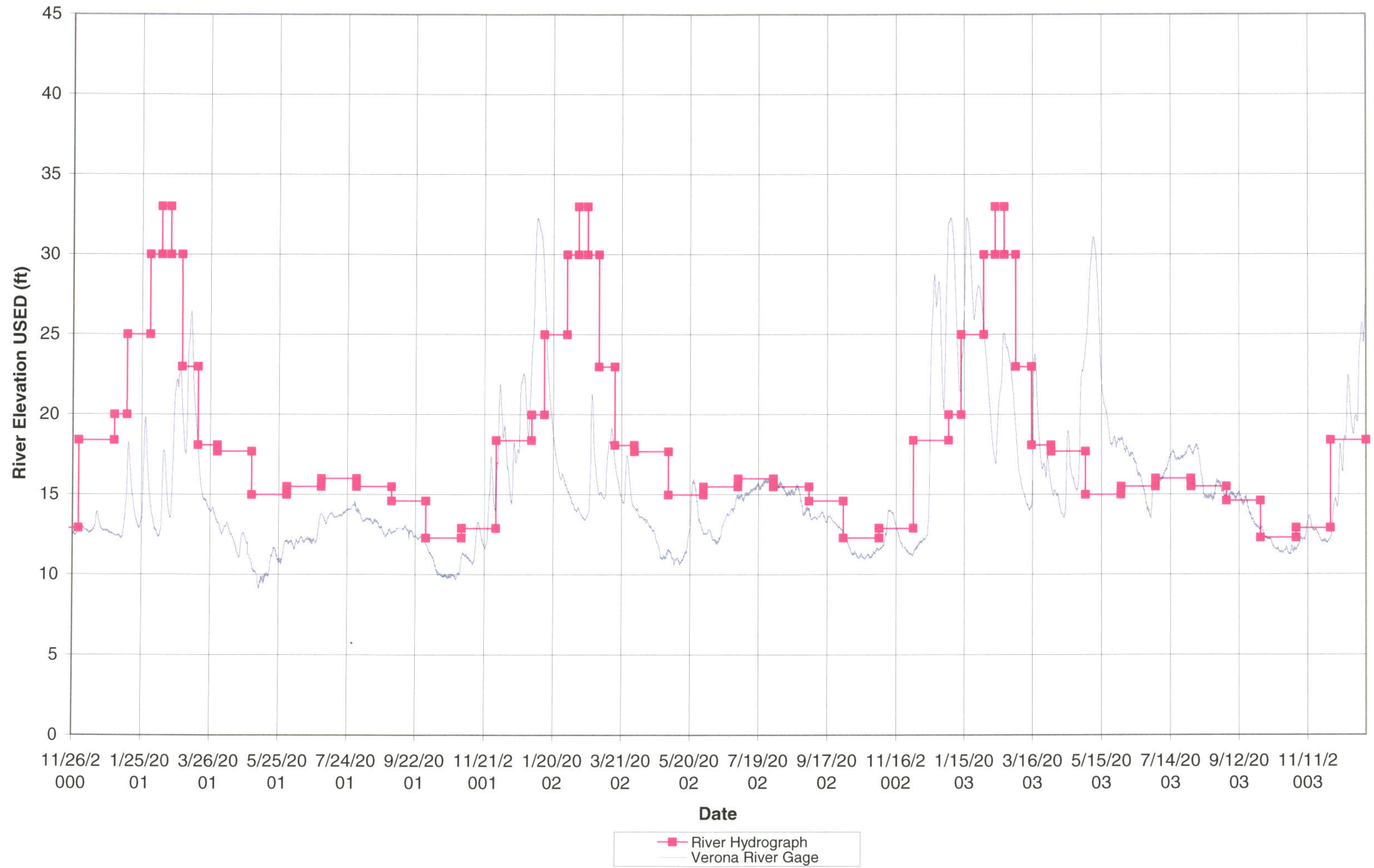
Ref: http://cdec.water.ca.gov/queryStation.html



Ref: http://cdec.water.ca.gov/queryStation.html

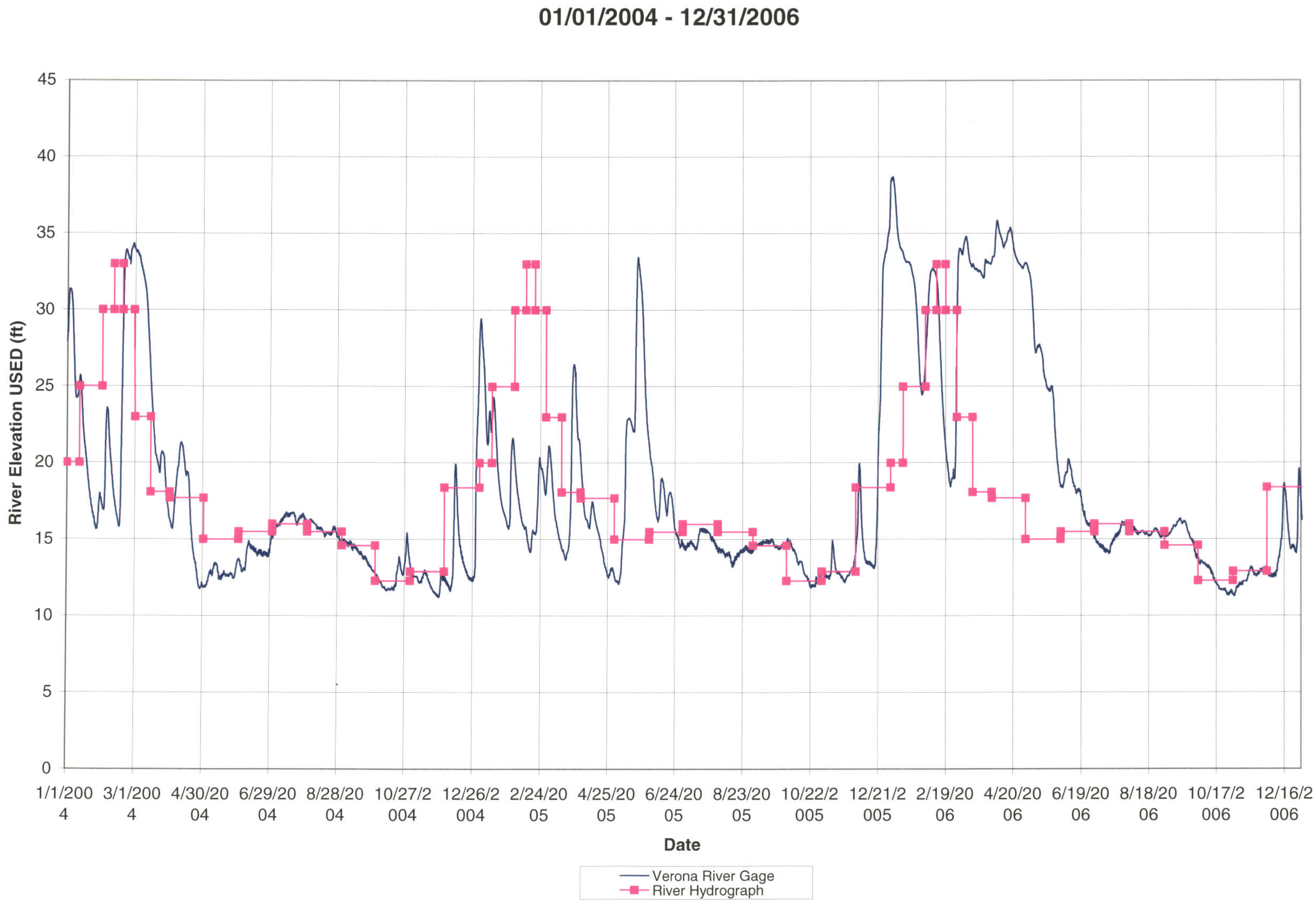
KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 2
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		

11/26/2000 - 12/31/2003



Ref: http://cdec.water.ca.gov/queryStation.html

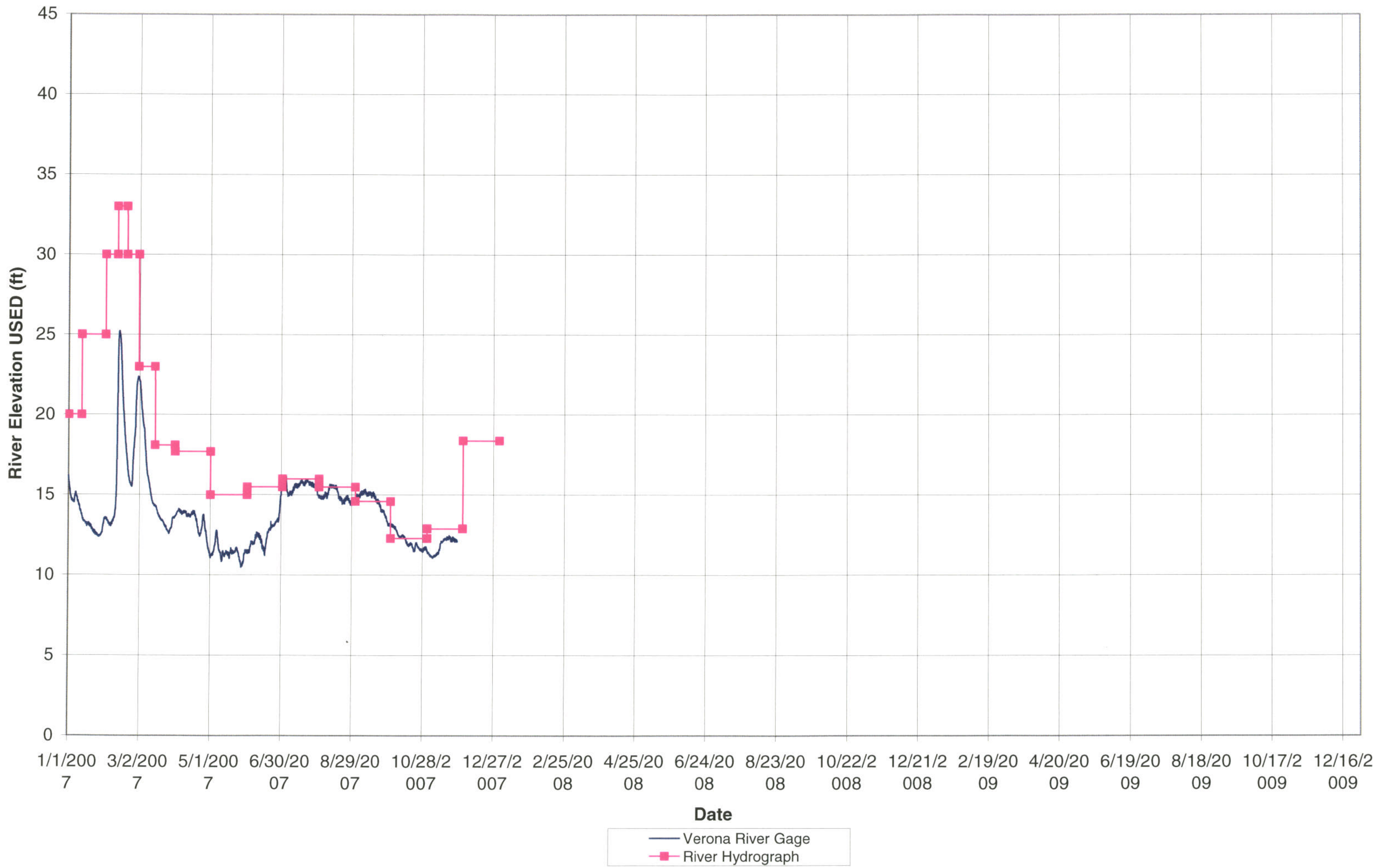
KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 3
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		



Ref: http://cdec.water.ca.gov/queryStation.html

KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 4
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		

01/01/2007 - 11/26/2007



Ref: http://cdec.water.ca.gov/queryStation.html

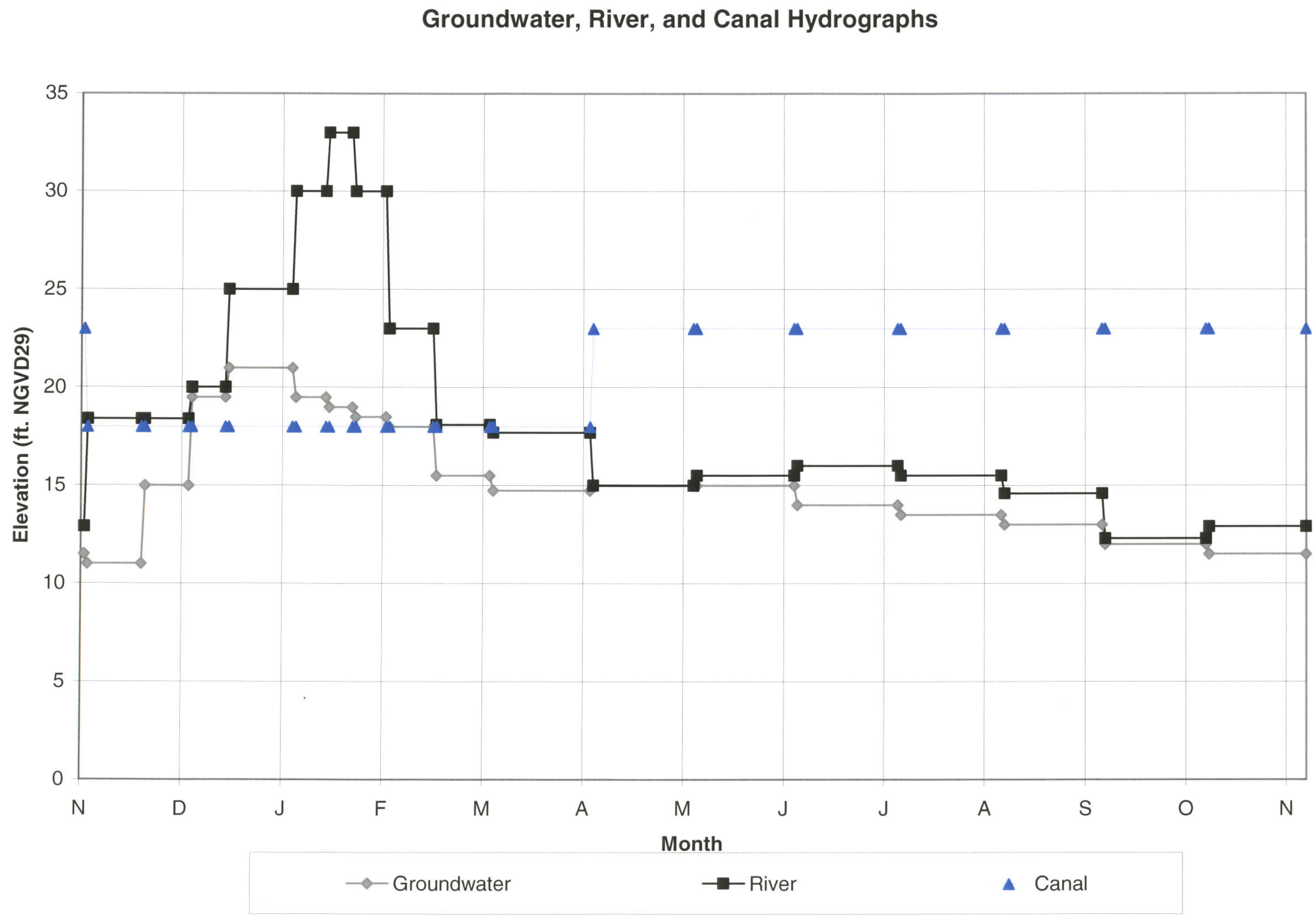
KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 5
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		

Sacramento River Elevation in ft

Elevation	% of Days per Year River at Given El.	Days per Year River at El.
15	5.4	20
16	3.5	1
17	2.3	8
18	1.8	7
19	1.9	7
20	1.5	6
21	1.4	5
22	1.7	6
23	1.2	4
24	0.8	3
25	1	4
26	0.8	3
27	0.7	3
28	0.8	3
29	1.2	4
30	2.6	10
31	2.8	10
32	2.7	10

Note: Historical river elevations in Plates 1-5 are reported in the USED datum. Elevations reported above are using NGVD29 datum. Satistics are based on data from the Verona River Gage obtained from http://cdec.water.ca.gov/queryStation.html from the period 11/26/1995-11/26/2007.

KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 6
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		



KLEINFELDER

Graphic By: ESS
Project No. 72834

Date: 11/29/2007
File: App. Cutoff Wall

Evaluation of Cutoff Wall Impact on Groundwater Recharge
Sacramento River East Levee

PLATE 7

Transient Time Step Table

Time Step	Date	River Elevation	Ground Water Elevation	Canal Elevation	Time Step	Date	River Elevation	Ground Water Elevation	Canal Elevation
1	2/11	33	19	18	18	8/31	15.5	13.5	23
2	2/18	33	19	18	19	9/1	14.6	13	23
3	2/19	30	18.5	18	20	9/30	14.6	13	23
4	2/28	30	18.5	18	21	10/1	12.3	12	23
5	3/1	23	18	18	22	10/31	12.3	12	23
6	3/14	23	18	18	23	11/1	12.9	11.5	23
7	3/15	18.1	15.5	18	24	11/30	12.9	11.5	23
8	3/31	18.1	15.5	18	25	12/1	18.4	11	18
9	4/1	17.7	14.75	18	26	12/17	18.4	11	18
10	4/30	17.7	14.75	18	27	12/18	18.4	15	18
11	5/1	15	15	23	28	12/31	18.4	15	18
12	5/31	15	15	23	29	1/1	20	19.5	18
13	6/1	15.5	15	23	30	1/11	20	19.5	18
14	6/30	15.5	15	23	31	1/12	25	21	18
15	7/1	16	14	23	32	1/31	25	21	18
16	7/31	16	14	23	33	2/1	30	19.5	18
17	8/1	15.5	13.5	23	34	2/10	30	19.5	18

KLEINFELDER

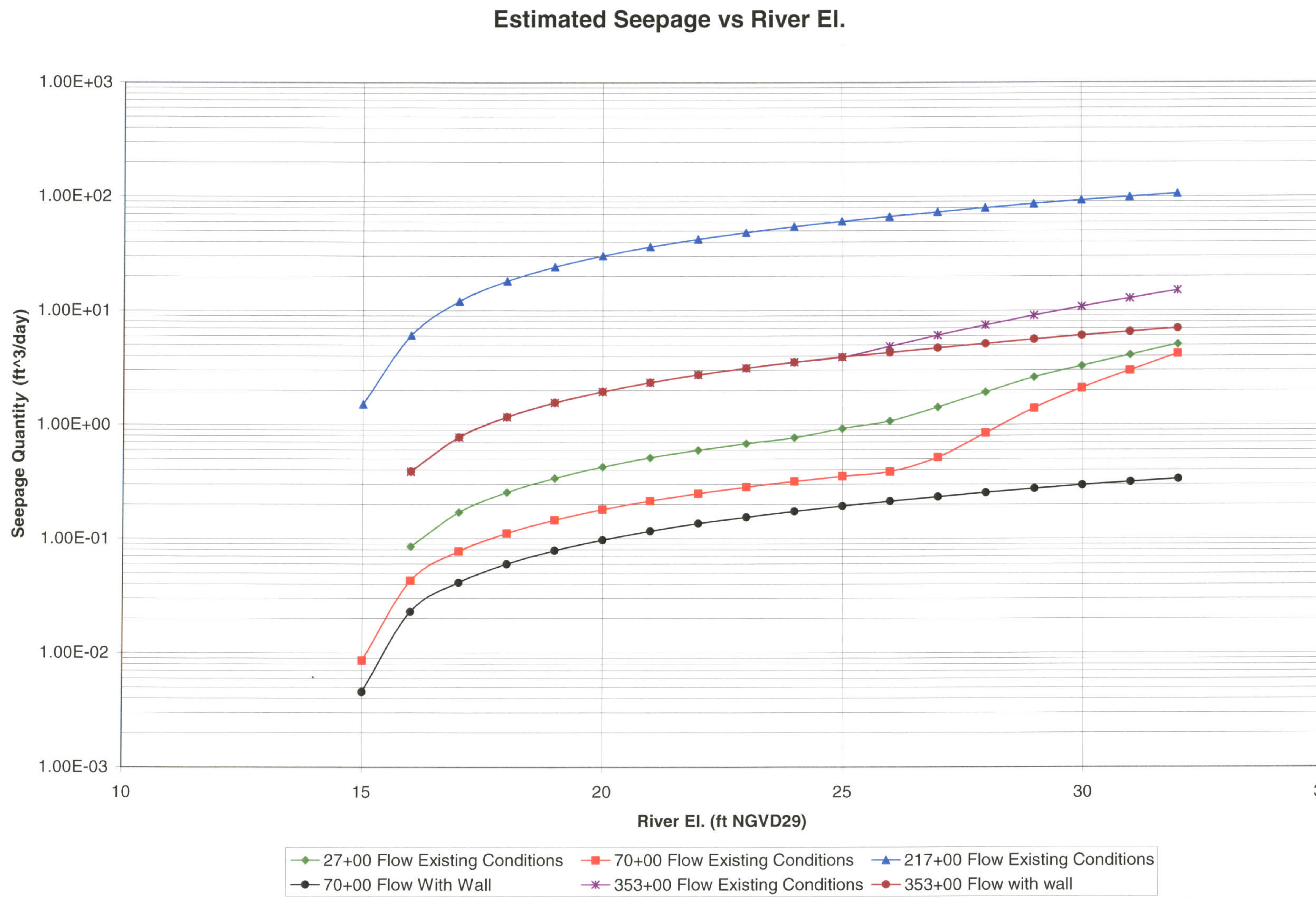
Graphic By: ESS
Project No. 72834

Date: 11/29/2007
File: App. Cutoff Wall

Evaluation of Cutoff Wall Impact on Groundwater Recharge
Sacramento River East Levee

PLATE

8



KLEINFELDER

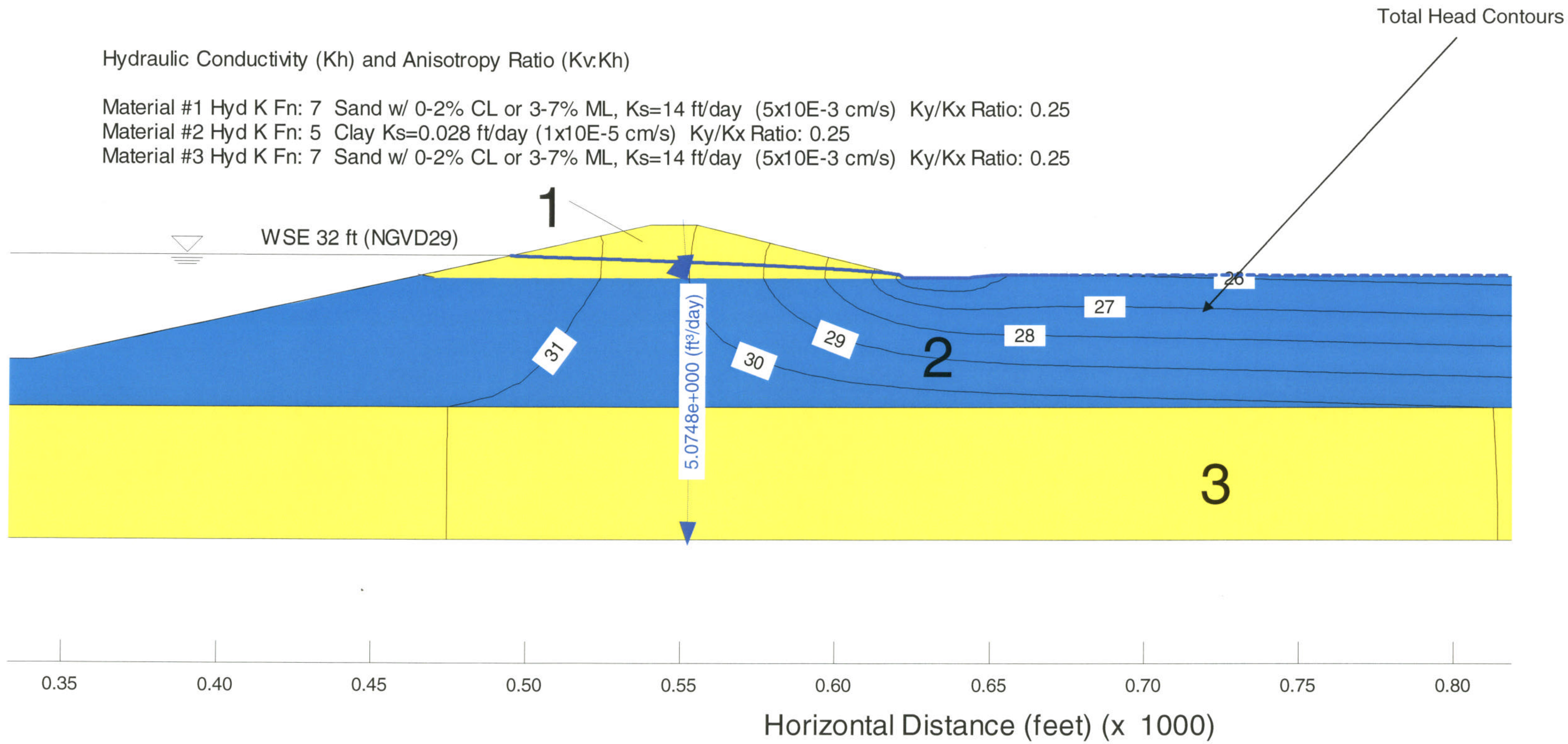
Graphic By: ESS
Project No. 72834

Date: 11/29/2007
File: App. Cutoff Wall

Evaluation of Cutoff Wall Impact on Groundwater Recharge
Sacramento River East Levee

PLATE
9

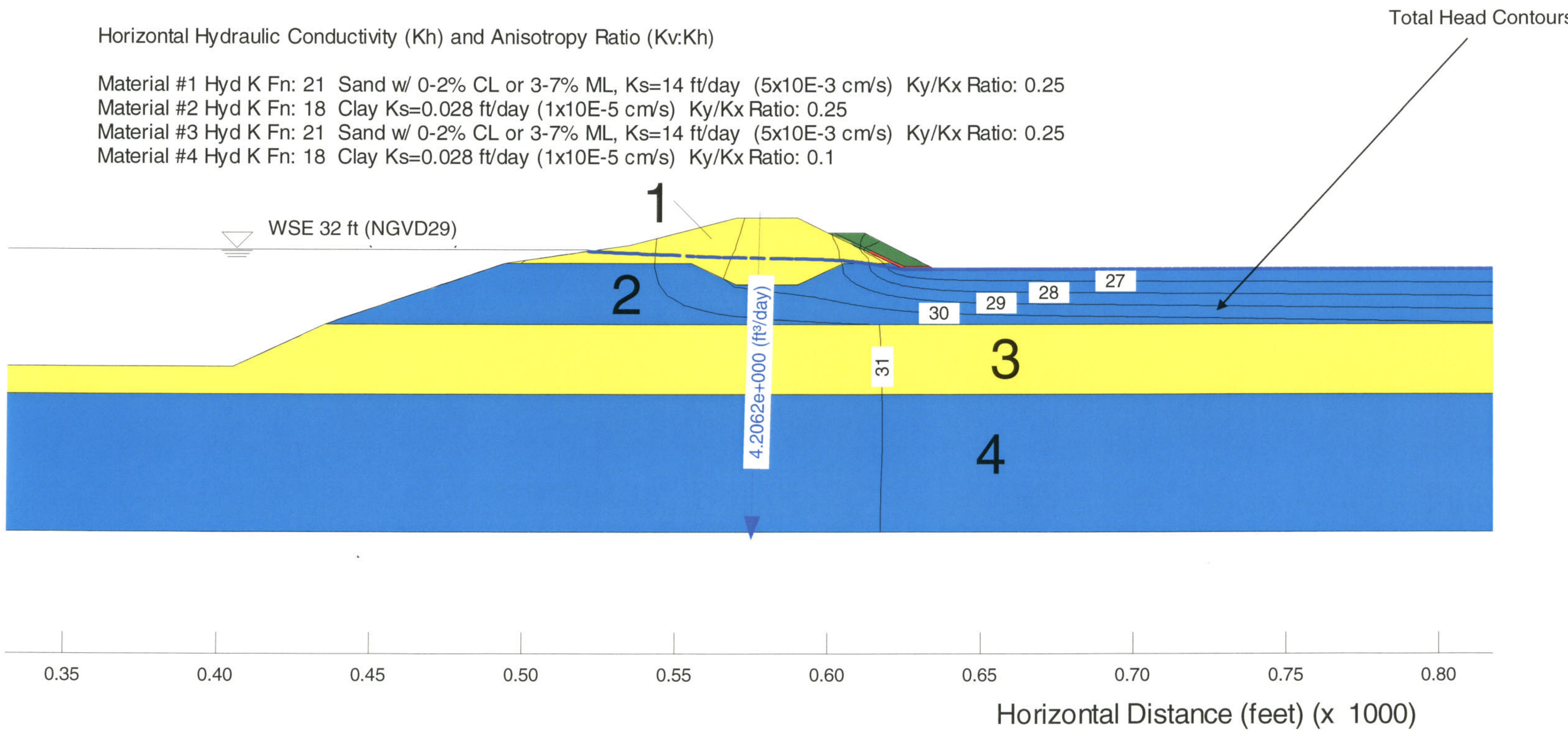
STA 27+00, steady-state analysis, existing conditions
Total Flow: 3.9 acre ft/yr/1000 ft



Note: Cutoff wall impact is determined using a simplified cross section at STA 70+00 and STA 353+00 in conjunction with STA 27+00 and STA 217+00 to best represent the actual conditions present. El. 15 through El. 32 were used to run our model.

KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 10
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		

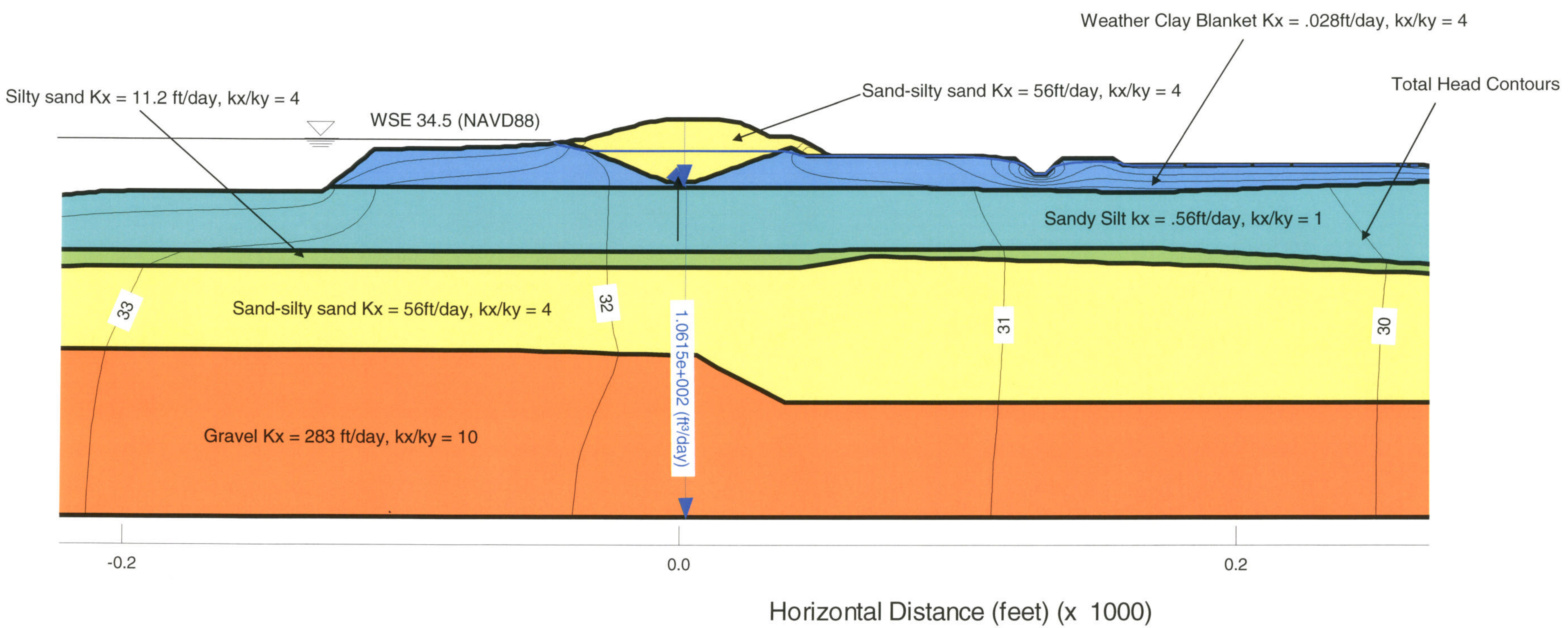
STA 70+00, steady-state analysis, existing conditions
Total Flow: 2.6 acre ft/yr/1000 ft



Note: Cutoff wall impact is determined using a simplified cross section at STA 70+00 and STA 353+00 in conjunction with STA 27+00 and STA 217+00 to best represent the actual conditions present. El. 15 through El. 32 were used to run our model.

KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 11
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		

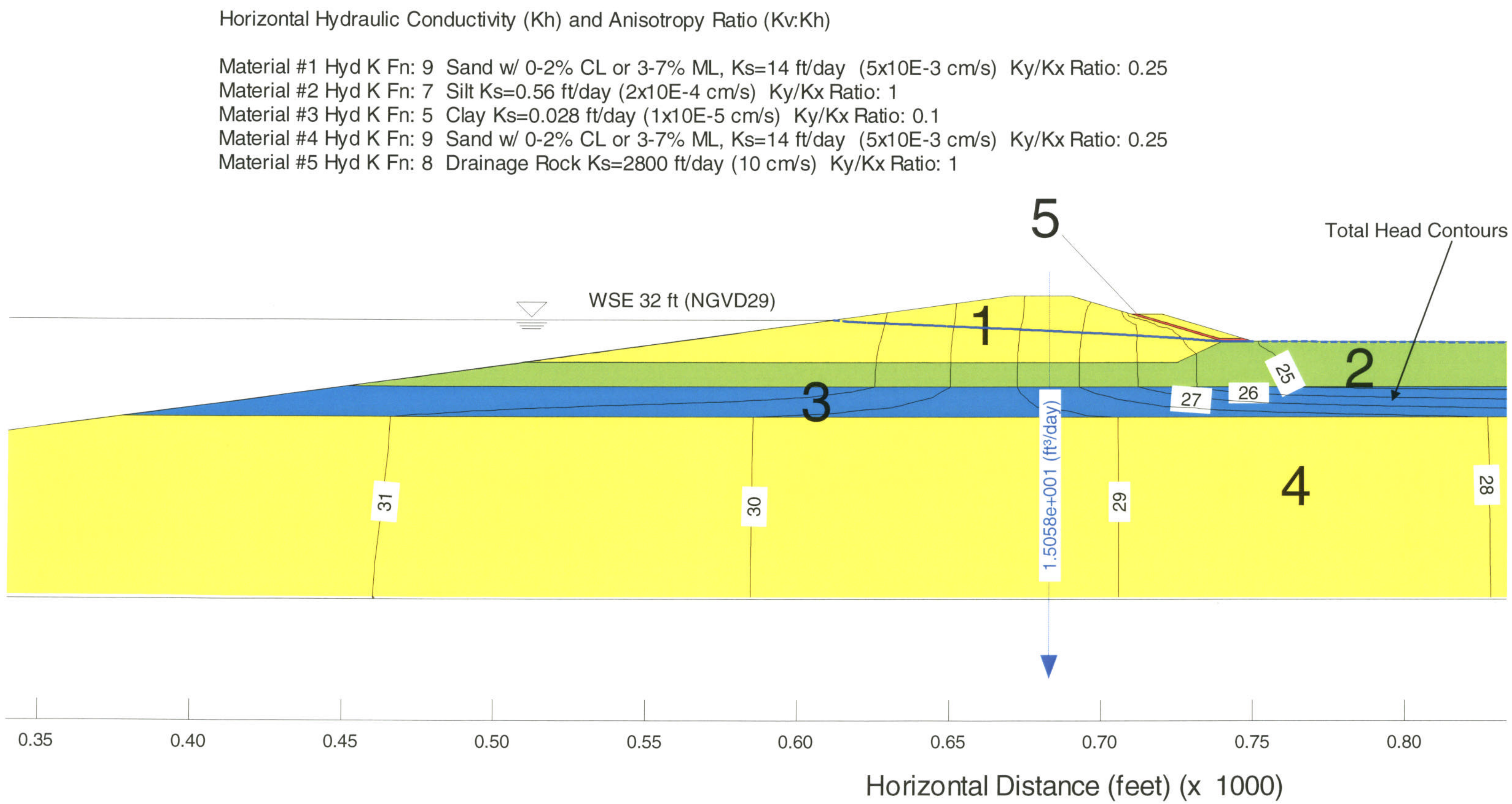
STA 217+00, steady-state analysis, existing conditions
Total Flow: 129 acre ft/yr/1000 ft
Ref: URS model 217+00 from Sac Levees report 2007



Note: Cutoff wall impact is determined using a simplified cross section at STA 70+00 and STA 353+00 in conjunction with STA 27+00 and STA 217+00 to best represent the actual conditions present. El. 15 through El. 32 were used to run our model.

KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 12
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		

STA 353+00, steady-state analysis, existing conditions
Total Flow: 13.4 acre ft/yr/1000 ft



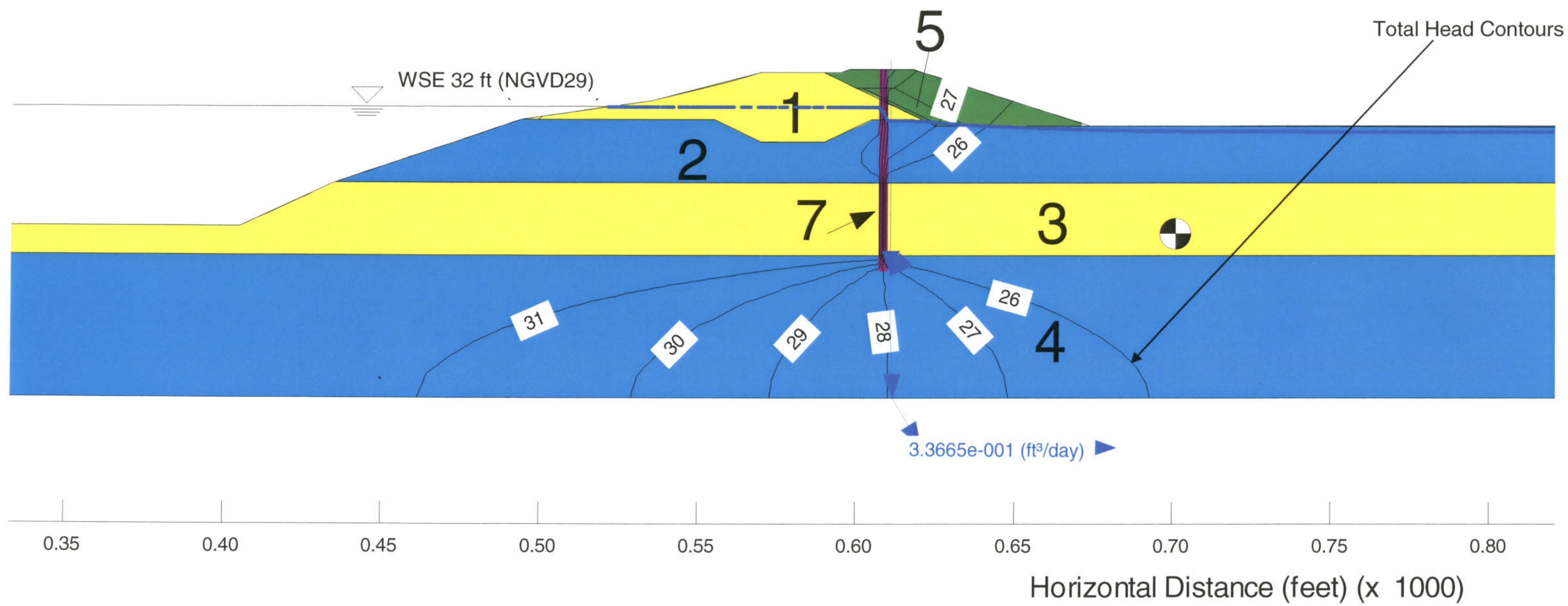
Note: Cutoff wall impact is determined using a simplified cross section at STA 70+00 and STA 353+00 in conjunction with STA 27+00 and STA 217+00 to best represent the actual conditions present. El. 15 through El. 32 were used to run our model.

KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 13
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		

STA 70+00, steady-state analysis, adjacent levee, with wall
Total Flow: 0.4 acre ft/yr/1000 ft

Horizontal Hydraulic Conductivity (Kh) and Anisotropy Ratio (Kv:Kh)

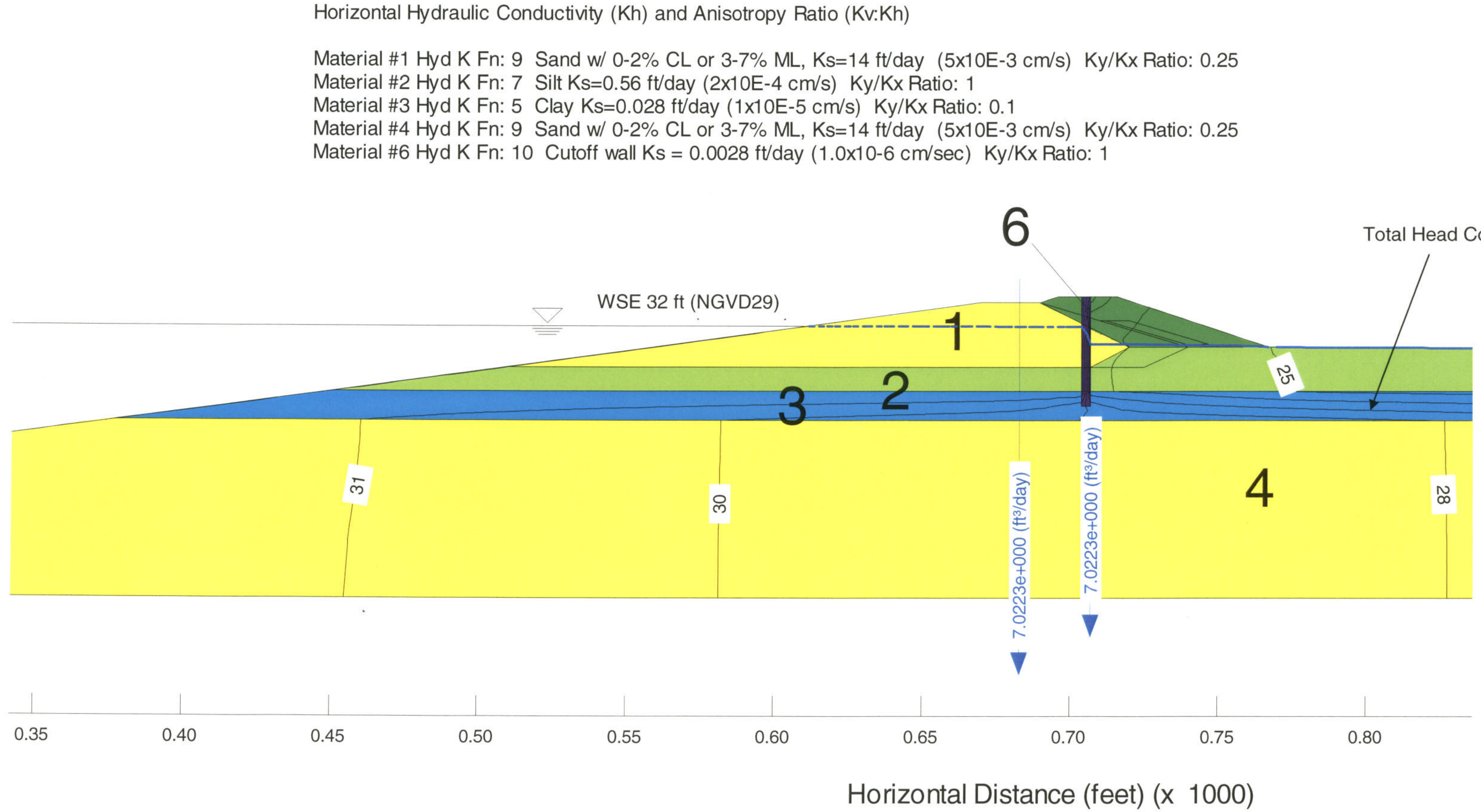
Material #1 Hyd K Fn: 10 Sand w/ 0-2% CL or 3-7% ML, Ks=14 ft/day (5x10E-3 cm/s) Ky/Kx Ratio: 0.25
Material #2 Hyd K Fn: 7 Clay Ks=0.028 ft/day (1x10E-5 cm/s) Ky/Kx Ratio: 0.25
Material #3 Hyd K Fn: 10 Sand w/ 0-2% CL or 3-7% ML, Ks=14 ft/day (5x10E-3 cm/s) Ky/Kx Ratio: 0.25
Material #4 Hyd K Fn: 7 Clay Ks=0.028 ft/day (1x10E-5 cm/s) Ky/Kx Ratio: 0.1
Material #5 Hyd K Fn: 8 Silt Ks= 0.028 ft/day (1x10E-5 cm/s) Ky/Kx Ratio: 0.25
Material #7 Hyd K Fn: 11 Cutoff wall Ks = 0.0028ft/day (1.0x10-6 cm/sec) Ky/Kx Ratio: 1



Note: Cutoff wall impact is determined using a simplified cross section at STA 70+00 and STA 353+00 in conjunction with STA 27+00 and STA 217+00 to best represent the actual conditions present. El. 15 through El. 32 were used to run our model.

KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 14
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		

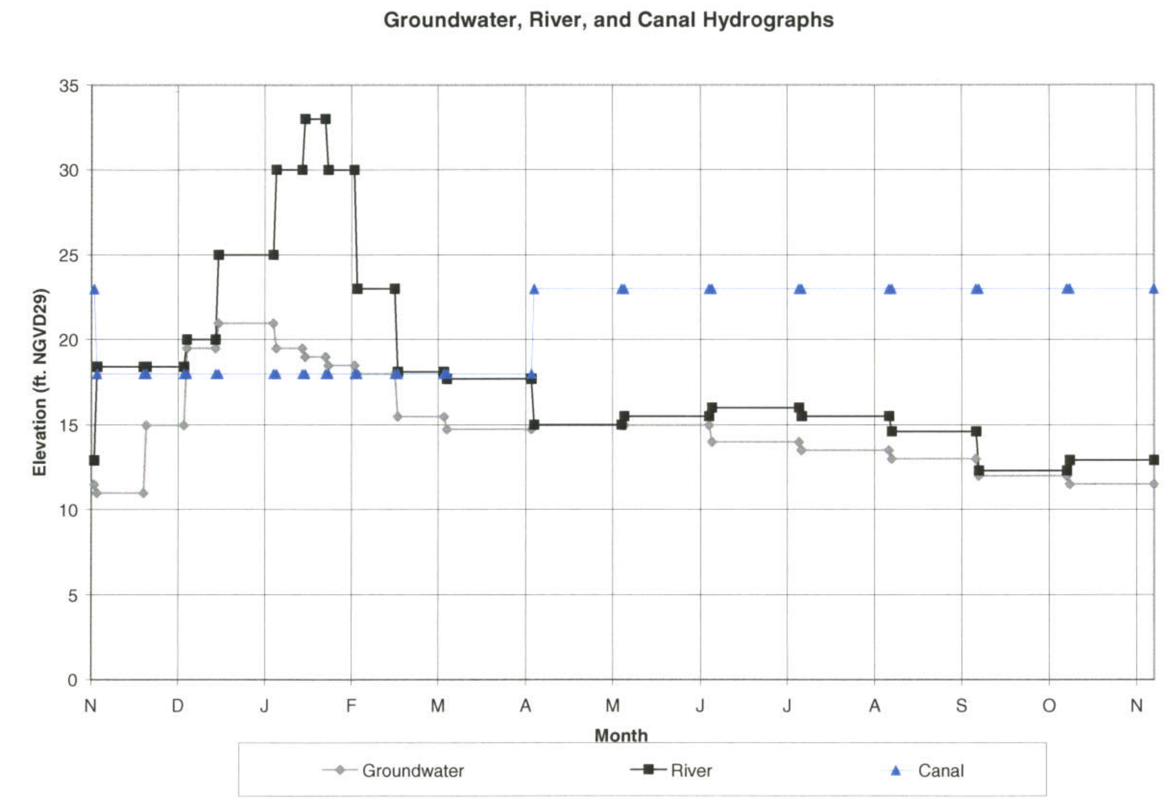
STA 353+00, steady-state analysis, adjacent levee, with wall
Total Flow: 8.4 acre ft/yr/1000 ft

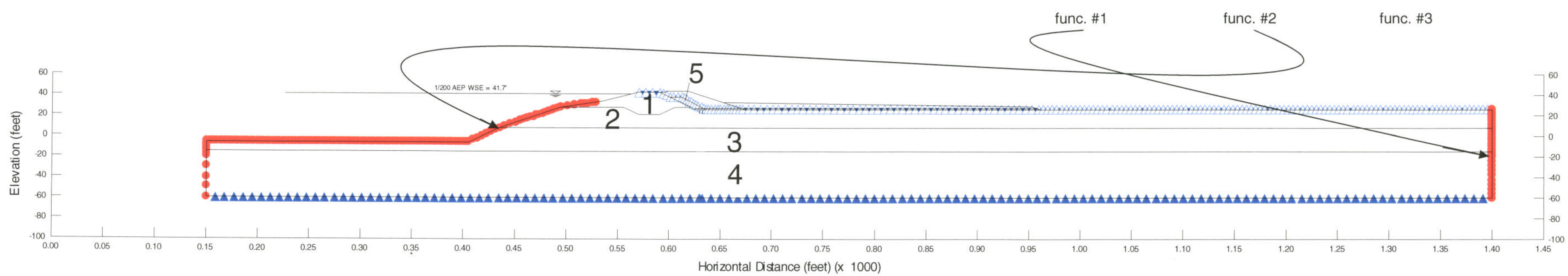


Note: Cutoff wall impact is determined using a simplified cross section at STA 70+00 and STA 353+00 in conjunction with STA 27+00 and STA 217+00 to best represent the actual conditions present. El. 15 through El. 32 were used to run our model.

KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 15
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		

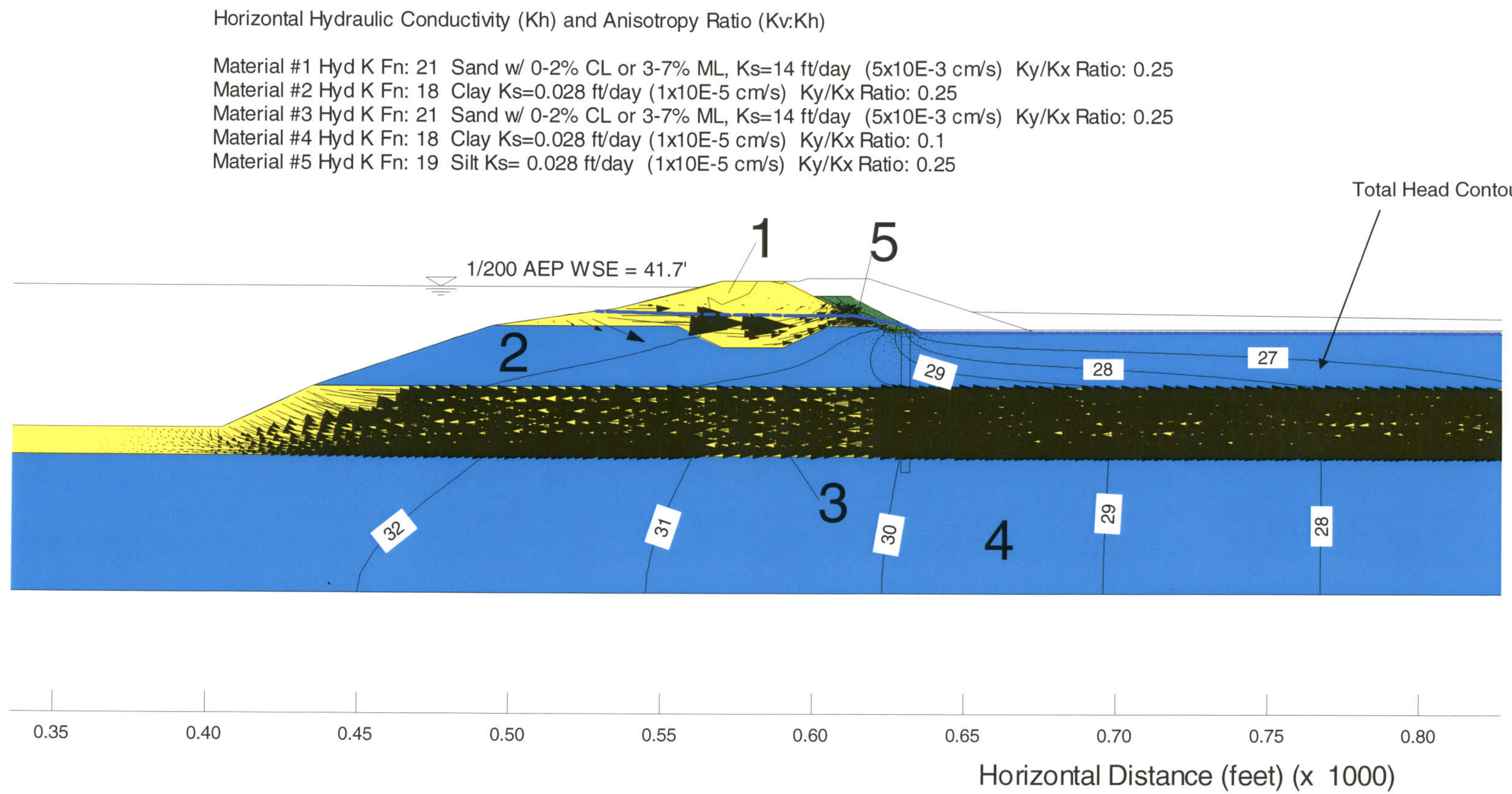
STA 70+00, boundary conditions
Transient analysis, existing conditions





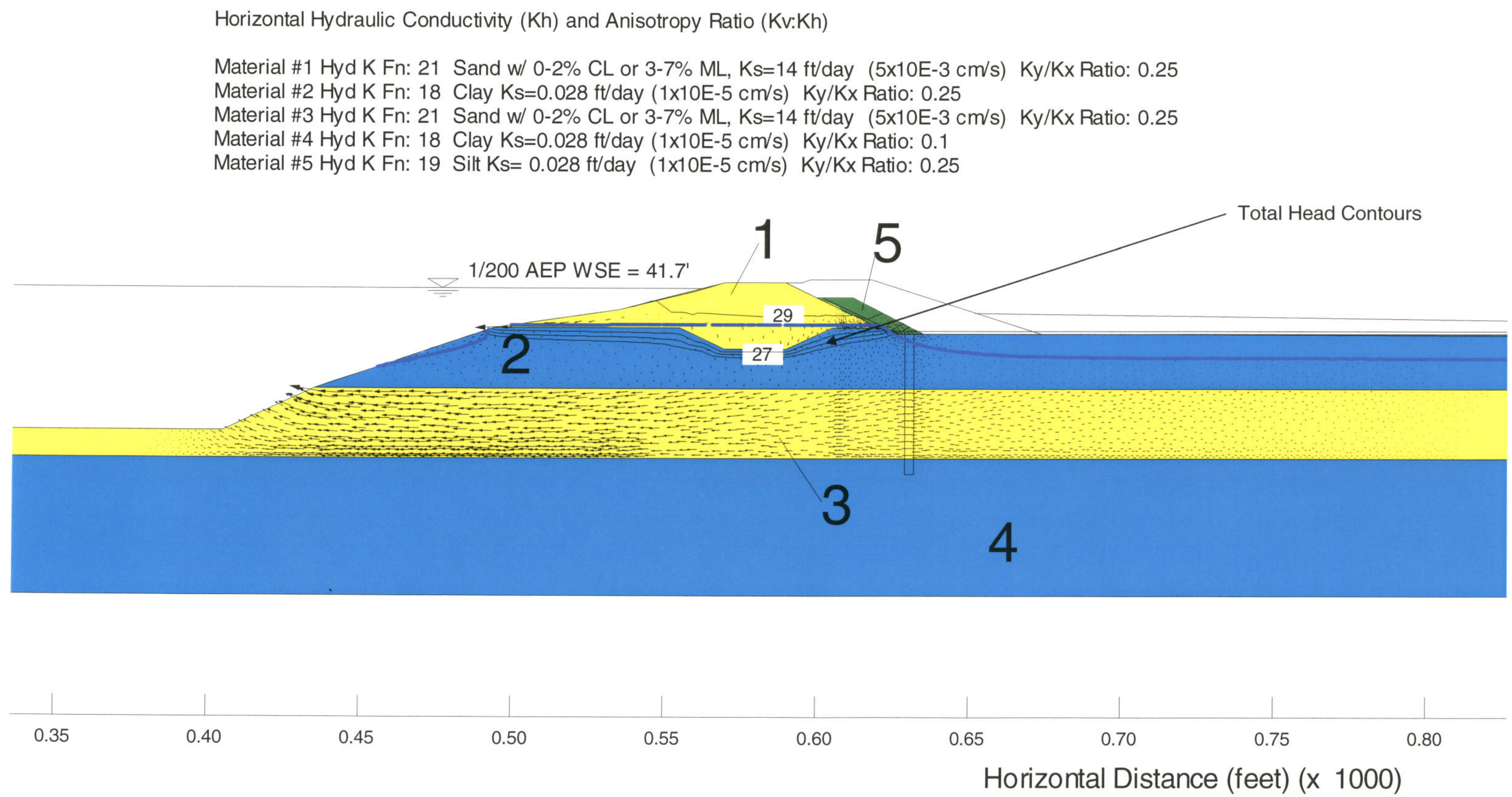
KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 16
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		

STA 70+00, transient analysis, existing conditions
Time Step: 2 (Winter)



KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 17
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		

STA 70+00, transient analysis, existing conditions
Time Step: 11 (Summer)

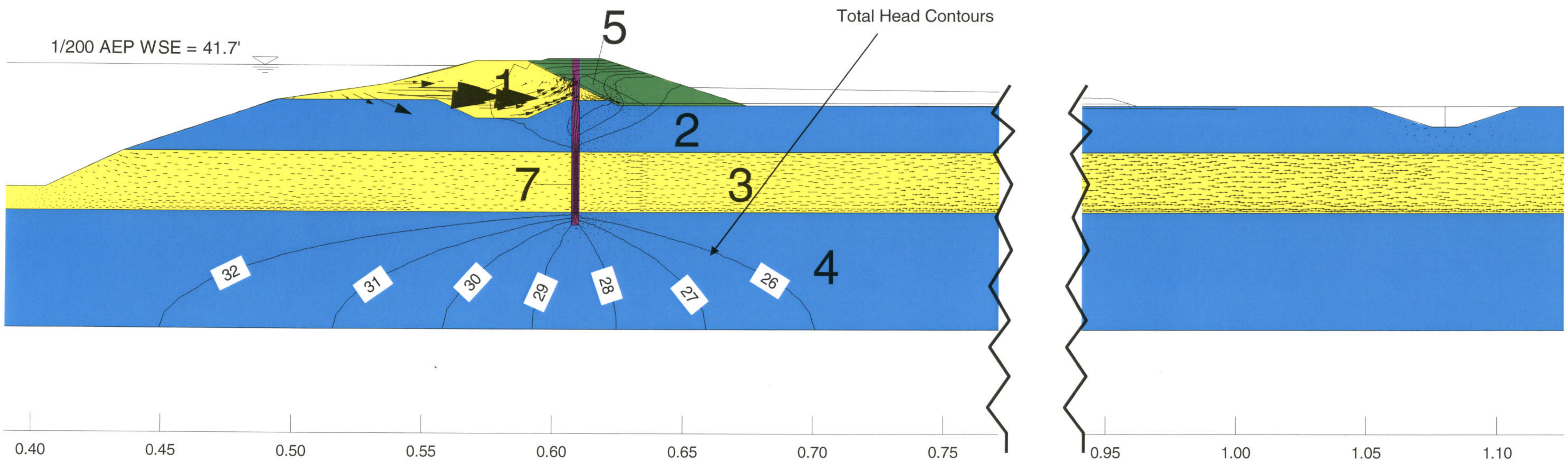


KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 18
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		

STA 70+00, transient analysis with cutoff wall
Time Step: 2 (Winter)

Horizontal Hydraulic Conductivity (Kh) and Anisotropy Ratio (Kv:Kh)

Material #1 Hyd K Fn: 21 Sand w/ 0-2% CL or 3-7% ML, Ks=14 ft/day (5x10E-3 cm/s) Ky/Kx Ratio: 0.25
Material #2 Hyd K Fn: 18 Clay Ks=0.028 ft/day (1x10E-5 cm/s) Ky/Kx Ratio: 0.25
Material #3 Hyd K Fn: 21 Sand w/ 0-2% CL or 3-7% ML, Ks=14 ft/day (5x10E-3 cm/s) Ky/Kx Ratio: 0.25
Material #4 Hyd K Fn: 18 Clay Ks=0.028 ft/day (1x10E-5 cm/s) Ky/Kx Ratio: 0.1
Material #5 Hyd K Fn: 19 Silt Ks= 0.028 ft/day (1x10E-5 cm/s) Ky/Kx Ratio: 0.25
Material #7 Hyd K Fn: 22 Cutoff wall Ks = 0.0028 ft/day (1.0x10-6 cm/sec) Ky/Kx Ratio: 1

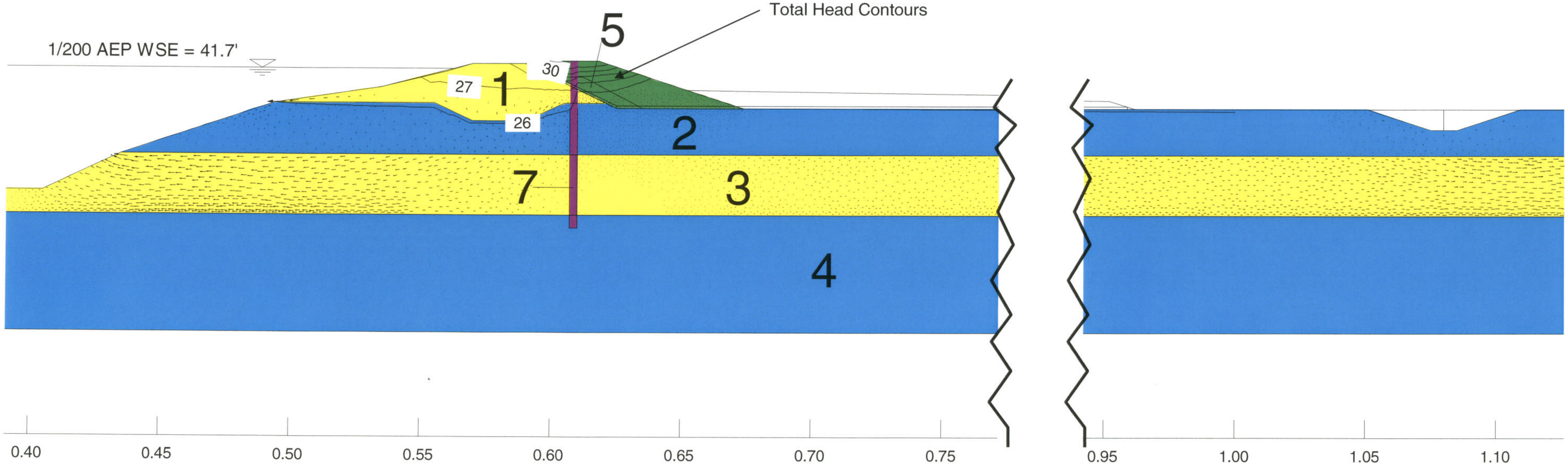


KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 19
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		

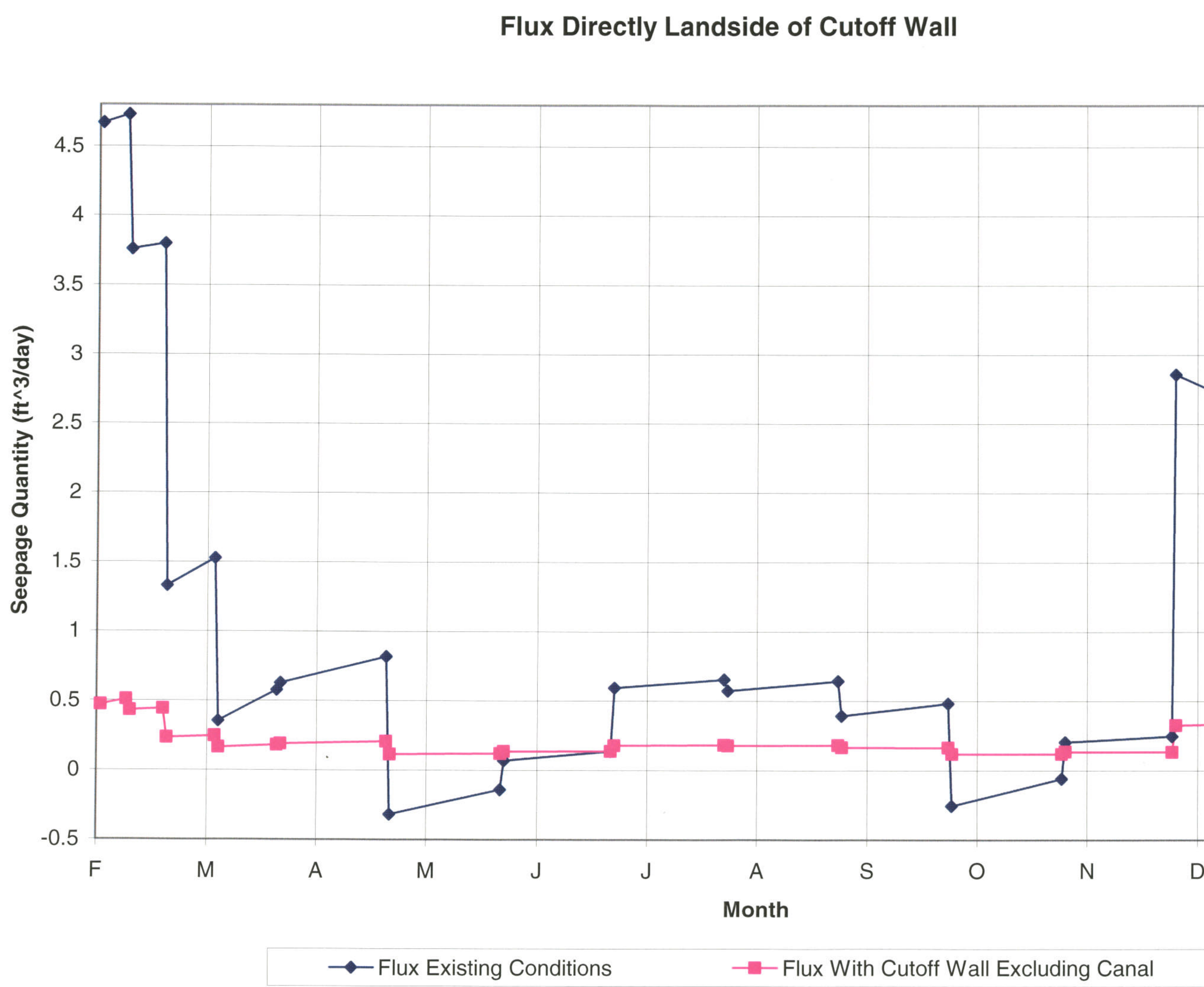
STA 70+00, transient analysis with cutoff wall
Time Step: 16 (Summer)

Horizontal Hydraulic Conductivity (Kh) and Anisotropy Ratio (Kv:Kh)

Material #1 Hyd K Fn: 21 Sand w/ 0-2% CL or 3-7% ML, Ks=14 ft/day (5x10E-3 cm/s) Ky/Kx Ratio: 0.25
Material #2 Hyd K Fn: 18 Clay Ks=0.028 ft/day (1x10E-5 cm/s) Ky/Kx Ratio: 0.25
Material #3 Hyd K Fn: 21 Sand w/ 0-2% CL or 3-7% ML, Ks=14 ft/day (5x10E-3 cm/s) Ky/Kx Ratio: 0.25
Material #4 Hyd K Fn: 18 Clay Ks=0.028 ft/day (1x10E-5 cm/s) Ky/Kx Ratio: 0.1
Material #5 Hyd K Fn: 19 Silt Ks= 0.028 ft/day (1x10E-5 cm/s) Ky/Kx Ratio: 0.25
Material #7 Hyd K Fn: 22 Cutoff wall Ks = 0.0028 ft/day (1.0x10-6 cm/sec) Ky/Kx Ratio: 1

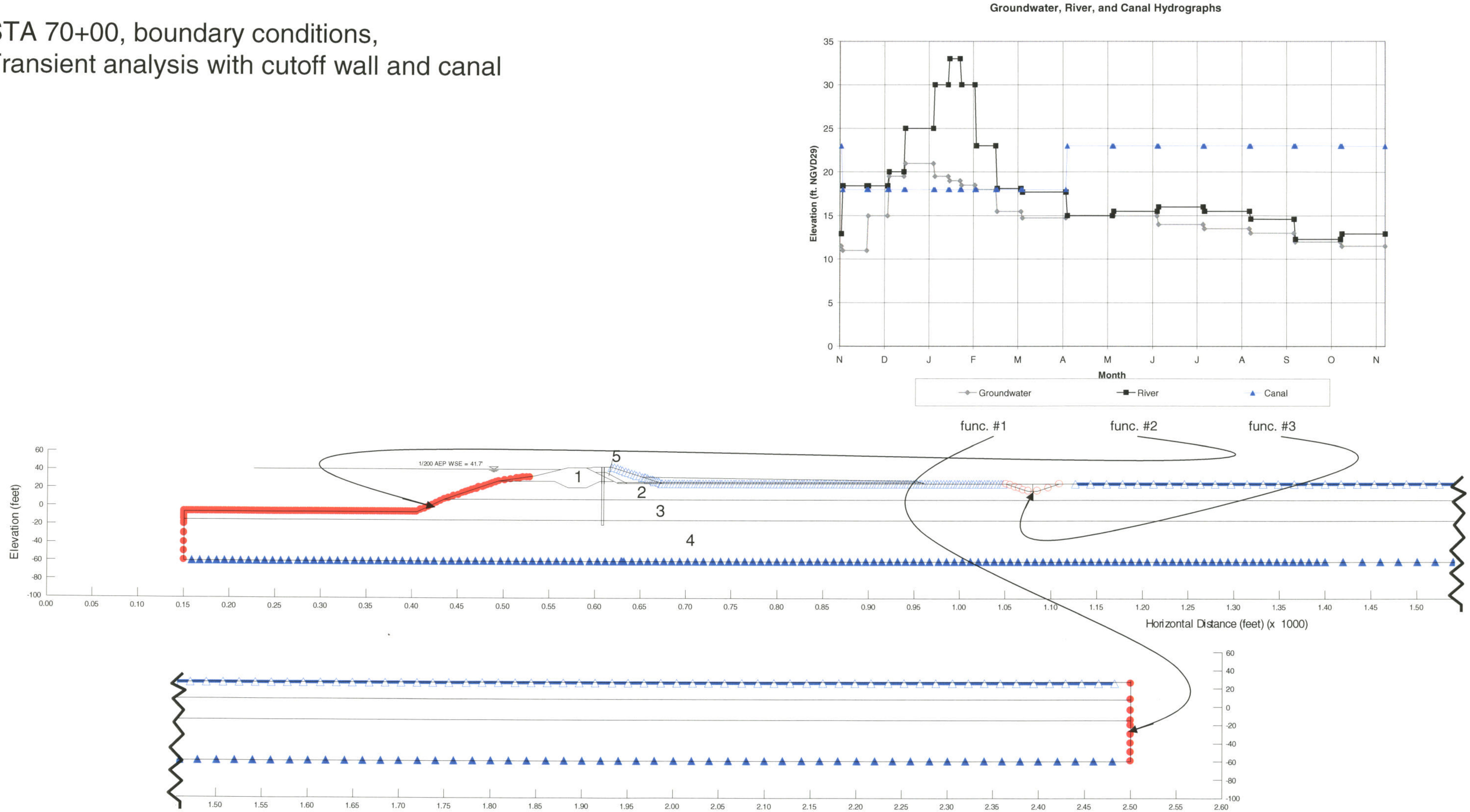


KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 20
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		

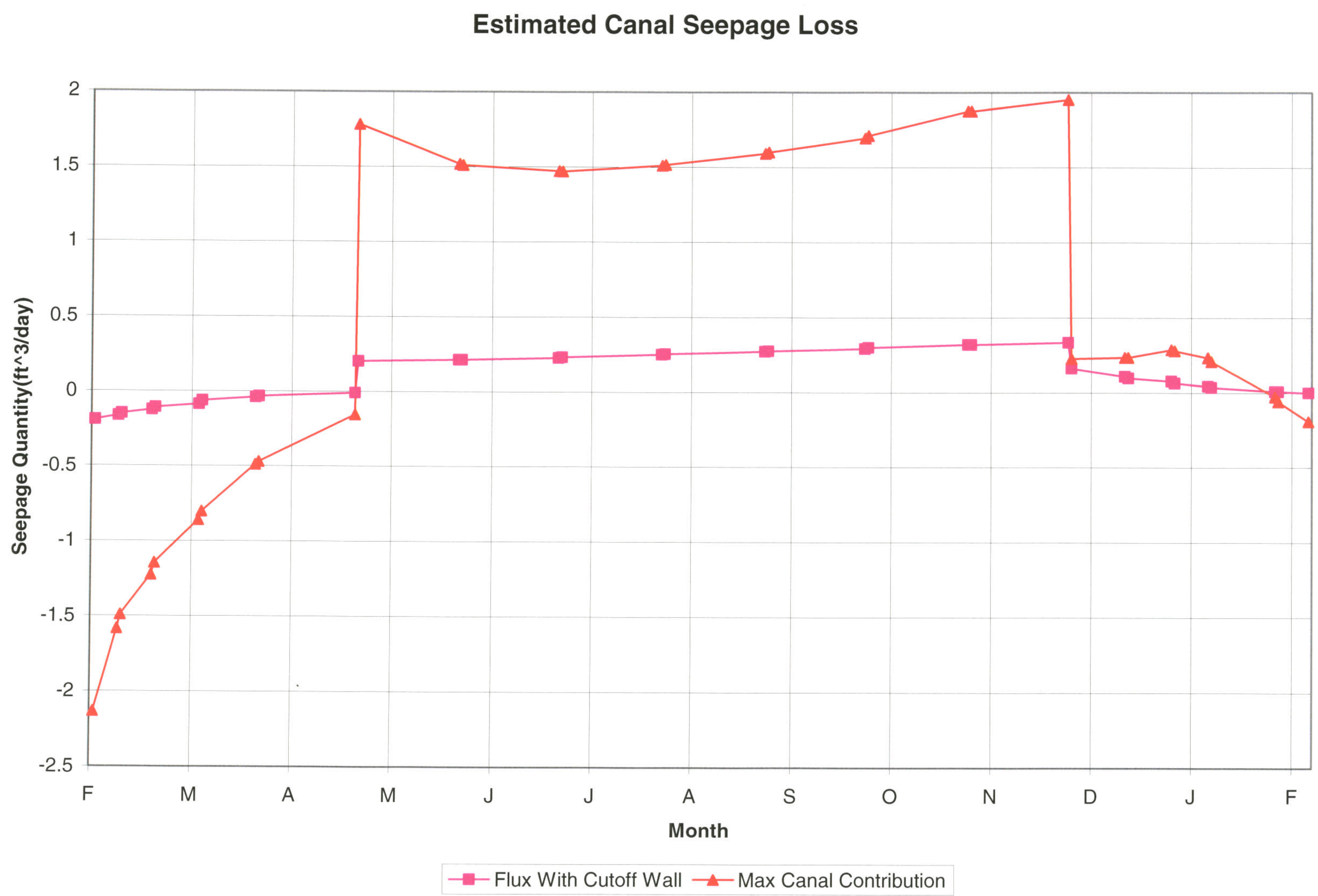


KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 21
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		

STA 70+00, boundary conditions,
Transient analysis with cutoff wall and canal

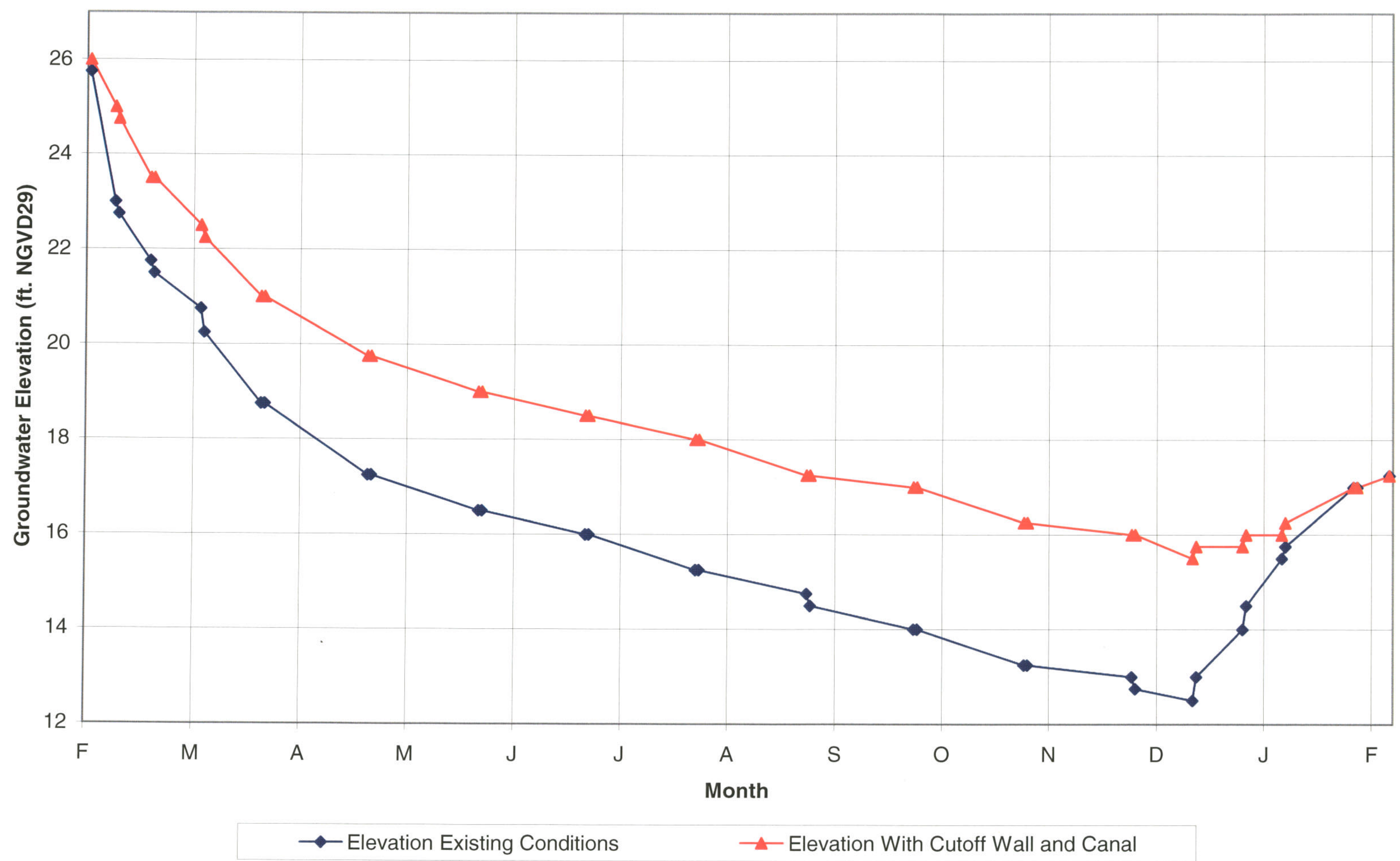


KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 22
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		



KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 23
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		

Estimated Groundwater Table Elevation

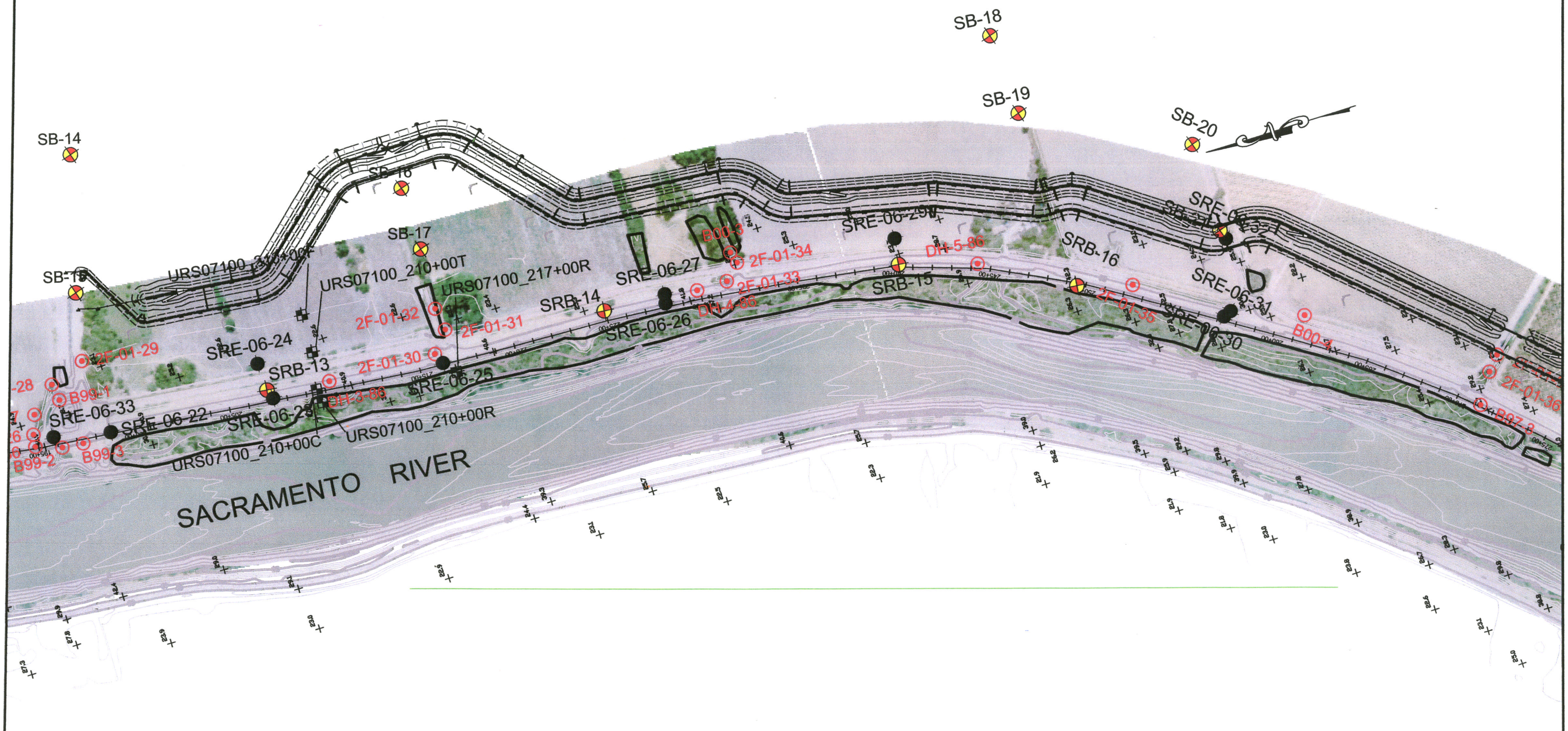


Note: Groundwater table elevation estimated at the locations halfway between the existing levee and the canal (~500 ft from levee toe)

KLEINFELDER		Evaluation of Cutoff Wall Impact on Groundwater Recharge Sacramento River East Levee	PLATE 24
Graphic By: ESS Project No. 72834	Date: 11/29/2007 File: App. Cutoff Wall		

ATTACHMENT C

PROPOSED CANAL PLAN



LEGEND

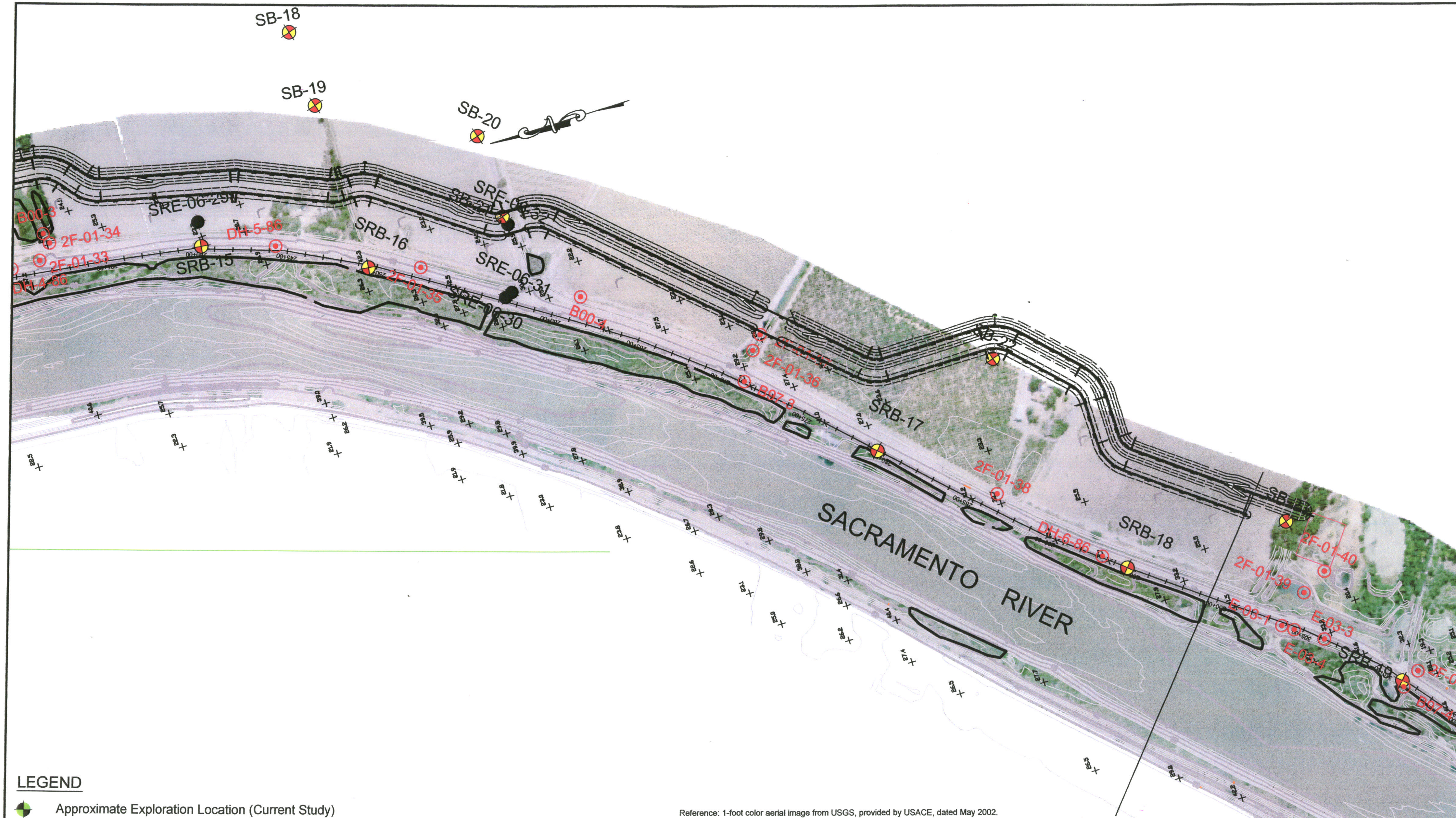
- Approximate Exploration Location (Current Study)
- Approximate URS Exploration (2007)
- Approximate Exploration Location (KA 2006)
- Approximate Exploration Location (KA 2005)
- Approximate Exploration Location (Previous Studies)

500 0 250 500 1,000

APPROXIMATE SCALE: 1 inch = 500 ft.

Reference: 1-foot color aerial image from USGS, provided by USACE, dated May 2002.

KLEINFELDER		BORING LOCATION MAP SACRAMENTO RIVER EAST LEVEE NATOMAS BASIN EVALUATION SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA	PLATE 1
Drawn By: D. ROSS Project No.: 58824/PSRE	Date: 10/21/2005 Filename: 58824SAC2.dwg		



LEGEND

- Approximate Exploration Location (Current Study)
- Approximate URS Exploration (2007)
- Approximate Exploration Location (KA 2006)
- Approximate Exploration Location (KA 2005)
- Approximate Exploration Location (Previous Studies)

500 0 250 500 1,000

APPROXIMATE SCALE: 1 inch = 500 ft.

Reference: 1-foot color aerial image from USGS, provided by USACE, dated May 2002.

KLEINFELDER		BORING LOCATION MAP SACRAMENTO RIVER EAST LEVEE NATOMAS BASIN EVALUATION SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA	PLATE 2
Drawn By: D. ROSS Project No.: 58824/PSRE	Date: 10/21/2005 Filename: 58824SAC2.dwg		

B2. Evaluation of Potential Groundwater Impacts (August 2008)

Draft

Evaluation of Potential Groundwater Impacts Due to Proposed Construction for Natomas Levee Improvement Program

prepared for:

Sacramento Area Flood Control Agency
(SAFCA)

prepared by:

Luhdorff & Scalmanini,
Consulting Engineers

August 15, 2008

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1.0 Introduction

The Sacramento Area Flood Control Agency (SAFCA) requested that Luhdorff and Scalmanini, Consulting Engineers (LSCE) conduct an investigation of the potential groundwater impacts of levee improvements proposed by SAFCA along portions of the Sacramento River East Levee in the Natomas Basin. Most of proposed levee improvements will have no effect on groundwater, but there are potential effects due to land use changes and slurry cutoff walls. New or relocated canals and borrow site excavation will also affect groundwater and are evaluated in this report. LSCE (2008a) prepared a preliminary evaluation on the effects of proposed Sacramento River East Levee slurry cutoff walls in a previous report entitled *Evaluation of Potential Groundwater Impacts Due to Proposed Sacramento River East Levee Improvements with Emphasis on Reaches 2 and 3*. This information in this report updates and supercedes the contents of the previous report.

This report includes detailed water budgets prepared for the Natomas Basin to evaluate the groundwater impacts of all SAFCA construction activities. The water budgets are partially based on the results of two existing numerical groundwater flow models that together simulate the North and South American Subbasins (including the Natomas Basin) in Sutter, Placer, and Sacramento Counties. Water Resources and Information Management Engineering, Inc. (WRIME) updated these models in 2007-2008 to better reflect existing and predicted future land and water use in the Natomas Basin. Some of the groundwater budget results summarized below are based on the 2030 simulations, which are summarized in LSCE (2008b). A groundwater budget for proposed SAFCA construction activities was calculated separately and was used to evaluate the cumulative impacts of these activities on existing and future groundwater conditions in the Natomas Basin and the North American Subbasin.

1.1 Project Description

The analysis of groundwater impacts in this report relies on project descriptions for proposed SAFCA construction activities obtained from a variety of sources. These include the Draft and Final Environmental Impact Report (EIR) for the Natomas Levee Improvement Project (NLIP) prepared by EDAW (2007a and 2007b), the Draft Environmental Impact Statement (EIS) prepared by the U.S. Army Corps of Engineers (2008), Design and engineering work for most of these projects is still in progress, so assumptions were made about the most likely configuration of each project. In cases where even preliminary project descriptions were not available, a conservative option was selected for analysis. Assumptions about many of these projects were provided primarily via personal communications (pers. comm.) with David Rader of EDAW and Marieke Armstrong of Mead & Hunt (M&H). Other information was provided by Wood Rodgers and the engineering team at Kleinfelder.

1.1.1 Levee Improvements

Groundwater impacts from proposed levee improvements are primarily limited to the potential effects of land use changes and slurry cutoff walls. Slurry cutoff walls and seepage berms are proposed mitigation measures to reduce problems of excess seepage beneath the levees, but no direct groundwater impacts are expected from seepage berms because they would be above the water table. The slurry cutoff walls are intended to reduce groundwater flow beneath the levees, and impacts resulting from this reduction are addressed in this report. The location of the five levees discussed below are shown in **Figure 1-1**.

Sacramento River East Levee – Levee improvements will require land use changes, including removal of 20 acres of rice, 175 acres of field crops, and five acres of orchard. Slurry cutoff walls are proposed for 12 reaches (total of eight miles) of the 18.1 mile length of the East Levee. These cutoff walls will range in depth from about 50 to 110 feet, with an average depth of 78 feet.

Natomas Cross Canal South Levee – Proposed land use changes along the Natomas Cross Canal (NCC) South Levee will require removal of about five acres of rice fields. Slurry cutoff walls are being constructed for the entire length (about 5.3 miles) of the NCC. These cutoff walls are projected to be about 70 feet deep. Approximately 5,400 lineal feet (lf) of cutoff wall was installed in 2007, and another 3,600 lf will be installed in 2008.

Pleasant Grove Creek Canal West Levee – The Pleasant Grove Creek Canal (PGCC) West Levee is about 3.3 miles long. Improvements to the PGCC West Levee are in the early planning stages, but slurry cutoff walls with an average depth of 60 feet are currently proposed for about 5,000 lf of the levee. Proposed land use changes along the PGCC West Levee would require removal of about 50 acres of rice fields.

Natomas East Main Drainage Canal West Levee – The Natomas East Main Drainage Canal (NEMDC) and Steelhead Creek West Levee is about 13.3 miles long. Improvements to the NEMDC West Levee are in the very early planning stages, but slurry cutoff walls are being considered for about 16,000 lf (3.0 miles) of the levee. The estimated depths of these cutoff walls are about 80 feet for 7,000 lf of wall and 60 feet for 9,000 lf feet of wall. Land use changes due to NEMDC levee improvements have not been evaluated, but irrigated agriculture is limited to the northern portion of the levee and effects are expected to be minimal.

American River North Levee – The American River North Levee is about 2.2 miles long in the Natomas Basin. Planning for improvements to this levee are in the very early planning stages, but slurry cutoff walls with an estimated depth of 85 feet are under consideration for up to 5,000 lf of this levee between Interstate 5 and Northgate Blvd. There is no irrigated agriculture in this area to be affected by levee improvements.

1.1.2 Canal Improvements

SAFCA is planning to construct one new canal in the Natomas Basin and relocate or improve three existing canals. This construction will necessitate land use changes, including the loss of irrigated agricultural land. Although seepage from existing canals has not been quantified, it is considered to be a significant contributor to groundwater recharge in the Natomas Basin. The new and relocated canals will be unlined and will result in an overall increase the rate of canal seepage. The proposed locations of the new canal and existing canals discussed below are shown on **Figure 1-1**.

Giant Garter Snake/Drainage Canal – SAFCA plans to construct a new Giant Garter Snake (GGS) and Drainage Canal east and roughly parallel to the Sacramento River East Levee. The GGS/Drainage Canal will be about 4.4 miles long and 50 feet wide at the waterline, and will be unlined. A total of 45 acres of the land where the GGS/Drainage Canal will be constructed is currently planted to field crops.

West Drainage Canal – The GGS/Drainage Canal begins at the terminus of the West Drainage Canal. A number of improvements to the West Drainage Canal are planned, including rerouting of about 4,700 lf of the existing canal. The overall length of the canal will increase from about 3.6 to 3.9 miles, and the average width at the waterline will increase from 30 to 72 feet.

Elkhorn Canal – The Elkhorn Canal, which is located east of the Sacramento River East Levee and northwest of the Sacramento International Airport (SIA), is about 3.8 miles long and about 16 feet wide. SAFCA plans to relocate this canal to make room for levee improvements. The relocated canal will be about 4.2 miles long and 32 feet wide. Approximately one mile of the existing Elkhorn Canal is lined with concrete, and about 6,000 lf of the relocated canal is proposed to be lined. In addition, two sections of the relocated canal (total of about 3,950 lf), primarily through the Teal Bend Golf Course, would be piped.

Riverside Canal – This canal, which is located east of the Sacramento River East Levee in the southwestern corner of the Natomas Basin is about 3.7 miles long and about seven feet wide. SAFCA plans to relocate the Riverside Canal to accommodate levee construction, and the new canal would be about 3.9 miles long and 10 feet wide.

1.1.3 Borrow Sites

SAFCA will require several borrow sites in the Natomas Basin to obtain sufficient soil for the proposed levee and canal improvements. The locations of these borrow sites are shown on **Figure 1-1**.

Airport North Bufferlands – The Airport North Bufferlands borrow site consists of 737 acres owned by the SIA and located north of the airport. Approximately 630 acres of this site that had previously been planted to rice have recently been removed from rice cultivation or other land uses that would attract water fowl at the request of the Federal Aviation Agency (FAA) and is currently fallow. SAFCA plans to remove about four to six feet of borrow material and restore the site to non-irrigated grassland.

Brookfield Property – The Brookfield property consists of 353 acres at the northern tip of the Natomas Basin. Approximately 325 acres of this property is currently planted to rice, and SAFCA plans to restore it to rice cultivation after removing the borrow material. The current crop mix is about 50% regular rice and 50% wild rice (Jack DeWit, pers. comm., July 8, 2008). Up to six feet of soil will be excavated, including one foot of topsoil that will be stockpiled and replaced after borrow operations are complete. The property is currently irrigated with groundwater, but SAFCA plans to provide the infrastructure so that most of the property can be irrigated with surface water after removal of borrow material. Engineering work is still in progress, but SAFCA estimates that about 80 percent of the property would be irrigated with surface water in the future after reclamation is complete.

Fisherman's Lake – The Fisherman's Lake borrow site is located at the northern end of the existing Fisherman's Lake in the southwestern portion of the Natomas Basin. Engineering work has not been completed for this site, but SAFCA estimates that about 100 acres of land currently planted to rice would be used for borrow material and would be restored to managed marsh.

1.2 Potential Impacts

The purpose of this report is to evaluate the potential groundwater impacts of SAFCA's proposed construction activities. These potential impacts can be grouped into three general categories:

1) Changes in groundwater recharge. These will occur due to land use changes and canal improvements. Specifically, the conversion of land from irrigated to non-irrigated land uses will reduce groundwater recharge, and canal construction and widening will increase groundwater recharge.
2) Changes in groundwater flow. Groundwater flow beneath the levees surrounding the Natomas Basin will be reduced due to the proposed slurry cutoff walls. Reductions in groundwater flow will generally be in the form of:
    a) Reduced groundwater recharge from the Sacramento and American Rivers;
    b) Reduced subsurface inflow from the north beneath the NCC; or
    c) Reduced subsurface outflow to the east beneath the PGCC and NEMDC.
3) Changes in groundwater pumping.

Other potential groundwater impacts include:

- Groundwater quality degradation in the Natomas Basin due to reduced inflow of good quality recharge from the River and reduced groundwater outflow; and
- Impacts to the yield of wells located along levees where the cutoff walls would be constructed.

2.0 Hydrogeologic Conditions

2.1 Land Use and Water Supply

The Natomas Basin was used as the primary study area for the water budgets discussed below. As shown on **Figure 1-1**, the Natomas Basin is located on the east side of the Sacramento River, between the rural community of Pleasant Grove and the City of Sacramento, in Sutter and Sacramento counties. It consists of about 54,400 acres of agricultural and urban land surrounded by the Sacramento River on the west, the NCC on the north, the PGCC and the NEMDC on the east, and the American River on the south. Except for the SIA and the Teal Bend Golf Course, urban development in the area is primarily limited to the southeast corner of the Natomas Basin at present. This is expected to change in the future as several large developments are in the planning stages.

The Natomas Basin contains about 81 square miles and is surrounded by 42 miles of levees, which are maintained by Reclamation District No. 1000 (RD 1000). RD 1000 also operates and maintains a large drainage system within its boundaries to recirculate or dispose of agricultural and urban runoff. This system includes seven large pumping plants and 180 miles of canals and ditches.

Land use in the Natomas Basin is primarily agricultural, with rice being the primary crop. Approximately 28,700 acres were irrigated in 2004, and rice accounted for about 79 percent of the total. Other crops include alfalfa, clover, and oat hay; tomatoes and sugar beets; and crops such as wheat and safflower that are rotated with rice and tomatoes. Most of the agricultural land is irrigated by surface water diverted from the Sacramento River by Natomas Central Mutual Water Company (NCMWC). Much of the information provided below is based on the NCMWC Draft Groundwater Management Plan (2002) and the Integrated Water Resources Management Plan (American States Water Company, et al., 2006).

NCMWC operates three primary river diversions on the Sacramento River. Water is also diverted at two locations from the NCC. Water diverted from the NCC flows from north to south, while water diverted from the River flows generally from west to east, then south. NCMWC’s surface water diversions average about 100,000 acre-feet per year (afy). This includes an estimated 10,000 afy diverted during the fall and winter to reflood fields for rice straw decomposition.

NCMWC completed the installation of a tailwater recirculation system in 1986 so that drainage water can be reused during the irrigation season to improve Sacramento River water quality, reduce river diversions, and increase overall efficiency. The recirculation system recaptures tailwater for re-use either directly to fields or back into the main irrigation canals. In recent years, NCMWC has relied heavily on recycled tailwater to supplement its Sacramento River entitlement. Tailwater is recycled partly because it cannot be discharged back to the Sacramento River due to water quality regulations. During a normal irrigation season, all agricultural drainage water is recirculated during the rice growing season, which typically ends in August. The NCMWC Groundwater Management Plan contains an estimate of 30,000 afy of recycled tailwater (NCMWC, 2002).

Approximately 3,300 acres of agricultural land are irrigated primarily with groundwater. This includes the entire northeastern portion of the Natomas Basin, which is not served by the existing NCMWC surface water distribution systems. The total groundwater pumpage in the Natomas Basin was estimated to be about 24,500 af in 2004 (LSCE, 2008b). Most of this was agricultural pumpage and included about 18,500 af in Sutter County and 6,000 af in Sacramento County.

The Natomas Basin Conservancy (NBC) currently owns over 4,000 acres of land in the Natomas Basin. The NBC began land acquisitions after completion of the Natomas Basin Habitat Conservation Plan (NBHCP) by the U.S. Fish and Wildlife Service and the California Department of Fish and Game in 1997. The NBHCP specified that lands be acquired for habitat conservation as mitigation for the effects of urban development in the Natomas Basin on endangered species and other wildlife. Under the terms of the NBHCP, NBC will ultimately acquire 8,750 acres of land to mitigate the loss of approximately 17,500 acres slated for development. Most of the NBC mitigation lands have historically been planted to rice, and NBC plans to keep 50 percent of the lands in rice production and convert 25 percent to managed marsh and another 25 percent to upland habitat. As of 2004, approximately 475 acres had been converted to managed marsh.

Irrigated acreage within the Natomas Basin has decreased in recent years as more land has been converted to urban uses. Land use estimates indicate that the acreage irrigated with surface water decreased by about 4.7 percent per year between 1996 and 2006 (American States Water Company, et al., 2006). NCMWC land use data indicate that the amount of irrigated shareholder lands decreased by about 5.2 percent per year between 2004 and 2007.

2.2 Groundwater Basin and Subbasin Description

The Natomas Basin does not represent a groundwater basin or subbasin as defined by the California Department of Water Resources (DWR). It is located within the North American Subbasin, which is part of the Sacramento Valley Groundwater Basin. The North American Subbasin is located along the eastern edge of the Sacramento River Valley and encompasses about 351,000 acres in Sutter, Placer, and Sacramento counties. The North American Subbasin is bounded by the Bear River on the north, the Feather and Sacramento Rivers on the west, the American River on the south, and the approximate edge of the alluvial aquifer in the Sierra Nevada foothills on the east. The North American Subbasin and adjacent groundwater subbasins are shown on **Figure 2-1**.

2.3 Geology of the Natomas Basin

Prior to development, groundwater in the northern portion of the North American Subbasin flowed to the west and southwest from the Sierra Nevada toward the Feather and Sacramento Rivers. Most wells in the subbasin pump groundwater from either the volcanic Mehrten Formation or the overlying alluvial deposits, which have a westerly dip toward the axis of the valley. The following summary of geologic conditions in the Natomas Basin is based primarily on the *Feasibility Report, American Basin Conjunctive Use Project* (DWR, 1997). This summary focuses on the shallow aquifers that could potentially be impacted by the proposed slurry cutoff walls.

The thickness of the fresh water-bearing deposits in the Natomas Basin increases from about 1,100 feet in the northeast to over 2,000 feet in the southwest. These deposits can be divided into upper and lower aquifer systems. The division between the two aquifer systems is inexact due to data limitations and the difficulty in accurately determining formation contacts. DWR (1997) indicates that the upper aquifer system consists of saturated Laguna Formation and younger sediments that collectively extend to a depth of 200 to 300 feet. For purposes of this study, the upper zone is defined as the upper 300 feet of the aquifer system, and the lower zone is assumed to extend from a depth of 300 feet to the base of fresh water.

The upper aquifer system in the Natomas Basin generally appears to be unconfined or semi-confined due to the presence of clay and silt confining layers within and underlying the upper zone. Sands and gravels in the upper zone are generally thin and laterally discontinuous, and there are thick sequences of fine-grained strata between the more permeable aquifer materials.

The youngest geologic units in the Natomas Basin are flood basin deposits and alluvium. Laterally extensive exposures generally occur along the western margin, adjacent to and within the active channels of the Sacramento River. The flood basin deposits are predominantly fine-grained sediments that have accumulated in flood basins along the major rivers of the Sacramento Valley. The flood basin deposits consist primarily of silt and clay, which yield little water to wells. The flood basin deposits also contain local lenses of sand and gravel deposited by the migrating ancestral river channels. These lenses have high permeabilities and can yield large quantities of groundwater to wells. The thickness of the flood basin deposits in the subbasin ranges up to 100 feet (Olmstead and Davis, 1961).

The alluvium consists primarily of sand, gravel, and silt, with minor amounts of clay, deposited in Recent geologic time (last 10,000 years) by the Sacramento River. Although the alluvium is highly permeable, it is too thin to represent a significant groundwater source. Most high-yield wells completed in the recent alluvium also draw groundwater from underlying formations.

Underlying the alluvium, the Riverbank and Modesto formations of Pleistocene age consist of a heterogeneous mixture of silt, sand, gravel, and clay. The units exhibit large variability in grain size over short distances, both laterally and vertically. The maximum combined thickness of the two units is 50 to 75 feet in the subbasin. On average, these units have moderate permeability but contain some coarser zones with high permeability (Olmstead and Davis, 1961).

The Laguna Formation of Pliocene age and the Turlock Lake Formation of early Pleistocene-age underlie the Riverbank and Modesto formations. Both formations consist primarily of a heterogeneous mixture of interbedded silt, clay, and sand. They contain a few gravel lenses, which are poorly sorted and have relatively low permeability. In general, these two formations are more fine-grained than overlying units, although it is difficult to determine subsurface contacts from drillers' logs. Wells completed in clean Laguna Formation sands and gravels can produce significant quantities of groundwater. The combined thickness of the two units in the subbasin is probably less than 200 feet.

The lower aquifer system consists of non-marine, Mehrten Formation deposits and includes a smaller percentage of coarse-grained sediments. However, individual coarse-grained zones in the lower aquifer are typically thicker than in the upper aquifer. In some areas, the lower aquifer is further divided into two distinct units. The upper unit is comprised of gray to black andesitic sand and associated lenses of stream gravel containing andesitic cobbles and boulders interbedded with thicker blue or brown clay. The lower unit has been described as a dense, hard, gray tuff breccia. It is composed of angular pieces and blocks of andesite in a cemented matrix of andesite, devitrified lapilli, and ash derived from volcanic eruptions in the Sierra Nevada. Based on information from DWR monitoring wells, the Mehrten Formation is at least 900 feet thick near the Sacramento Airport, and the typical lower unit gray tuff does not occur at that location. The lower zone exhibits more confinement than the upper zone but is still considered to be semi-confined. There is a delayed response to imposed stresses in the upper aquifer, indicating hydraulic interconnection between these water-bearing strata.

2.4 Aquifer Hydraulic Conductivity

The ability of an aquifer to transmit water is measured by its hydraulic conductivity (which is closely related to permeability) and saturated thickness; the product of these two parameters is commonly known as aquifer transmissivity. The hydraulic conductivity of alluvial aquifer materials varies over many orders of magnitude, with fine-grained materials (clay and silt) at the bottom of the range and coarse-grained materials (sand and gravel) at the top. Most groundwater flow occurs through sand units, which are much more common in the subsurface than gravels. The hydraulic conductivity of sands is highly variable, depending on grain size, sorting, and cementation.

Long-term, constant-rate pumping tests are the preferred method for estimating hydraulic conductivity and other aquifer properties. Other field methods include short-term pumping tests and slug tests. If borehole logs are available, equations that estimate hydraulic conductivity based on grain-size distribution can be used in the absence of test data. The most common of these is the Kozeny-Carman equation (Kozeny, 1927 and Carman, 1937 and 1956) which has been used by Kleinfelder Inc. (Kleinfelder) and URS Corporation (URS) to estimate the hydraulic conductivity of geologic materials beneath the east levee.

As further discussed below, the hydraulic conductivity of sand units underlying the levee is a primary input and the source of greatest uncertainty for models used to estimate seepage beneath the levee. A summary of hydraulic conductivity estimates for the Natomas Basin is provided in **Table 2-1**. The estimates vary by more than an order of magnitude, from 14 to 488 feet per day (ft/day), with a mean of 116 ft/day and a median of 51 ft/day. Values at the low end of the range were estimated by Kleinfelder using the Kozeny-Carman equation, and the highest value was estimated from a short-term pumping test. LSCE estimated a hydraulic conductivity of 36 ft/day based on an aquifer test conducted in a the Paulson well in southern Sutter County (LSCE, 2008b).

Groundwater flow models that encompass the North American Subbasin also have relatively high hydraulic conductivities in the Natomas Basin. Hydraulic conductivity estimates used in numerical groundwater flow models are typically adjusted during the calibration process. A groundwater flow model of the Sacramento Valley developed by DWR (1978) used hydraulic conductivity estimates of 51 to 139 ft/day for the upper layer of the model in the Natomas Basin. The groundwater models discussed in Chapter 4 have hydraulic conductivities in the upper layer ranging from 33 to 118 ft/day in the Natomas Basin.

3.0 Groundwater Levels and Flow

3.1 Sacramento River East Levee Piezometers

DWR has conducted groundwater level monitoring at a number of wells in the Natomas Basin since 1948. DWR monitored approximately 20 wells in 2003 but only 7 wells in 2007. In addition to the wells monitored by DWR, a series of shallow piezometers was constructed along the Sacramento River East Levee in the Natomas Basin to collect groundwater level data for previous investigations of seepage beneath the levee. A total of 38 piezometers has been installed along the levee since 1991, and at least some groundwater level data are available for 27 of these. Groundwater elevations measured in these piezometers have been plotted in order to determine the location and seasonal fluctuations of gaining and losing reaches along the Sacramento River East Levee. The 27 piezometers with water level data include four installed by Kleinfelder in 1998, 13 installed by the U.S. Army Corps of Engineers (USACE) in 2001, and 10 installed by Kleinfelder in 2004. The construction of the piezometers is summarized in **Table 3-1**, and the piezometer locations are shown on **Figure 3-1**. The piezometers range in depth from 12 to 90 feet, but most are between 25 and 50 feet deep. Many of the piezometers are paired based either on depth (shallow vs. deep) or location (closer to the River vs. further away). The latter pairings are particularly useful to show the direction and magnitude of the hydraulic gradient near the River.

Water level measurements at the piezometers have been intermittent, resulting in varying periods of record for water level data between 1999 and 2007. Data from the USACE piezometers are the most useful because the wellhead elevations have been surveyed and manual water level measurements are available. The USACE piezometers have a period of record from January 2002 to October 2003.

The Kleinfelder piezometers were not surveyed at the time of installation, and those installed in 1998 have a short period of record (December 2005 to April 2006). The piezometers installed by Kleinfelder in 2001 have a longer period of record (October 2004 to July 2006). There are no manual measurements available for these piezometers, however, and some of the transducer data are questionable as discussed below. The Kleinfelder piezometers were surveyed by LSCE on February 28 and 29, 2008 using survey-grade Global Positioning System (GPS) equipment with a horizontal vertical accuracy of at least one inch. The survey results are shown in **Table 3-1**. No bollards had been installed to protect these piezometers, and two of them (PZ-4 and PZ-7) had been destroyed (apparently by farm equipment) by the time of the survey.

Data from the shallow levee piezometers were combined with other water level data to prepare contour maps of equal groundwater elevation for the North American Subbasin and more detailed maps for the Natomas Basin. The contour maps were prepared prior to the GPS survey of the Kleinfelder piezometers; therefore, data from these piezometers were not used to create the contour maps. Hydrographs were also prepared showing groundwater elevations in 23 piezometers and estimated stage in the Sacramento River adjacent to the piezometers. These contour maps and hydrographs were used to evaluate gaining and losing conditions along the Sacramento River and to estimate the hydraulic gradient between the River and the shallow aquifer.

3.2 Groundwater Elevation Contour Maps

Groundwater elevations and flow directions in the study area are illustrated on groundwater elevation contour maps. DWR (1997) includes spring water level contour maps for the years 1950, 1960, 1965, 1970, 1977, 1980, 1985, 1990, and 1992. As noted by DWR, groundwater generally flowed in a southwesterly direction (from the foothills toward the axis of the valley) under pre-development conditions. Groundwater levels began to decline during the 1940s (or earlier), and the 1960 water level contour map shows that three pumping depressions had started to develop by 1960. From north to south, these were located east of Nicolaus, near Pleasant Grove, and near the eastern edge of the Natomas Basin along the Sutter-Sacramento County line. By 1965, the pumping depression east of Nicolaus had largely disappeared, but the pumping depression near Pleasant Grove had deepened and merged with that along the eastern edge of the Natomas Basin. The 1980 DWR contour map shown on **Figure 3-2** indicates that, by 1980, the pumping depression southeast of Pleasant Grove had deepened to about –30 feet msl and merged with a deeper pumping depression beneath McClellan Air Force Base (AFB) in Sacramento County. These pumping depressions are centered about three miles east of the eastern edge of the Natomas Basin.

A fall 1997 groundwater elevation contour map prepared by the Sacramento County Water Resources Division and reproduced in NCMWC (2002) is shown on **Figure 3-3**. This contour map indicates that the McClellan AFB pumping depression was linked with two other pumping depressions centered beneath the City of Elk Grove and east of the City of Galt. The Elk Grove pumping depression is the largest and deepest of the three, with a groundwater elevation below –70 feet msl at the center. The Pleasant Grove and McClellan AFB pumping depressions are located in the North American Subbasin; the other two depressions are located in the South American Subbasin.

The DWR and Sacramento County groundwater elevation contour maps were developed using data from wells of variable and often unknown perforated intervals. These composite maps must be considered approximations that do not reflect the fact that groundwater elevations can be significantly different in wells of different depths. Hydrographs of DWR's multiple-completion monitoring wells show that deeper wells in the area typically have lower ground-water elevations than shallower wells because most groundwater pumping occurs from deeper zones and these zones are more confined. Upper zone groundwater elevation contour maps were prepared for this study, as discussed below.

Water level data for wells completed in the upper zone in the North American Subbasin were evaluated to select recent periods with sufficient data for contouring purposes. Because the primary focus of this investigation is on groundwater flow in the Natomas Basin, contour maps were prepared for periods for which data from the USACE levee piezometers (the only piezometers with surveyed wellhead elevations at that time) were available, and spring and fall contour maps were prepared for 2003. Two versions of the 2003 contour maps were created, one showing the entire subbasin and another showing a more detailed view of the Natomas Basin. Data from about 90 wells were used to prepare each map. The subbasin-scale groundwater elevation contour maps have a contour interval of ten feet; the more detailed maps have a two-foot contour interval. The vertical datum for all contour maps and hydrographs prepared for this report is NGVD29. The periods selected for groundwater elevation contour maps, area of coverage, and the number of wells used for each map are as follows:

- **Figure 3-4:** Spring 2003 (North American Subbasin),
- **Figure 3-5**: Spring 2003 (Natomas Basin),
- **Figure 3-6**: Fall 2003 (North American Subbasin),
- **Figure 3-7**: Fall 2003 (Natomas Basin).

The spring 2003 groundwater elevation contour map for the North American Subbasin (**Figure 3-4**) shows that the direction of groundwater flow in the upper zone in most of the subbasin is toward the pumping depression centered in the McClellan AFB area, which had a minimum elevation of about –40 feet msl based on data from McClellan AFB monitoring wells. The northeastern portion of the subbasin is the only area where the groundwater flow direction was not toward the McClellan AFB pumping depression on **Figure 3-4**. The direction of groundwater flow in this area is toward the Bear and Feather Rivers, which indicates that both rivers were gaining in the spring of 2003. A gaining reach occurs when groundwater levels are higher than the river stage, creating a gradient for groundwater to flow to the river. Losing conditions occur when the river stage is higher than groundwater levels adjacent to the river, which results in recharge from the River to the aquifer.

The Sacramento River west of the Natomas Basin appears to be a losing reach in spring 2003. Groundwater elevations shown on **Figure 3-4** range from about 20 feet msl in the northern and northwestern portions of the Natomas Basin to about –20 feet msl along the eastern edge. The direction of groundwater flow is easterly toward the McClellan AFB pumping depression. The hydraulic gradient is relatively flat especially in the northern half of the study area (about three ft/mile) but becomes much steeper along the eastern edge (up to 20 ft/mile).

In order to provide additional detail on groundwater elevations and flow directions in the Natomas Basin, the spring 2003 water level data were re-contoured with a contour interval of two feet. The resulting map, shown on **Figure 3-5**, confirms that the direction of groundwater flow is easterly across most of the Natomas Basin. All reaches of the Sacramento River appear to be losing in the spring of 2003, but the magnitude of the hydraulic gradient near the River gradually increases from north to south. In the northern portion of the Natomas Basin, the hydraulic gradient for flow away from the River is less than three ft/mile. In the southern portion, the easterly hydraulic gradient increases to about nine ft/mile.

The fall 2003 groundwater elevation contour map shown on **Figure 3-6** is generally similar to the spring 2003 map, and the direction of groundwater flow was essentially the same during both periods. Comparison of the two contour maps indicates that fall groundwater levels along the Sacramento River were five to ten feet lower than in the spring, but levels at these two times were similar in the eastern portion of the Natomas Basin. Fall 2003 groundwater levels were also similar to spring levels in the McClellan AFB pumping depression but were about ten feet lower than in the spring in the pumping depression in southwestern Placer County.

Figure 3-7 shows fall 2003 groundwater levels in the Natomas Basin re-contoured with a contour interval of two feet. Although groundwater levels in fall 2003 were lower along the Sacramento River than in the spring, the general direction of groundwater flow was still easterly in most of the study area. The only exception is the northern portion of the Natomas Basin where the direction of groundwater flow was to the south-southwest parallel to the Sacramento River. These reaches of the River appear to be neutral (no significant gain or loss) in fall 2003. Losing conditions prevailed in the southern reaches, but the gradient for flow away from the River was less steep than in the spring.

3.3 Hydrographs of Groundwater Levels and River Stage

Water level hydrographs were prepared for the shallow piezometers along the Sacramento River East Levee in order to evaluate seasonal variations in gaining and losing conditions. In addition to groundwater elevation data from the levee piezometers, river stage estimates are also shown on the hydrographs. Under separate contract for SAFCA, MBK Engineers used stage data from the Verona, Bryte, and I Street gages (**Figure 3-8**) to estimate the daily average stage at each piezometer location based on a linear interpolation (Mike Archer, MBK, pers. comm., January 22, 2008). One source of error in the stage estimates is that tidal effects at the Bryte and I Street gages do not propagate upstream to the Verona gage. However, MBK checked the estimates against stage profiles simulated with a calibrated Hydrologic Engineering Center (HEC) surface water model, and concluded that the stage estimates were reasonable.

Hydrographs of groundwater elevations in the shallow piezometers and estimated Sacramento river stage are shown from north to south on **Figures 3-9** through **3-16**. Where piezometers are paired based on distance from the River, data from both piezometers are plotted on the same hydrograph using different symbols. As discussed above, losing conditions occur when groundwater elevations are lower than river stage. For the paired piezometers, a gradient away from the River indicates losing conditions, while a gradient toward the River indicates gaining conditions. The groundwater level data are color coded on the hydrographs, with data showing losing conditions plotted in red and data showing gaining conditions plotted in blue. For the piezometers with surveyed elevations, stage estimates can also be compared with measured groundwater elevations to indicate gaining or losing conditions at unpaired piezometer locations. The groundwater level data plotted on these hydrographs are also color coded to show gaining or losing conditions. Uncertainty in the data is highlighted by the fact that a number of hydrographs show gaining conditions in the spring and fall of 2003 even in the southern half of the Natomas Basin, while the groundwater elevation contour map (**Figure 3-8**) shows losing conditions in this area.

During the winter when the river stage is high, all hydrographs show losing conditions and steep gradients for groundwater flow away from the River. The results are much more variable during the rest of the year when the river stage is lower. Hydraulic gradients are relatively flat during periods of low stage, and gradient reversals appear to be common. Gaining conditions are most likely to occur during the summer and fall when the river stage is lowest. There is more uncertainty about the determination of gaining or losing conditions during the summer and fall because groundwater levels and river stage are similar during these periods. There is also uncertainty during periods of rapidly declining stage because groundwater levels decline at a slower rate than river stage. Continuous data would be needed during these periods to accurately determine the fluctuations between gaining and losing conditions.

Gaining and losing reaches vary by both location and time. URS (2003) indicated that river stage was approximately nine to ten feet above groundwater levels at high stage and one to three feet below groundwater levels at low stage at the northernmost USACE piezometer (2F-01-15N). At the southernmost USACE piezometer (2F-01-19S), river stage was approximately four to five feet above groundwater levels at high stage and one to 1.5 feet below groundwater levels at low stage. For USACE paired piezometers 2F-01-26N and 28N, URS noted that groundwater levels were about 1.25 feet higher in the piezometer closer to the River during high stage and generally similar during low stage. For paired piezometers 2F-01-68N and 69N, URS indicated that groundwater levels were about three feet higher in the piezometer closer to the River during high stage and generally similar during low stage. URS also noted that groundwater levels tended to lag river stage by several days (URS, 2003). The individual hydrographs are discussed below.

Figure 3-9 shows hydrographs of the northernmost piezometers. This includes USACE piezometer 2F-01-15N in Reach 2 and paired Kleinfelder piezometers PZ-7 and PZ-8 in Reach 4a. The hydrograph of 2F-01-15N shows losing conditions during periods of high stage in the winter and spring and gaining conditions during the rest of the year. This is the deepest of the levee piezometers with a screened interval of 80 to 90 feet. This makes the comparison with river stage less valid, but there are no nearby shallow piezometers to show the head difference between shallow and deeper zones. Paired piezometers PZ-7 and PZ-8 show losing conditions during a limited period of record (intermittent from October 13, 2004 to July 12, 2006). The fact that the groundwater elevations were notably lower than the stage estimates for all periods suggests inaccuracies in either the stage estimates, the wellhead elevation, or the water level measurements. The indication of consistently losing conditions should be considered questionable since most other piezometers show a mix of gaining and losing conditions.

Figure 3-10 shows hydrographs of paired USACE piezometers 2F-01-26N and 28N in Reach 4b and paired Kleinfelder piezometers PZ-5D and PZ-6D in Reach 6b. Both piezometer pairs show generally losing conditions during the winter and spring and consistently gaining conditions during the summer and fall. The continuous transducer data from the Kleinfelder piezometers clearly show losing conditions at high stage and gaining conditions at low stage during the winter and spring. This effect is especially noticeable from December 2004 to May 2005 but also occurred during the winter and spring of 2005-2006.

Figure 3-11 show hydrographs of unpaired USACE piezometers 2F-01-51N in Reach 8 and 2F-01-49N in Reach 9a, and **Figure 3-12** show hydrographs of unpaired USACE piezometers 2F-01-56N in Reach 9b and 2F-01-62N in Reach 11b. Compared against estimated river stage, all four piezometers show mostly losing conditions except during periods of rapidly fluctuating stage in the spring and periods of very low stage during the fall. The spring of 2003 was the longest period of gaining conditions during the 22 month period of record.

Figure 3-13 shows hydrographs of paired Kleinfelder PZ-3 and PZ-4 and USACE piezometers 2F-01-68N and 69N in Reach 11b. Piezometers PZ-3 and PZ-4 show losing conditions based on groundwater level data during the entire period of record (October 13, 2004 to October 7, 2006). As for piezometers PZ-7 and PZ-8, the fact that the groundwater elevations were notably lower than the stage estimates for all periods suggests inaccuracies in either the stage estimates, the wellhead elevation, or the water level measurements. The indication of consistently losing conditions should be considered questionable since most other piezometers show a mix of gaining and losing conditions. The data from paired USACE piezometers 2F-01-68N and 69N in Reach 11b are more similar to piezometers in other reaches, with losing conditions occurring during periods of high stage and a mixture of gaining and losing conditions during the rest of the year. Gaining conditions occurred primarily in the spring of 2002 and during periods of lowest stage.

Figure 3-14 shows hydrographs of unpaired USACE piezometers 2F-01-05S in Reach 13 and 2F-01-15S in Reach 15 compared with estimated stage. Most of the data from 2F-01-05S appear to be questionable, with low groundwater levels in the spring and higher levels during the summer, especially in 2002. The data from USACE piezometer 2F-01-15S in Reach 13 track the estimated stage much more closely, but the estimated stage appears to be low relative to the groundwater levels. In particular, the indication of gaining conditions during almost all of 2002 is probably incorrect. The stage estimates appear to be more accurate from December 2002 through October 2003, with losing conditions during periods of high or rising stage and gaining conditions during periods of low or declining stage.

Figure 3-15 shows hydrographs of unpaired USACE piezometers 2F-01-17S and 2F-01-19S in Reach 16 compared with estimated stage. Both piezometers have similar hydrographs, and the estimated stage tracks the groundwater data closely. The hydrographs generally show losing conditions during periods of high or rising stage and gaining conditions during periods of low or declining stage.

Figure 3-16 shows hydrographs of paired Kleinfelder piezometers in Reaches 18b and 19a. The transducers in Kleinfelder piezometers PZ-1 and PZ-2 were not working during most of the monitoring period. Almost all of the data that were collected in January and June-August 2005 show gaining conditions, which is inconsistent with the other piezometers. Water level measurements in paired Kleinfelder piezometers LMW-1 and LMW-4 were made manually, but the measurements made prior to January 2006 appear to be too high when compared with the estimated stage. The measurements made from December 2005 to April 2006 appear to be more reasonable but were made only during periods of high stage. The groundwater level data indicate losing conditions throughout this period.

Depths to water measured in the USACE piezometers located on the land side levee toe typically range from about six feet during the winter to about 18 feet during the summer and fall. This represents a seasonal fluctuation of only about 12 feet. Similarly high groundwater levels and small seasonal fluctuations have been observed at DWR's multiple-completion wells elsewhere in the Natomas Basin. The small seasonal fluctuations are due to a combination of the buffering effect of recharge from the River and from rice fields throughout the Natomas Basin and the fact that most pumping is from deeper zones. Recharge from rice irrigation in the summer months keeps shallow groundwater levels high and is a primary factor in the gaining conditions observed at many of the levee piezometers during periods of low stage.

3.4 Hydraulic Gradient Estimates

The differences in hydraulic head between the paired piezometers and also between the unpaired piezometers and the estimated stage are tabulated in **Table 3-2**, and these head differences were used to estimate the hydraulic gradient. Losing conditions are indicated by positive head differences and hydraulic gradients, and negative values indicate gaining conditions. Head differences were calculated for the entire period of record and range from about –3 feet to more than 11 feet. For paired piezometers that have been surveyed, head differences were calculated based on both groundwater data and stage estimates.

Average annual head differences and hydraulic gradients were calculated for each individual or paired piezometer based on the most recent 12-month period for which data are available. Due to the problems with some of the piezometer data discussed above, hydraulic gradients were not calculated for USACE piezometer 2F-01-15S and Kleinfelder piezometers PZ-1, PZ-2, LMW-1, and LMW-4. For the two sets of paired USACE piezometers, gradients were estimated by comparing the estimated stage with head in the piezometer closest to the River. Because more data were available from the USACE piezometers during the winter and spring, an average hydraulic gradient was calculated for each month. The monthly gradients were then averaged to determine the average hydraulic gradient for the 12-month period.

As shown in **Table 3-2**, the minimum hydraulic gradient at each piezometer location ranged from –0.0098 to 0.0003 ft/ft, with an average of –0.0039 ft/ft. The minimum hydraulic gradient was negative at all but one site, which indicates gaining conditions. The maximum hydraulic gradient ranged from 0.0054 to 0.0239 ft/ft, with an average of 0.0161 ft/ft. The magnitude of the average maximum hydraulic gradient (0.0239 ft/ft) is more than twice as large as the average minimum gradient (–0.0098 ft/ft) because the gradient is steeper during periods of high stage.

Average monthly hydraulic gradients were calculated for 13 piezometer locations (individual or paired), and an average annual gradient was calculated by averaging the monthly values. As shown in **Table 3-2**, the average annual hydraulic gradient at each piezometer ranged from 0.0006 to 0.0089 ft/ft. All of the average annual hydraulic gradients were positive, which indicates that all reaches exhibited losing conditions over the 12-month period. Although the groundwater elevation contour maps show steeper gradients in the southern portion of the Natomas Basin, there are too many sources of error in the gradient estimates to allow quantification of these spatial variations.

The average annual hydraulic gradient for all piezometers shown in **Table 3-2** was 0.0032 ft/ft or about 17 ft/mile. This represents the estimated average annual gradient for seepage loss from the River to the shallow aquifer based on a combination of piezometer data and estimated stage. This gradient is almost twice as steep as the maximum gradient east of the Sacramento River shown on the spring and fall 2003 groundwater elevation contour maps for the Natomas Basin (**Figures 3-5** and **3-7**). The groundwater contour maps are based on groundwater data only and have too large a scale to show the gradient between these closely spaced piezometers. The steeper gradient near the River calculated above is also due to the low permeability of the riverbed and the fact that the greatest head differences between surface water and groundwater occur during periods of high stage.

4.0 Water Budgets for Existing and Future Groundwater Conditions in the Natomas Basin

4.1 IGSM Models

In order to evaluate the cumulative effects of SAFCA's proposed construction activities on groundwater conditions, a pair of existing numerical groundwater flow models were used to simulate groundwater conditions in the North American Subbasin and calculate groundwater budgets for the Natomas Basin. The models are based on the Integrated Groundwater and Surface Water Model (IGSM) platform developed by Montgomery Watson, Inc. (MW) in the 1990s. As discussed below, model results were used to calculate groundwater budgets for existing conditions (based on 2004) and future conditions (based on 2030).

The Sacramento County IGSM model is referred to as the SACIGSM and was originally developed by MW in 1993. The SACIGSM was updated by MW in 1995 and by WRIME in 2005, 2007, and 2008. The IGSM model for the Sutter/Placer County portion of the North American Subbasin is referred to as the North American River (NAR) IGSM and was originally developed by MW in 1995. The NARIGSM was subsequently updated by DWR (1997) and MW (2001). The grids used for both models are shown on **Figure 4-1**.

The IGSM models were updated most recently by WRIME in 2008 to reflect more current conditions in the Natomas Basin in order to simulate the groundwater impacts of the proposed Sutter Pointe development in southeastern Sutter County, which were summarized in the *Sutter Pointe Specific Plan Groundwater Supply Assessment* prepared by LSCE (2008b) . WRIME linked the NARIGSM and SACIGSM models and used them to simulate the effect of variations in the rate, timing, and location of pumping to supply the proposed Sutter Pointe Specific Plan along with other land use and pumping projected for a 35-year simulation period that included different water year types.

IGSM is a finite element, quasi three-dimensional numerical groundwater flow model that simulates all major components of the hydrologic cycle. These include precipitation, runoff, evaporation, consumptive use, groundwater recharge, groundwater extraction and injection, and subsurface inflow and outflow along the model boundaries. As indicated in the model name, the simulation also includes interactions between surface water (streams and lakes) and groundwater. The primary components of the groundwater budget calculated by IGSM are:

Inflows

- Deep percolation from rainfall and irrigation applied water;
- Recharge due to stream seepage;
- Recharge from other sources such as irrigation canals and recharge ponds;
- Boundary inflows from outside the model area; and
- Subsurface inflows from adjacent model areas.

Outflows

- Groundwater pumping;
- Outflow to streams and rivers;
- Subsurface outflows to adjacent model areas; and
- Boundary outflows.

4.1.1 Sacramento County IGSM Model

The Sacramento County IGSM model covers most of Sacramento County and includes portions of northern San Joaquin County and western Amador County (**Figure 4-1**). The model is physically represented as a three-layer system consisting of the following layers: 1) the uppermost layer represents the unconfined or semi-confined aquifer system consisting of alluvial sediments that overlie the Mehrten Formation, 2) the middle layer represents the confined aquifer system of the Mehrten Formation, and 3) the lowermost layer represents groundwater of generally poorer quality in marine sediments underlying the Mehrten Formation. Near the southern boundary of the Natomas Basin, Layer 1 is about 200 feet thick and is overlain and underlain by aquitards with thicknesses of about 60 and 130 feet, respectively. Layer 2 starts at a depth of about 360 feet and is over 1,500 feet thick in this area. Layering of the SACIGSM model in the southern portion of the Natomas Basin is shown on **Figure 4-2** (see **Figure 4-1** for cross-section location). All groundwater pumping is simulated in the two upper layers.

Boundary conditions were established to designate heads for all boundary nodes and allow for surface and subsurface flows through the model boundaries. Boundary conditions reported by WRIME (2007) are as follows:

- The eastern boundary of the model is a no flow boundary but incorporates surface-water inflow to the model based on ungaged watersheds.

- General head conditions are used for the southern boundary (along the Mokelumne River). The heads for this boundary are provided from the Stanislaus Basin IGSM, which has a simulation period ending in 1993, and values of head in nodes along this boundary in 1995 to 2004 use values from 1993.

- The western model boundary is along the Sacramento River. The northern section (north of Pocket Road) uses general head boundary conditions provided by the Central Valley IGSM (CVIGSM). The southern section of the western boundary (south of Pocket Road) is simulated as constant head conditions. Both the general head and constant head conditions are interpolated from prior model nodes to the updated SACIGSM nodes for the western boundary. Because the general heads in the prior SACIGSM stop in 1995, the updated SACIGSM uses the 1995 values for subsequent years (1996 to 2004).

- General head conditions are used for the northern model boundary. These heads are provided by the NARIGSM, which was run concurrently with the SACIGSM. The linkage between the two models was done by correlating the boundary nodes of the models, updating the NARIGSM from monthly to daily time steps, and using the 1995 general heads in the NARISGM for subsequent years (1996 to 2004).

4.1.2 North American River IGSM Model

As shown in **Figure 4-1**, the NARIGSM includes the portions of eastern Sutter County and western Placer County that comprise the northern two-thirds of the North American Subbasin. This includes the Sutter County portion of the Natomas Basin. In 2001, the NARIGSM was refined to better assess groundwater impacts resulting from the water supply project and program alternatives being considered for the Regional Water Master Plan (MWH, 2001). The data sets that were updated included land use, streamflow, agricultural demand, surface-water diversions, urban water demand, groundwater pumping, precipitation, and groundwater levels.

The layering of the NARIGSM is similar to that of the SACIGSM. In the Sutter County portion of the Natomas Basin, Layer 1 extends from about 80 to 300 feet in depth and is overlain and underlain by aquitards. Layer 2 extends from about 420 to 1,420 feet in depth.

The boundaries for the NARIGSM were developed based on a combination of geological, hydrological, and political boundaries. MWH (1995) describes the original model boundaries as follows:

- The western model boundary is the Feather and Sacramento Rivers, which are an important source of recharge that create a groundwater divide in the upper aquifer system. General head conditions are used for this boundary based on the regional CVIGSM.

- The southern model boundary follows the Placer/Sacramento and Sutter/Sacramento County lines, and extends from the Sacramento River in the west to the eastern edge of the groundwater basin. This boundary is also the northern boundary of the SACIGSM. General head conditions are used for this boundary. As described above, the SACIGSM was linked to the NARIGSM to achieve consistent heads along this boundary.

- The eastern model boundary represents the geologic boundary between the Sacramento Valley Groundwater Basin and the Sierra Nevada foothills. No flow conditions are used for this boundary.

- The northern model boundary is the Bear River, which coincides with the Placer/Yuba and Sutter/Yuba County lines. General head conditions are used for this boundary based on the regional CVIGSM.

4.2 Model Inputs

Both the calibration and the future conditions simulations were run for a 35-year simulation period based on 1970-2004 hydrologic conditions. This was a period of approximately average precipitation, which included three single-dry years and three periods of multiple-dry years based on DWR's Sacramento River Basin Index. Initial conditions (starting heads) for the beginning of the calibration period were established using historical groundwater levels published by DWR to generate regional groundwater level contour maps and assign initial (September/October

1969) groundwater levels to each model node. Initial conditions for the simulation of future conditions are discussed in Section 4.4 below.

The IGSM models simulate transient conditions whereby hydraulic heads and groundwater flow can vary with time. Discretization over time occurs by dividing the continuous simulation period into time steps. Both models originally used monthly time steps, but have since been updated to use daily time steps (WRIME, 2007). Some model inputs such as streamflow and precipitation are daily, while others such as surface-water deliveries and municipal and industrial (M&I) groundwater pumping are monthly. Agricultural water demands are estimated by the model based on historical crop acreage, soil moisture requirements, effective rainfall, potential evapotranspiration, and irrigation efficiency.

The aquifer properties required by the model include hydraulic conductivity, storage coefficient, and specific yield for each layer. In the Natomas Basin, the hydraulic conductivity used for Layer 1 ranges from 33 to 118 ft/day across the Natomas Basin. Hydraulic conductivities are lower in Layer 2 (15-20 ft/day) and Layer 3 (3-12 ft/day).

Specific yield values used in the models range from 0.08 to 0.12 for the NARIGSM and from 0.04 to 0.20 for the SACIGSM. Storage coefficients in the Natomas Basin area ranged from 1.4 x 10^{-4} to 1.4 x 10^{-3} in Layer 1 to 3.5 x 10^{-5} to 3.0 x 10^{-4} in Layer 2, and 3.0 x 10^{-5} to 3.0 x 10^{-3} in Layer 3.

4.2.1 Simulation of Streams

To simulate streamflow, the IGSM models calculate a water balance for each stream element. The stream elements are a series of one-dimensional line elements that are used to describe the stream system in the model area. The gain or loss due to stream-aquifer interaction is computed based on head in the stream (stage) and head in the underlying aquifer (WRIME, 2006). The stream stage is computed using stage-discharge relationships at the corresponding stream node. Input data for the stream system include:

- Stream configuration;
- Stream node elevation;
- Stream channel cross section;
- Stage-discharge relationship;
- Stream inflows at boundary (including surface-water flow entering the model area and also gains or losses of the stream system due to stream-aquifer interaction);
- Tributary inflows;
- Wastewater discharges to streams; and
- Streamflow diversions that remove water from the stream system.

In the Natomas Basin, only the Sacramento and American Rivers are simulated as streams (recharge from smaller streams and canals is included in areal recharge discussed below).

4.2.2 Areal Recharge

The IGSM models account for a number of processes in the soil zone, including evapotranspiration (ET), direct runoff, infiltration, and deep percolation from rainfall and applied water (WRIME, 2006). ET is computed based on crop consumptive use requirements and available soil moisture. Direct runoff from rainfall and applied water is computed using a modified Soil Conservation Service (SCS) runoff curve number method. Input data for simulation of hydrologic processes in the soil zone include (MW, 1995; WRIME, 2006):

- Initial soil moisture;
- Rainfall;
- Land use category;
- SCS hydrologic soil group;
- Minimum soil moisture requirements for each crop type;
- Crop consumptive use (amount of applied water consumptively used to satisfy ET or soil moisture requirements);
- Root zone depth for each crop; and
- Surface drainage pattern.

The two primary sources of water to the soil zone in agricultural and urban areas are precipitation and applied water. Agricultural areas in the NARIGSM area tend to have the largest amount of deep percolation due to the amount of irrigation water applied to rice fields in addition to the natural rainfall, while the amount of deep percolation from undeveloped areas is relatively small (MW, 1995).

Water infiltrating beyond the soil zone (deep percolation) results in groundwater recharge. IGSM models simulate the vadose zone with the mathematical equation of unsaturated flow solved numerically at every time step (WRIME, 2006). The vadose zone is divided into a number of discrete layers of specified thickness; the water passing through the soil zone becomes the inflow to the uppermost vadose zone layer. This process repeats until the outflow from the last vadose zone layer becomes inflow to the first layer of the aquifer system. As discussed further in Chapter 5, deep percolation is a significant inflow component of the overall groundwater budget.

4.2.3 Model Calibration

Calibration is the process of adjusting parameters used in the model so that the model approximates the observed behavior of the aquifer system, especially measured groundwater levels. After the model is calibrated, it can be used to evaluate the response of the aquifer system to new or changing stresses. The original model calibration period for both IGSM models was water years 1970-1990. For the current versions of the models, the calibration period has been extended to water years 1970-1995 for the NARIGSM (MWH, 2001) and to 1970-2004 for the SACIGSM (WRIME, 2007).

During the calibration process, model generated heads were compared against measured water levels at selected calibration wells. A total of 81 calibration wells were used for the NARIGSM, and 138 wells were used for calibration of the SACIGSM. The models were found to generally produce simulated water levels that were in good agreement with observed values under various hydrologic conditions. For the northern portion of the SACIGSM model, including the Sacramento County portion of the Natomas Basin, WRIME (2007) reported that 76 percent of the simulated heads fell within ten feet of observed heads.

Since they were last calibrated (2001 for the NARIGSM and 2007 for the SACIGSM), a number of changes have been made to both models. A check of the calibration was performed in fall 2007 after the refinement of the hydraulic conductivity values in the Natomas Basin to match recent aquifer test data provided by LSCE. Additional updates and refinements were made to the model through late 2007 and early 2008, but were considered to have only a minor effect on the calibration.

Since the model is an approximation of the physical system, it does not exactly reproduce observed groundwater levels. Although the calibration was considered acceptable for the primary intended purpose of the model (regional planning), there are notable differences between measured and simulated heads in the Natomas Basin. In particular, calibration hydrographs included in LSCE (2008b) and WRIME (2007) show declining heads at some of the Natomas Basin calibration wells over the 1970-2004 period. This is not supported by actual data, which generally show stable or increasing water levels since the early 1980s except for small seasonal fluctuations.

4.3 Water Budget for Existing Conditions

The groundwater budget for existing conditions in the Natomas Basin is based on the final water year of the 1970-2004 calibration period for the SACIGSM model. For the NARIGSM model, the calibration period ended in 1995 but the simulation period was extended to 2004 to create the water budget. Although a number of other IGSM simulations have been conducted for different purposes, the calibration period simulation was considered the best available representation of existing groundwater conditions in the Natomas Basin.

The groundwater budget for the end of calibration simulation (2004) is shown in **Table 4-1** and summarized below The results are grouped into inflow and outflow components, and the change in storage represents the difference between the inflow and outflow.

Inflow Components

- Deep Percolation – This includes infiltration from precipitation, applied irrigation water, seepage from ditches and canals, and recharge from smaller streams. Deep percolation is assumed to be greatest from agricultural land planted to rice. A deep percolation rate of 1.32 acre-feet per acre per year (af/ac/yr), not including precipitation, was estimated for rice in the Natomas Basin (WRIME, 2008). The simulated deep percolation shown in **Table 4-1** totaled 31,429 af in 2004.

- Net Recharge from Streams – The direction of flow between streams and the underlying aquifer can vary seasonally or by reach. Flow from a stream to the aquifer system (losing conditions) is classified as inflow to the groundwater basin, and flow from the aquifer system to a stream (gaining conditions) is classified as outflow. For the Natomas Basin, only flow to and from the Sacramento and American Rivers is included in this component. Although there is some seasonal variation, all reaches of the Sacramento and American Rivers were simulated as losing in 2004. The simulated net recharge from streams shown in **Table 4-1** was 6,469 afy for the Sacramento River and 1,086 afy for the American River.

- Net Boundary Inflow – This represents groundwater inflow or outflow through model boundaries. The Sacramento River forms the western boundary of both IGSM models, and positive values of boundary inflow represent groundwater flow from the west beneath the Sacramento River. Boundary inflow shown in **Table 4-1** totaled 10,365 afy. Available water level data do not show a noticeable gradient for significant groundwater flow beneath the Sacramento River from the west. Therefore, some of this boundary inflow, especially that which occurs in Layer 1, may actually represent additional recharge from the Sacramento River.

- Subsurface Inflow – This component represents groundwater inflow from one model subregion to another. For the Natomas Basin, there is a small amount of inflow from the north beneath the NCC (241 afy) and a larger amount of outflow from the south beneath the American River (2,714 afy). The total inflow shown in **Table 4-1** is 2,955 afy.

<u>Outflow Components</u>

- Subsurface Outflow – This component represents groundwater outflow from one model subregion to another. For the 2004 simulation, there was a large amount of outflow from the Natomas Basin to the east (21,738 afy), as shown in **Table 4-1**.

- Groundwater Pumping – This represents the largest outflow component and, in the Natomas Basin, is primarily for agricultural use. The simulated groundwater pumping shown in **Table 4-1** is 35,537 afy.

<u>Change in Storage</u>

- Change in Storage – The basic equation for a water budget is:

  Inflow – Outflow = Change in Storage.

  A positive change in storage indicates rising groundwater levels while a negative change in storage indicates declining groundwater levels. As discussed above, hydrographs indicate that groundwater levels in the Natomas Basin are generally stable but show small fluctuations in response to climatic conditions. 2004 was classified as a normal year based on DWR's Sacramento River Basin Index, but precipitation in the Sacramento area was slightly below average. The simulated change in storage shown in **Table 4-1** is -4,970 afy.

This reduction in groundwater storage means that simulated heads were declining at the end of the calibration simulation. A decline in groundwater storage of almost 5,000 afy divided by the area of the Natomas Basin represents a small decrease in storage on a per acre basis (less than 0.1 af/ac/yr). As discussed above, the specific yield used in the model ranges from 0.04 to 0.20. Assuming a specific yield of 0.10, the simulated decrease in storage equates to an average decrease in head of about one foot.

4.4 Simulation of Future Conditions

The water budget for future conditions discussed below is based on a simulation conducted by WRIME to estimate the effect of proposed land and water use changes due to proposed developments in the North American Subbasin on groundwater conditions in 2030. For this scenario, the IGSM models were run for a 35-year simulation period based on 1970-2004 hydrologic conditions. As discussed above, this was a period of approximately average precipitation, which included three single-dry years and three periods of multiple-dry years based on DWR's Sacramento River Basin Index. This simulation represents proposed future land and water uses in the Natomas Basin, including the Sutter Pointe development at buildout (labeled Scenario 2B in LSCE, 2008b).

The 2030 simulation is based on estimated conditions in the groundwater basin in 2030 without SAFCA's construction activities. Future water supply conditions for northern Sacramento County were primarily based on Urban Water Management Plans for individual water districts in the area. As reported by WRIME (2007), most of the plans indicate a significant transition from groundwater to surface-water utilization to meet municipal water demands. Future water supply conditions for Placer County were based on several sources including the *Western Placer County Groundwater Management Plan* prepared by MWH (2007) on behalf of the City of Roseville, City of Lincoln, Placer County Water Agency, and California American Water. Water demand and supply data for proposed developments such as Placer Vineyards and Placer Ranch were obtained from the Specific Plan, EIR, or Notice of Preparation for each development.

The 2030 water budget presented below is based on Scenario 2B in LSCE (2008b), which includes full buildout of the Sutter Pointe development along with the other developments in the North American Subbasin discussed above. All agricultural land uses in the proposed development areas are simulated as being replaced by M&I land uses by 2030. Groundwater usage in the Sutter Pointe area is projected to be 13,072 afy in a normal year, which represents about 52 percent of the total demand M&I water demand, with the remainder supplied by surface water.

4.4.1 Water Budget for Future Conditions

The groundwater budget for the simulation of future conditions (2030) without SAFCA's planned construction is shown in **Table 4-1**. The future conditions water budget is based on the last 23 years of the simulation period (1982-2004). Precipitation during this period was approximately average, and this period includes nine wet years, four normal years, two single-dry years, and two multiple-dry periods (1987-1992 and 2001-2002) based on the Sacramento River 40-30-30 Index.

There are significant differences between the water budgets for the 2004 and 2030 simulations shown in **Table 4-1**. Many of these differences are due to much higher heads east of the Natomas Basin due to the planned transition from groundwater to surface water to meet M&I demands in northern Sacramento County. Heads are also higher in most of the Natomas Basin due in part to reduced pumping outside of the Sutter Pointe area. Higher heads result in less recharge from streams, less boundary inflow, and less subsurface outflow for the Natomas Basin water budget.

There are also differences between the values shown in **Table 4-1** for the 2030 simulation and the Scenario 2B results summarized in LSCE (2008b). These differences occurred because the latter simulation included an area of about 1,000 acres east of the Natomas Basin in southern Sutter County, which was removed from the area used for the water budget in **Table 4-1**. Due to the additional area, deep percolation and groundwater pumping were 2,300 and 3,000 afy higher, respectively, for the Scenario B water budget (LSCE, 2008b).

The inflow components shown in **Table 4-1** are deep percolation (27,187 afy), which represents a reduction of 4,243 afy from 2004 due to increased urbanization. Recharge from streams is 1,100 afy for the Sacramento River and –500 afy for the American River. The negative recharge for the American River indicates that it is simulated as a gaining reach for this model run. The total net recharge from streams (600 afy) is 6,955 afy lower than for the 2004 simulation. Boundary inflow from the west in 2030 (3,700 afy) is 6,665 afy lower than in 2004. Subsurface inflow from the north and south (3,700 afy) is 745 afy higher, however, due primarily to drawdown caused by proposed Sutter Pointe pumping in southern Sutter County. The outflow components for the 2030 simulation include groundwater pumping (31,615 afy), which is 3,922 afy lower than in 2004. The other outflow components, subsurface outflow to the east and south, total 2,000 afy, which is 19,738 afy lower than in 2004. The average change in storage was 1,572 afy, which indicates increasing heads over the simulation period.

5.0 Effects of SAFCA Construction Activities

Most of SAFCA's proposed levee improvements will have no effect on groundwater in the Natomas Basin, but the proposed slurry cutoff walls are intended to reduce groundwater flow beneath the levees and will affect groundwater conditions. Some of SAFCA's construction activities will involve land use changes that will reduce groundwater recharge. This reduction will be at least partially offset by seepage from new and relocated canals, which will increase groundwater recharge. Finally, water supply changes at the Brookfield property borrow site will result in a large reduction in groundwater pumping. A summary of assumptions about proposed SAFCA construction activities used to prepare water budgets and evaluate impacts is provided in **Table 5-1**. The groundwater impacts of proposed slurry cutoff walls are addressed in Chapter 6; the groundwater impacts of SAFCA's other proposed construction activities are summarized below.

5.1 Deep Percolation from Irrigated Agricultural Land

Most groundwater recharge in the Natomas Basin results from deep percolation of applied irrigation water. As shown in **Table 5-2**, estimates of applied water for various crops range from 2.5 af/ac/yr for field crops, grains, and hay to 6.5 af/ac/yr for rice (LSCE, 2008b). Most of this water is consumed by evapotranspiration but some goes to tailwater runoff and deep percolation. The amount of deep percolation is estimated to range from about 10 percent of applied water for field crops (0.25 af/ac/yr) to 17 percent of applied water for orchard (0.68 af/ac/yr). These estimates represent deep percolation from irrigation only; they do not include deep percolation from direct precipitation in the winter and spring. Deep percolation from precipitation was estimated to be about 0.23 af/ac/yr and is not included in the estimates because it would occur regardless of land use (except for areas covered by pavement or other impermeable materials). Estimates of deep percolation from applied water for other crops include 0.77 af/ac/yr for rice, 0.41 af/ac/yr for grains and hay, and 0.61 af/ac/yr for pasture (LSCE, 2008b).

5.2 Land Use Changes due to Levee Construction

Proposed levee construction activities that will affect land use include raising levees, modifying levee slopes, and adding seepage berms. As summarized in **Table 5-1**, planned improvements to the Sacramento River East Levee will require about 486.5 acres of land and will result in the loss of about 20 acres of rice, 175 acres of field crops, and five acres of orchard (EDAW, 2008). Proposed improvements to other levees are expected to result in the loss of an additional five acres of rice along the NCC South Levee and 50 acres of rice along the PGCC West Levee. Improvements to the NEMDC West Levee are still in the design phase, but irrigated crop land is limited to the northern portion of this levee and any changes in agricultural land use are expected to be small. No agricultural land would be affected by improvements to the American River North Levee, which is located within the City of Sacramento.

Table 5-3 shows existing and future agricultural land uses affected by proposed levee improvements and the resulting change in deep percolation from applied water. The estimated loss of deep percolation is 74 afy for the Sacramento River East Levee, seven afy for the NCC South Levee, and 66 afy for the PGCC West Levee.

5.3 Effects of Canal Improvements

Construction of the new GGS/Drainage Canal and relocation/improvement of three existing canals will increase groundwater recharge in the Natomas Basin. The new GGS/Drainage Canal and most of the relocated canals will be unlined, which will result in additional seepage from the canals to the underlying aquifer. Canal construction activities will also necessitate land use changes, including the loss of some irrigated agricultural land. The assumptions shown in **Table 5-1** were used to estimate the effects of land use changes and seepage from the canals for the water budget. For canals that would be relocated, this includes the total length of the existing and relocated canals, the length of any lined or piped segments, the approximate width of the canals at the waterline, existing land uses for the area where the relocated canal would be constructed, and the proposed future land uses for the existing canal that would be removed.

5.3.1 Giant Garter Snake/Drainage Canal

The new GGS/Drainage Canal will be about 23,200 feet (4.4 miles) long and will extend from the west end of the West Drainage Canal at the south to Pumping Plant No. 2 (east of the Pritchard Lake Pumping Plant) at the north (**Figure 1-1**). The new canal will be entirely unlined, with an average width at the waterline of about 50 feet including benches.

Construction of the GGS/Drainage Canal and associated infrastructure will require about 58.5 acres of land, as indicated in **Table 5-1**. Approximately 45 acres of this area is currently planted to field crops such as corn (EDAW, 2008). As shown in **Table 5-3**, the total amount of deep percolation that will be lost due to the removal of these field crops is estimated to be 11 afy.

The loss of deep percolation of applied water would be offset by increased seepage from the canal. Kleinfelder (2007b) used the SEEP/W groundwater flow model to estimate seepage from a two-mile segment of the new GGS/Drainage canal. The canal was simulated with a 10-foot width and an underlying soil hydraulic conductivity of 10^{-5} cm/sec. The canal was simulated as being filled with about five feet of water from May through December, but some seepage was assumed to occur during the winter. The Kleinfelder seepage estimate was 1.4 af/1,000 lf or 1.4 x 10^{-4} af per square foot of wetted canal area (af/ft^2). For the total length (23,200 lf) and average width (50 feet) of the GGS/Drainage Canal, this represents a seepage rate of 162 afy, as shown in **Table 5-4**. As discussed below, the estimated seepage rate per wetted area (1.4 x 10^{-4} af/ft^2) was also used to estimate increased seepage due to relocation or improvement of the West Drainage Canal, the Elkhorn Canal, and the Riverside Canal.

5.3.2 West Drainage Canal

The West Drainage Canal is located south of I-5 and the SIA (**Figure 1-1**) and is about 19,000 feet long. Approximately 4,700 lf of this canal is proposed to be relocated. The existing canal is unlined, and the relocated segment of the canal is also planned to be unlined. In addition to the partial relocation, SAFCA plans to widen the entire canal from about 30 feet to 72 feet, including a bench area that will be planted to tules (EDAW, 2008; M&H, 2008). As shown in **Table 5-1**, only about 1.5 acres of the area where the relocated canal will be constructed is currently planted to field crops. The loss of deep percolation from applied water due to the canal relocation is estimated to be 0.4 afy (**Table 5-3**).

Canal seepage was estimated using the seepage rate calculated from the Kleinfelder model for the GGS/Drainage Canal (1.4×10^{-4} af/ft^2). As shown in **Table 5-4**, seepage from the existing West Drainage Canal was estimated to be about 80 afy. Due to lengthening and widening of the canal, the future seepage rate is projected to be 208 afy, which represents an increase of 128 afy.

5.3.3 Elkhorn Canal

The existing Elkhorn Canal is located just east of the Sacramento River East Levee (**Figure 1-1**) and is about 19,850 feet (3.8 miles) long and 16 feet wide. Approximately one mile of the existing canal is concrete lined. The canal is being relocated farther east to make room for levee widening and other improvements. The relocated canal will be about 22,300 feet long and 32 feet wide. Approximately 6,100 lf of the relocated canal are planned to be lined, and another 2,950 lf would be piped. This includes the 2,050 lf alignment crossing the Teal Bend Golf Course and another 900 lf adjacent to an area of existing homes (M&H, 2008).

As shown in **Table 5-1**, relocation of the Elkhorn Canal and associated infrastructure will require about 30 acres of land. Most of the area where the new canal will be constructed is currently planted to irrigated crops. As shown in **Table 5-3**, there are about 15 acres of field crops, three acres of orchard, and 11 acres of grains, hay, and pasture. The loss of deep percolation due to removal of these crops is estimated to be 11 afy.

Canal seepage was estimated similarly to the West Drainage Canal, using the seepage rate calculated from the Kleinfelder model for the GGS/Drainage Canal (1.4×10^{-4} af/ft^2). As shown in **Table 5-4**, seepage from the existing Elkhorn Canal was estimated to be about 33 afy. The seepage rate of the relocated canal is projected to be 59 afy, which represents an increase of 27 afy.

5.3.4 Riverside Canal

The existing Riverside Canal is located just east of the southern portion of the Sacramento River East Levee in the Natomas Basin (**Figure 1-1**) and is about 19,600 feet (3.7 miles) long and seven feet wide. The Riverside Canal is also being relocated farther east to make room for levee improvements. The relocated canal is planned to be about 20,550 feet long and 10 feet wide (M&H, 2008).

As shown in **Table 5-1**, relocation of the Riverside Canal and associated infrastructure will require about 54 acres of land. Most of the area where the new canal will be constructed is currently planted to irrigated crops. As shown in **Table 5-3**, there are about four acres of rice, 33 acres of field crops, six acres of orchard, and seven acres of grains, hay, and pasture. The loss of deep percolation due to removal of these crops is estimated to be 21 afy.

As for the other canals, canal seepage was estimated using the seepage rate calculated from the Kleinfelder model for the GGS/Drainage Canal (1.4 x 10^{-4} af/ft^2). As shown in **Table 5-4**, seepage from the existing Riverside Canal was estimated to be 19 afy. The seepage rate of the relocated canal is projected to be 29 afy, which represents an increase of ten afy.

5.4 Effects of Borrow Sites

Excavation of the three borrow sites that will be the primary source of soil for SAFCA's proposed levee improvements and other construction activities will have effects on groundwater recharge in the Natomas Basin. **Table 5-1** includes a summary of assumptions about the borrow sites that were used for water budget estimates. These include the area of each borrow site and existing and proposed future land uses.

5.4.1 Airport North Bufferlands

The Airport North Bufferlands is a 737-acre site located north of the SIA (**Figure 1-1**). Approximately 630 acres of this site that had previously been planted to rice has recently been removed from rice cultivation or other land uses that would attract water fowl by the SIA. SAFCA plans to remove about four to six feet of borrow material from this site, which is currently considered non-irrigated grassland. Future land uses are not expected to change after reclamation of the site. As shown in **Table 5-3**, there will be no change in deep percolation from this site as a result of SAFCA's activities.

5.4.2 Brookfield Property

The Brookfield property consists of 353 acres at the northern tip of the Natomas Basin. Approximately 325 acres of this property is currently planted to rice, and SAFCA plans to restore most of this site to rice cultivation. Up to six feet of soil will be excavated, including one foot of topsoil that will be stockpiled and replaced after borrow operations are complete.

SAFCA plans to return about 286 acres of the Brookfield property to rice cultivation after construction activities are complete. The remaining 39 acres of rice fields would be lost due to construction along the PGCC West Levee and other factors. As shown in **Table 5-3**, an estimated 51 afy of deep percolation will be lost due to the conversion of rice land to other uses. The Brookfield property is currently irrigated entirely with groundwater, but SAFCA plans to provide the infrastructure so that most of the borrow site can be irrigated with surface water in the future. Engineering work is still in progress, but current estimates are that about 80 percent of the property would be irrigated with surface water rather than groundwater after reclamation (M&H, 2008). The current crop mix is about 50 percent regular rice and 50 percent wild rice (Jack DeWit, pers. comm., July 8, 2008). Regular rice and wild rice have estimated water demands of 6.5 and 6.0 af/ac/yr, respectively. Therefore, current groundwater pumpage to irrigate this property is estimated to be about 2,030 afy. This would be reduced by 1,625 afy due to the planned transition from groundwater to surface water.

In addition to increasing heads in the vicinity of the Brookfield site, the reduction in pumping would also result in increased groundwater outflow from the northern portion of the Natomas Basin. An analytical groundwater model based on the Theis (1935) equation for groundwater flow in a confined aquifer was used to estimate the amount of water level recovery that would occur due to the reduced pumping. An aquifer transmissivity of 7,620 ft^2/day and a storage coefficient of 0.001 were used for this simulation based on LSCE (2008b). The maximum simulated water level recovery beneath the Brookfield property was about 17 feet at the end of the irrigation season in September. At the midpoint of the PGCC West Levee (south of the Brookfield property), the simulated recovery ranged from 1.6 to 7.6 feet, with an average annual value of 3.8 feet. This would result in an average increase in the hydraulic gradient for flow to the east of about 4.4×10^{-5} ft/ft. The increase in subsurface outflow was estimated using Darcy's Law (Darcy, 1856), which can be written as:

$$Q = KAi$$

where:
Q = volumetric flow rate,
K = hydraulic conductivity of the porous medium,
A = cross-sectional area of the porous medium, and
i = hydraulic gradient.

The cross-sectional area was estimated based on the assumption that almost all of the flow would occur in the upper 400 feet of the aquifer system. Using this equation, the increase in subsurface outflow from the Natomas Basin was predicted to be 76 afy.

5.4.3 Fisherman's Lake

Fisherman's Lake – The Fisherman's Lake borrow site is located at the northern end of the existing Fisherman's Lake in the southwestern portion of the Natomas Basin. Engineering work has not been completed for this site, but the current estimate is that about 400 acres of land would be used for borrow material.

As shown in **Table 5-1**, current land uses on this site are 49 acres of rice, 266 acres of field crops, and 85 acres of managed marsh. After reclamation, there would be about 175 acres of managed marsh and 225 acres of non-irrigated grassland or woodland. As shown in **Table 5-3**, the creation of managed marsh will result in an increase in deep percolation of 51 afy. Overall, however, there will be a net loss in deep percolation of 15 afy due to the conversion of field crops to non-irrigated grassland.

5.5 Summary

This chapter summarized the groundwater impacts of SAFCA's proposed construction activities, with the exception of slurry cutoff walls, which are addressed in Chapter 6. The above analysis addressed three types of groundwater impacts:

- Land use changes due to levee and canal improvements and borrow sites will result in the conversion of some irrigated agricultural land to non-irrigated land uses, which will reduce groundwater recharge from deep percolation of applied water. The total loss of deep percolation from applied water is estimated to be 256 afy, as shown in **Table 5-3**.

- The new and relocated canals would result in increased groundwater recharge due to additional canal seepage. The total estimated increase in canal seepage is 327 afy, as shown in **Table 5-4**.
- There will be a large reduction in groundwater pumping due to the planned shift in water supply from groundwater to surface water for 80 percent of the Brookfield property. The reduction in pumping is estimated to be about 1,625 afy. This will result in higher heads and increased groundwater outflow in the northern portion of the Natomas Basin.

6.0 Effects of Slurry Cutoff Walls

Slurry cutoff walls are currently proposed for a total of about 17 miles of the levees surrounding the Natomas Basin. This includes eight miles of the Sacramento River East Levee, all (5.4 miles) of the NCC South Levee, 0.9 miles of the PGCC West Levee, three miles of the NEMDC West Levee, and 0.9 miles of the American River North Levee. Groundwater flow beneath the levees with and without the proposed cutoff walls was estimated by various methods. These methods and the resulting estimates are discussed in this section.

Groundwater flow beneath the Sacramento River East Levee and the NCC South Levee with and without slurry cutoff walls was estimated by both URS and Kleinfelder using the SEEP/W groundwater flow model. The most recent estimate was made by Kleinfelder (December 19, 2007) and is summarized below. LSCE used a spreadsheet model to develop a revised estimate for the Sacramento River East Levee.

No modeling has been done to estimate the impacts of proposed slurry cutoff walls along the other three levees that surround the Natomas Basin. For these areas, groundwater flow without slurry cutoff walls was estimated based on the IGSM models discussed in Chapter 4. Two different simulations were used for this purpose: one representing existing conditions based on 2004 data, and the other representing future conditions in 2030. To be conservative, the estimate of cutoff wall impacts used in the water budget was based on the simulation that showed the largest impact. Based on the model results, an estimate of groundwater flow per cross-sectional area was developed. For the reaches where slurry cutoff walls are proposed, the estimate flow per cross-sectional area were reduced by a fixed percentage based on the Kleinfelder model results for the Sacramento River East Levee and the NCC South Levee.

6.1 Sacramento River East Levee

Measures proposed to mitigate seepage problems beneath the Sacramento River East Levee are shown in **Table 6-1**. Slurry cutoff walls are currently proposed for 14 reaches, seepage berms are proposed for four reaches, and no mitigation is planned for seven reaches. The reaches where cutoff walls are proposed are shown in **Figure 6-1**.

6.1.1 Kleinfelder Model

Kleinfelder (2007b) used the SEEP/W groundwater flow model to estimate seepage beneath the Sacramento River East Levee with and without slurry cutoff walls. SEEP/W is a two-dimensional, finite-element model based on Darcy's Law (Darcy, 1856). As discussed in Chapter 5, the inputs to Darcy's equation are the hydraulic conductivity, the hydraulic gradient, and the cross-sectional area for groundwater flow. SEEP/W has the capability to simulate flow in multiple layers, and a separate hydraulic conductivity is required for each layer. Hydraulic conductivities used in the Kleinfelder model ranged from 0.028 ft/day for clay to 283 ft/day for gravel. The maximum hydraulic conductivity used for the permeable layers in most reaches was 14 ft/day (representing sand).

The SEEP/W model allows both steady-state and transient simulations to be conducted. As discussed below, a transient simulation was conducted for one station, but the results were not used in the overall seepage estimate. The reported model results were based on steady-state simulations conducted for four stations, which were considered to be representative of the different geologic conditions observed on geologic profiles created from borehole data. The modeled stations were located at Stations 27+00 in Reach 1, 70+00 in Reach 2, 217+00 in Reach 4b, and 353+00 in Reach 7b. Model results from these stations were applied to other reaches with similar geology. The percentage of the entire length of the Sacramento River East Levee represented by each modeled station was 11 percent for Station 27+00, 23 percent for Station 70+00, 42 percent for Station 217+00, and 24 percent for Station 353+00,

An "average" groundwater elevation of 15 ft msl was used for all simulations. This was compared against river stage at the Verona gage ranging from 15 to 32 ft msl in one-foot increments to calculate the gradient between the River and shallow groundwater. The steady-state model was run separately for each stage height, and the estimated seepage was multiplied by the number of days that the stage was calculated to be at each elevation based on data from 1995-2007. The lowest stage height (15 ft msl) had the longest duration (20 days/year), and the three highest stage heights (30, 31, and 32 ft msl) each had a duration of 10 days/year.

Since almost all of the groundwater flow occurs in the sand layers, the model is very sensitive to the hydraulic conductivity used for sands. A hydraulic conductivity of 14 ft/day was used for sand layers in three of the four modeled reaches, and the calculated seepage rate was relatively low (2.6 to 13.4 afy/1,000 lf) in these reaches. Hydraulic conductivities of 56 and 283 ft/day were used for sand and gravel, respectively, at Station 217+00, and the resulting seepage rate was much higher (129 afy/1,000 lf). These seepage estimates were multiplied by the length of each reach to estimate the total seepage, and the results are shown in **Table 6-2**. The total seepage was estimated to be about 5,650 afy without slurry cutoff walls using this approach.

The model was rerun for Stations 70+00 and 353+00 with the slurry cutoff walls in place to estimate the effect of the cutoff walls. A hydraulic conductivity of 2.8×10^{-3} ft/day was estimated for the cutoff walls. For Station 70+00, the cutoff wall was assumed to fully penetrate the permeable sand layer and a seepage reduction of 85 percent was calculated. At Station 353+00, the cutoff wall was assumed to not fully penetrate the permeable sand layer and was calculated to reduce seepage by only 40 percent. The model results for the four stations were multiplied by one of these percentages to estimate the impacts of the other cutoff walls. The 85 percent reduction was used for reaches where the cutoff wall was considered to fully penetrate the permeable sand layer, and the 40 percent reduction was used for reaches where the wall would not be fully penetrating. As shown in **Table 6-2**, the total amount of groundwater flow that would be blocked by the eight miles of proposed slurry cutoff walls is about 1,320 afy, which represents 23 percent of the total flow for the entire 18-mile reach of the River in the Natomas Basin.

A transient version of the model was created for Station 70+00 to check the results of the steady-state simulations. The transient model was run with and without the slurry cutoff walls for a one-year period divided into 34 time steps. Groundwater elevations and river stage were allowed to fluctuate based on stage measured at the Verona gage and groundwater levels at USACE piezometer 2F-01-15N. Seepage without the cutoff wall calculated with the transient model was three times higher than that calculated with the steady-state model. Seepage through the cutoff wall was about four times higher with the transient model as compared to the steady-state model. On a percentage basis, the calculated flow reduction for the transient model was about 80 percent, which is slightly less than the 85 percent reduction calculated with the steady-state model.

Overall, the Kleinfelder transient model results appear to be more realistic than the steady-state results. This would be expected since steady-state models require an assumption of equilibrium conditions and cannot simulate conditions that vary with time. For this reason, transient model results are considered more accurate for most applications. However, steady-state model results had to be used for Kleinfelder's overall seepage estimate shown in **Table 6-2** because only one station was simulated with the transient model. As discussed below, some of the Kleinfelder transient model results are used for LSCE's evaluation of cutoff wall impacts on seepage from the River and head changes in private wells along the east levee.

On a percentage basis, the transient and steady-state models showed similar results for flow reductions caused by the cutoff walls. Flow reductions of 80 to 85 percent due to horizontal flow through a fully-penetrating cutoff walls are considered to be reasonable estimates. These estimates are conservative in that they do not account for increased vertical flow beneath the cutoff walls or horizontal flow around the cutoff walls. A three-dimensional model would be expected to show a somewhat smaller flow reduction due to the cutoff walls.

6.12 LSCE Seepage Estimates

Since almost all of the groundwater flow beneath the levees occurs in the permeable sand and gravel layers, a seepage estimate equivalent to the SEEP/W model can be obtained by simply calculating groundwater flow in the sand and gravel layers using Darcy's Law. The estimate made by LSCE (2008a) is summarized in **Table 6-3** and discussed in this section. As noted above, Darcy's Law states that the volumetric rate of groundwater flow is equal to the product of the hydraulic conductivity, the cross-sectional area, and the hydraulic gradient (Darcy, 1856). Groundwater flow for 25 reaches was estimated separately and then summed to estimate the total net recharge from the River. The term "net recharge" is used because the hydraulic gradient used for the simulations is an average value that accounts for the fact that the Sacramento River fluctuates between gaining and losing conditions over the course of the year. On an annual basis, however, all reaches of the Sacramento River in the Natomas Basin appear to be losing, as discussed above in Chapter 3.

For these simulations, groundwater flow in fine to medium sands was calculated separately from that in coarse sands and gravels. For each category, the hydraulic conductivity and gradient were assumed to be constant for all reaches. Hydraulic conductivities used in the model are based on estimates summarized in **Table 2-1**. A hydraulic conductivity of 28 ft/day was used for the fine to medium sands, which is higher than the estimate used by Kleinfelder for three of the stations simulated with the SEEP/W model (14 ft/day). A hydraulic conductivity of 140 ft/day was used for coarse sands and gravels, which is within the range of estimates used by Kleinfelder for similar materials at Station 217+00 (56 to 283 ft/day).

The hydraulic gradient used for the Darcy's Law estimate was 0.0033 ft/ft based on the average annual value estimated in LSCE (2008a). As discussed in Section 4, this hydraulic gradient accounts for the large seasonal fluctuations observed in the hydrographs of groundwater levels and estimated stage. Steep positive gradients (losing conditions) occurring during periods of rising and high stage are partially offset by shallow negative gradients (gaining conditions) during periods of declining and low stage. Although the groundwater contour maps show that the gradient is steeper in the southern portion of the Natomas Basin, the piezometer data and stage estimates were not accurate enough to allow this spatial variability to be quantified.

For each reach, the saturated thickness of permeable sands and gravels was estimated from the geologic profiles, which contain data for the upper 100 to 120 feet of the aquifer system. The permeable saturated thickness for fine to medium sands ranged from 20 to 80 feet, with an average of 45 feet. The permeable saturated thickness for coarse sands to gravels ranged from zero to 53 feet, with an average of eight feet. These thicknesses were multiplied by the length of each reach to calculate the cross-sectional area for groundwater flow. Because the overall length of the Sacramento River East Levee is about 18 miles, the total cross-sectional area is very large (about 5.6 million square feet or almost 130 acres).

As shown in **Table 6-3**, the estimated groundwater flow in each reach ranges by several orders of magnitude from 5 to about 3,100 afy. The total estimated groundwater flow in the shallow aquifer without slurry cutoff walls is 8,470 afy. Although the coarse sand and gravel layers account for only 25 percent of the total saturated thickness, groundwater flow in these layers accounts for 63 percent of the total estimated flow. The total flow is about 55 percent more than was estimated by Kleinfelder using the steady-state SEEP/W model but is less than would be expected had Kleinfelder applied its transient model to all reaches.

The effect of the slurry cutoff walls was estimated partially based on the Kleinfelder transient model results. The estimate of an 80 percent reduction in groundwater flow obtained with the transient model was used for reaches where the cutoff wall fully penetrated the permeable sand layer. LSCE's interpretation of the geologic profiles indicates that the slurry cutoff walls will only be fully penetrating for three of the 13 reaches where cutoff walls are proposed. For the other ten reaches, an 80 percent flow reduction was assumed for the depth of the cutoff wall and no flow reduction below the bottom of the cutoff wall. Using this approach, the effect of the cutoff walls is estimated to range from 6 to 70 percent of the total flow in these reaches. The estimated flow reduction due to all proposed cutoff walls is 1,245 afy, as shown in **Table 6-3**. This represents a reduction of 15 percent of the total estimated flow beneath the Sacramento River East Levee.

The estimate of slurry cutoff wall impacts in **Table 6-3** is based on existing groundwater conditions in the Natomas Basin. In order to estimate impacts in 2030, the hydraulic gradient was increased to reflect the steeper gradient that would occur in the northern portion of the Natomas Basin primarily due to pumping to supply the proposed Sutter Pointe development. As shown in **Table 6-4**, the magnitude of the predicted increase ranges from a maximum of 0.0018 ft/ft in Reaches 2 and 3 to zero in Reaches 14 through 20. The total estimated recharge from the River without slurry cutoff walls would increase to 9,370 afy, and the estimated flow reduction due to all proposed cutoff walls would increase to 1,350 afy.

Like the Kleinfelder model results, the reduction in flow due to the proposed slurry cutoff walls calculated by LSCE is conservative because the model only accounts for horizontal flow beneath the cutoff walls. Increased vertical flow due to the cutoff walls and increased horizontal flow around the ends of the cutoff walls are not included in the model, which means that the actual flow reduction will be less than simulated. The reduction in groundwater flow beneath the levee due to the cutoff walls equates to reduced recharge from the Sacramento River to the Natomas Basin. During periods when the River is losing, heads will be lower on the land side of the levee and higher on the river side due to the impedance caused by the cutoff walls and the resultant reduction in groundwater flow. Flow that would be impeded by the cutoff walls would be expected to remain in the River, which will provide a benefit to downstream users.

6.2 Natomas Cross Canal South Levee

Seepage beneath the NCC South Levee with and without slurry cutoff walls was also estimated by Kleinfelder using the SEEP/W groundwater flow model. The model results are included in a report entitled *Evaluation of Cutoff Walls Impact on Groundwater Recharge, Natomas Cross Canal South Levee, Natomas Levee Improvement Project, Sacramento and Sutter Counties, California* (Kleinfelder, 2008) and are summarized below.

Hydraulic conductivities used in the model ranged from 0.028 ft/day for clay to 28 ft/day for sand. This maximum hydraulic conductivity is an order of magnitude less than the 283 ft/day used for some reaches of the Sacramento River East Levee, because boreholes drilled along the NCC South Levee did not encounter significant gravel lenses. However, the permeable sand layers were assigned a hydraulic conductivity of 28 ft/day, which is double that used for model of the Sacramento River East Levee.

Both steady state and transient simulations were conducted for the NCC South Levee, but the results of the transient simulations were not used for the overall seepage estimate. The reported model results were based on steady-state simulations conducted for three stations, which were considered to be representative of the different geologic conditions observed on geologic profiles created from borehole data. The modeled stations were located at Stations 135+00 (Reach 4), 183+00 (Reach 5), and 213+00 (Reach 6). Stations 135+00 and 183+00 were modeled as having two relatively thin sand layers separated by a clay layer. Station 213+00 was modeled as having a single thicker sand layer. Model results from these stations were applied to other reaches with similar geology. The percentage of the entire length of the NCC South Levee represented by each modeled station was 35 percent for Station 135+00, 40 percent for Station 183+00, and 25 percent for Station 213+00.

An “average” depth to water of 7.5 feet was used for all simulations. This equates to groundwater elevations of 25.3 to 32.3 ft msl and was compared against NCC stage ranging from 17.3 to 34.3 ft msl in one-foot increments to calculate the gradient between the canal and shallow groundwater. The steady-state model was run separately for each stage height, and the estimated seepage was multiplied by the number of days that the stage was calculated to be at each elevation based on data from the Sacramento River Verona gage for 1995-2007. The lowest stage height (17.3 ft msl) had the longest duration (about 20 days/year), and the three highest stage heights (32.3, 33.3, and 34.3 ft msl) each had a duration of about 10 days/year.

Unlike its seepage model of the Sacramento River East Levee, Kleinfelder modeled all three stations of NCC South Levee using the same hydraulic conductivity (28 ft/day) for the most permeable layers. Therefore, the simulated seepage for the NCC was much less variable. Station 135+00 had the lowest estimated seepage rate (3.1 afy/1,000 lf). Station 183+00 had a seepage rate of 9.8 afy/1,000 lf, and Station 213+00 had a seepage rate of 9.1 afy/1,000 lf. These seepage estimates were multiplied by the length of each reach to estimate the total seepage, and the results are shown in **Table 6-5**. The total seepage was estimated to be about 218 afy without slurry cutoff walls using this approach.

The model was rerun for all three stations with the slurry cutoff walls in place to estimate the effect of the cutoff walls on seepage from the NCC. A hydraulic conductivity of 2.8 x 10^{-3} ft/day was assumed for the cutoff walls. For Station 135+00, the cutoff wall was assumed to fully penetrate both sand layers, resulting in an estimated seepage reduction of 90 percent. For Station 183+00, however, the cutoff wall was assumed to penetrate only the upper sand layer, which resulted in an estimated seepage reduction of 30 percent. For Station 213+00, the cutoff wall was assumed to fully penetrate the single sand layer, which also resulted in an estimated seepage reduction of 90 percent. The model results for the four stations were multiplied by one of these percentages to estimate the impacts of the other cutoff walls. As shown in **Table 6-5**, the total amount of groundwater flow that would be blocked by the slurry cutoff walls along the NCC South Levee under existing conditions is about 126 afy. This represents 90 percent of the flow through the cutoff wall cross section and 58 percent of the total flow calculated by the model.

In addition to the Kleinfelder model results for existing conditions, slurry cutoff wall impacts were estimated for 2030 conditions based in part on the IGSM model results. Estimated groundwater flow with and without slurry cutoff walls for all five levees based on existing and future conditions are shown in **Table 6-6**. Groundwater flow beneath the NCC South Levee without slurry cutoff walls was estimated to be much larger (about 3,700 afy) in 2030 (**Table 4-1**) due primarily to drawdown caused by proposed M&I pumping in the Sutter County portion of the Natomas Basin. It was assumed that almost all of this flow would occur in the upper 400 feet of the aquifer system. Flow through the cross-sectional area where cutoff walls are proposed was estimated to be 648 afy, and an 80 percent flow reduction due to the slurry cutoff walls was assumed based on the Kleinfelder transient simulation for the Sacramento River East Levee. The estimated flow reduction for the 2030 simulation is 518 afy.

As discussed above for the model of the Sacramento River East Levee, these estimates are conservative in that they do not account for increased vertical flow beneath the cutoff walls or horizontal flow around the cutoff walls. A three-dimensional model would be expected to show a somewhat smaller flow reduction due to the cutoff walls.

6.3 Pleasant Grove Creek Canal West Levee

As discussed above, no modeling has been done to estimate the impacts of proposed slurry cutoff walls along the PGCC West Levee, the NEMDC West Levee, and the American River North Levee. For these areas, groundwater flow without slurry cutoff walls was estimated based on the IGSM groundwater model results discussed in Chapter 4. Based on the model results, an estimate of groundwater flow per cross-sectional area was developed for the 2004 and 2030 simulations (**Table 6-6**). For the reaches where slurry cutoff walls are proposed, flow through the cross-sectional area of the cutoff walls was reduced by a fixed percentage (80 percent) based on the Kleinfelder transient model results for the Sacramento River East Levee.

Flow beneath the PGCC West Levee with and without slurry cutoff walls is estimated in **Table 6-6**. Groundwater flow to the east beneath the levee without cutoff walls was estimated to be 4,328 afy based on the 2004 IGSM simulation and 239 afy based on the 2030 simulation. It was assumed that almost all of this flow occurs in the upper 400 feet of the aquifer system, which corresponds to Layer 1 and the upper portion of Layer 2 of the IGSM models. The slurry cutoff walls along the PGCC West Levee were assumed to be 5,000 feet long and an average of 60 feet deep. Groundwater flow through this cross section without the cutoff walls was estimated to be 187 afy and 10 afy, based on the 2004 and 2030 simulations, respectively. An 80 percent flow reduction due to the slurry cutoff walls was assumed based on the Kleinfelder transient simulation for the Sacramento River East Levee. The estimated flow reduction is 149 afy for the 2004 simulation and 8 afy for the 2030 simulation, as shown in **Table 6-6**. These flow reductions will be at least partially offset by the estimated increase in groundwater outflow beneath the PGCC due pumping reductions planned for the Brookfield borrow site.

6.4 Natomas East Main Drainage Canal West Levee

The impacts of proposed slurry cutoff walls along the NEMDC West Levee were estimated similarly to the PGCC West Levee in **Table 6-6**. Groundwater flow to the east beneath the levee without cutoff walls was estimated to be 17,410 afy based on the IGSM 2004 simulation and 961 afy based on the 2030 simulation. As for the PGCC, it was assumed that almost all of this flow occurs in the upper 400 feet of the aquifer system. The slurry cutoff walls along the NEMDC West Levee were assumed to be 16,000 feet long and an average of 69 feet deep.

Groundwater flow through this cross-sectional area without the cutoff walls was estimated to be 684 afy and 38 afy, based on the 2004 and 2030 simulations, respectively. An 80 percent flow reduction due to the slurry cutoff walls was assumed based on the Kleinfelder transient simulation for the Sacramento River East Levee. The estimated flow reduction is 547 afy for the 2004 simulation and 30 afy for the 2030 simulation, as shown in **Table 6-6**.

6.5 American River North Levee

The impacts of proposed slurry cutoff walls along the American River North Levee were estimated similarly to the PGCC and NEMDC West Levees in **Table 6-6**. Recharge from the American River to the Natomas Basin was estimated to be 1,086 afy based on the IGSM 2004 simulation. For the 2030 simulation, the direction of groundwater flow was toward the River (gaining conditions), and simulated groundwater flow to the River was 500 afy. In both cases, it was assumed that almost all of the flow to and from the River occurs in the upper 120 feet of the aquifer system. The slurry cutoff walls along the American River North Levee were assumed to be 5,000 feet long and an average of 85 feet deep.

Recharge from the River through the cross-sectional area where cutoff walls are proposed was estimated to be 332 afy for the 2004 simulation and –153 afy for the 2030 simulation. An 80 percent flow reduction due to the slurry cutoff walls was again assumed based on the Kleinfelder transient simulation for the Sacramento River East Levee. The estimated reduction in flow from the River was 265 afy for the 2004 simulation as shown in **Table 6-6**. The estimated reduction in flow to the River was 122 afy for the 2030 simulation,

6.6 Summary

The proposed slurry cutoff walls are expected to reduce groundwater flow beneath the levees as intended. Cutoff wall impacts shown in **Table 6-6** were estimated separately based on simulations of existing (or 2004) and future (2030) conditions. Estimates were based on models by Kleinfelder (2007 and 2008) and LSCE (2008a) and IGSM model results (WRIME, 2007 and LSCE, 2008b). The predicted impacts of cutoff walls beneath each of the five levees surrounding the Natomas Basin discussed in Chapter 7 are based on both the existing/2004 and 2030 results, because the maximum impact varies both by location and simulation period. The maximum impact to groundwater supplies in the Natomas Basin occurs based on the 2004 simulation for the American River North Levee and the 2030 simulation for the other four levees. The total predicted impact of all slurry cutoff walls is 940 afy based on the “existing” or 2004 conditions and 1,707 afy based on future conditions in 2030.

There are also potential groundwater impacts east of the Natomas Basin, primarily because the proposed slurry cutoff walls beneath the PGCC and NEMDC West Levees will reduce groundwater outflow from the Natomas Basin. These impacts are predicted to occur primarily under existing conditions (based on the 2004 simulation) because the gradient for groundwater flow to the east is relatively flat for the 2030 simulation. As shown in **Table 6-6**, the reduction in groundwater outflow due to the slurry cutoff walls based on the 2004 simulation is 149 afy for the PGCC West Levee and 547 afy for the NEMDC West Levee. The total predicted reduction in groundwater outflow is 696 afy. This would be reduced to 620 afy due to increased outflow beneath the PGCC West Levee resulting from pumping reductions at the Brookfield borrow site.

7.0 Groundwater Impacts of SAFCA Construction Activities

The effects of SAFCA's proposed construction activities on groundwater conditions in the Natomas Basin were evaluated using the water budget approach discussed above. Water budget impacts resulting from land use changes and canal construction were addressed in Chapter 5, and water budget impacts due to proposed slurry cutoff walls were addressed in Chapter 6. All of the predicted impacts of SAFCA's activities are summarized in **Table 7-1** for existing/2004 conditions and in **Table 7-2** for 2030 conditions. This chapter also addresses cumulative impacts for 2004 and 2030 conditions based on the groundwater budgets calculated by the IGSM models.

7.1 Levee Improvements

Groundwater impacts from proposed levee improvements are primarily limited to the effects of land use changes and slurry cutoff walls. No direct groundwater impacts are expected from increasing the height or width of levees, modifying levee slopes, or building seepage berms because all of this construction would be above the water table.

Proposed land use changes will result in the loss of about 20 acres of rice, 175 acres of field crops, and five acres of orchard along the Sacramento River East Levee. Other land use changes include the loss of five acres of rice along the NCC South Levee and 50 acres of rice along the PGCC West Levee. As shown in **Tables 7-1** and **7-2**, these changes are estimated to reduce deep percolation from applied water by a total of 105 afy.

Estimated reductions in groundwater flow beneath the levees due to the proposed slurry cutoff walls are shown in **Table 6-6** based both on simulations of "existing" (or 2004) and future (2030) conditions. The 2004 simulation summarized in **Table 7-1** showed smaller impacts in the Natomas Basin and larger impacts east of the Natomas Basin compared to the 2030 simulation. Estimated inflow reductions for existing/2004 conditions include 1,510 afy of recharge from the Sacramento and American Rivers and 126 afy of inflow to the Natomas Basin beneath the NCC. Cutoff walls along the PGCC and the NEMDC are estimated to reduce subsurface outflow from the Natomas Basin to the east by 149 and 547 afy, respectively. The effect of all proposed slurry cutoff walls along the levees surrounding the Natomas Basin based on the 2004 simulation will be to reduce groundwater inflow by 1,741 afy and groundwater outflow by 696 afy, resulting in a decrease in groundwater storage of 1,045 afy.

Estimated inflow reductions for 2030 conditions shown in **Table 7-2** include 1,228 afy of recharge from the Sacramento and American Rivers and 518 afy of inflow to the Natomas Basin beneath the NCC. Cutoff walls along the PGCC and the NEMDC are estimated to reduce subsurface outflow from the Natomas Basin to the east by 8 and 30 afy, respectively. The estimated effect of all proposed slurry cutoff walls based on the 2030 simulation will be to reduce groundwater inflow by 1,851 afy and groundwater outflow by 38 afy, resulting in a larger decrease in groundwater storage (1,812 afy).

7.2 Canal Improvements

The construction of the new GSS/Drainage Canal and relocation and improvements to the West Drainage Canal, the Elkhorn Canal, and the Riverside Canal will affect deep percolation from applied water (due to land use changes) and seepage from the canals. For all four canals, deep percolation is estimated to decrease by 43 afy and canal seepage is estimated to increase by 327 afy (**Tables 7-1** and **7-2**). The net effect of proposed canal construction would be to increase groundwater storage in the Natomas Basin by about 285 afy.

7.3 Borrow Sites

Excavation and reclamation of the Brookfield and Fisherman's Lake borrow sites is expected to have an indirect effect on groundwater conditions due to proposed land use and water supply changes. No such changes are planned for the Airport North Bufferlands borrow site.

At the Brookfield borrow site, approximately 325 acres are currently planted to rice, and SAFCA plans to restore about 286 acres to rice cultivation after construction activities are complete. As shown in **Tables 7-1** and **7-2**, an estimated 30 afy of deep percolation will be lost at this site due to the reduction in irrigated acreage. The Brookfield site is currently irrigated entirely with groundwater, but SAFCA plans to provide the infrastructure so that about 80 percent of the borrow site can be irrigated with surface water after reclamation. This transition would reduce groundwater pumping by about 1,625 afy. Groundwater levels will increase due to the reduced pumping, which is expected to increase subsurface outflow beneath the PGCC by about 76 afy.

At the Fisherman's Lake borrow site, about 400 acres of land would be used for borrow material, including 49 acres currently planted to rice, 266 acres of field crops, and 85 acres of managed marsh. After reclamation, there would be about 175 acres of managed marsh and 225 acres of non-irrigated grassland or woodland. The predicted net loss in deep percolation is 36 afy at this site, as shown in **Tables 7-1** and **7-2**.

The reduction in groundwater pumping at the Brookfield site more than offsets the loss of deep percolation at all borrow sites. The net effect of excavation and reclamation of all borrow sites will be to increase groundwater storage by about 1,483 afy.

7.4 Summary of SAFCA Groundwater Impacts

The totals at the bottom of **Tables 7-1** and **7-2** show the combined effect of SAFCA's proposed construction activities based on exising/2004 and 2030 conditions, respectively. For both simulations, deep percolation is estimated to decrease by 213 afy, seepage from canals is estimated to increase by 327 afy, and groundwater pumping is estimated to decrease by 1,625 afy. Other changes for existing/2004 conditions include decreases in net recharge from streams (1,510 afy), subsurface inflow (126 afy), and subsurface outflow (620 afy). Summing these terms results in a decrease in groundwater storage in the Natomas Basin of 723 afy for 2004, which means that groundwater levels would be expected to increase slightly due to the construction activities. The reduction in subsurface outflow of 620 afy would have a slightly negative effect on groundwater levels and storage east of the Natomas Basin.

The totals at the bottom of **Table 7-2** show the combined effect of SAFCA's proposed construction activities based on future conditions in 2030. Estimated changes in deep percolation, seepage from canals, and groundwater pumping are the same as for existing/2004 conditions. The estimated reduction in net recharge from streams (1,228 afy) is smaller than in 2004, and the reduction in subsurface inflow (518 afy) is larger. A small decrease in groundwater storage in the Natomas Basin (45 afy), and a small increase in subsurface outflow to the east (38 afy) are predicted in 2030.

7.5 Cumulative Effects

The cumulative impacts of SAFCA's construction activities on existing groundwater conditions based on the 2004 and 2030 IGSM simulation are shown in **Tables 7-3** and **7-4**. On these tables, the estimated SAFCA impacts discussed above are added to the groundwater budget for the Natomas Basin discussed in Chapter 4. The 2004 groundwater budget showed a total groundwater inflow to the Natomas Basin of 52,304 afy without the effects of SAFCA's proposed construction and 50,782 afy including SAFCA (**Table 7-3**). There is a similar reduction in groundwater outflow from 57,275 afy without the SAFCA construction to 55,030 afy including SAFCA. The simulated reduction in groundwater storage for 2004 is 4,971 afy without SAFCA, which represents an average water level decline of about one foot. The decrease in groundwater storage would be smaller (4,248 afy) due to SAFCA's construction activities. Overall, SAFCA's proposed construction would have a small positive impact on groundwater supplies in the Natomas Basin based on existing conditions. Outside of the Natomas Basin, the predicted reduction in groundwater outflow to the east (620 afy) would have a small negative impact on groundwater levels and storage within the cones of depression east of the Natomas Basin.

The estimate of the cumulative impacts of SAFCA's construction activities based on the simulation of future (2030) groundwater conditions is summarized in **Table 7-4**. SAFCA's estimated groundwater impacts are slightly negative for the Natomas Basin, and the positive change in storage indicated by the 2030 IGSM simulation would decrease slightly from 1,572 afy to 1,527 afy due to SAFCA's activities. Subsurface outflow to the east would increase slightly to 1,238 afy . Overall, SAFCA's activities would have a negligible effect on groundwater levels and storage within and east of the Natomas Basin in 2030.

8.0 Effects on Groundwater Quality and Private Wells

8.1 Potential Groundwater Quality Impacts

The primary potential groundwater quality impact of SAFCA's proposed construction activities will be a slight reduction in groundwater recharge to the Natomas Basin, including stream recharge and deep percolation from rice fields and other irrigated farmland. This recharge is generally of high quality, especially the stream recharge, which typically has very low salinity and few contaminants. Seepage from canals is another source of good quality recharge, and this will increase due to SAFCA's proposed canal construction. Water recharged via deep percolation has somewhat higher salinity than river water due to the use of recycled tailwater and the effects of ET.

As estimated above, the combined effect of SAFCA's proposed construction activities would be to reduce low-salinity groundwater recharge from rivers and canals by 1,183 afy for existing conditions and by 901 afy for future conditions. These inflow reductions would be expected to have a slight impact on groundwater quality but represent less than three percent of the total groundwater inflow to the Natomas Basin. Based on estimates for existing conditions, salt accumulation in the Natomas Basin could also increase slightly because slurry cutoff walls along the PGCC and NEMDC are estimated to reduce groundwater outflow by 620 afy. This represents less than three percent of the total groundwater outflow from the Natomas Basin to the east. The opposite would occur for the 2030 simulation, which shows a slight increase in groundwater outflow (38 afy). The effect on groundwater quality in the Natomas Basin due to decreased groundwater inflow and outflow can be considered negligible.

In the vicinity of the Brookfield borrow site, groundwater quality would improve due to the transition from groundwater to surface water for about 80 percent of the rice acreage. Groundwater quality would improve in this area because deep percolation from fields irrigated with surface water will have lower salinity than from fields irrigated with groundwater.

The slurry cutoff walls will be constructed primarily of soil mixed with bentonite, but Portland cement may be used as an additive in some cases. Bentonite is a naturally occurring form of clay, and Portland cement is made from limestone and clay. Neither bentonite nor cured Portland cement are water soluble, and grouts composed of both materials are widely used in the water well industry. Both bentonite and cement are used to construct seals in wells drilled for various purposes, including drinking water supply. No groundwater contamination would be expected due to construction of the proposed slurry cutoff walls and other improvements proposed for the levees surrounding the Natomas Basin.

Although SAFCA's proposed construction activities would cause slight groundwater quality impacts in some areas and improvements in other areas, the effects would be too small to be measurable. The overall effect of SAFCA's proposed construction on groundwater quality in the Natomas Basin can be considered negligible.

8.2 Potential Impacts to Private Wells

For the *Sacramento River Basinwide Water Management Plan*, DWR reviewed drillers' logs in the Natomas Basin and reported that average well depths were 149 feet for domestic wells, 313 feet for irrigation wells, 378 feet for industrial wells, and 308 feet for municipal wells (DWR, 2003c). The majority of the wells in the Natomas Basin are domestic or agricultural wells, which typically extract groundwater from the upper aquifer system as defined above.

Figure 8-1 shows wells with known well locations in and near the Natomas Basin. "Private wells" along the Sacramento River East Levee and the NCC South Levee are primarily domestic wells mapped by M&H (Stephen Sullivan, pers. comm., January 23, 2008) but include some irrigation wells. Well numbers provided for these wells correspond to numbers assigned by M&H. Wells along the Sacramento River East Levee probably represent the majority of the domestic wells in the Natomas Basin, but the map is incomplete in that similar mapping has not been conducted in other areas. **Figure 8-1** also shows wells with water level data have been mapped by LSCE based on locations provided by DWR and other sources. Symbols used for these wells indicate the depth zone (upper, lower, multiple, and unknown). Most of these are agricultural wells, M&I wells, or monitoring wells. If available, the wells are numbered based on the last four digits of the State Well Number.

Approximately 138 private wells along the Sacramento River East Levee have been mapped by M&H (2008), and these are grouped by depth and type in **Table 8-1**. There are 103 domestic wells, 15 irrigation wells, and 20 wells used for other or unknown purposes. Monitoring and municipal wells are not included on this table. All of the domestic wells are less than 300 feet deep, and 84 percent are between 100 and 200 feet deep. All but one of the irrigation wells are also less than 300 feet deep, with 6 wells between 100 and 200 feet deep and 8 wells between 200 and 300 feet deep. The average depth of the private wells along the Sacramento River East Levee is 158 feet. As reported by LSCE (2008a), approximately two-thirds of these wells are located on the river side of the levee and one-third of the land side. Wells on the river side of the levee have an average depth of 151 feet, and wells on the land side have an average depth of 163 feet. The land side wells are slightly deeper on average because they include more agricultural wells.

As shown in **Table 8-1**, nine wells along the NCC South Levee were mapped by M&H (2008). These include one domestic well and eight irrigation wells. The domestic well is between 100 and 200 feet deep. One of the irrigation wells is between 100 and 200 feet deep, three are between 200 and 300 feet deep, two are between 300 and 400 feet deep, and two are of unknown depth. The average depth of these wells is 260 feet.

Kleinfelder (2007b) estimated the water level changes due to the slurry cutoff walls along the Sacramento East Levee using the steady-state and transient versions of the seepage model discussed above. The transient version of the model is considered to be more accurate, and the changes in head due to the slurry cutoff walls along the Sacramento River East Levee predicted by the transient model are shown on **Figure 8-2**. On the river side of the levee, the predicted effects of the cutoff walls are negligible at low stage, and there would be a slight increase in head (less than one foot) at high stage. On the land side of the levee, the Kleinfelder simulation shows that heads would be slightly lower due to the cutoff wall (typically 0.25 to 0.5 foot). Head changes due to slurry cutoff walls along the NCC South Levee would likely be similar to those along the Sacramento River East Levee. These small effects are considered to be negligible even for the shallowest domestic wells (less than 100 feet deep). No measurable decrease in well yields or increase in pumping costs are expected due to slurry cutoff walls.

9.0 Summary of Potential Impacts

Most of SAFCA's proposed levee improvements will have no effect on groundwater in the Natomas Basin, but the proposed slurry cutoff walls are intended to reduce groundwater flow beneath the levees and will affect groundwater conditions. Some of SAFCA's construction activities will involve land use changes that will reduce groundwater recharge. This reduction will be at least partially offset by seepage from new and relocated canals, which will increase groundwater recharge. Finally, water supply changes at the Brookfield property borrow site will result in a large reduction in groundwater pumping.

The effects of SAFCA's proposed construction activities on groundwater conditions in the Natomas Basin were evaluated using the water budget approach and other methods discussed above. Potential impacts resulting from land use changes and canal construction were addressed in Chapter 5, potential impacts due to proposed slurry cutoff walls were addressed in Chapter 6, and the potential cumulative impacts were addressed in Chapter 7. The analysis of potential impacts to groundwater quality and private wells was discussed in Chapter 8. Each of these potential impacts is summarized below.

9.1 Potential Water Budget Impacts

9.1.1 Levee Improvements

Groundwater impacts from proposed levee improvements are primarily limited to the effects of land use changes and slurry cutoff walls. No direct groundwater impacts are expected from increasing the height or width of levees, modifying levee slopes, building seepage berms, or other construction above the water table.

Proposed land use changes for all five levees will result in the loss of about 75 acres of existing rice, 175 acres of field crops, and five acres of orchard. These changes are estimated to reduce deep percolation from applied water by a total of 105 afy.

Groundwater flow reductions due to the slurry cutoff walls were estimated based on simulations of "existing" (or 2004) and future (2030) conditions. The combined effect of all proposed slurry cutoff walls along the levees surrounding the Natomas Basin for existing/2004 conditions is estimated to reduce groundwater inflow by 1,741 afy and groundwater outflow by 696 afy, resulting in a reduction in groundwater storage in the Natomas Basin of about 1,045 afy (**Table 7-1**). For 2030 conditions, groundwater inflow is predicted to be reduced by 1,851 afy and groundwater outflow by 38 afy, resulting in a reduction in groundwater storage of about 1,812 afy (**Table 7-2**).

9.1.2 Canal Improvements

The construction of the new GSS/Drainage Canal and relocation and improvements to the West Drainage Canal, the Elkhorn Canal, and the Riverside Canal will affect deep percolation from applied water (due to land use changes) and seepage from the canals. For all four canals, deep percolation is estimated to decrease by 41 afy and canal seepage is estimated to increase by 327 afy. The net effect of proposed canal construction would be to increase groundwater storage in the Natomas Basin by about 285 afy (**Tables 7-1** and **7-2**).

9.1.3 Borrow Sites

Excavation of two of the three primary borrow sites is expected to have an indirect effect on groundwater conditions due to proposed land use and water supply changes. At the Brookfield borrow site, approximately 325 acres is currently planted to rice, and SAFCA plans to restore about 286 acres to rice cultivation after construction activities are complete. At the Fisherman's Lake borrow site, about 400 acres of land would be used for borrow material, including 49 acres currently planted to rice, 266 acres of field crops, and 85 acres of managed marsh. After reclamation, there would be about 175 acres of managed marsh and 225 acres of non-irrigated grassland or woodland. No land use changes are planned at the Airport North Bufferlands borrow site due to airport safety considerations. The predicted net loss in deep percolation for all borrow sites is 67 afy.

The Brookfield borrow site is currently irrigated entirely with groundwater, but SAFCA plans to provide the infrastructure so that about 80 percent of the borrow site can be irrigated with surface water after reclamation. This transition would reduce groundwater pumping in the Natomas Basin by about 1,625 afy. The reduction in groundwater pumping at the Brookfield site more than offsets the loss of deep percolation at all borrow sites. The reduced pumping would also result in slightly increased groundwater outflow from the northern portion of the Natomas Basin. The net effect of excavation and reclamation of all borrow sites will be to increase groundwater storage by about 1,483 afy (**Tables 7-1** and **7-2**).

9.1.4 Summary of Potential Water Budget Impacts

The combined effects of SAFCA's proposed construction activities for both existing and future conditions include estimated decreases in groundwater deep percolation (213 afy) and groundwater pumping (1,625 afy) and an increase in seepage from canals of 327 afy. The other water budget components vary between the existing/2004 and 2030 simulations. For the existing/2004 period, there are predicted decreases in net recharge from streams (1,510 afy), subsurface inflow (126 afy), and subsurface outflow (620 afy). Groundwater storage is estimated to increase by 723 afy for the existing/2004 period. This means that groundwater levels in the Natomas Basin would be expected to increase slightly due to SAFCA's construction activities. The estimated reduction in subsurface outflow (620 afy) would result in a small decrease in groundwater levels and storage east of the Natomas Basin.

For the 2030 period, decreases in groundwater inflow include net recharge from streams (1,228 afy) and subsurface inflow (518 afy). There would be a small decrease groundwater storage (45 afy) and a small increase in subsurface outflow (38 afy). These small changes would have a negligible effect on groundwater levels in or near the Natomas Basin.

The cumulative impacts of SAFCA's proposed construction activities on existing and future groundwater conditions were based primarily on the 2004 and 2030 IGSM simulations discussed in Chapter 4. The 2004 simulation results show a reduction in groundwater storage of 4,971 afy in the Natomas Basin without SAFCA's construction; this equates to an average head decline of about one foot. The decrease in groundwater storage would be slightly smaller (4,248 afy) due to SAFCA's construction activities. Subsurface outflow from the Natomas Basin to the east would decrease slightly (from 21,738 to 21,118 afy) due to SAFCA's activities. Overall, SAFCA's activities would have a small positive impact on groundwater supplies in the Natomas Basin and a small negative impact on groundwater east of the Natomas Basin based on existing conditions.

The 2030 IGSM simulation provides an estimate of the cumulative impacts of SAFCA's construction activities on future groundwater conditions. The results of the 2030 simulation show a positive change in groundwater storage in the Natomas Basin of 1,572 afy, which would decrease slightly to 1,527 afy due to SAFCA's activities. This means that heads in the Natomas Basin would still be expected to increase but at a slightly lower rate. There would be a similarly small increase in groundwater outflow (from 1,200 to 1,238 afy). Overall, the cumulative impact of SAFCA's proposed construction activities on future groundwater conditions is predicted to be negligible.

9.2 Potential Water Quality Impacts

This investigation also included a summary of potential impacts to groundwater quality due to SAFCA's construction activities. The primary potential groundwater quality impact will be a slight reduction in groundwater recharge to the Natomas Basin, including stream recharge and deep percolation from rice fields and other irrigated farmland. This recharge is generally of high quality, especially the stream recharge, which has very low salinity. Seepage from canals is generally considered to be a source of good quality recharge, and increased seepage due to SAFCA's proposed canal construction will offset some of the reductions in groundwater recharge due to slurry cutoff walls. In the vicinity of the Brookfield borrow site, groundwater quality would improve due to the transition from groundwater to surface water for about 80 percent of the rice acreage. No groundwater contamination would be expected due to construction of the proposed slurry cutoff walls and other improvements proposed for the levees surrounding the Natomas Basin.

Although SAFCA's proposed construction activities would cause slight groundwater quality degradation in some areas and improvements in other areas, the effects would be too small to be measurable. The overall effect of SAFCA's proposed construction on groundwater quality in the Natomas Basin can be considered negligible.

9.3 Potential Impacts to Private Wells

The majority of the domestic wells along the Sacramento River East Levee are between 100 and 200 feet deep, and irrigation wells in this area are slightly deeper. The average depth of the domestic and irrigation wells along the Sacramento River East Levee is 158 feet.

Kleinfelder estimated the water level changes due to the slurry cutoff walls along the Sacramento East Levee using the SEEP/W groundwater model. On the river side of the levee, the predicted effect of the cutoff wall is negligible at low stage, and there would be a slight increase in head (less than one foot) at high stage. On the land side of the levee, the simulated heads are slightly lower due to the cutoff wall (typically 0.25 to 0.5 foot). In both cases, any impacts would be small enough to be considered negligible even for the shallowest domestic wells (less than 100 feet deep). No measurable decrease in groundwater levels or well yields or increase in pumping costs is expected due to the slurry cutoff walls.

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Tables

Table 2-1
Hydraulic Conductivity Estimates in Natomas Basin

Estimated By	Location	Hydraulic Conductivity (ft/day)	Material Type	Source
Kleinfelder (2007)[1]	-	14	Sand with 3-7% silt	Kozeny-Carman equation
	-	28	Sand with 0-2% silt	Kozeny-Carman equation
URS (2007)[2]	STA 217+00	56	Sand to silty-sand	Kozeny-Carman equation
		283	Gravel	Kozeny-Carman equation
LSCE	Bianchi Wells 1 and 2	33-49	Sand to silty-sand	Estimated from specific capacity
	Lennar Westlake Well 1	488	Fine to coarse sand with gravel	2-hour pump test (11/21/00) in well perforated 112-132 ft.
	Lennar Paulson Well	36	Sand to silty-sand	36-hour pump test (7/3/07) in well perforated 185-397 ft.
DWR (1978)[3]	Node 37 (Sutter County)	51	Mixed	Sacramento Valley groundwater flow model
	Node 43 (Sacramento County)	139	Mixed	Sacramento Valley groundwater flow model
WRIME	Sutter County portion of Natomas Basin	86-118	Mixed	Layer 1 of North American River IGSM model
	Sacramento County portion of Natomas Basin	33-53	Mixed	Layer 1 of Sacramento County IGSM model
	Average	**116**		
	Median	**51**		

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2. URS Corporation, 2007. Preliminary Geotechnical Reevaluation Report, Sacramento River East Levee (Draft)
3. DWR. 1978. Evaluation of Groundwater Resources: Sacramento Valley

Table 3-1
Construction of Sacramento River East Levee Piezometers in Natomas Basin

Well ID	NLIP Station	River Mile (Approx)	Levee Mile (Approx)	Land Side Offset (Approx.) (ft)	Ground Surface Elevation (ft msl)[1]	Wellhead Elevation (ft msl)[1]	Screened Interval (ft)	Northing (ft)[2]	Easting (ft)[2]	Installed By	Date Drilled
2F-01-15N	98+30	76.8	1.9	0	25.10	26.90	80 - 90	2037443	6678210	USACE	2001
2F-01-26N	195+00	74.9	3.7	0	26.16	28.98	45 - 46	2028392	6675030	USACE	2001
2F-01-28N	196+35	74.9	3.7	250	27.51	28.75	38 - 48	2028227	6675252	USACE	2001
2F-01-51N	394+00	71.0	7.5	200	23.38	23.08	30 - 37	2011639	6667053	USACE	2001
2F-01-49N	402+13	70.9	7.6	0	25.39	25.01	40 - 60	2010756	6666969	USACE	2001
2F-01-56N	466+76	69.7	8.8	100	23.15	25.51	30 - 40	2005770	6670729	USACE	2001
2F-01-62N	541+43	68.2	10.3	50	24.88	27.06	33 - 43	2000269	6675756	USACE	2001
2F-01-68N	611+56	67.0	11.6	50	22.67	22.50	30 - 40	1997685	6680572	USACE	2001
2F-01-69N	611+59	67.0	11.6	200	21.71	21.51	26 - 36	1997813	6680474	USACE	2001
2F-01-05S	679+40	65.9	12.9	100	21.75	21.22	25 -35	1996993	6686228	USACE	2001
2F-01-15S	760+30	64.3	14.4	0	24.50	27.05	25 - 35	1988983	6687344	USACE	2001
2F-01-17S	787+77	63.7	14.9	100	19.53	19.28	30 - 40	1986284	6687689	USACE	2001
2F-01-19S	812+34	63.2	15.4	250	20.27	22.88	35 - 45	1984077	6688570	USACE	2001
LMW-1	867+30	62.2	16.5	Land Side	21.0	37.78	20 - 25	1980996	6692226	Kleinfelder	Oct. 1998
LMW-4	867+30	62.2	16.5	Water Side	20.0	38.08	20 - 25	1980918	6692285	Kleinfelder	Oct. 1998
LMW-2	867+30	62.2	16.5	Land Side	18.4	37.78	40 - 45	1980996	6692226	Kleinfelder	Oct. 1998
LMW-3	867+30	62.2	16.5	Water Side	19.6	38.08	40 - 45	1980918	6692285	Kleinfelder	Oct. 1998
PZ-7[3]	140+00	76.1	2.7	0	21.5	-	32 - 33	2033745	6676601	Kleinfelder	Oct. 2004
PZ-8	140+00	76.1	2.7	100	19.6	21.63	32 - 33	2033576	6676663	Kleinfelder	Oct. 2004
PZ-5S	310+00	72.7	5.9	0	34.0	35.43	11 - 12	2018478	6670369	Kleinfelder	Oct. 2004
PZ-5D	310+00	72.7	5.9	0	34.0	35.43	34 - 35	2018478	6670369	Kleinfelder	Oct. 2004
PZ-6S	310+00	72.7	5.9	100	30.2	31.5	12 - 13	2018489	6670533	Kleinfelder	Oct. 2004
PZ-6D	310+00	72.7	5.9	100	30.2	31.5	30.5 - 31.5	2018489	6670533	Kleinfelder	Oct. 2004
PZ-3	570+00	67.8	10.8	0	25.0	26.28	29.5 - 30.5	1998067	6676831	Kleinfelder	Oct. 2004
PZ-4[3]	570+00	67.8	10.8	100	23.4	-	32 - 33	1998216	6676951	Kleinfelder	Oct. 2004
PZ-1	850+00	62.5	16.1	0	21.0	23.53	32 - 33	1981001	6690265	Kleinfelder	Oct. 2004
PZ-2	850+00	62.5	16.1	100	19.2	21.83	31 - 32	1980925	6690401	Kleinfelder	Oct. 2004

1. Vertical datum = NGVD29.
2. Horizontal datum = NAD83, California State Plane Zone 2.
3. Destroyed.

Table 3-2
Hydraulic Gradients Along Sacramento River East Levee Based on Groundwater Elevations in Shallow Piezometers and Estimated Stage

Reach	NLIP Station	Monitoring Location		Distance[1] (ft)	Period of Record	Period for Annual Average	Head Difference (ft)[2]			Hydraulic Gradient (ft/ft)[2]		
		River Side	Land Side				Min	Max	Annual Average[3]	Min	Max	Annual Average[3]
2	98+30	River	2F-01-15N	370	01/07/02 - 10/28/03	11/01/02 - 10/31/03	-2.70	8.83	0.47	-0.0073	0.0239	0.0013
4a	140+00	PZ-7	PZ-8	100	10/13/04 - 07/05/06	08/01/05 - 07/31/06	-0.35	1.31	0.89	-0.0035	0.0131	0.0089
4b	195+00 196+35	2F-01-26N	2F-01-28N	220	01/07/02 - 10/28/03	11/01/02 - 10/31/03	-0.40	1.26	0.20	-	-	-
		River	2F-01-26N	260		11/01/02 - 10/31/03	-0.35	5.40	1.29	-0.0014	0.0208	0.0050
6b	310+00	PZ-5D	PZ-6D	100	10/14/04 - 07/12/06	08/01/05 - 07/31/06	-0.42	2.03	0.37	-0.0042	0.0203	0.0037
8	394+00	River	2F-01-51N	600	01/07/02 - 10/28/03	11/01/02 - 10/31/03	-1.83	9.92	1.82	-0.0030	0.0165	0.0030
9a	402+13	River	2F-01-49N	260	01/07/02 - 10/28/03	11/01/02 - 10/31/03	-1.47	6.28	0.99	-0.0057	0.0241	0.0038
9b	466+76	River	2F-01-56N	330	01/07/02 - 10/28/03	11/01/02 - 10/31/03	-1.34	4.98	0.77	-0.0041	0.0151	0.0023
11b	541+43	River	2F-01-62N	300	01/07/02 - 10/28/03	11/01/02 - 10/31/03	-2.95	3.45	0.33	-0.0098	0.0115	0.0011
	570+00	PZ-3	PZ-4	100	10/13/04 - 10/07/06	10/01/05 - 09/30/06	0.03	1.54	0.60	0.0003	0.0154	0.0060
	611+56 611+59	2F-01-68N	2F-01-69N	160	01/07/02 - 10/28/03	11/01/02 - 10/31/03	-0.53	2.94	0.44	-	-	-
		River	2F-01-68N	500		11/01/02 - 10/31/03	-1.95	7.13	0.54	-0.0039	0.0143	0.0011
13	679+40	River	2F-01-05S	520	03/05/02 - 09/30/03	10/01/02 - 09/30/03	-2.14	10.71	2.30	-0.0041	0.0206	0.0044
15	760+30	River	2F-01-15S	270	01/07/02 - 10/28/03	11/01/02 - 10/31/03	-0.97	1.92	-0.11	-	-	-
16	787+77	River	2F-01-17S	370	01/07/02 - 10/28/03	11/01/02 - 10/31/03	-0.76	2.90	0.29	-0.0020	0.0078	0.0008
	812+34	River	2F-01-19S	550	01/07/02 - 10/28/03	11/01/02 - 10/31/03	-0.97	2.96	0.32	-0.0018	0.0054	0.0006
18b	850+00	PZ-1	PZ-2	100	01/20/05 - 08/19/05	01/20/05 - 08/19/05	-1.21	1.06	-0.78	-	-	-
19a	867+30	LMW-4	LMW-1	100	02/03/99 - 04/24/06	11/01/05 - 10/31/06	-1.73	8.86	1.80	-	-	-
						Average	**-1.22**	**4.64**	**0.70**	**-0.0039**	**0.0161**	**0.0032**

1. Approximate distance between paired piezometers or between unpaired piezometers and Sacramento River.
2. Positive head differences and gradients indicate losing conditions (flow away from the River); negative values indicate gaining conditions.
3. The annual average was calculated from monthly averages to adjust for seasonal variations in the measurement frequency.

Table 4-1
Simulated Groundwater Budgets for Natomas Basin
(Not Including SAFCA Activities)

	Water Budget Component	2004 Simulation[1] (afy)	2030 Simulation[2] (afy)	Difference (afy)
Inflow	Deep Percolation (Including Canal Seepage)	31,429	27,187	4,242
	Recharge from Sacramento River	6,469	1,100	5,369
	Recharge from American River	1,086	-500	1,586
	Boundary Inflow from West	10,365	3,700	6,665
	Subsurface Inflow from North and South	2,955	3,700	-745
	Total Inflow	**52,304**	**35,187**	**17,117**
Outflow	Groundwater Pumping	35,537	31,615	3,922
	Subsurface Outflow to East	21,738	1,200	20,538
	Subsurface Outflow to South	0	800	-800
	Total Outflow	**57,275**	**33,615**	**23,660**
Inflow minus Outflow	**Change in Storage**	**-4,971**	**1,572**	**-6,543**

1. Based on final year of calibration simulation (LSCE, 2008b).
2. Based on 1982-2004 average for Sutter Pointe Project Scenario 2B (LSCE, 2008b).

Table 5-1
SAFCA Construction Assumptions for Water Budget Estimates

		Slurry Cutoff Walls		Canals					
	Total Length (ft)	Length (ft)	Average Depth (ft)	Length of Lined or Piped Segments (ft)	Average Width at Waterline (ft)	Total Area (ac)	Existing Agricultural Land Uses	Future Land Uses	Notes/Sources
Levees									
Sacramento River East Levee	96,000	42,490	78	-	-	486.5	20 ac rice, 175 ac field crops, 5 ac orchard	Levee	Kleinfelder (2007b); Land use based on EDAW Table 3
NCC South Levee	28,700	28,700	70	-	-	148.5	5 ac rice	Levee	Kleinfelder (2008), Land use based on EDAW Table 3
PGCC West Levee	17,400	5,000	60	-	-	89.5	50 ac rice	Levee	Wood Rodgers (2008), land use based on EDAW Table 3
NEMDC West Levee	70,000	16,000	69	-	-	-	South NEMDC - none; North NEMDC - unknown	Levee	Length & depth per John Lloyd, Kleinfelder, 4-11-08 memo:
American River North Levee	11,600	5,000	85	-	-	-	None	Levee	David Rader, EDAW (7-7-08)
Canals									
GGS/Drainage Canal	23,200	-	-	0	50	58.5	45 ac field crops	-	Width (M&H, 7-15-08); Land use based on EDAW Table 3
West Drainage Canal (Existing)	19,000	-	-	0	30	7	-	Managed grassland	4,700 LF section to be relocated
West Drainage Canal (Relocated)	20,600	-	-	0	72	8	1.5 ac field crops	-	Relocated section = 6,300 LF, rest widened to 72 ft.
Elkhorn Canal (Existing)	19,850	-	-	5,280	16	30	-	Levee	Length & width (M&H, 7-15-08)
Elkhorn Canal (Relocated)	22,300	-	-	9,050	32	34	15 ac field crops, 3 ac orchard, 11 ac other	-	Land use estimated by LSCE based on 2004 land use map from LSCE (2008b)
Riverside Canal (Existing)	19,600	-	-	0	7	50	-	Levee	
Riverside Canal (Relocated)	20,550	-	-	0	10	54	12 ac rice, 102 ac field crops, 17 ac orchard, 24 ac other	-	Land use estimated by LSCE based on 2004 land use map from LSCE (2008b)
Borrow Sites									
Airport North Bufferlands	-	-	-	-	-	737	Previously planted to rice but currently non-irrigated at request of FAA.	Managed grassland	Acreage (M&H, 7-15-08); current land uses per SAFCA
Brookfield Property	-	-	-	-	-	353	325 ac rice irrigated w/ 100% groundwater (1/2 & 1/2 reg. & wild rice)	286 ac rice irrigated w/ 20% groundwater, 80% surface water	Assumption of 286 ac in rice in future based on work on adjacent PGCC west levee (M&H, 2008)
Fisherman's Lake	-	-	-	-	-	400	49 ac rice, 266 ac field crops, 85 ac marsh	175 ac managed marsh, 225 ac grassland or woodland	Acreage, land use from Marieke Armstrong, M&H (7-18-08)

Table 5-2
Deep Percolation from Applied Water in the Natomas Basin

Crop	Applied Water[1] (af/ac/yr)	Deep Percolation from Applied Water[2] (af/ac/yr)	(%)
Rice or managed marsh	6.5	0.77	12%
Field and Row Crops	2.5	0.25	10%
Orchard	4.0	0.68	17%
Grains and Hay	2.5	0.41	16%
Pasture	4.8	0.61	13%

1. Source: LSCE (2008b).
2. Source: LSCE 2008b. Estimated as total deep percolation minus deep percolation from precipitation.

Table 5-3
Effects of Land Use Changes Due to Proposed SAFCA Construction on Deep Percolation

SAFCA Construction Activity	Existing Agricultural Land Uses (ac)				Future Agricultural Land Uses (ac)		Loss of Deep Percolation from Applied Water (afy)				Total Loss of Deep Percolation from Applied Water (afy)
	Rice[1]	Field Crops	Orchard	Grains, Hay, and Pasture	Rice or Managed Marsh	Other	Rice[2]	Field Crops[3]	Orchard[4]	Grains, Hay, and Pasture[5]	
Levee Improvements:											
Sacramento River East Levee	20	175	5	0	0	0	15	44	3	0	63
NCC South Levee	5	0	0	0	0	0	4	0	0	0	4
PGCC West Levee	50	0	0	0	0	0	39	0	0	0	39
NEMDC West Levee[6]	0	0	0	0	0	0	0	0	0	0	0
American River North Levee	0	0	0	0	0	0	0	0	0	0	0
Subtotal	**75**	**175**	**5**	**0**	**0**	**0**	**58**	**44**	**3**	**0**	**105**
Canals:											
GGS/Drainage Canal	0	45	0	0	0	0	0	11	0	0	11
West Drainage Canal	0	1.5	0	0	0	0	0	0.4	0	0	0.4
Elkhorn Canal	0	15	3	11	0	0	0	4	2	5	11
Riverside Canal	4	33	6	7	0	0	3	8	4	3	19
Subtotal	**4**	**95**	**9**	**18**	**0**	**0**	**3**	**24**	**6**	**8**	**41**
Borrow Sites:											
Airport North Bufferlands	0	0	0	0	0	0	0	0	0	0	0
Brookfield Property	325	0	0	0	286	0	30	0	0	0	30
Fisherman's Lake	134	266	0	0	173	0	-30	67	0	0	36
Subtotal	**459**	**266**	**0**	**0**	**459**	**0**	**0**	**67**	**0**	**0**	**67**
Total	**538**	**536**	**14**		**459**	**0**	**61**	**134**	**10**	**8**	**213**

1. Includes 85 ac of managed marsh at the Fisherman's Lake borrow site.
2. Deep percolation from applied water estimated to be 0.77 af/ac/yr for rice by LSCE (2008b).
3. Deep percolation from applied water estimated to be 0.25 af/ac/yr for field crops by LSCE (2008b).
4. Deep percolation from applied water estimated to be 0.68 af/ac/yr for orchards by LSCE (2008b).
5. Deep percolation from applied water estimated to be 0.41 af/ac/yr for grains/hay and 0.61 af/ac/yr for pasture by LSCE (2008b). A weighted average of 0.47 af/ac was used above.
6. Design of NEMDC levee improvements is in the early stages, and there is no current estimate of land use changes due to levee constructiion. An estimate of 50 ac of rice based on the PGCC was also used for the NEMDC because land uses west of the northern portion of the NEMDC is similar to the PGCC. Land uses west of the southern portion of the NEMDC are urbanized or vacant.

Table 5-4
Effects of SAFCA's Proposed Canal Construction on Canal Seepage

Canal Name		Total Length (ft)	Length of Lined or Piped Segments (ft)	Length of Unlined Portion (ft)	Width at Waterline (ft)	Area at Waterline[1] (ft^2)	Seepage Rate per Sq. Foot[2] ($af/ft^2/yr$)	Total Seepage Rate (afy)	Seepage Increase (afy)
GGS/Drainage Canal	New	23,200	0	23,200	50	1,160,000	1.4E-04	162	162
West Drainage Canal	Existing	19,000	0	19,000	30	570,000	1.4E-04	80	
	Relocated	20,600	0	20,600	72	1,483,200	1.4E-04	208	128
Elkhorn Canal	Existing	19,850	5,280	14,570	16	233,120	1.4E-04	33	
	Relocated	22,300	9,050	13,250	32	424,000	1.4E-04	59	27
Riverside Canal	Existing	19,600	0	19,600	7	137,200	1.4E-04	19	
	Relocated	20,550	0	20,550	10	205,500	1.4E-04	29	10
Total	**Existing**	**58,450**	**5,280**	**53,170**		**940,320**		**132**	
	New or Relocated	**86,650**	**9,050**	**77,600**		**3,272,700**		**458**	**327**

1. Area of unlined portion only.
2. Based on results of Kleinfelder (2007b) seepage model for portion of GGS/Drainage Canal.

Table 6-1
Proposed Mitigation for Seepage Beneath Sacramento River East Levee[1]

Reach	Stations	Proposed Mitigation	Length of Reach (ft)	Length of Cutoff Wall (ft)	Top of Levee Elevation (ft msl)	Cutoff Wall Bottom Elevation (ft msl)	Sand Layer Bottom Elevation (ft msl)	Depth of Cutoff Wall (ft)
1	00+00 to 48+00	None	4,800					
2	48+00 to 100+00	Cutoff Wall	5,200	5,200	43	-25	-85	68
3	100+00 to 110+00	Cutoff Wall	1,000	1,000	43	-25	-80	68
4a	110+00 to 190+00	100-ft Berm	8,000					
4b	190+00 to 228+00	300-ft Berm	3,800					
5a	228+00 to 263+00	100-ft Berm	3,500					
5b	263+00 to 280+00	None	1,700					
6	280+00 to 330+00	Cutoff Wall	5,000	5,000	41	-70	-65	111
7	330+00 to 362+00	Cutoff Wall	3,200	3,200	40	-60	-50	100
8	362+00 to 402+00	Cutoff Wall	4,000	4,000	39	-60	-50	99
9a	402+00 to 430+10	None	2,810					
9b	430+10 to 468+10	Cutoff Wall	3,800	3,800	39	-70	-50	109
10	468+10 to 495+00	Cutoff Wall	2,690	2,690	39	-25	-60	64
11	495+00 to 635+00	100-ft Berm	14,000					
12	635+00 to 667+00	None	3,200					
13	667+00 to 700+00	Cutoff Wall	3,300	3,300	39	-20	-100	59
14	700+00 to 732+00	None	3,200					
15	732+00 to 780+00	Cutoff Wall	4,800	4,800	39	-10	-80	49
16	780+00 to 832+00	None	5,200					
17	832+00 to 842+00	Cutoff Wall	1,000	1,000	39	-25	-80	64
18	842+00 to 857+00	Cutoff Wall	1,500	1,500	39	-25	-80	64
19a	857+00 to 875+00	Cutoff Wall	1,800	1,800	39	-25	-80	64
19b	875+00 to 925+00	Cutoff Wall	5,000	5,000	38	-25	-40	63
20a	925+00 to 927+00	Cutoff Wall[2]	200	200	38	-12	-40	50
20b	927+00 to 960+00	None	3300					
		Total Length	96,000	42,490				

1. Partially based on Table 3 in Kleinfelder (2007b).
2. Cutoff wall 200 to 500 feet long proposed at pump station in Reaches 20a and 20b.

Table 6-2
Kleinfelder Model Results: Estimated Groundwater Flow Beneath Sacramento River East Levee in Natomas Basin With and Without Slurry Cutoff Walls[1]

Reach	Stations Start	Stations End	Seepage Based on Simulated Station	Length of Reach (ft)	Seepage Without Cutoff Walls (afy)	Seepage With Cutoff Walls (afy)	Impact of Cutoff Walls (afy)	Impact of Cutoff Walls (%)
1	00+00	48+00	27+00	4,800	19	19	0	0
2	48+00	100+00	70+00	5,200	14	2	12	85
3	100+00	110+00	70+00	1,000	3	0.4	2.6	85
4a	110+00	120+00	70+00	1,000	3	3	0	0
4a	120+00	190+00	353+00	7,000	95	95	0	0
4b	190+00	228+00	217+00	3,800	490	490	0	0
5a	228+00	263+00	70+00	3,500	10	10	0	0
5b	263+00	280+00	27+00	1,700	6	6	0	0
6	280+00	330+00	217+00	5,000	650	100	550	85
7a	330+00	345+00	353+00	1,500	20	3	17	85
7b	345+00	362+00	353+00	1,700	23	3	20	85
8	362+00	402+00	353+00	4,000	55	8	47	85
9	402+00	430+00	353+00	2,800	38	38	0	0
9	430+00	468+10	353+00	3,800	50	8	42	85
10	468+10	495+00	217+00	2,690	350	210	140	40
11	495+00	635+00	217+00	14,000	1810	1810	0	0
12	635+00	640+00	217+00	500	65	65	0	0
12	640+00	667+00	70+00	2,700	7	7	0	0
13	667+00	700+00	353+00	3,300	45	30	15	40
14	700+00	732+00	70+00	3,200	8	8	0	0
15	732+00	780+00	217+00	4,800	620	375	245	40
16	780+00	832+00	217+00	5,200	675	675	0	0
17	832+00	842+00	217+00	1,000	130	80	50	40
18	842+00	857+00	217+00	1,500	195	120	75	40
19a	857+00	875+00	217+00	1,800	235	140	95	40
19b	875+00	925+00	70+00	5,000	15	8	7	40
20a	925+00	925+50	27+00	50	0.2	0.2	0	0
20b	925+50	960+00	27+00	3,550	13	13	0	0
Total				**96,090**	**5,650**	**4,330**	**1,320**	**23**

1. Based on Table 5 in Kleinfelder (2007b). Shading indicates reaches with proposed cutoff walls.

Table 6-3
Darcy's Law Estimate of Groundwater Recharge from Sacramento River to Natomas Basin With and Without Slurry Cutoff Walls Based on Existing Conditions

					Saturated Fine/Medium Sand Thickness		Saturated Coarse Sand & Gravel Thickness		Permeable Area (length x thickness) Fine/Medium Sand Area		Coarse Sand & Gravel Area		Hydraulic Conductivity[2]			Estimated Flow Without Cutoff Walls				Estimated Flow With Cutoff Walls			Impact of Cutoff Walls	
Reach	Length (ft)	Current Proposed Mitigation[1]	Cutoff Wall Depth (ft)	Average Depth to Water (ft)	Total (ft)	To Base of Wall (ft)	Total (ft)	To Base of Wall (ft)	Total (sq. ft)	To Base of Wall (sq. ft)	Total (sq. ft)	To Base of Wall (sq. ft)	Fine/ Medium Sand (ft/day)	Coarse Sand & Gravel (ft/day)	Hydraulic Gradient[3] (ft/ft)	Fine/ Medium Sand (afy)	Coarse Sand & Gravel (afy)	Total Flow (afy)	Flow Through Cross-Sectional Area of Cutoff Walls (afy)	Flow Through Cutoff Walls[4] (afy)	Flow Beneath/ Around Cutoff Walls (afy)	Total Flow (afy)	(afy)	(%)
1	4,800	None	-		35	-	0	-	168,000	N/A	0	N/A	28	140	0.0032	126	0	126	0	0	126	126	0	0
2	5,200	Cutoff Wall	68	12	67	22	0	0	348,400	114,400	0	0	28	140	0.0032	262	0	262	86	17	176	193	69	26
3	1,000	Cutoff Wall	68		23	19	0	0	23,000	19,000	0	0	28	140	0.0032	17	0	17	14	3	3	6	11	66
4a	8,000	100-ft Berm	-		33	-	27	-	264,000	N/A	216,000	N/A	28	140	0.0032	198	811	1,009	0	0	1,009	1,009	0	0
4b	3,800	300-ft Berm	-	16	40	-	15	-	152,000	N/A	57,000	N/A	28	140	0.0032	114	214	328	0	0	328	328	0	0
5a	3,500	100-ft Berm	-		27	-	10	-	94,500	N/A	35,000	N/A	28	140	0.0032	71	131	202	0	0	202	202	0	0
5b	1,700	None	-		22	-	0	-	37,400	N/A	0	N/A	28	140	0.0032	28	0	28	0	0	28	28	0	0
6	5,000	Cutoff Wall	111		47	47	20	20	235,000	235,000	100,000	100,000	28	140	0.0032	176	375	552	552	110	0	110	441	80
7	3,200	Cutoff Wall	100		45	38	0	0	144,000	121,600	0	0	28	140	0.0032	108	0	108	91	18	17	35	73	68
8	4,000	Cutoff Wall	99	12	35	35	0	0	140,000	140,000	0	0	28	140	0.0032	105	0	105	105	21	0	21	84	80
9a	2,800	None	-	13	42	-	0	-	117,600	N/A	0	N/A	28	140	0.0032	88	0	88	0	0	88	88	0	0
9b	3,800	Cutoff Wall	109	14	32	32	0	0	121,600	121,600	0	0	28	140	0.0032	91	0	91	91	18	0	18	73	80
10	2,690	Cutoff Wall	64		28	10	22	22	75,320	26,900	59,180	59,180	28	140	0.0032	57	222	279	242	48	36	85	194	70
11	14,000	100-ft Berm	-	13	32	-	53	-	448,000	N/A	742,000	N/A	28	140	0.0032	336	2,785	3,122	0	0	3,122	3,122	0	0
12	3,200	None	-		65	-	0	-	208,000	N/A	0	N/A	28	140	0.0032	156	0	156	0	0	156	156	0	0
13	3,300	Cutoff Wall	59	13	40	5	20	15	132,000	16,500	66,000	49,500	28	140	0.0032	99	248	347	198	40	149	188	159	46
14	3,200	None	-		53	-	0	-	169,600	N/A	0	N/A	28	140	0.0032	127	0	127	0	0	127	127	0	0
15	4,800	Cutoff Wall	49	17	60	10	15	0	288,000	48,000	72,000	0	28	140	0.0032	216	270	487	36	7	450	458	29	6
16	5,200	None	-	12	58	-	12	-	301,600	N/A	62,400	N/A	28	140	0.0032	226	234	461	0	0	461	461	0	0
17	1,000	Cutoff Wall	64		73	16	2	0	73,000	16,000	2,000	0	28	140	0.0032	55	8	62	12	2	50	53	10	15
18	1,500	Cutoff Wall	64		75	16	0	0	112,500	24,000	0	0	28	140	0.0032	84	0	84	18	4	66	70	14	17
19a	1,800	Cutoff Wall	64		80	26	0	0	144,000	46,800	0	0	28	140	0.0032	108	0	108	35	7	73	80	28	26
19b	5,000	Cutoff Wall	63		60	20	0	0	300,000	100,000	0	0	28	140	0.0032	225	0	225	75	15	150	165	60	27
20a	200	Cutoff Wall	50		20	0	2	0	4,000	0	400	0	28	140	0.0032	3	2	5	0	0	5	5	0	0
20b	3,400	None	-		24	-	2	-	81,600	N/A	6,800	N/A	28	140	0.0032	61	26	87	0	0	87	87	0	0
Average				**14**	**45**	**21**	**8**	**4**																
Total	**96,090 ft total (42,490 ft of cutoff walls)**								**4,183,120**	**1,029,800**	**1,418,780**	**208,680**				**3,140**	**5,330**	**8,470**	**1,560**	**310**	**6,910**	**7,220**	**1,245**	**15**

1. Shading indicates reaches where cutoff walls are proposed.
2. Hydraulic conductivity based on estimates in Table 2-1.
3. Hydraulic gradient based on annual average value in Table 3-2.
4. Assumes an 80% reduction in flow through the cutoff wall based on the Kleinfelder transient model results (Kleinfelder, 2007).

Table 6-4

Darcy's Law Estimate of Groundwater Recharge from Sacramento River to Natomas Basin With and Without Slurry Cutoff Walls Including Increase in Hydraulic Gradient Due to Additional Pumping in 2030

Reach	Length (ft)	Current Proposed Mitigation[1]	Cutoff Wall Depth (ft)	Average Depth to Water (ft)	Saturated Fine/Medium Sand Thickness		Saturated Coarse Sand & Gravel Thickness		Permeable Area (length x thickness): Fine/Medium Sand Area		Permeable Area (length x thickness): Coarse Sand & Gravel Area		Hydraulic Conductivity[2]		Increase in Hydraulic Gradient[3] (ft/ft)	Hydraulic Gradient Including Sutter Pointe Pumping (ft/ft)	Estimated Flow Without Cutoff Walls			Flow Through Cross-Sectional Area of Cutoff Walls (afy)	Estimated Flow With Cutoff Walls			Impact of Cutoff Walls	
					Total (ft)	To Base of Wall (ft)	Total (ft)	To Base of Wall (ft)	Total (sq. ft)	To Base of Wall (sq. ft)	Total (sq. ft)	To Base of Wall (sq. ft)	Fine/ Medium Sand (ft/day)	Coarse Sand & Gravel (ft/day)			Fine/ Medium Sand (afy)	Coarse Sand & Gravel (afy)	Total Flow (afy)		Flow Through Cutoff Walls[4] (afy)	Flow Beneath/ Around Cutoff Walls (afy)	Total Flow (afy)	(afy)	(%)
1	4,800	None	-		35	-	0	-	168,000	N/A	0	N/A	28	140	0.0010	0.0042	164	0	164	0	0	164	164	0	0
2	5,200	Cutoff Wall	68	12	67	22	0	0	348,400	114,400	0	0	28	140	0.0018	0.0050	407	0	407	134	27	273	300	107	26
3	1,000	Cutoff Wall	68		23	19	0	0	23,000	19,000	0	0	28	140	0.0018	0.0050	27	0	27	22	4	5	9	18	66
4a	8,000	100-ft Berm	-		33	-	27	-	264,000	N/A	216,000	N/A	28	140	0.0011	0.0043	268	1,097	1,365	0	0	1,365	1,365	0	0
4b	3,800	300-ft Berm	-	16	40	-	15	-	152,000	N/A	57,000	N/A	28	140	0.0011	0.0043	154	289	444	0	0	444	444	0	0
5a	3,500	100-ft Berm	-		27	-	10	-	94,500	N/A	35,000	N/A	28	140	0.0005	0.0037	82	151	233	0	0	233	233	0	0
5b	1,700	None	-		22	-	0	-	37,400	N/A	0	N/A	28	140	0.0005	0.0037	32	0	32	0	0	32	32	0	0
6	5,000	Cutoff Wall	111		47	47	20	20	235,000	235,000	100,000	100,000	28	140	0.0003	0.0035	191	406	596	596	119	0	119	477	80
7	3,200	Cutoff Wall	100		45	38	0	0	144,000	121,600	0	0	28	140	0.0002	0.0034	116	0	116	98	20	18	38	78	68
8	4,000	Cutoff Wall	99	12	35	35	0	0	140,000	140,000	0	0	28	140	0.0002	0.0034	110	0	110	110	22	0	22	88	80
9a	2,800	None	-	13	42	-	0	-	117,600	N/A	0	N/A	28	140	0.0001	0.0033	92	0	92	0	0	92	92	0	0
9b	3,800	Cutoff Wall	109	14	32	32	0	0	121,600	121,600	0	0	28	140	0.0001	0.0033	95	0	95	95	19	0	19	76	80
10	2,690	Cutoff Wall	64		28	10	22	22	75,320	26,900	59,180	59,180	28	140	0.0001	0.0033	59	231	290	252	50	38	88	202	70
11	14,000	100-ft Berm	-	13	32	-	53	-	448,000	N/A	742,000	N/A	28	140	0.0001	0.0033	348	2,884	3,232	0	0	3,232	3,232	0	0
12	3,200	None	-		65	-	0	-	208,000	N/A	0	N/A	28	140	0.0001	0.0033	162	0	162	0	0	162	162	0	0
13	3,300	Cutoff Wall	59	13	40	5	20	15	132,000	16,500	66,000	49,500	28	140	0.0001	0.0033	102	255	357	204	41	153	194	163	46
14	3,200	None	-		53	-	0	-	169,600	N/A	0	N/A	28	140	0.0000	0.0032	127	0	127	0	0	127	127	0	0
15	4,800	Cutoff Wall	49	17	60	10	15	0	288,000	48,000	72,000	0	28	140	0.0000	0.0032	216	270	487	36	7	450	458	29	6
16	5,200	None	-	12	58	-	12	-	301,600	N/A	62,400	N/A	28	140	0.0000	0.0032	226	234	461	0	0	461	461	0	0
17	1,000	Cutoff Wall	64		73	16	2	0	73,000	16,000	2,000	0	28	140	0.0000	0.0032	55	8	62	12	2	50	53	10	15
18	1,500	Cutoff Wall	64		75	16	0	0	112,500	24,000	0	0	28	140	0.0000	0.0032	84	0	84	18	4	66	70	14	17
19a	1,800	Cutoff Wall	64		80	26	0	0	144,000	46,800	0	0	28	140	0.0000	0.0032	108	0	108	35	7	73	80	28	26
19b	5,000	Cutoff Wall	63		60	20	0	0	300,000	100,000	0	0	28	140	0.0000	0.0032	225	0	225	75	15	150	165	60	27
20a	200	Cutoff Wall	50		20	0	2	0	4,000	0	400	0	28	140	0.0000	0.0032	3	2	5	0	0	5	5	0	0
20b	3,400	None	-		24	-	2	-	81,600	N/A	6,800	N/A	28	140	0.0000	0.0032	61	26	87	0	0	87	87	0	0
Average				**14**	**45**	**21**	**8**	**4**																	
Total	**96,090 ft total (42,490 ft of cutoff walls)**								**4,183,120**	**1,029,800**	**1,418,780**	**208,680**					**3,520**	**5,850**	**9,370**	**1,690**	**340**	**7,680**	**8,020**	**1,350**	**14**

1. Shading indicates reaches where cutoff walls are proposed.
2. Hydraulic conductivity based on estimates in Table 2-1.
3. Increase from hydraulic gradient of 0.0032 shown in Tables 3-2 and 6-3. Increase simulated by IGSM models for Sutter Pointe Scenario 2B.
4. Assumes an 80% reduction in flow through the cutoff wall based on the Kleinfelder transient model results (Kleinfelder, 2007).

Table 6-5
Kleinfelder Model Results: Estimated Groundwater Flow Beneath Natomas Cross Canal South Levee With and Without Slurry Cutoff Walls[1]

Reach	Stations		Seepage Based on Simulated Station	Length of Reach (ft)	Seepage Without Cutoff Walls (afy)	Seepage With Cutoff Walls (afy)	Impact of Cutoff Walls	
	Start	End					(afy)	(%)
1	00+00	5+70	135+00	570	2	0.2	1.8	90
2	5+70	20+00	135+00	1,430	5	0.5	4.5	90
2	20+00	70+00	183+00	5,000	50	35	15	30
2	70+00	105+00	135+00	3,500	10	1	9	90
3	105+00	123+00	135+00	1,800	6	0.6	5.4	90
4	123+00	150+00	135+00	2,700	8	0.8	7.2	90
4	150+00	170+00	213+00	2,000	20	2	18	90
4	170+00	173+00	183+00	300	3	2.1	0.9	30
5	173+00	195+00	183+00	2,200	22	15.4	6.6	30
6	195+00	207+00	183+00	1,250	15	10.5	4.5	30
6	207+00	260+00	213+00	5,250	50	5	45	90
6	260+00	280+00	183+00	2,000	20	14	6	30
7	280+00	287+00	183+00	700	7	4.9	2.1	30
Total				**28,700**	**218**	**92**	**126**	**58**

1. Based on Table 5 in Kleinfelder (2008).

Table 6-6
Effects of Proposed Slurry Cutoff Walls on Groundwater Flow

Levee	Time Period	Total Length of Levee (ft)	Saturated Thickness for Ground-Water Flow (ft)	Cross-Sectional Area for Flow (ft^2)	Total Flow Without Cutoff Walls[1] (afy)	Flow per Cross-Sectional Area (afy/ft^2)	Length of Proposed Cutoff Walls (ft)	Avg. Depth of Cutoff Walls (ft)	Cross-Sectional Area of Cutoff Walls (ft^2)	Flow Through Cross-Sectional Area of Cutoff Walls (afy)	Flow Through, Beneath, or Around Cutoff Walls (afy)	Flow Reduction Due to Cutoff Walls[7] (afy)	Flow Reduction Due to Cutoff Walls[7] (%)
Sacramento River East Levee	Existing	96,000	120	11,520,000	8,470 [2]	7.35E-04	42,490	78	3,314,220	1,557	7,225	1,245	15
	2030				9,379 [3]	8.14E-04				1,688	8,029	1,350	14
NCC South Levee	Existing	28,700	110	3,157,000	218 [4]	6.91E-05	28,700	70	2,009,000	102	92	126	58
	2030		400	11,480,000	3,700 [5]	3.22E-04				648	3,182	518	14
PGCC West Levee	2004	17,400	400	6,960,000	-4,328 [6]	-6.22E-04	5,000	60	300,000	-187	-4,178	-149	3
	2030				-239 [4]	-3.43E-05				-10	-231	-8	
NEMDC West Levee	2004	70,000	400	28,000,000	-17,410 [6]	-6.22E-04	16,000	69	1,100,000	-684	-16,863	-547	3
	2030				-961 [5]	-3.43E-05				-38	-931	-30	
American River North Levee	2004	11,600	120	1,392,000	1,086 [6]	7.80E-04	5,000	85	425,000	332	821	265	24
	2030				-500 [5]	-3.59E-04				-153	-378	-122	
Total (Existing or 2004)					**-11,964**					**1,120**	**-12,904**	**940**	
Total (2030)					**11,379**					**2,135**	**9,672**	**1,707**	
Total (All)		**223,700**					**97,190**		**7,148,220**				

1. Positive values indicate groundwater inflow; negative values indicate goundwater outflow.
2. Source of total flow estimate = Kleinfelder (2007b) and LSCE (2008a).
3. Source of total flow estimate = Table 6-4 with increased gradient due to Sutter Pointe pumping (LSCE, 2008b).
4. Source of total flow estimate = Kleinfelder (2008).
5. Source of total flow estimate = IGSM 2030 Simulation.
6. Source of total flow estimate = IGSM 2004 Simulation.
7. Increased groundwater inflow (or decreased outflow) shown as positive value; increased outflow (or decreased inflow) is shown as negative. 80% flow reduction assumed for slurry cutoff walls except for NCC South Levee based on Kleinfelder (2007b). 90% flow reduction assumed for NCC South Levee cutoff walls based on Kleinfelder (2008).

Table 7-1
Groundwater Budget for Proposed SAFCA Construction Activities Based on Existing Conditions

SAFCA Construction Activity	Inflow (afy)[1]					Outflow (afy)[1]			Change in Storage (afy)
	Deep Percolation	Net Recharge from Streams	Seepage from Canals	Subsurface Inflow	Total Inflow	Subsurface Outflow	Groundwater Pumping	Total Outflow	
Levee Improvements[2]									
Sacramento River East Levee	-63	-1,245	0	0	**-1,308**	0	0	**0**	-
NCC South Levee	-4	0	0	-126	**-130**	0	0	**0**	-
PGCC West Levee	-39	0	0	0	**-39**	-149	0	**-149**	-
NEMDC West Levee	0	0	0	0	**0**	-547	0	**-547**	-
American River North Levee	0	-265	0	0	**-265**	0	0	**0**	-
Subtotal	**-105**	**-1,510**	**0**	**-126**	**-1,741**	**-696**	**0**	**-696**	**-1,045**
Canal Improvements									
New GGS/Drainage Canal	-11	0	162	0	**151**	0	0	**0**	-
West Drainage Canal	0	0	128	0	**127**	0	0	**0**	-
Elkhorn Canal relocation	-11	0	27	0	**16**	0	0	**0**	-
Riverside Canal relocation	-19	0	10	0	**-9**	0	0	**0**	-
Subtotal	**-41**	**0**	**327**	**0**	**285**	**0**	**0**	**0**	**285**
Borrow Sites									
Airport North	0	0	0	0	**0**	0	0	**0**	-
Brookfield	-30	0	0	0	**-30**	76	-1,625	**-1,549**	-
Fisherman's Lake	-36	0	0	0	**-36**	0	0	**0**	-
Subtotal	**-67**	**0**	**0**	**0**	**-67**	**76**	**-1,625**	**-1,549**	**1,483**
Total	**-213**	**-1,510**	**327**	**-126**	**-1,522**	**-620**	**-1,625**	**-2,245**	**723**

1. Increased groundwater inflow (or decreased outflow) shown as a positive value; increased outflow (or decreased inflow) is shown as negative.
2. Effect of slurry cutoff walls represent existing/2004 results from Table 6-6.

Table 7-2
Groundwater Budget for Proposed SAFCA Construction Activities Based on Future (2030) Conditions

SAFCA Construction Activity	Inflow (afy)[1]					Outflow (afy)[1]			Change in Storage (afy)
	Deep Percolation	Net Recharge from Streams	Seepage from Canals	Subsurface Inflow	Total Inflow	Subsurface Outflow	Groundwater Pumping	Total Outflow	
Levee Improvements[2]									
Sacramento River East Levee	-63	-1,350	0	0	**-1,413**	0	0	**0**	-
NCC South Levee	-4	0	0	-518	**-522**	0	0	**0**	-
PGCC West Levee	-39	0	0	0	**-39**	-8	0	**-8**	-
NEMDC West Levee	0	0	0	0	**0**	-30	0	**-30**	-
American River North Levee	0	122	0	0	**122**	0	0	**0**	-
Subtotal	**-105**	**-1,228**	**0**	**-518**	**-1,851**	**-38**	**0**	**-38**	**-1,812**
Canal Improvements									
New GGS/Drainage Canal	-11	0	162	0	**151**	0	0	**0**	-
West Drainage Canal	0	0	128	0	**127**	0	0	**0**	-
Elkhorn Canal relocation	-11	0	27	0	**16**	0	0	**0**	-
Riverside Canal relocation	-19	0	10	0	**-9**	0	0	**0**	-
Subtotal	**-41**	**0**	**327**	**0**	**285**	**0**	**0**	**0**	**285**
Borrow Sites									
Airport North	0	0	0	0	**0**	0	0	**0**	-
Brookfield	-30	0	0	0	**-30**	76	-1,625	**-1,549**	-
Fisherman's Lake	-36	0	0	0	**-36**	0	0	**0**	-
Subtotal	**-67**	**0**	**0**	**0**	**-67**	**76**	**-1,625**	**-1,549**	**1,483**
Total	**-213**	**-1,228**	**327**	**-518**	**-1,632**	**38**	**-1,625**	**-1,587**	**-45**

1. Increased groundwater inflow (or decreased outflow) shown as a positive value; increased outflow (or decreased inflow) is shown as negative.
2. Effect of slurry cutoff walls represent 2030 results from Table 6-6.

Table 7-3
Groundwater Budget for Natomas Basin Showing Effect of SAFCA Activities on Existing Groundwater Conditions (Based on 2004 Simulation)

	Water Budget Component	2004 Simulation[1] (afy)	Impact of SAFCA Activities (afy)	2004 Simulation Plus SAFCA Activities (afy)
Inflow	Deep Percolation (Including Canal Seepage)	31,429	114	31,543
	Recharge from Sacramento River	6,469	-1,245	5,224
	Recharge from American River	1,086	-265	821
	Boundary Inflow from West	10,365	0	10,365
	Subsurface Inflow from North and South	2,955	-126	2,829
	Total Inflow	**52,304**	**-1,522**	**50,782**
Outflow	Groundwater Pumping	35,537	-1,625	33,912
	Subsurface Outflow to East	21,738	-620	21,118
	Total Outflow	**57,275**	**-2,245**	**55,030**
Inflow minus Outflow	**Change in Storage**	**-4,971**	**723**	**-4,248**

1. Based on final year (2004) of calibration simulation (LSCE, 2008b).

Table 7-4
Groundwater Budget for Natomas Basin Showing Effect of SAFCA Activities on Future Groundwater Conditions (Based on 2030 Simulation)

	Water Budget Component	2030 Simulation[1] (afy)	Impact of SAFCA Activities (afy)	2030 Simulation Plus SAFCA Activities (afy)
Inflow	Deep Percolation (Including Canal Seepage)	27,187	114	27,301
	Recharge from Sacramento River[2]	1,100	-1,350	-250
	Recharge from American River	-500	122	-378
	Boundary Inflow from West	3,700	0	3,700
	Subsurface Inflow from North	3,700	-518	3,182
	Total Inflow	**35,187**	**-1,632**	**33,555**
Outflow	Groundwater Pumping	31,615	-1,625	29,990
	Subsurface Outflow to East	1,200	38	1,238
	Subsurface Outflow to South	800	0	800
	Total Outflow	**33,615**	**-1,587**	**32,028**
Inflow minus Outflow	**Change in Storage**	**1,572**	**-45**	**1,527**

1. Based on 1982-2004 average for Sutter Pointe Project Scenario 2B (LSCE, 2008b).

Table 8-1

Depths of Private Wells Along Sacramento River East Levee and Natomas Cross Canal South Levee

Levee	Well Type	Well Depth						Total
		0-100 ft	100-200 ft	200-300 ft	300-400 ft	> 400 ft	Unknown	
Sacramento River East Levee	Domestic	10	87	6	0	0	0	103
	Irrigation	0	6	8	0	1	0	15
	Other/Unknown	6	6	6	0	0	2	20
	Subtotal	**16**	**99**	**20**	**0**	**1**	**2**	**138**
Natomas Cross Canal South Levee	Domestic	0	1	0	0	0	0	1
	Irrigation	0	1	3	2	0	2	8
	Subtotal	**0**	**2**	**3**	**2**	**0**	**2**	**9**
Total		**16**	**101**	**23**	**2**	**1**	**4**	**147**

Figures

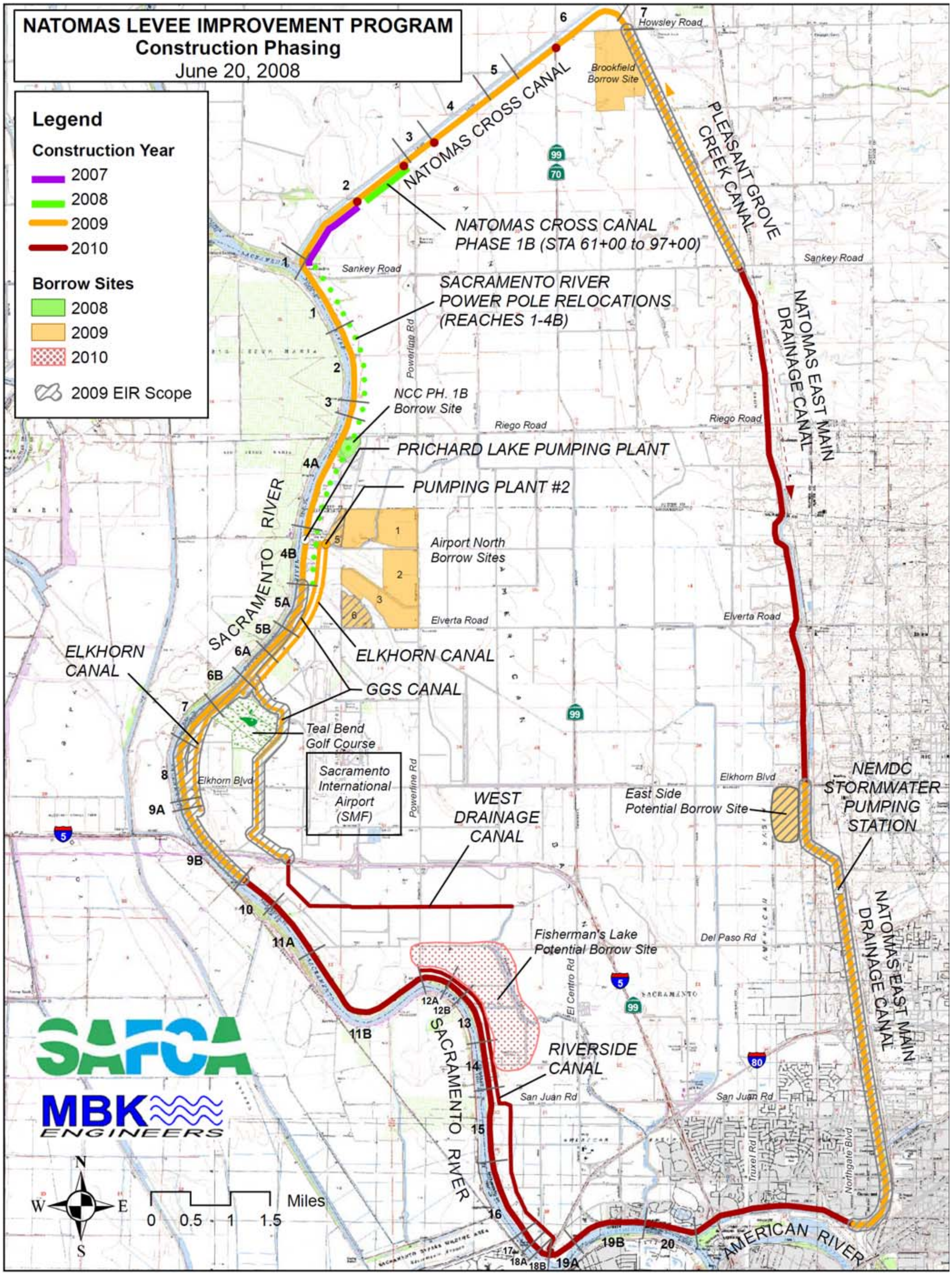

Figure 1-1
Proposed SAFCA Construction Locations for Natomas Levee Improvement Program

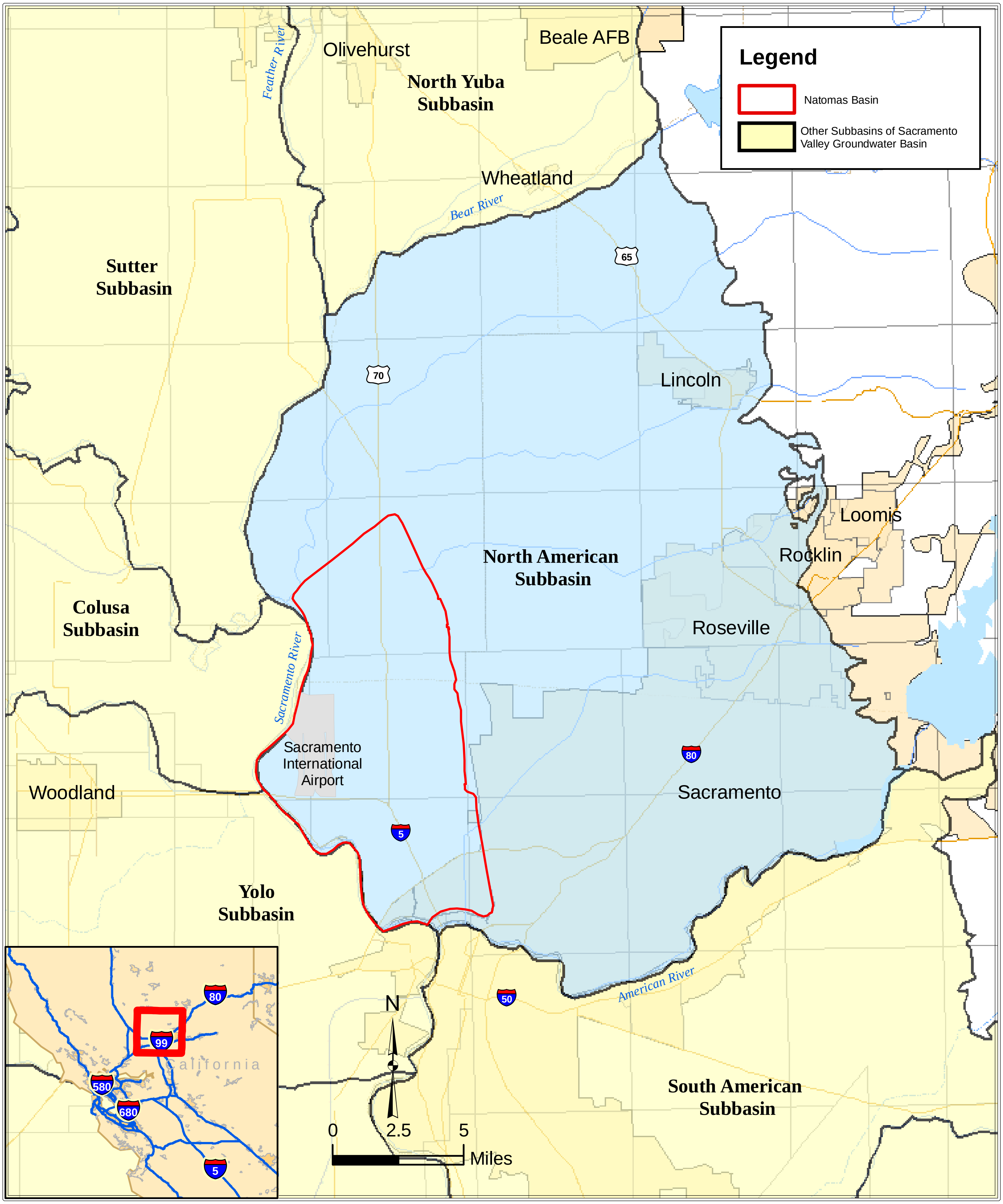

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Figure 2-1
Location of North American Subbasin and Adjoining Subbasins of the Sacramento Valley Groundwater Basin

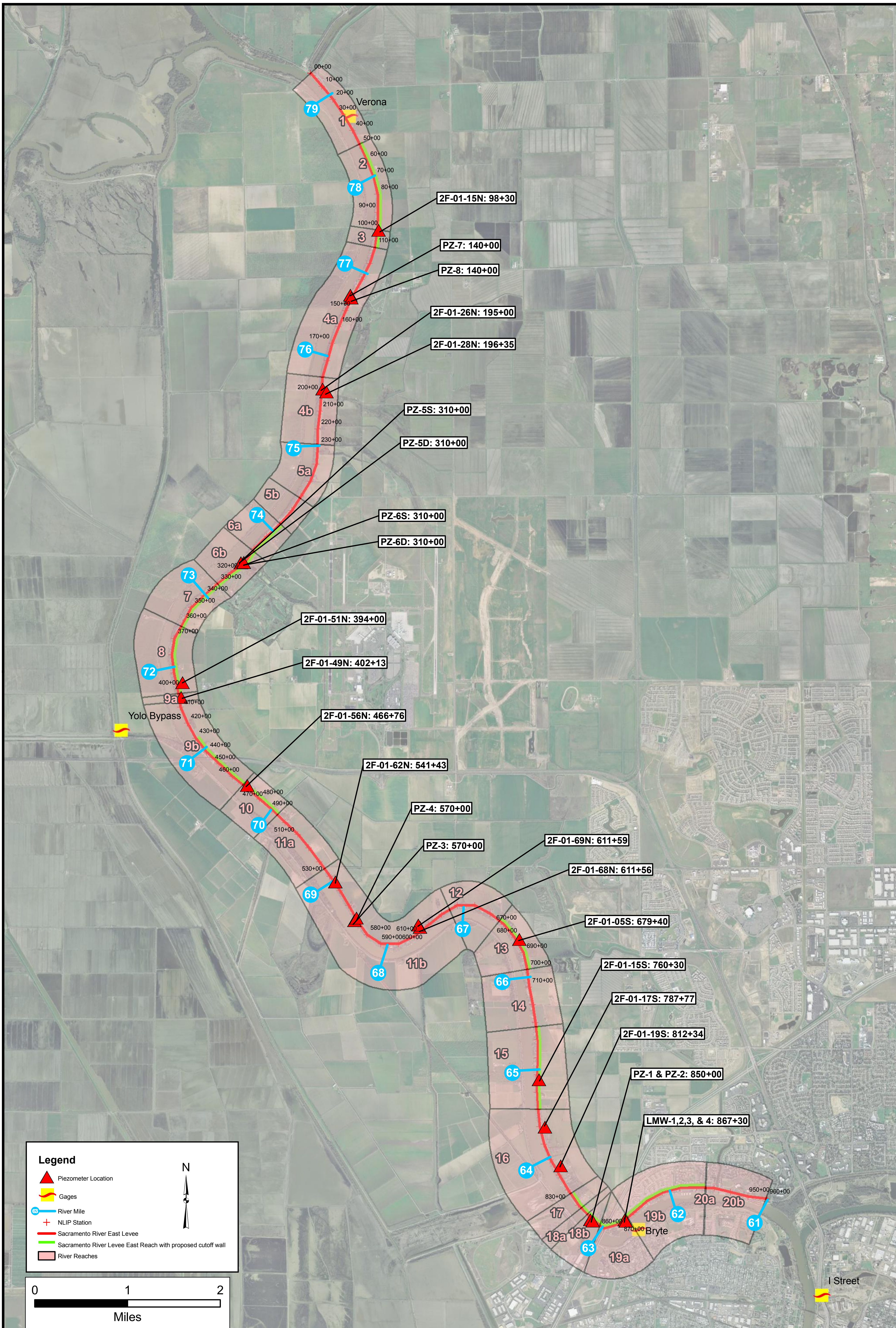

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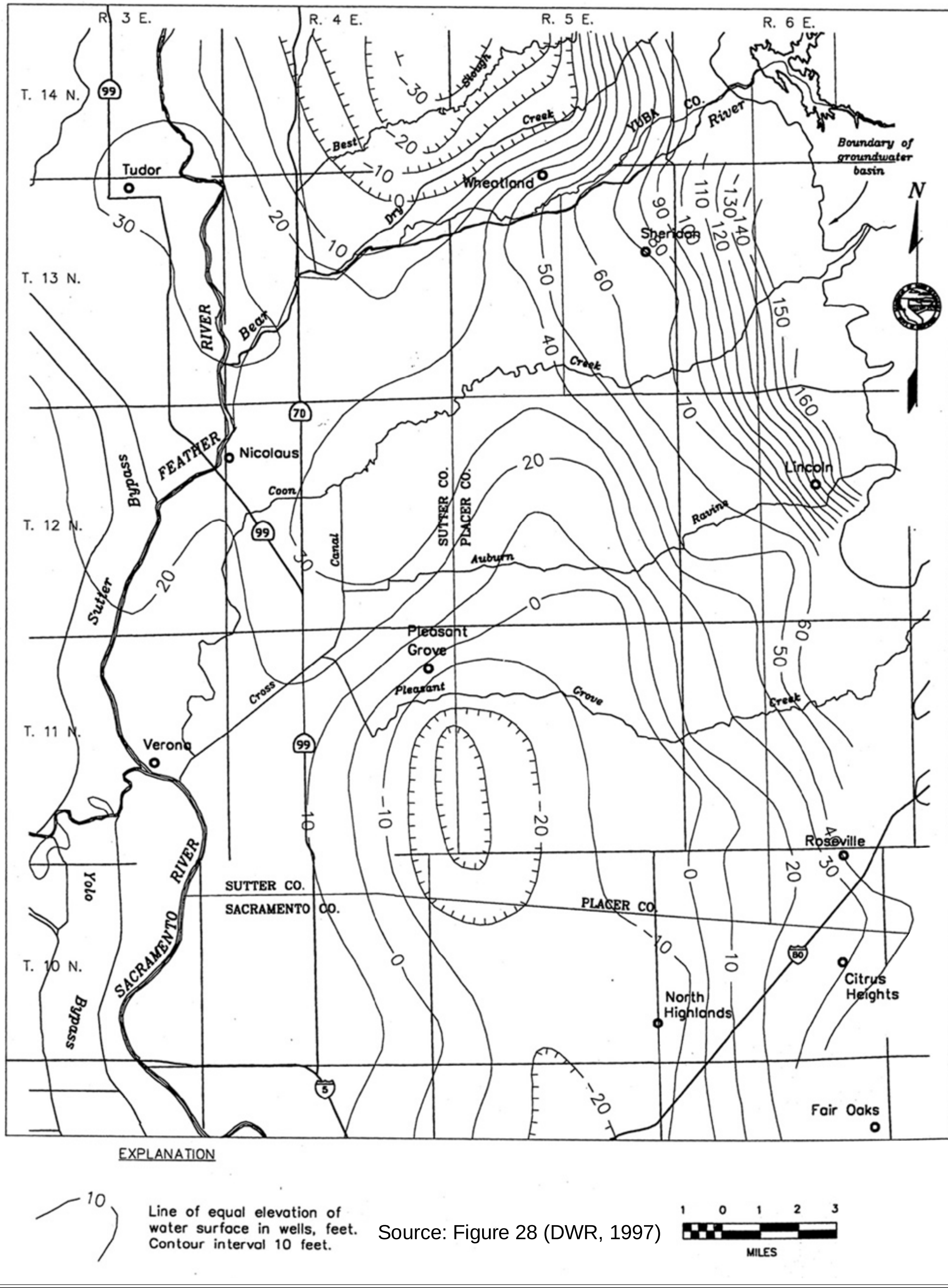
Figure 3-1
Piezometer Locations Along Sacramento River East Levee in Natomas Basin



FILE: \public\Sutter Pointe 07-1-012\GIS\Figure 4-4 Spring 1980 GWE contours.mxd DATE: 2/13/2008 11:12:09 AM

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Figure 3-2
Spring 1980 Groundwater Elevation Contours
Multiple Zone Wells in North American Subbasin

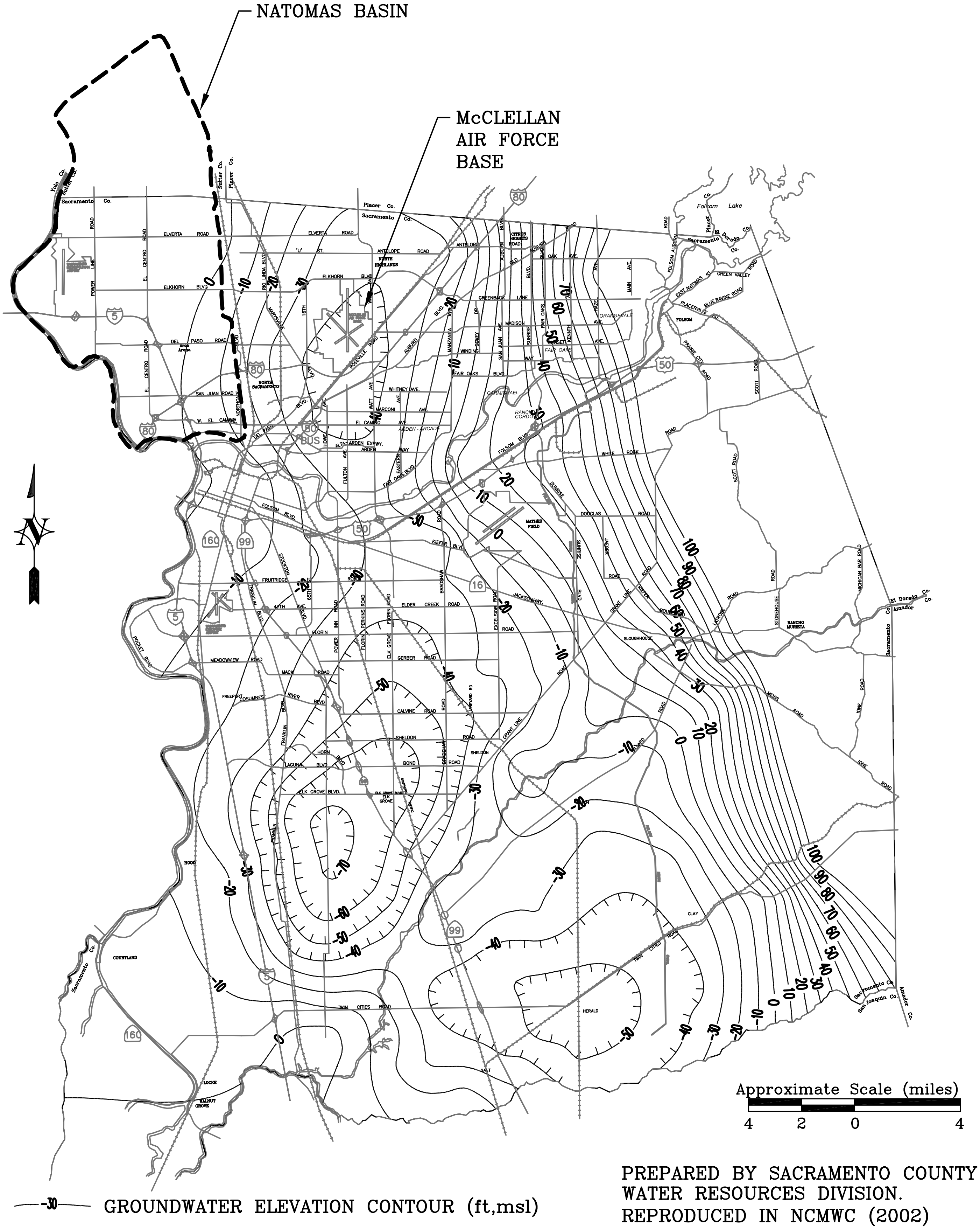

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Figure 3-3
Fall 1997 Groundwater Elevation Contours
Multiple Zone Wells in Sacramento County

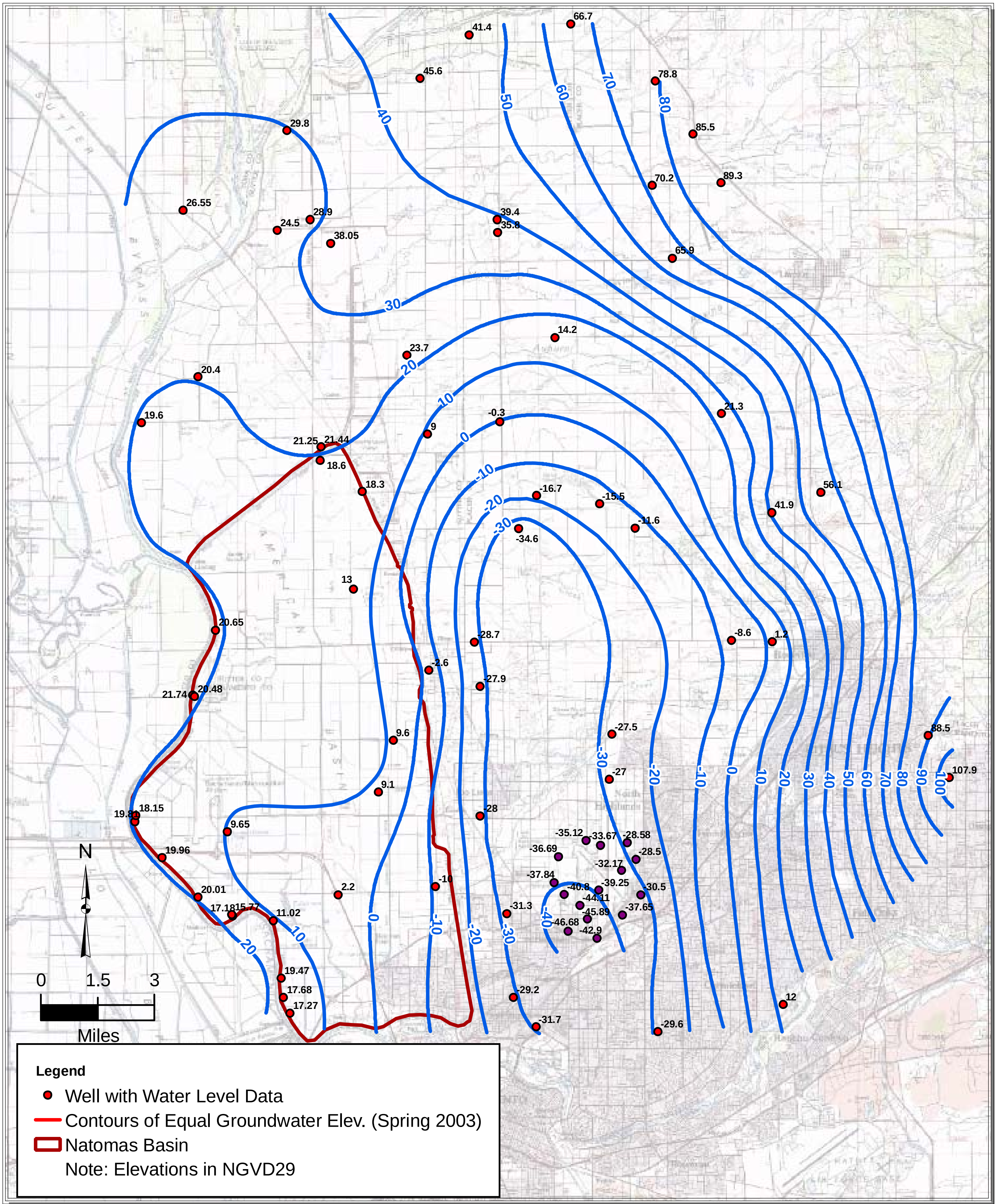

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Figure 3-4
Spring 2003 Groundwater Elevations Contours for Uppper Zone Wells in Natomas Basin

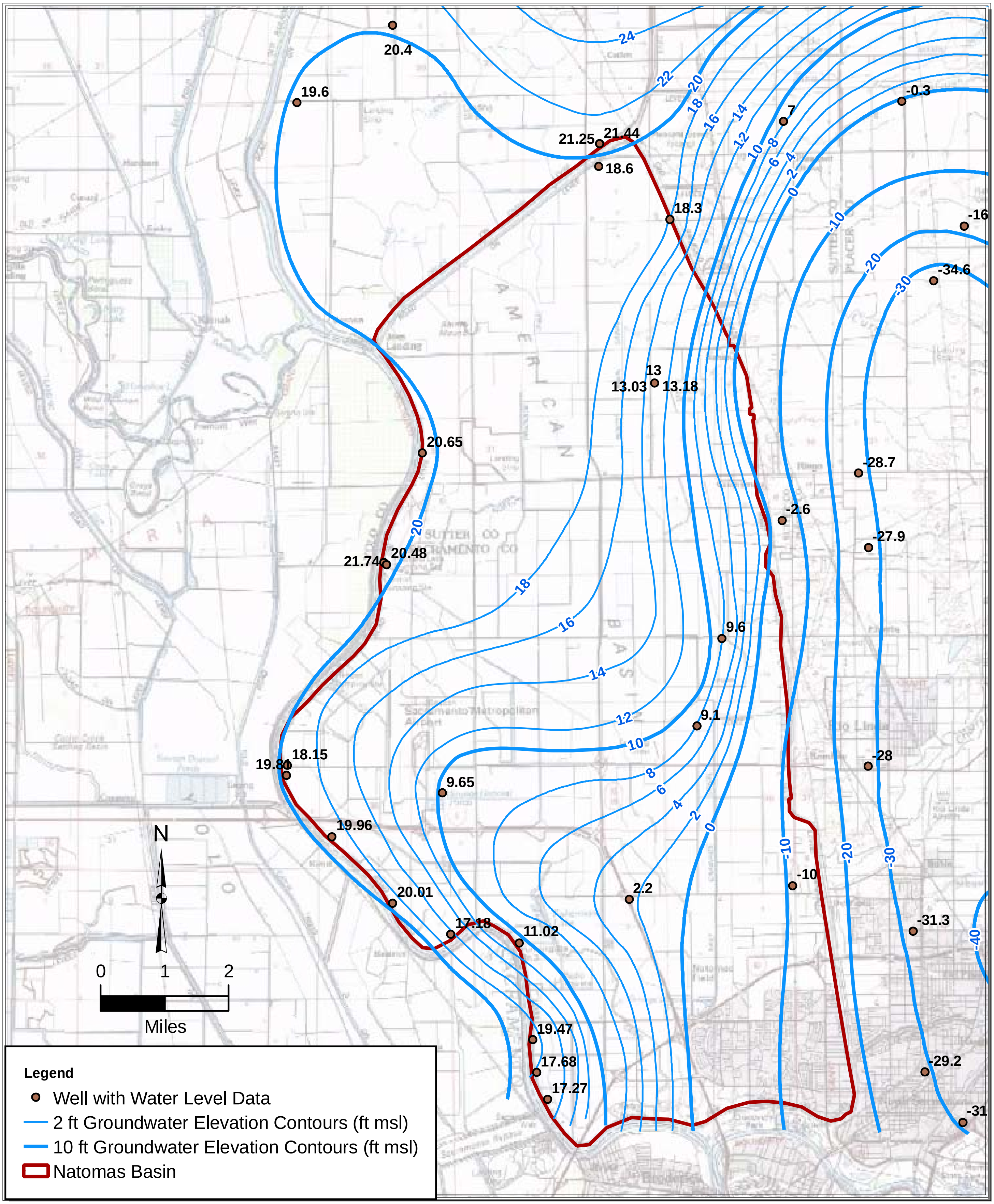

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Figure 3-5
Spring 2003 Groundwater Elevation Contours for Upper Zone Wells in Natomas Basin

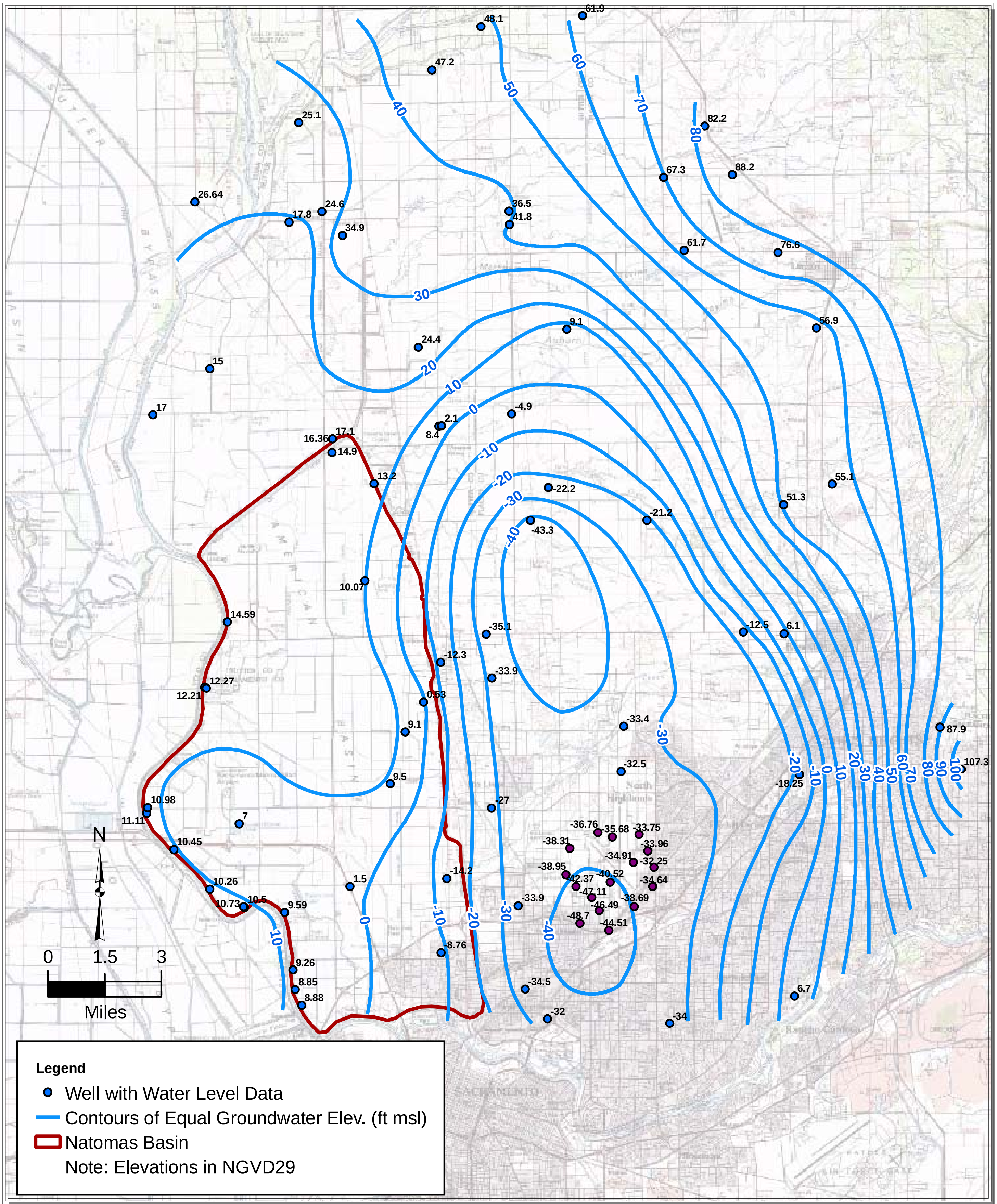

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Figure 3-6
Fall 2003 Groundwater Elevations Contours for Upper Zone Wells in North American Subbasin

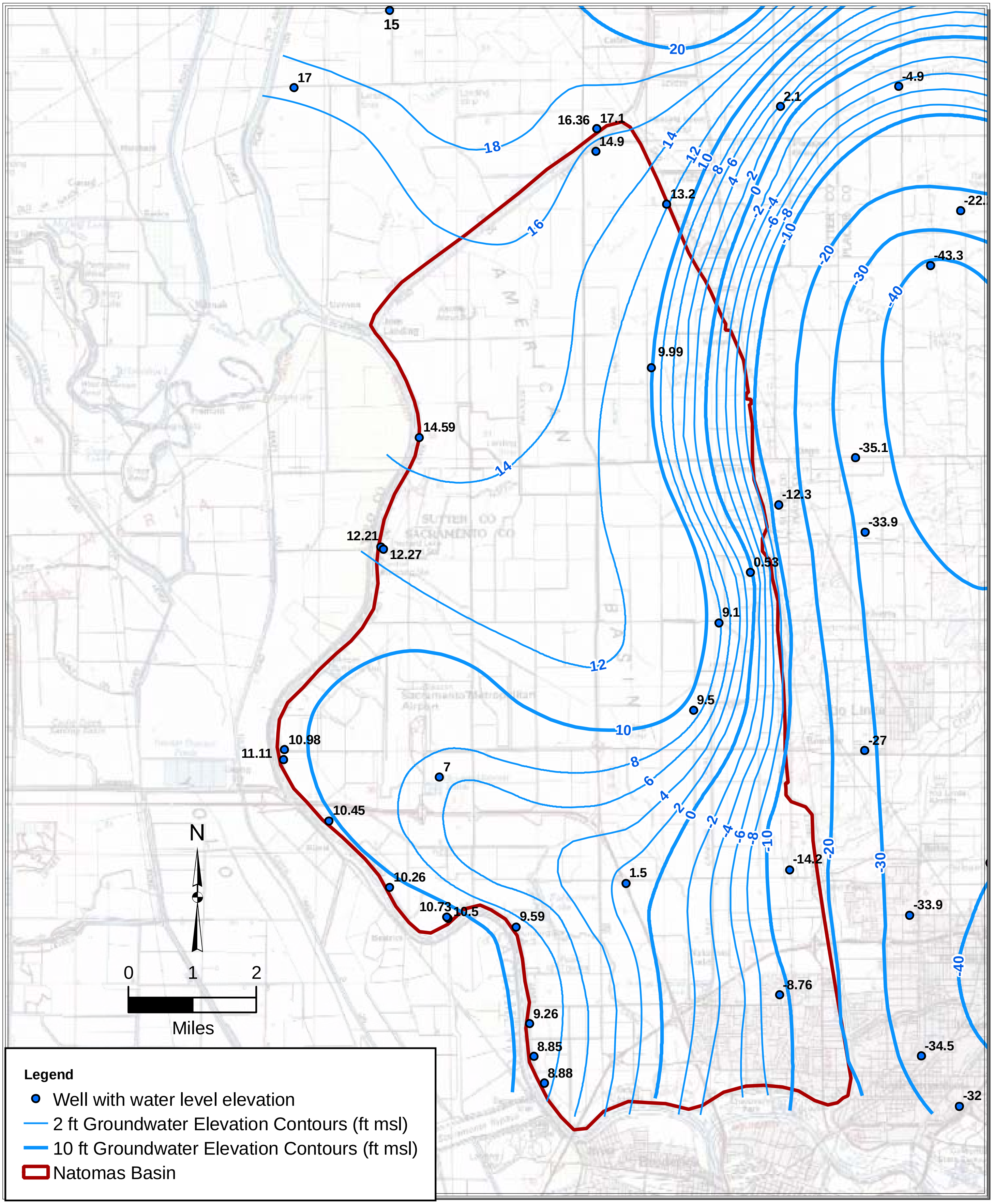

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Figure 3-7
Fall 2003 Groundwater Elevation Contours for Upper Zone Wells in Natomas Basin

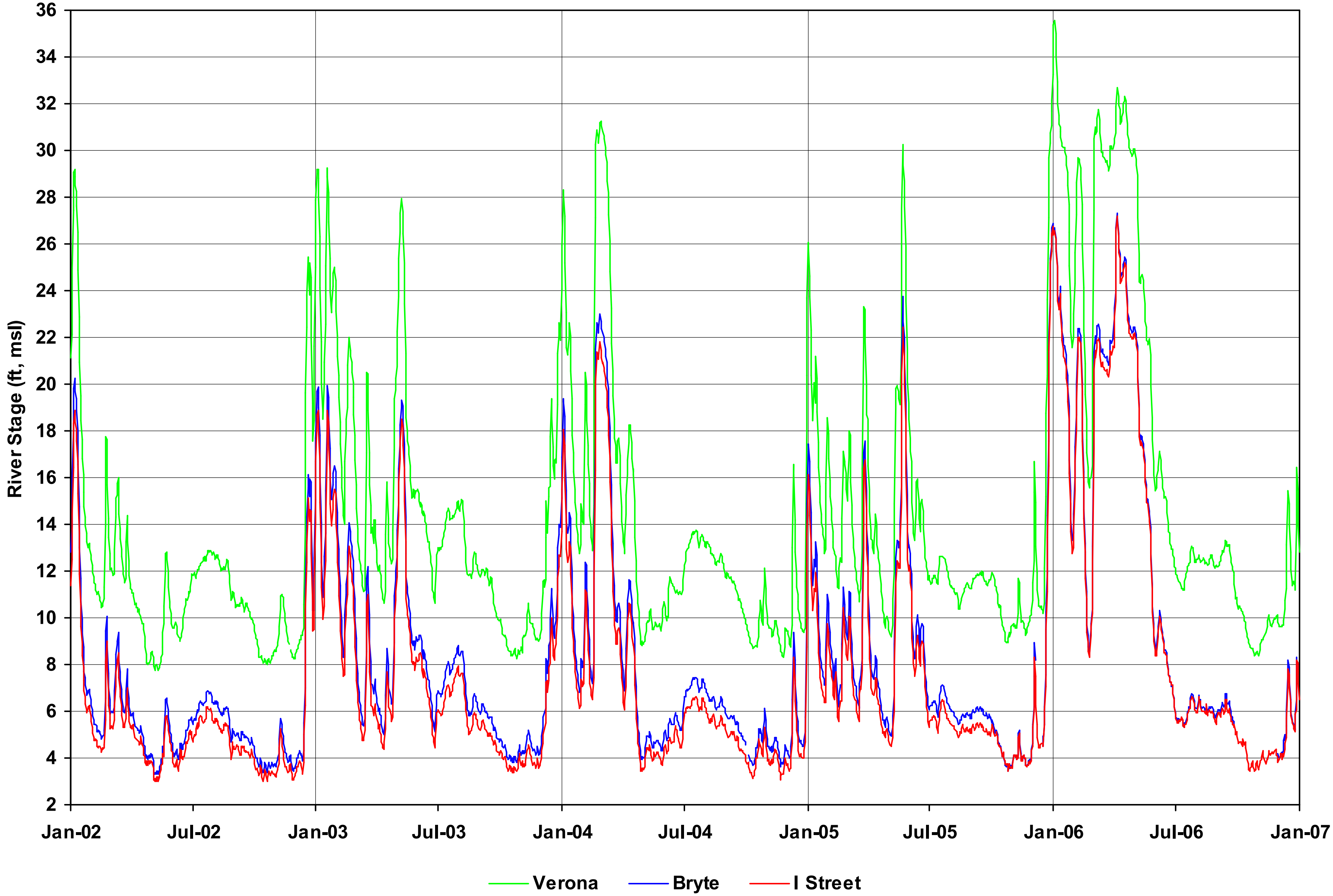

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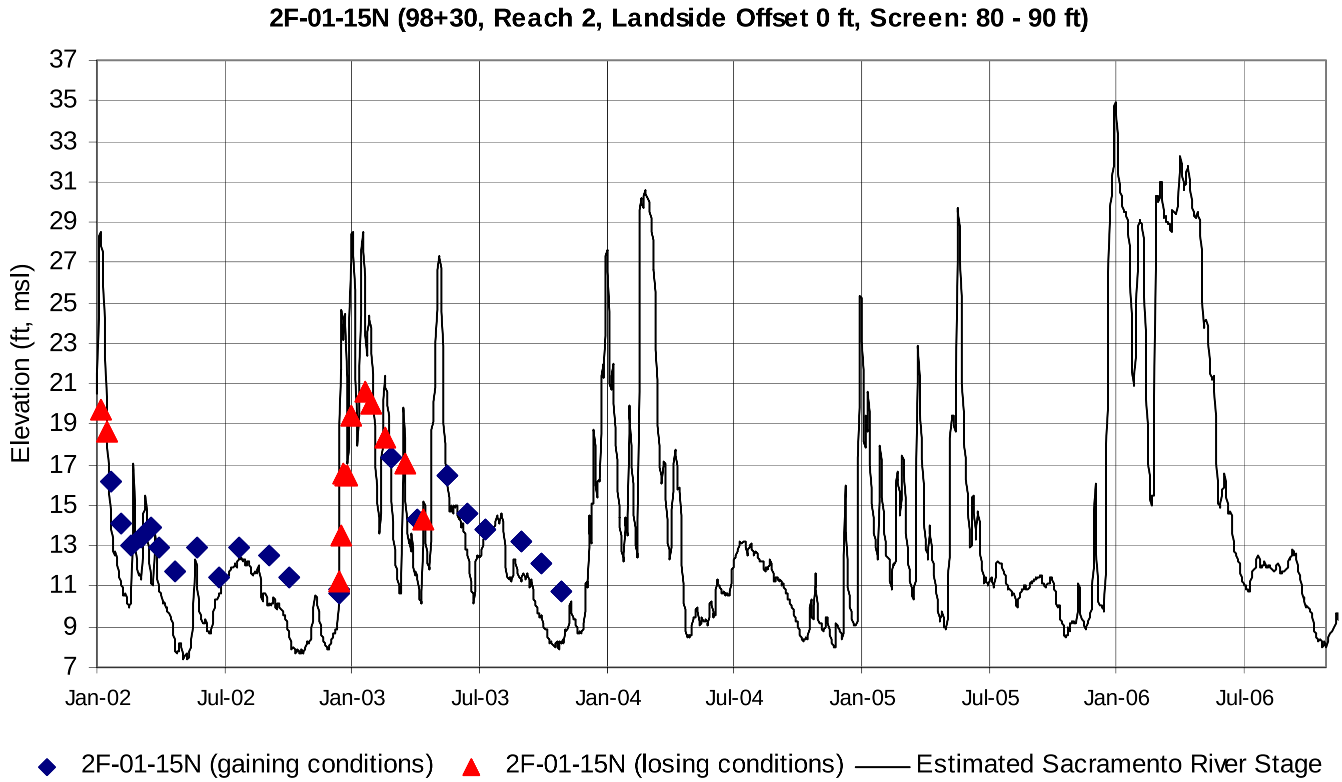
Figure 3-8
Hydrographs of Sacramento River Stage at the Verona, Bryte, and I Street Gages



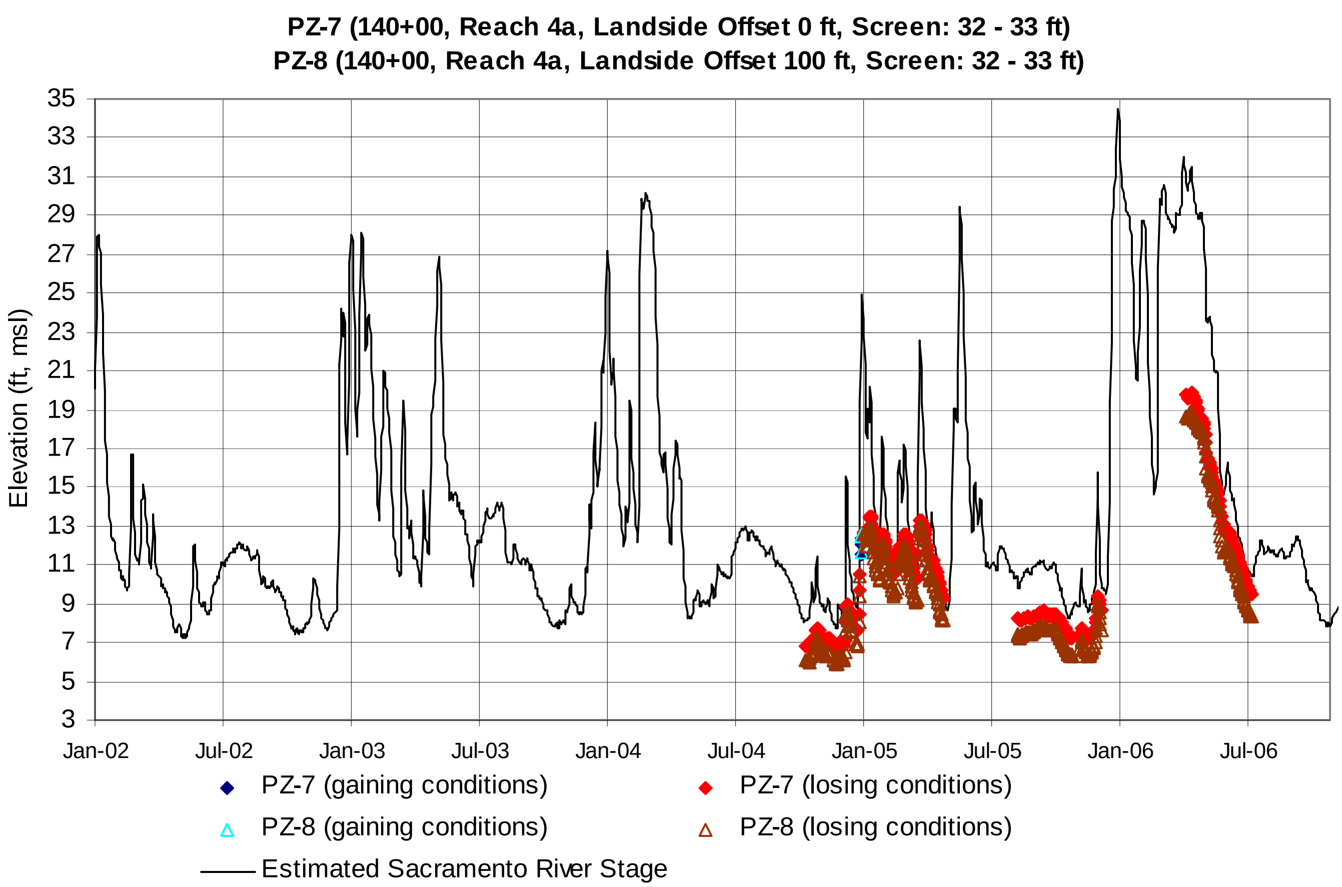


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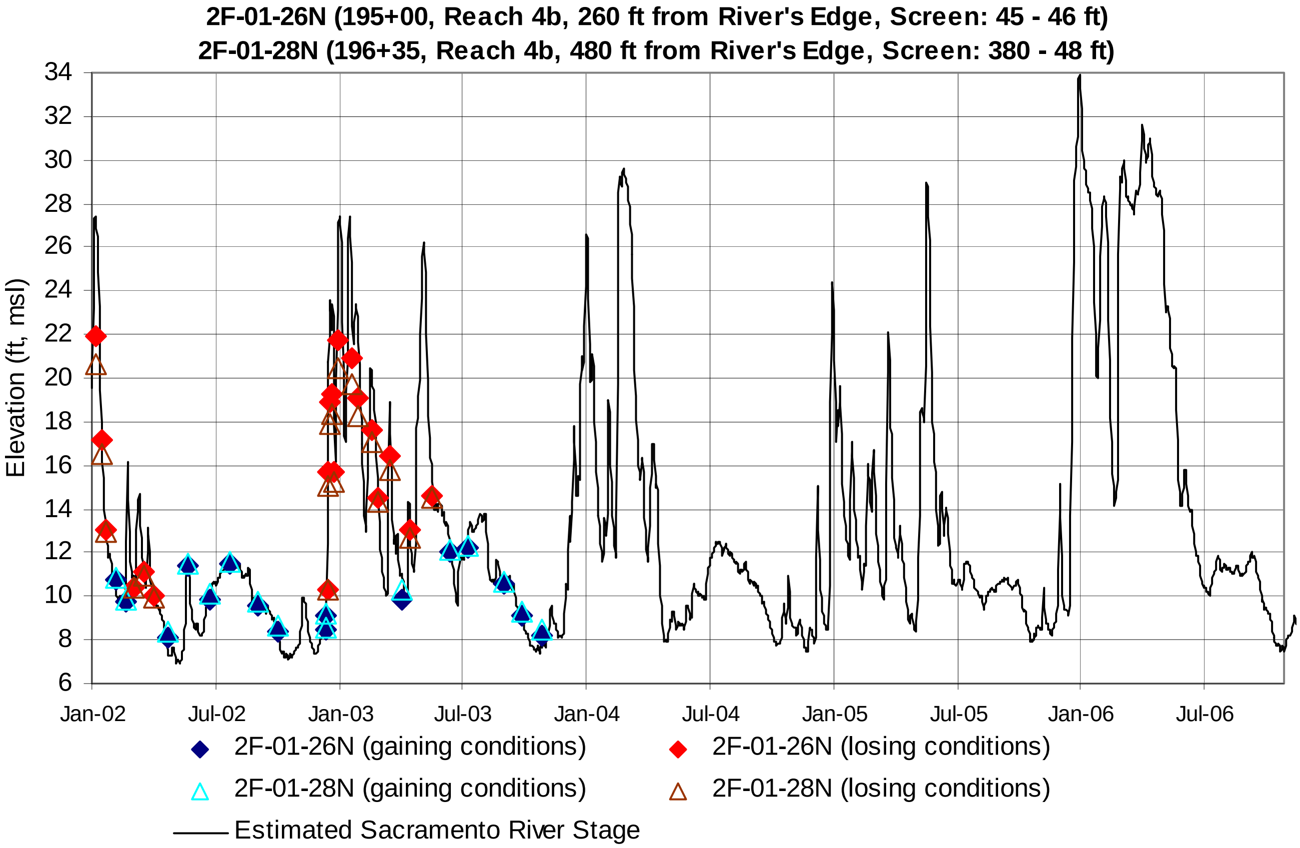
Figure 3-9
Hydrographs of Groundwater Elevations in Levee Piezometers and Estimated Stage in Reaches 2 and 4a



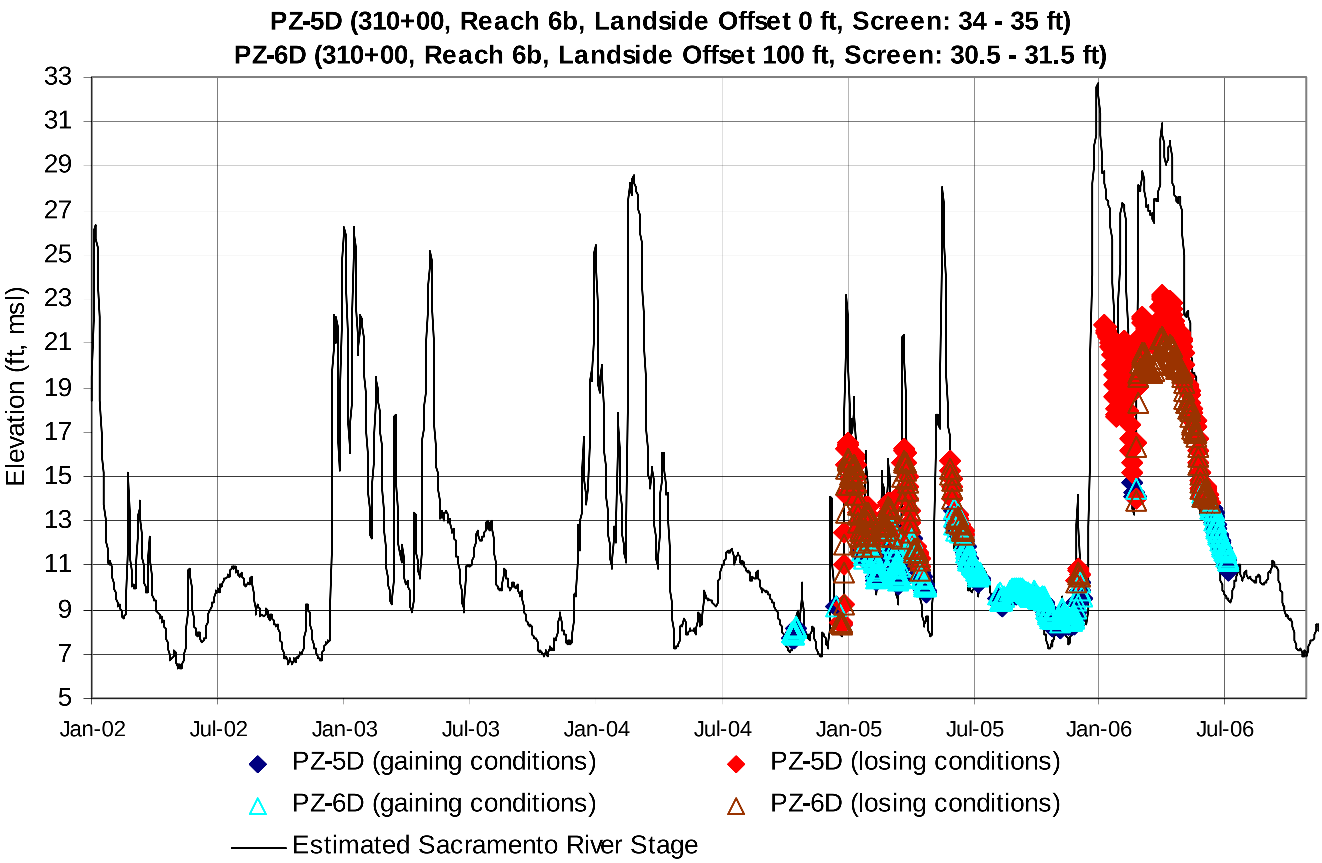


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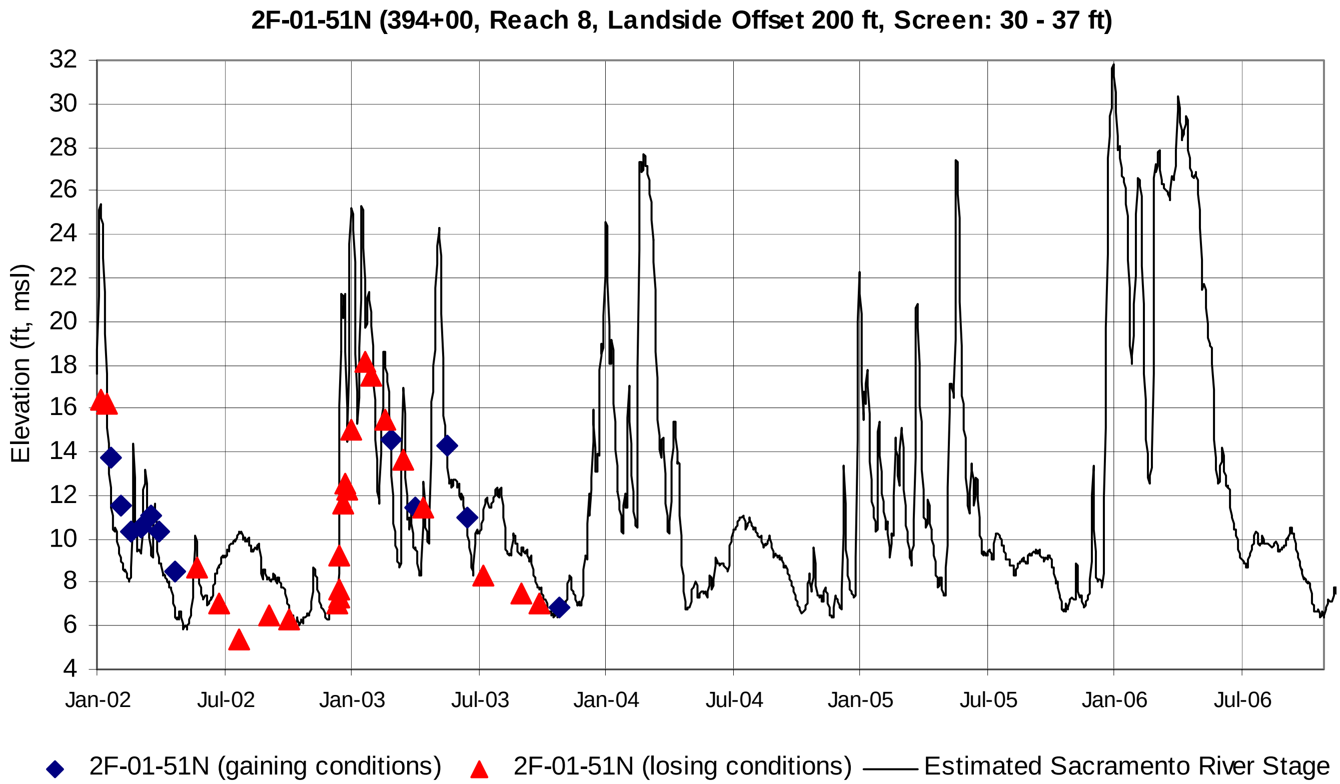
Figure 3-10
Hydrographs of Groundwater Elevations in Levee Piezometers and Estimated Stage in Reaches 4b and 6b



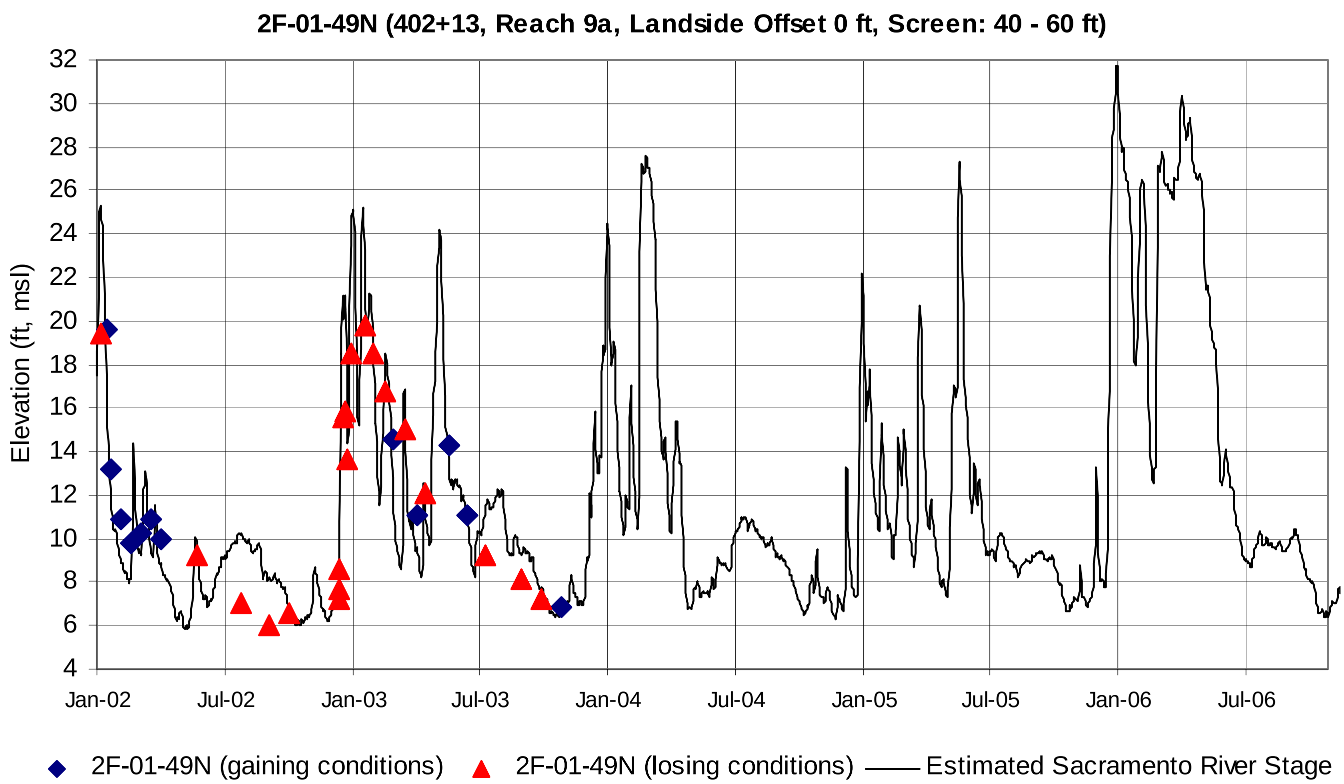


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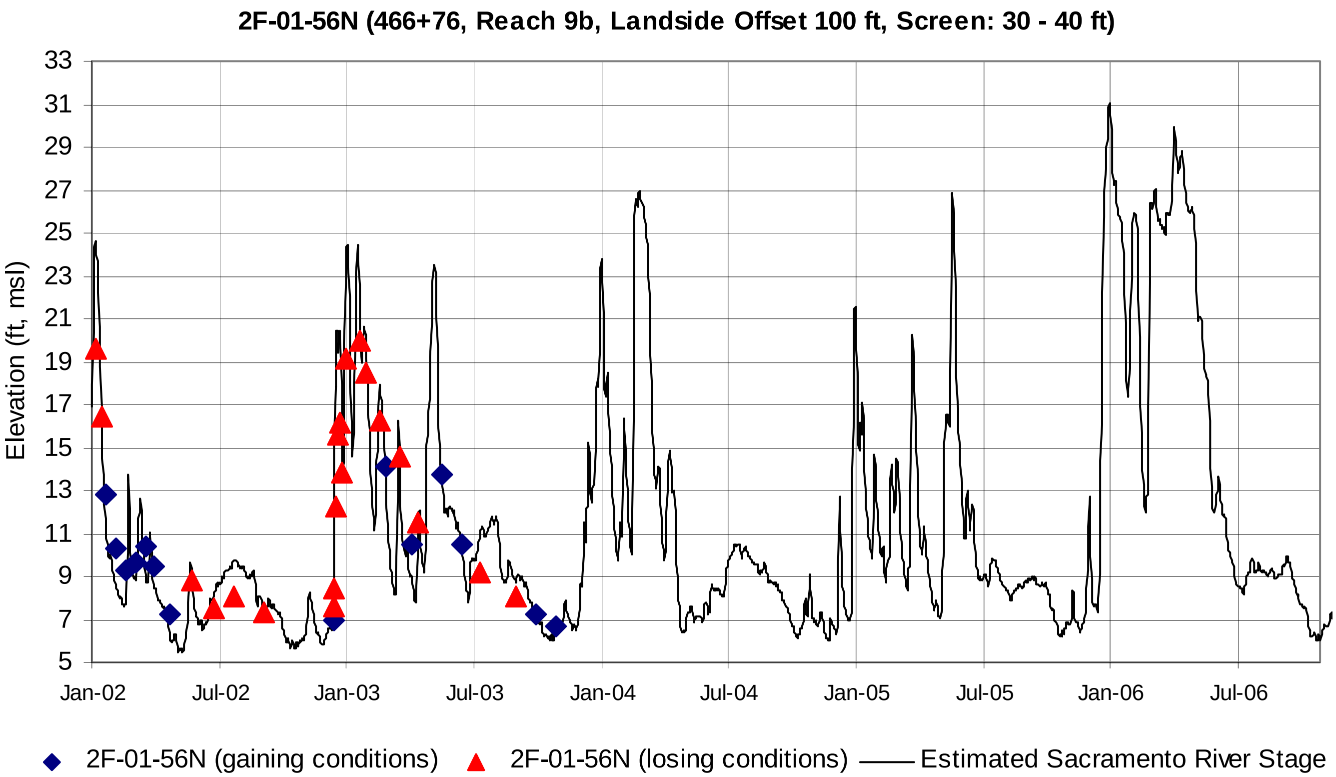
Figure 3-11
Hydrographs of Groundwater Elevations in Levee Piezometers and Estimated Stage in Reaches 8 and 9a



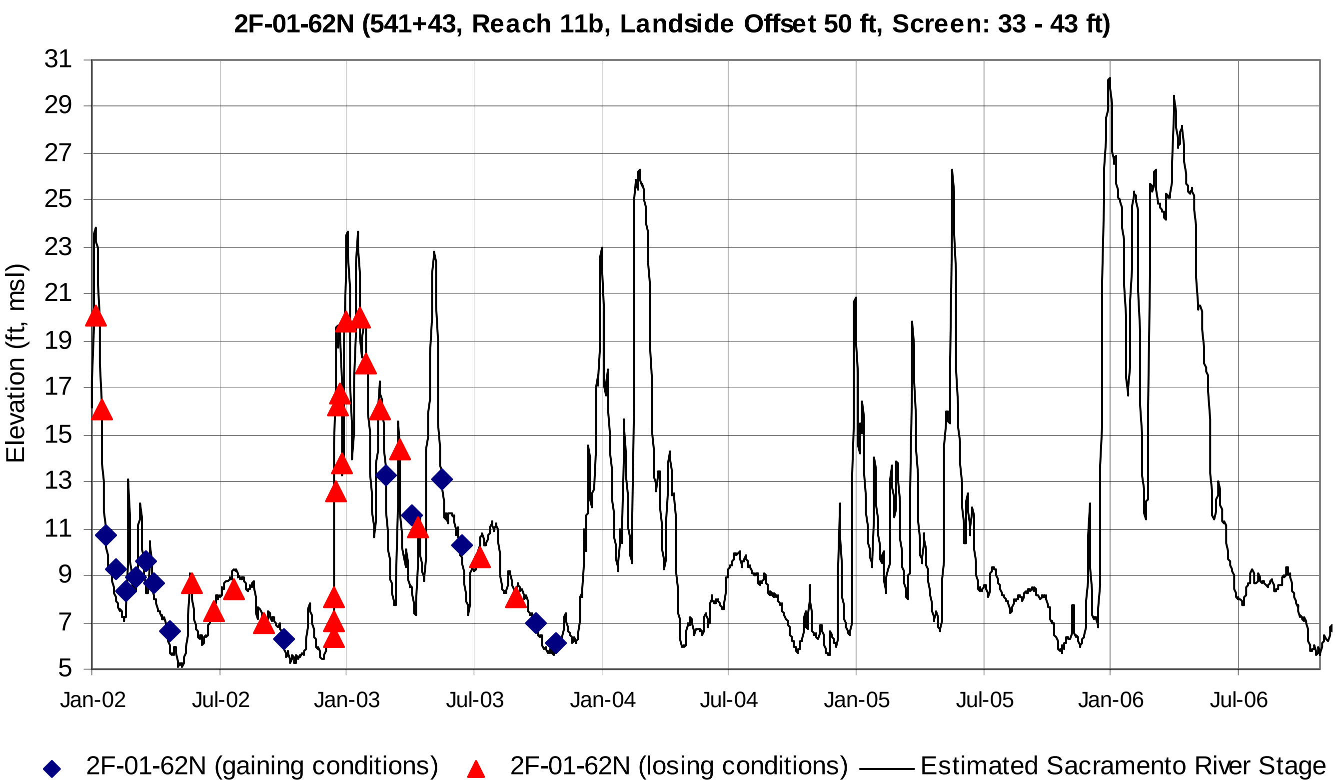


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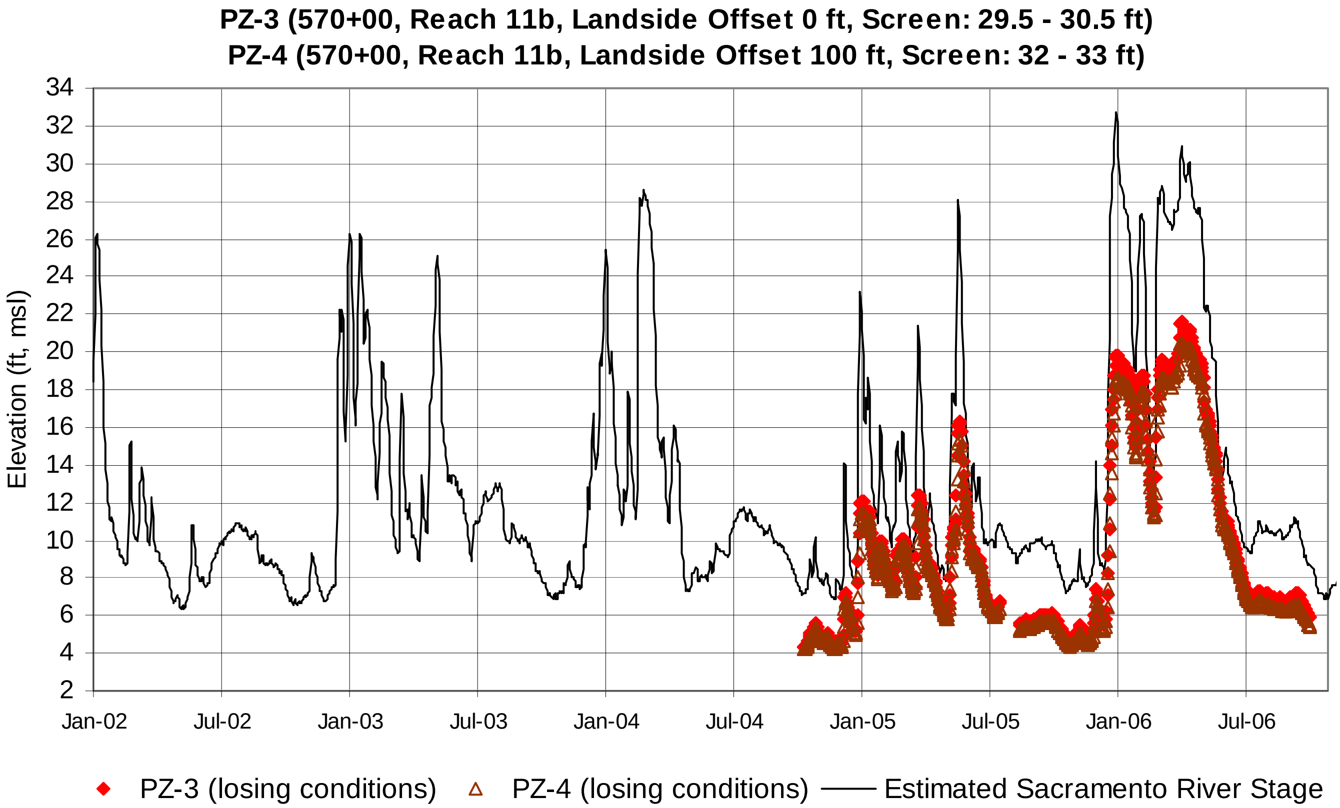
Figure 3-12
Hydrographs of Groundwater Elevations in Levee Piezometers and Estimated Stage in Reaches 9b and 11b



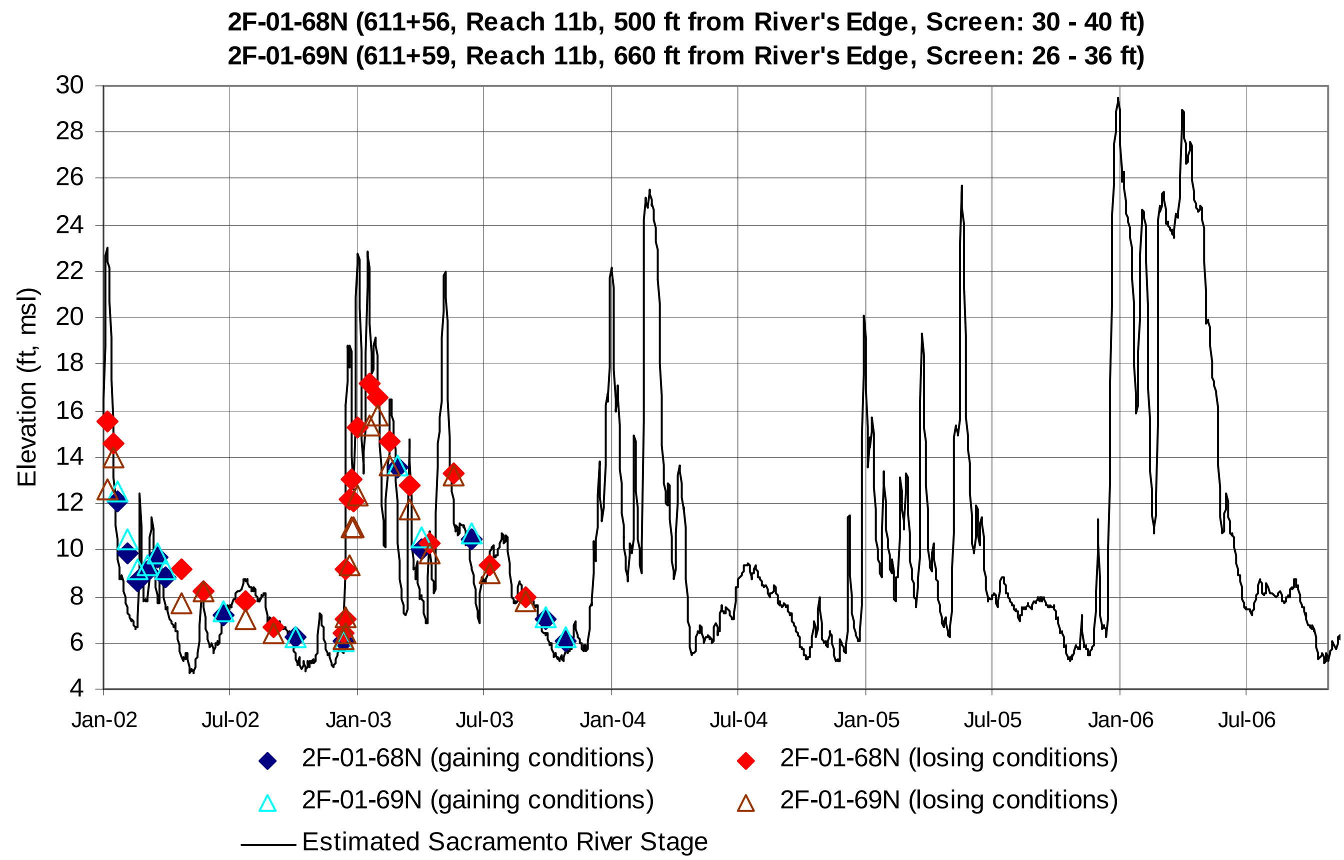


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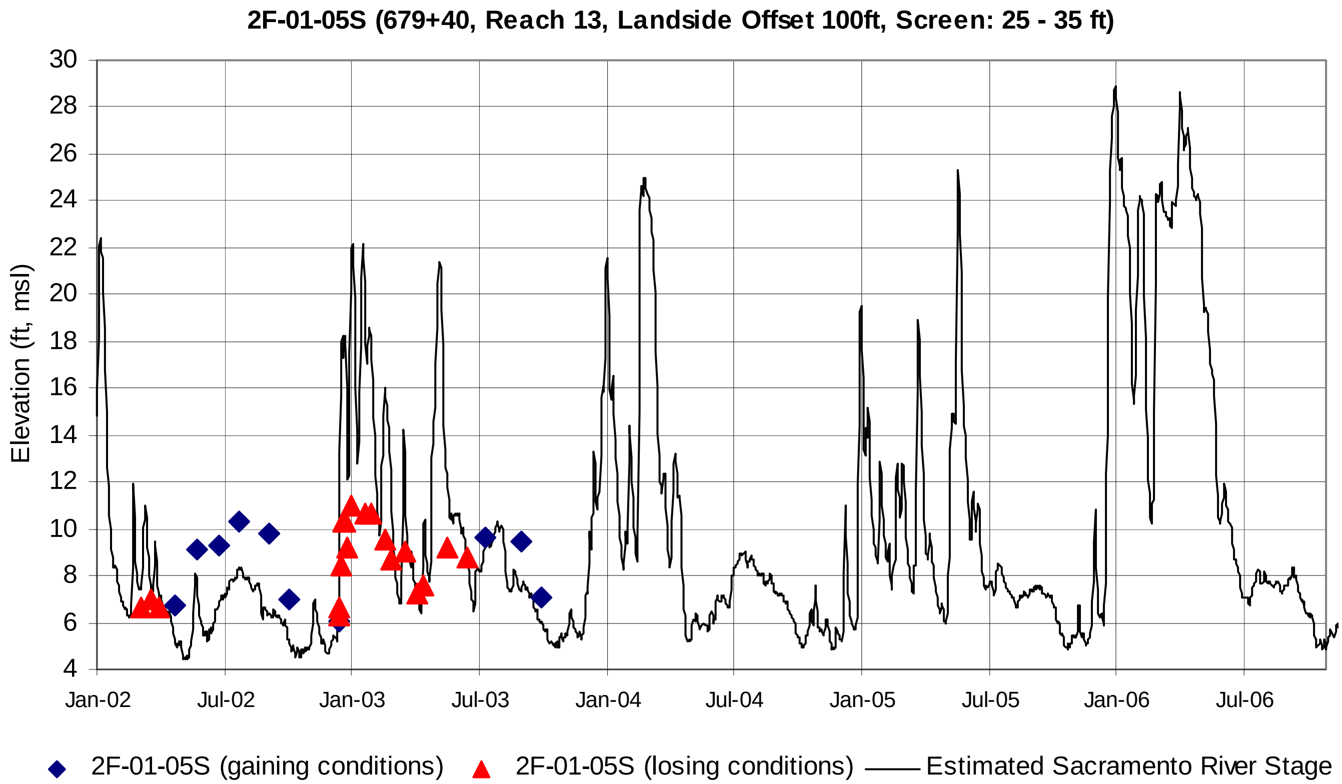
Figure 3-13
Hydrographs of Groundwater Elevations in Levee Piezometers and Estimated Stage in Reach 11b



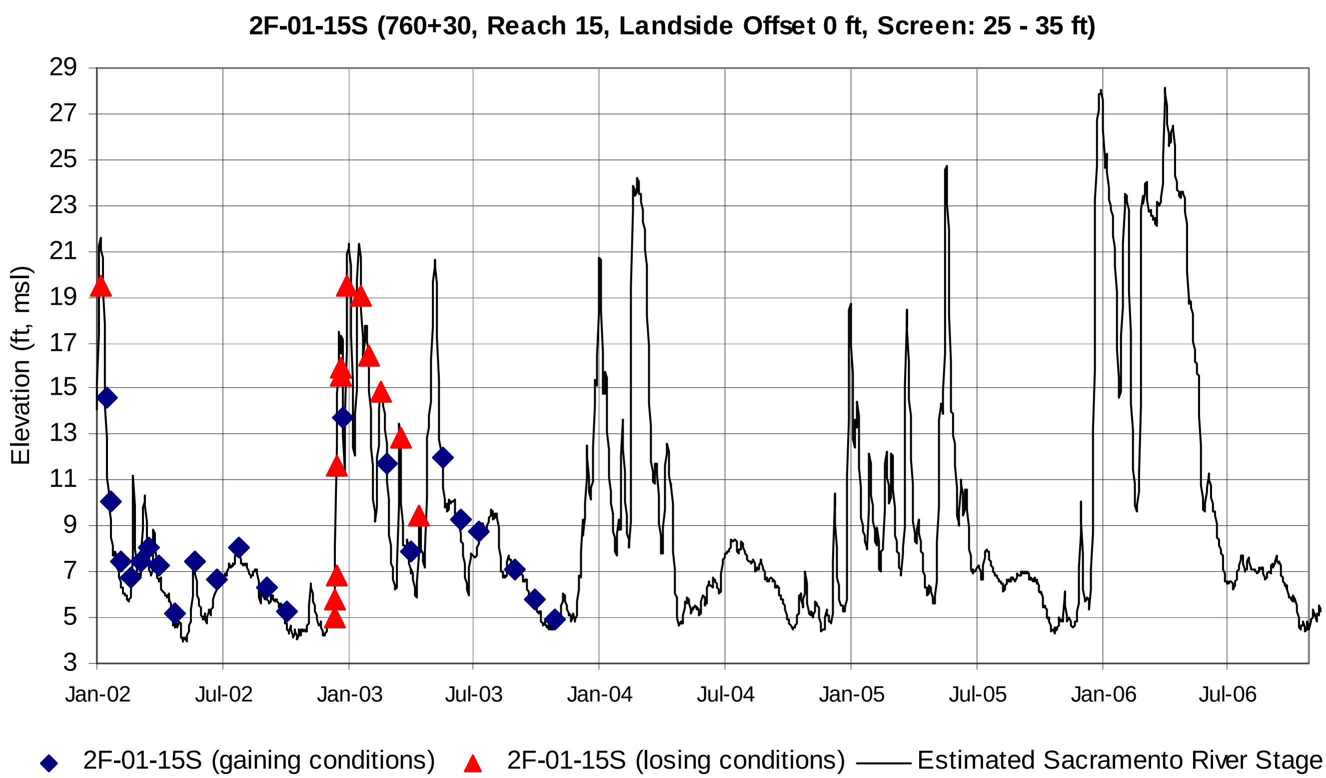


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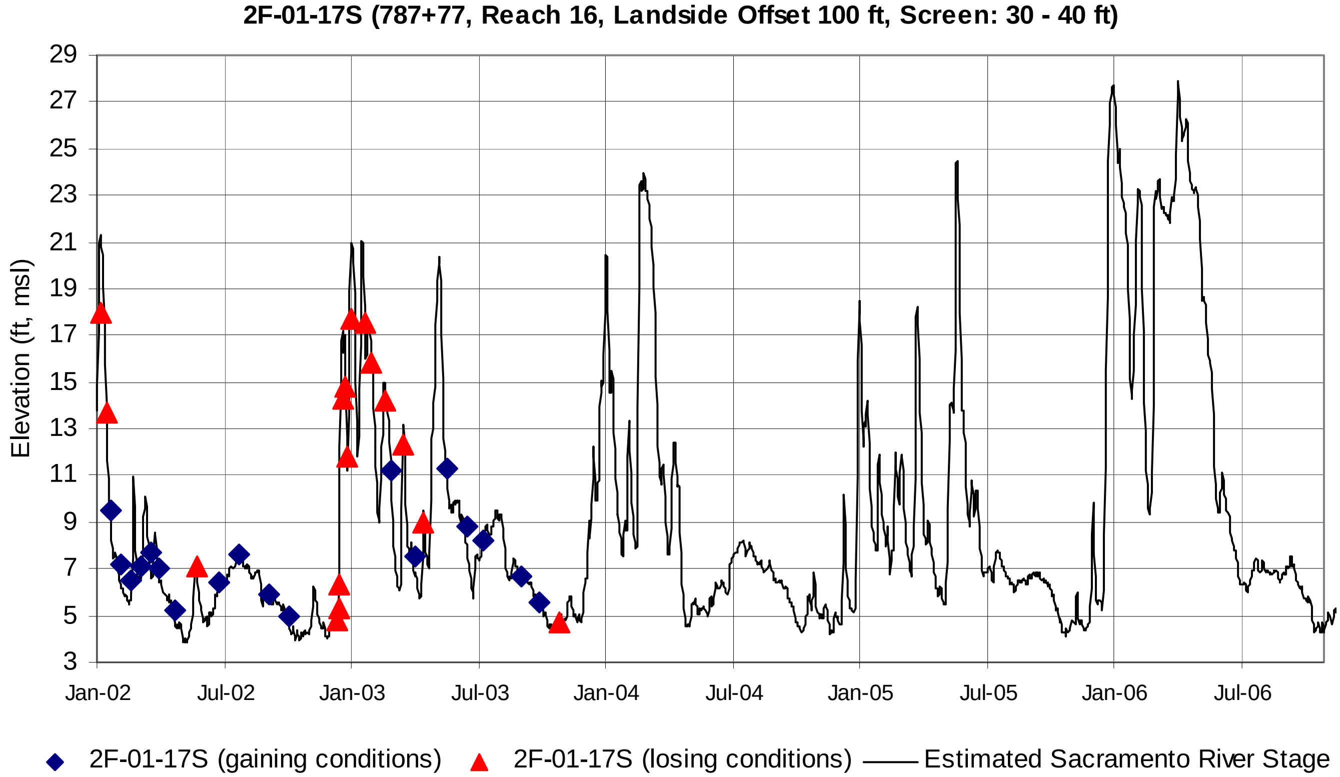
Figure 3-14
Hydrographs of Groundwater Elevations in Levee Piezometers and Estimated Stage in Reaches 13 and 15



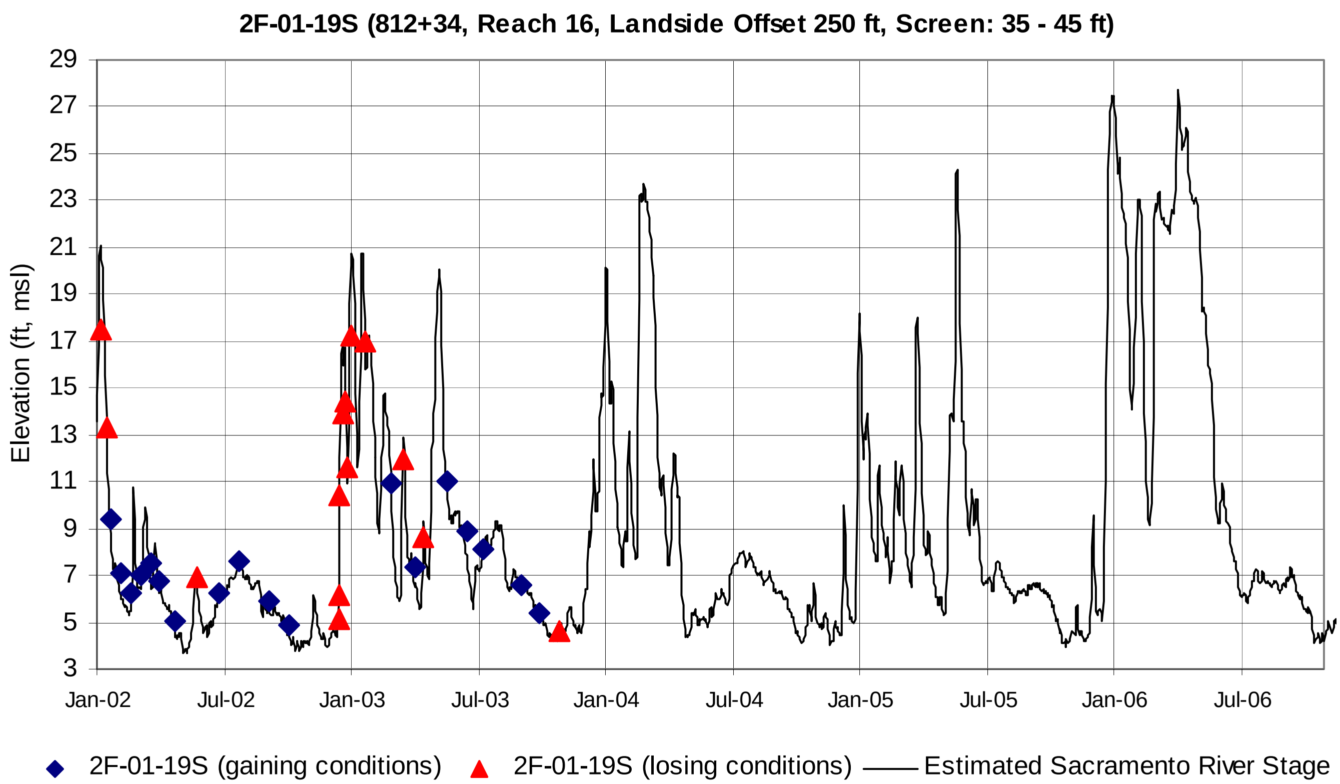


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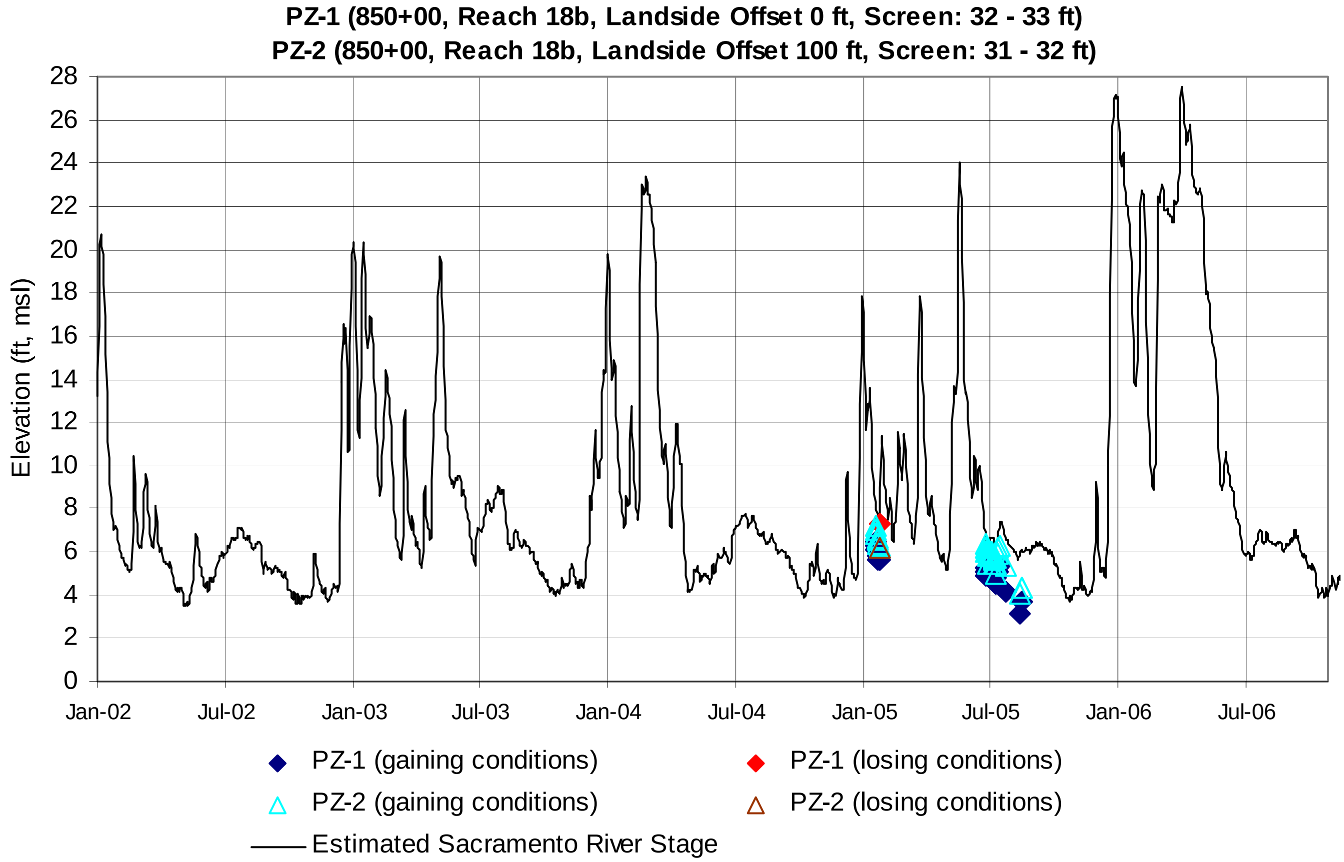
Figure 3-15
Hydrographs of Groundwater Elevations in Levee Piezometers and Estimated Stage in Reach 16



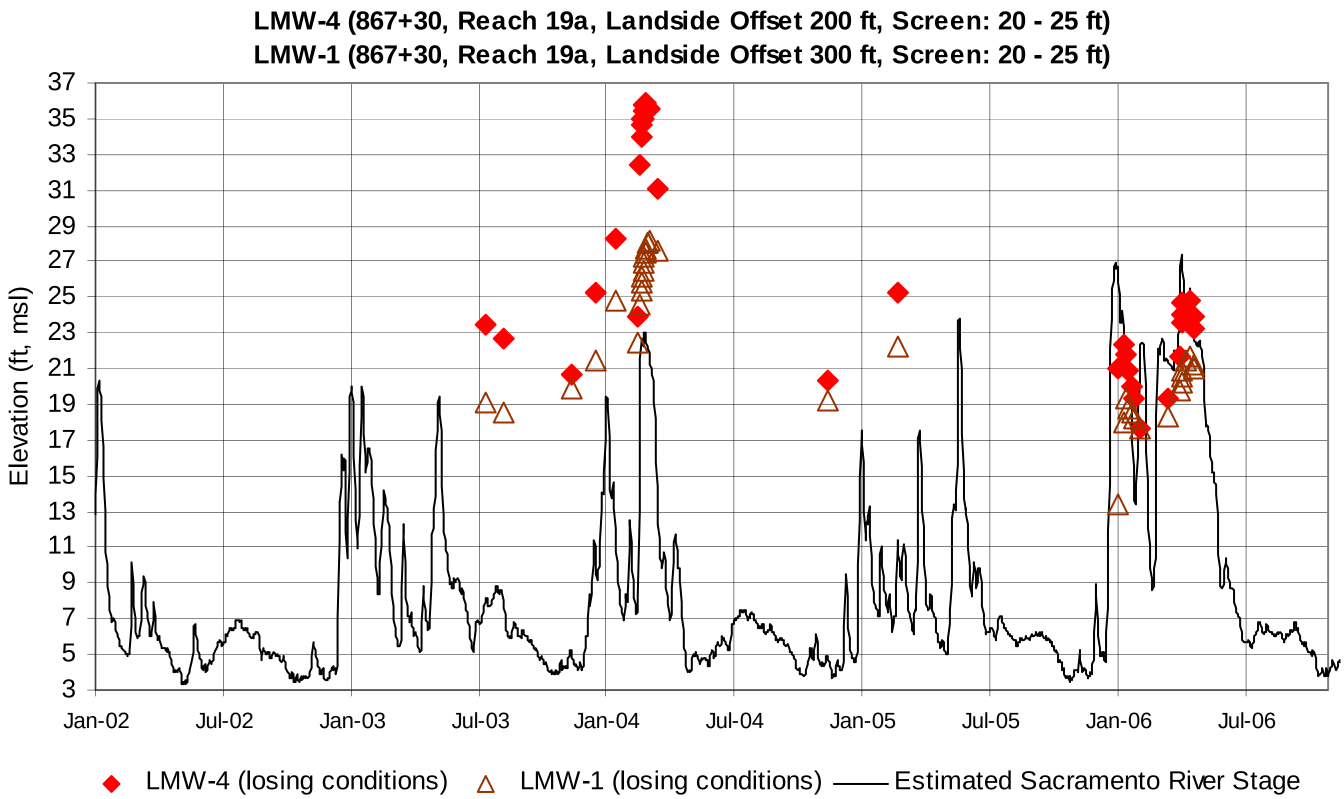


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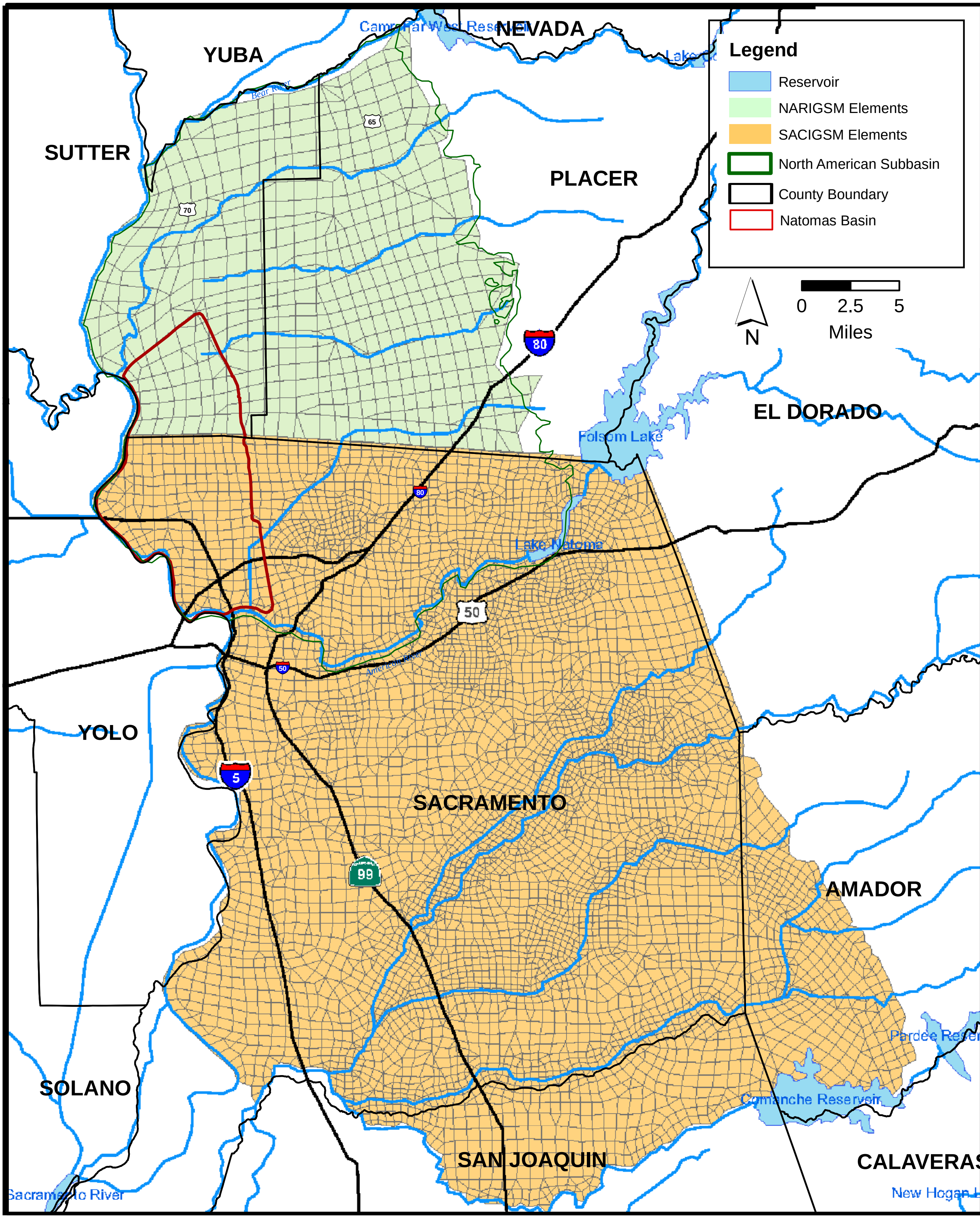
Figure 3-16
Hydrographs of Groundwater Elevations in Levee Piezometers and Estimated Stage in Reaches 18b and 19a



FILE: C:\Temp\SAFCA\Figure 7-1 Model Grids.mxd Date: 8/6/2008

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Figure 4-1
Model Grids for SACIGSM and NARIGSM Groundwater Flow Models

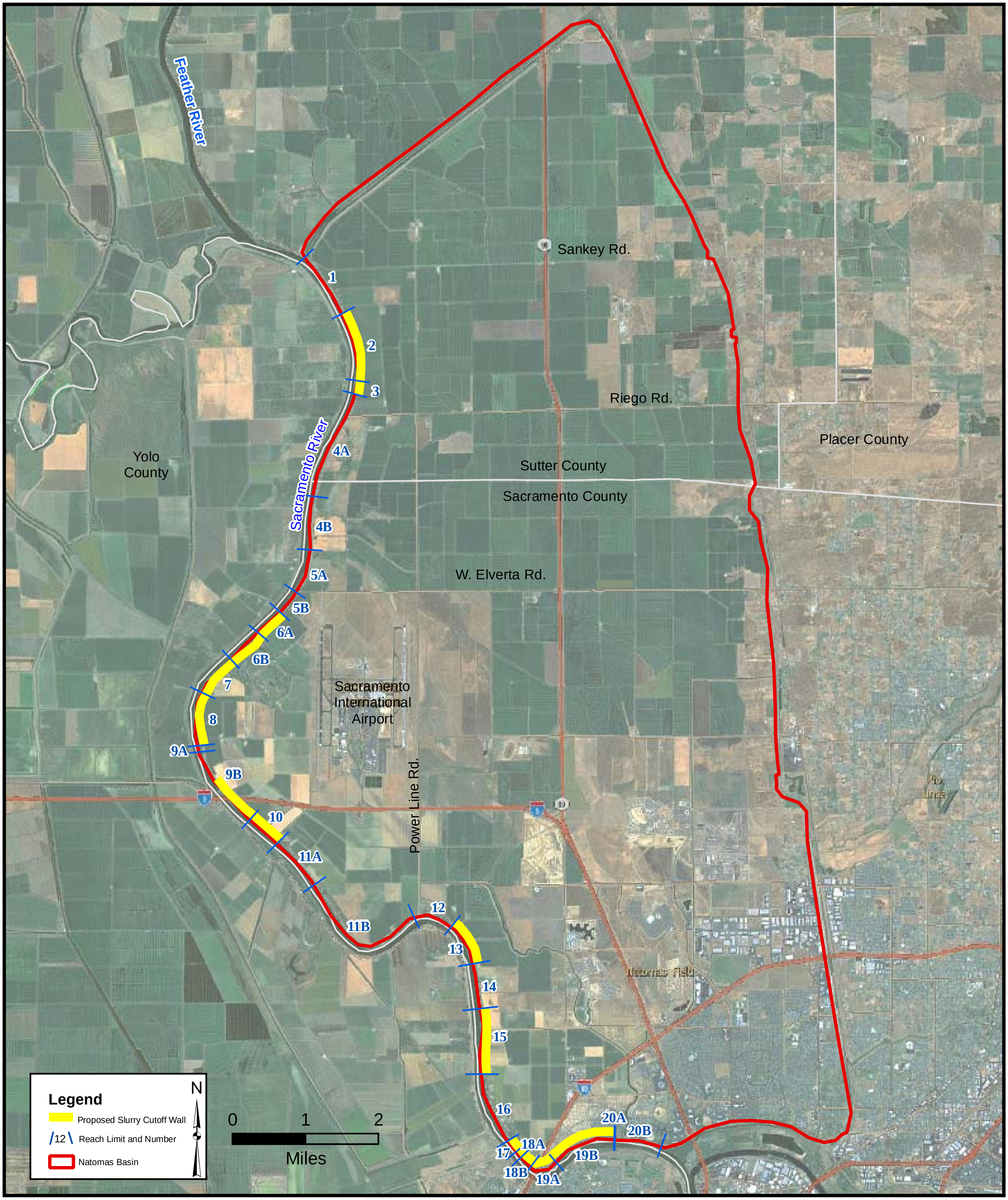

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Figure 6-1
Proposed Slurry Cutoff Walls
Along Sacramento River East Levee

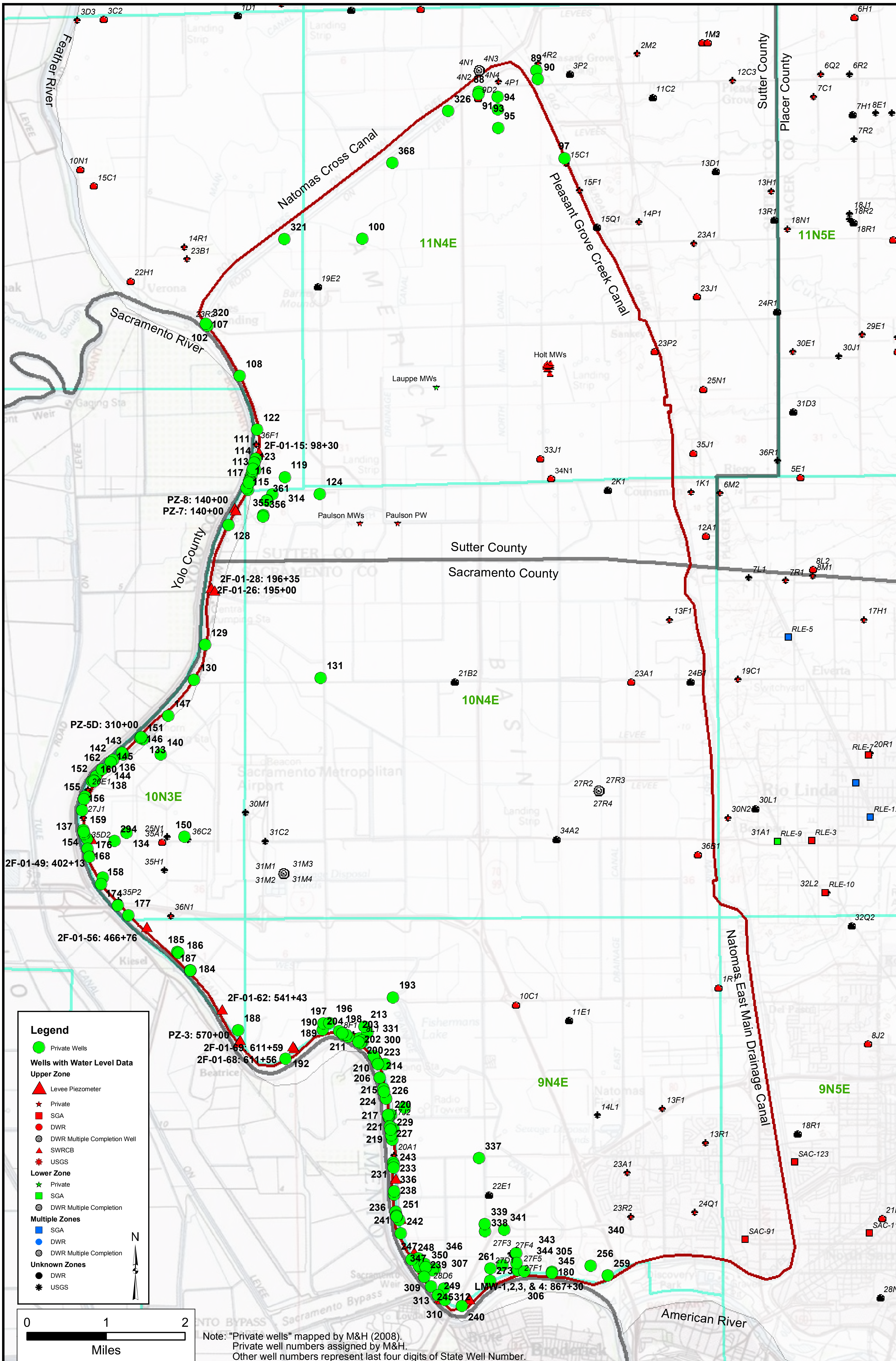

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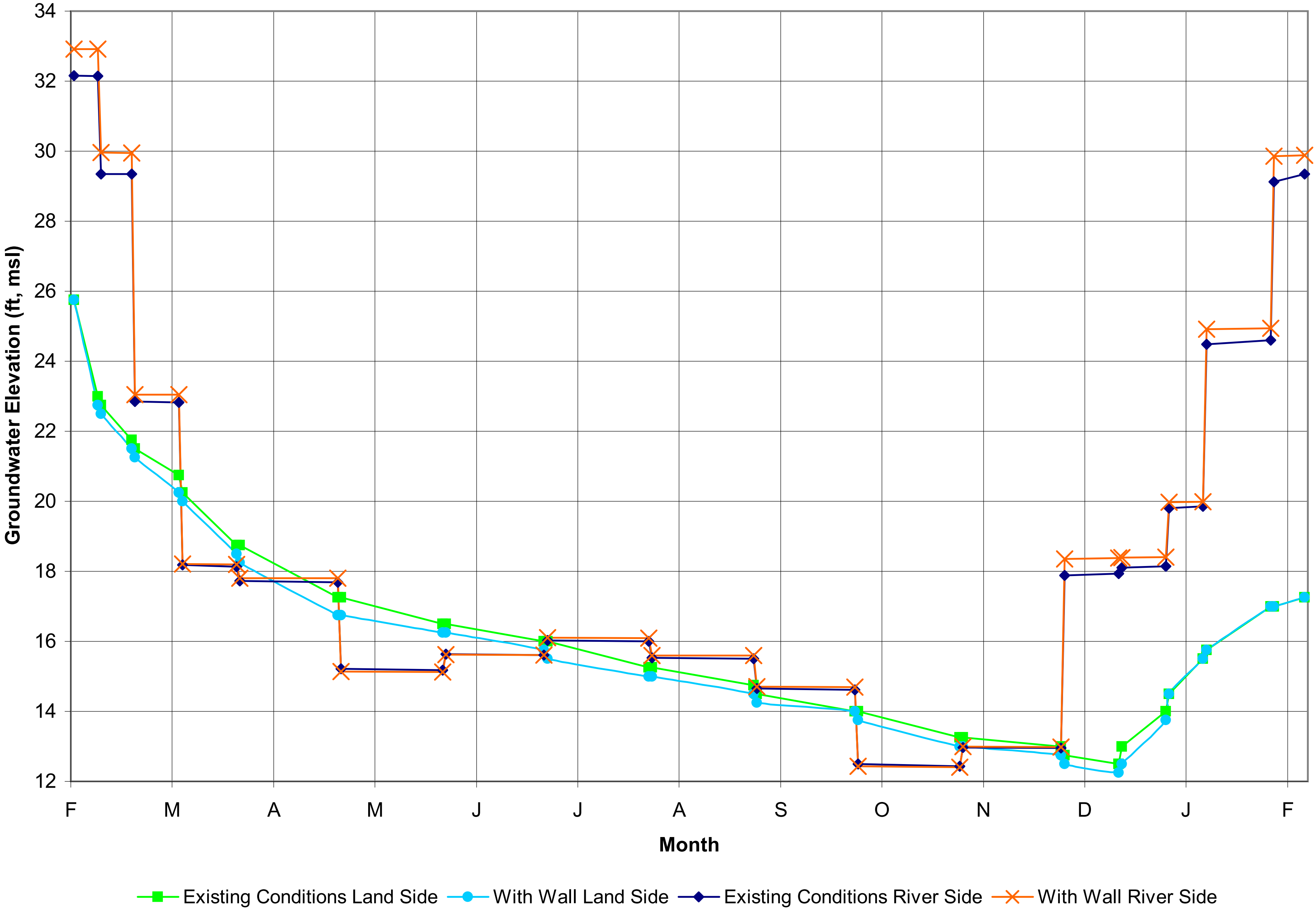
Figure 8-1
Wells in and Near the Natomas Basin



Y:\SAFCA\Cutoff Wall Impacts\Kleinfelder model\2000-2007 12-14-2007.xls\GWL

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Figure 8-2
Simulated Groundwater Elevations from Kleinfelder Transient Model With and Without Slurry Cutoff Walls

APPENDIX C

Cultural Resources Programmatic Agreement

PROGRAMMATIC AGREEMENT
AMONG THE U.S. ARMY CORPS OF ENGINEERS,
THE SACRAMENTO AREA FLOOD CONTROL AGENCY, AND
THE CALIFORNIA STATE HISTORIC PRESERVATION OFFICER

REGARDING THE ISSUANCE OF PERMISSION UNDER THE AUTHORITY OF SECTION 408 OF THE RIVERS AND HARBORS ACT OF 1899 AND SECTION 404 OF THE CLEAN WATER ACT FOR THE NATOMAS LEVEE IMPROVEMENT PROGRAM, LANDSIDE IMPROVEMENTS PROJECT

WHEREAS, the U.S. Army Corps of Engineers, Sacramento District (Corps) proposes to review an application that seeks permission for alteration of flood control structures under the authority of Section 408 of the Rivers and Harbors Act and to issue one or more permits to discharge fill to the waters of the United States under the authority of Section 404 of the Clean Water Act to the Sacramento Area Flood Control Agency (SAFCA) for the Natomas Levee Improvement Program Landside Improvements Project (Project); and

WHEREAS, The Corps has determined that the issuance of these permissions and permits constitute an undertaking per 36 CFR 800.16(y), which require compliance with Section 106 of the National Historic Preservation Act (NHPA) of 1966 as amended (16 U.S.C. 470f); and

WHEREAS the Project includes improvements to an extensive levee system surrounding the Natomas Basin and landscape and irrigation/drainage infrastructure modifications that will be implemented in three construction phases, currently scheduled for 2008, 2009, and 2010; and

WHEREAS, the Corps has determined that this undertaking will have an adverse effect on at least one Historic Property that has been determined eligible for inclusion in the National Register of Historic Places (NRHP), CA-SAC-485/H; and

WHEREAS, because of the complex and phased nature of the improvements, the Corps has not yet determined the exact area of potential effects (APE), nor has SAFCA acquired all of the rights-of-entry, easements and ownership interests that would allow a complete inventory and determination of effects on Historic Properties; and

WHEREAS, the Natomas Basin is sensitive for buried archaeological resources that cannot be accurately located prior to construction; and such buried sites may also be Historic Properties, and therefore SAFCA and the Corps need to document a framework for managing post-review discoveries per 36 CFR Section 800.13, including evaluation of those resources, assessment of effects, and resolution of potential adverse effects; and

WHEREAS, at such time as any unevaluated cultural resource may be discovered, it may require archaeological data recovery and/or other historic preservation activities, in compliance with Section 106 of the National Historic Preservation Act, concurrent with *active* construction; and

WHEREAS, the urgency of flood control improvements require a management framework for Historic Properties that will be implemented after the execution of this agreement in an expedited manner that thus departs from the process normally used under 36 CFR Section 800 et seq., yet still fulfills the requirements of Section 106 of the NHPA; and

WHEREAS, SAFCA has been invited to participate as a signatory to this Programmatic Agreement (PA) by the Corps and the California State Historic Preservation Officer (SHPO; and

WHEREAS, the Corps has consulted The Ione Band of Miwok Indians, the Shingle Springs Band of Miwok Indians and the United Auburn Indian Community, and they have been invited to concur in this PA; and

WHEREAS, the Corps shall make the terms and conditions of this PA as part of the conditions of any permissions and permits issued by the Corps for this project; and

WHEREAS, SAFCA has agreed to undertake responsibility for compliance with the NHPA on its own behalf, and on behalf of the Central Valley Flood Protection Board; and

WHEREAS, the Corps has consulted with the SHPO and the Advisory Council on Historic Preservation in accordance with regulations implementing Section 106 of the NHPA;

WHEREAS, the Council has been consulted and declined to participate in this agreement;

NOW, THEREFORE, the Corps, the SHPO, and SAFCA agree that the Project shall be implemented in accordance with the following stipulations in order to take into account the effects of the undertaking on Historic Properties.

The Corps shall ensure that the following stipulations of this PA are carried out.

STIPULATIONS

I. DEFINITIONS

The terms used in this Programmatic Agreement shall be as defined in regulations implementing Section 106 of the NHPA, and as follows:

"APE (Area of Potential Effect)" means any location at which any Project development activity will be constructed; and locations of any Project-related construction staging areas, borrow areas, and materials stockpile areas; and the locations of any other Project development activities. The APE shall be defined so as to include the maximum spatial dimensions of all Project-related construction and operations rights-of-way, easements, areas which potentially may be affected by Project activities, and other properties to which SAFCA has access, whether on a temporary or permanent basis, or ownership for Project development.

"Concurring parties" means their concurrence indicates that they are in agreement with the terms of the PA.

"Consulting parties" means the Corps, the SHPO, and SAFCA who are signatories to this PA. Only signatories have the authority to amend or terminate this PA.

"Cultural resources" means any property or location that was created, modified, or used by people at least 50 years in the past. Cultural resources include but are not limited to Historic Properties and traditional cultural properties/places (i.e., NRHP listed or eligible properties as defined at 36 CFR Part 60).

"Historic Property" means a cultural resource that has been determined eligible for or is listed on the NRHP (i.e., NRHP listed or eligible properties as defined at 36 CFR Part 60), either by formal nomination and listing or by concurrence between federal agencies and the SHPO.

"Historic preservation" means any activity conducted in accordance with the NHPA and its implementing regulations to, among other things, inventory, evaluate, manage, or treat cultural resources such as buildings, structures, sites, districts, and objects eligible for, or that may be determined eligible for, listing in the NRHP according to eligibility criteria at 36 CFR Part 60.

"Project development activities" means any physical action related to the Project that has the potential to damage or otherwise alter those characteristics of Historic Properties that would make them eligible for listing in the NRHP.

II. STANDARDS

(A.) Professional Qualifications. All technical work required for historic preservation activities implemented pursuant to this Programmatic Agreement shall be carried out by or under the direct supervision of a person or persons meeting at a minimum the *Secretary of Interior's Professional Qualifications Standards* for archaeology or history, as appropriate (48 FR 44739). "Technical work" here means all efforts to inventory, evaluate, and perform subsequent treatment such as data recovery excavation or recordation that is required under this Programmatic Agreement. This stipulation shall not be construed to limit peer review, guidance, or editing of documents by SAFCA or SAFCA's consultants.

(B.) Historic Preservation Standards. Historic preservation activities carried out pursuant to this Programmatic Agreement shall meet the *Secretary of Interior's Standards and Guidelines for Archaeology and Historic Preservation* (48 FR 44716-44740) as well as standards and guidelines for historic preservation activities established by the SHPO. The Corps shall ensure that all reports prepared pursuant to this Programmatic Agreement will be provided to the consulting parties and shall ensure that all such reports meet published standards of the California Office of Historic Preservation, specifically, *Preservation Planning Bulletin* Number 4(a), "Archaeological Resources Management Reports (ARMR): Recommended Contents and Format" (December 1989).

III. PROJECT DESCRIPTION

(A) PROJECT Description. A description of the Project is found in the Final Environmental Impact Report (November 2007). A summary of the Project's description in the environmental impact report is provided as **Attachment A** and is made a part of this Programmatic Agreement.

(B) Existing Conditions. An archival search and archaeological survey have been completed for all areas of the APE as currently defined to which SAFCA currently has access, and which currently are not covered by paving, built environment features, or agricultural crops. A report of the results of archival research and archaeological survey, "Cultural Resources Inventory Reports, Part 1 – Natomas Levee Improvement Program Landside Improvements Project, Sacramento and Sutter Counties, California" (October 2007) is made **Attachment B** to this Programmatic Agreement.

A number of prehistoric sites are known to be present along the banks of the Sacramento River. However, archaeological survey of the area is of limited value because the alluvial depositional environment may obscure and bury sites, leaving no surface manifestation of those archaeological resources. For most of the length of the Project, levees have been built on the riverbanks. These levees are one focus of the Project's activity, and occupy a substantial portion of the Project's APE. Furthermore, it has not been established whether certain known sites in proximity to the Project's development activities extend under the existing levees. The existing levees both obscure ground surfaces and prevent subsurface archaeological testing within their footprints. Because of these conditions, a full assessment of archaeological sites that may be present in the APE cannot be made in advance of construction. There is no definitive information, even for sites known to be in Project's proximity, of site boundaries relative to the APE, or of the significance or integrity of any portions of such sites that may be within the APE. For these reasons, even though archaeological deposits may extend into the APE, and even though some of these deposits may qualify as Historic Properties, it is impossible to develop meaningful site-specific Historic Properties Treatment Plans (HPTP) prior to all construction, or to carry out all necessary data recovery in advance of the Corps' approvals, permitting and construction.

For these reasons, unforeseen discoveries shall be treated pursuant to the provisions of 36 CFR 800.13 (Post-review discoveries).

(C) Project Phasing and Potential Changes to the APE: Because the improvements will occur in three phases (anticipated to be 2008, 2009, and 2010), it will be necessary to define the APE for each phase. The APE for each phase shall be submitted with the cultural resources inventory reports, and shall be consulted upon as part of that document, pursuant to **Stipulation IV**, below.

After the initial concurrence, changes to the APE may be necessary as SAFCA refines its phased Project plans. In particular, the ability of SAFCA to obtain access permissions of private landowners, determination of borrow sites and ongoing negotiations with resource agencies regarding species mitigation requirements may affect final Project's design, and may expand the current APE in some areas. Any changes to the APE shall be made in accordance with subsections D and E (below) of this Stipulation III. The SHPO, Corps, and SAFCA shall consult and reach concurrence in any changes to the APE. The final APE shall account for all Project development activities for the as-built Project. SAFCA shall notify the Corps of any change in the APE and the Corps shall determine the potential for Project development activities in a revised APE to affect cultural resources, through cultural resources inventory and testing as needed.

(1) If there is the potential that cultural resources exist in the revised APE, SAFCA shall submit to the Corps:
    (a) a map of the revised APE; and
    (b) a description of Project development activities to take place in the revised APE; and
    (c) a description of the inventory, nature, location, and known or potential significance of cultural resources in the revised APE; and
    (d) a description of any archaeologically sensitive areas in the revised APE that require monitoring by an archaeologist, and Native American monitor as appropriate; and
    (e) a plan for managing cultural resources in a manner that either avoids Project-related effects to cultural resources, or which mitigates any adverse effects, and which provides for the management of unforeseen cultural resources discoveries.

(2) If no cultural resources are identified within a revised APE, SAFCA shall document such a determination, provide documentation to the Corps and keep such documentation on file at its principal offices.

After the Corps and SAFCA agree to a revised APE and if such a change has the potential to have an effect on cultural resources, the Corps shall submit the documentation to the SHPO for their review. The SHPO shall have 30 calendar days from the date of receipt of the notice of a revision to the APE to review and to provide in writing either concurrence with or objection to the definition of the revised APE, and any proposed historic preservation activities. Should the SHPO not respond in writing within 30 calendar days, the Corps and SAFCA shall proceed as though the SHPO has concurred in the revised APE, and the proposed historic preservation activities, if any.

Should the SHPO object to the definition of the revised APE or proposed historic preservation activities, the Corps, SAFCA, and the SHPO shall consult for a period not to exceed 15 calendar days following the date of the receipt of the SHPO's written objection in an effort to come to agreement on the issues to which the SHPO has objected. Should the SHPO, the Corps, and SAFCA be unable to agree on the issues to which the SHPO has objected, the consulting parties to this Programmatic Agreement shall proceed in accordance with **Stipulation VIII (Resolving Objections)**, below.

(D) Scope of Identification Efforts in the APE: Inventories of Historic Properties within the established or revised APE shall be completed in accordance with **Stipulation IV (Inventory of Historic Properties)** of this Programmatic Agreement. Treatment of any adverse effects to Historic Properties within the established or revised APE shall be completed in accordance with **Stipulation V (Treatment of Effects)** of this Programmatic Agreement.

(E) Scope of the APE: For purposes of this Programmatic Agreement, a revised APE shall be defined to meet, at a minimum, the following criteria:

(1) The APE for any segment of the Natomas levees that are being improved as part of the Project and shall include the levee segment and a corridor extending not less than 75 feet from the land side toe of the levee segment. The APE also shall include:

- The extent of all Project construction and excavation activity required to construct flood control facilities and to modify irrigation and drainage infrastructure,
- The additional right-of-way/easements obtained by SAFCA as part of the Project's features,
- All areas used for excavation of borrow material and habitat creation, and
- All construction staging areas.

(2) The APE for Project activities shall include the direct footprint of the activity and a reasonable buffer determined by consultation between SAFCA and the Corps, according to the nature of the activity, SAFCA's ownership interest or easement, and the probability that ground-disturbing work may extend beyond the footprint of planned improvements and activities.

(3) The APE for any other type of Project development activities shall be defined by the Corps in consultation with the consulting parties.

IV. INVENTORY OF HISTORIC PROPERTIES

(A) Identification Efforts to Date and Further Work Required: An inventory of Historic Properties within the APE has been initiated consistent with the *Secretary of Interior's Standards and Guidelines for Archeology and Historic Preservation* (48 FR 44716–44740). The SAFCA shall submit a completed inventory and evaluation for each phase of Project work (2008, 2009, 2010) to the Corps. Such inventory shall be deemed complete by the Corps when the SHPO concurs in the NRHP eligibility recommendation for all cultural resources within the APE for that phase.

Areas of Archaeological Sensitivity: Areas of archaeological sensitivity will be monitored in accordance with HPTPs.

(C) Changes in the APE: If areas are added to the Project development activities subsequent to the SHPO concurrence on the map of the APE for a specific phase, SAFCA shall complete an inventory of Historic Properties within the expanded APE. Such inventory shall be undertaken and completed consistent with the *Secretary of Interior's Standards and Guidelines for Archeology and Historic Preservation* (48 FR 44716–44740). Such inventory shall be deemed completed by the Corps at such time as the SHPO concurs in the NRHP eligibility of all cultural resources within the established and revised APE for the Project, pursuant to this Stipulation IV.

V. TREATMENT OF EFFECTS

(A) Historic Property Treatment Plans: If Historic Properties are identified in cultural resources inventories that would be adversely affected by the Project, SAFCA shall prepare a Historic Properties Treatment Plan (HPTP) for review and written approval by the Corps and the SHPO for those specific properties. An HPTP applicable to every Historic Property that may sustain adverse effects by the Project shall be prepared, including for those Historic Properties found during construction. An HPTP may address individual or multiple Historic Properties. An HPTP shall stipulate those actions SAFCA shall take to resolve the adverse effects of the Project on Historic Properties. SAFCA shall ensure that all provisions of an HPTP are carried out in a timely manner. Any changes to an HPTP shall be reviewed and approved by the Corps. Copies of all reports pertaining to the treatment of Historic Properties shall be submitted to the consulting parties to this Programmatic Agreement. Reports and other data pertaining to the inventory of, and treatment of effects on, Historic Properties may be distributed to concurring parties to this Programmatic Agreement and to other members of the public consistent with **Stipulation VII (Confidentiality)** of this Programmatic Agreement. Individual HPTPs may be submitted simultaneously with the cultural resources inventory report for specific Project phases. If HPTPs are submitted simultaneously with an inventory report for a Project phase or with an addendum to such report for an expanded APE or Project description, the Corps and SHPO review period for such HPTP shall run concurrently with the review period for the inventory report.

Review Schedule: The SHPO and the Corps shall have 30 calendar days to review and comment upon in writing any HPTP submitted by SAFCA. The SHPO and the Corps shall indicate in their review that they find the HPTP either acceptable or not. In the event that comments are not made by the SHPO within 30 calendar days, the Corps shall assume the SHPO has accepted the HPTP as submitted. In the event the Corps and/or the SHPO provide written comment within the 30-day period, either SAFCA shall accept the comments and revise the HPTP accordingly, or SAFCA and the Corps may object to some or all comments. Comments from the Corps or the SHPO that are not acceptable to SAFCA shall be resolved by consultation among the Corps, the SHPO, and SAFCA for a period of not more than 15 calendar days. Should the Corps, the SHPO, and SAFCA be unable to resolve any dispute regarding the Corps or the SHPO comments, the consulting parties shall proceed in accordance with **Stipulation VIII (Resolving Objections)** of this Programmatic Agreement.

The Corps shall submit to the SHPO for review and comment any amendment, addendum, revision or other change to an HPTP. SAFCA shall proceed to make changes to an HPTP as per the procedure and schedule for the review and approval of an original HPTP. If a Historic Property is discovered within an expanded APE subsequent to an initial inventory effort for a phase, and the Corps and SAFCA agree that the Project may adversely affect the property, SAFCA shall submit an addendum to the HPTP or a new HPTP. The review schedule for this submittal follows the provisions of Stipulation V.

(B) Commencement of Construction and Project Work: Project development activities may commence within the APE after a Historic Properties inventory has been completed (per **Stipulations III and IV**, above), and prior to treatment of adverse effects on Historic Properties within the APE provided that:

(1) A plan to respond to inadvertent archaeological discoveries is prepared by SAFCA and approved by the Corps prior to the commencement of Project activities anywhere in the APE for that phase of the Project; and

(2) Project development activities do not encroach within 30 meters (100 ft) of the known boundaries of any Historic Property as determined from archaeological site record forms, other documentation, or as otherwise defined in consultation with the SHPO; and

(3) An archaeological monitor is present during any Project activities that are anticipated to extend either vertically or horizontally into any areas designated to be archaeologically sensitive by SAFCA in consultation with the Corps.

(C) Final Report Documenting Implementation of the Historic Properties Treatment Plan(s): Within one year after the completion of all work performed as part of the Project SAFCA shall submit to the Corps and SHPO a final report documenting the results of all work prepared under the HPTPs. This report shall be submitted to the Corps and SHPO for review and comments, which SAFCA shall incorporate.

VI. NATIVE AMERICAN AND OTHER PUBLIC CONSULTATION AND PUBLIC NOTICE

Members of the interested public shall be invited to consult regarding this Programmatic Agreement. Within 30 calendar days of the signing date of this Programmatic Agreement, the Corps, the SHPO, and SAFCA shall consult to compile a list of members of the interested public who shall be provided notice of this Programmatic Agreement. The opinions of local Native Americans with cultural ties to the APE and the opinions of other members of the public shall be taken into account by the consulting parties for historic preservation actions taken in accordance with this Programmatic Agreement. Native Americans and other members of the public may be invited to concur in this Programmatic Agreement. Native American monitor(s) shall be invited to assist SAFCA in the treatment of any Native American human remains and items associated with Native American burials discovered during the Project in accordance with California Public Resources Code Section 5097.98 and California Health and Safety Code Section 7050.5(b) and 7050.5(c).

VII. CONFIDENTIALITY

Confidentiality regarding the nature and location of the archaeological sites and any other cultural resources discussed in this Programmatic Agreement shall be maintained on a "need-to know" basis limited to appropriate personnel and agents of SAFCA, the Corps, and the SHPO involved in planning, reviewing and implementing this Programmatic Agreement consistent with Section 304 of the NHPA.

VIII. RESOLVING OBJECTIONS

(A.) Should any party to this Programmatic Agreement object to any action proposed or carried out pursuant to this Programmatic Agreement, the Corps shall consult with the objecting party(ies) for a period of time not to exceed *30 calendar days* to resolve the objection. If the Corps determines that the objection cannot be resolved, the Corps shall forward all documentation relevant to the dispute to the Council. Within 30 calendar days after receipt of all pertinent documentation, the Council shall either:

(1) Provide the Corps with recommendations, which the Corps shall take into account in reaching a final decision regarding the objection; or

(2) Notify the Corps that the Council will comment in accordance with the requirements of Section 106 of the NHPA, and proceed to comment. Any Council comment provided in response shall be taken into account by the Corps, pursuant to the requirements of Section 106 of the NHPA.

(3) Should the Council not exercise one of the above options within 30 days after receipt of all pertinent documentation, the Corps may assume the Council's concurrence in its proposed response to the objection.

(4) The Corps shall take into account any Council recommendation or comment provided in accordance with this stipulation with reference only to the subject of the objection; the Corps' responsibility to carry out all actions under this Programmatic Agreement that are not the subjects of the objection shall remain unchanged.

(B.) At any time during implementation of the measures stipulated in this Programmatic Agreement should an objection pertaining to the Programmatic Agreement be raised by a member of the public, the Corps or SAFCA shall notify the consulting parties to the Programmatic Agreement and take the objection into account, consulting with the objector and, should the objector so request, with any of the consulting parties to this Programmatic Agreement to address the objection.

IX. AMENDMENTS

Any consulting party to this Programmatic Agreement may propose that the Programmatic Agreement be amended, whereupon the Corps shall consult with the other consulting parties to this Programmatic Agreement to consider such amendment. Any amendment shall be executed by the consulting parties in the same manner as the original Programmatic Agreement.

If the Project has not been completed within five years of the date of the execution of this Programmatic Agreement, the consulting parties shall consult on a date not less than 90 days prior to the fifth anniversary of this Programmatic Agreement to either amend this Programmatic Agreement and acknowledge its continued applicability for the undertaking for a designated period of time, or terminate this Programmatic Agreement and proceed to again consult regarding the undertaking in accordance with regulations implementing Section 106 of the NHPA.

All attachments to this Programmatic Agreement, and other instruments prepared pursuant to this agreement such as, but not limited to, the Project's description, initial cultural resource inventory report and maps of the APE, HPTPs, and monitoring and discovery plans may be amended without requiring amendment of this Programmatic Agreement. Such amendments will be consulted on by the concurring parties and shall be final when agreement is reached by the parties.

X. FAILURE TO CARRY OUT THE TERMS OF THE AGREEMENT

Should the Corps fail to ensure that the terms of this Programmatic Agreement are carried out, the Corps shall notify the parties to this Programmatic Agreement and again consult with the SHPO and the Council in accordance with regulations implementing Section 106 of the NHPA. The Corps shall not take any action or make any irreversible decision that would affect an Historic Property, preclude historic preservation alternatives, or foreclose any opportunities for the Council to comment on the undertaking prior to completion of the process for considering and resolving effects on Historic Properties provided in this document.

XI. SCOPE OF THE PROGRAMMATIC AGREEMENT

Execution of this Programmatic Agreement by the Corps, the SHPO, and SAFCA, and implementation of its terms, evidence that Corps has afforded the Council an opportunity to comment on the undertaking for SAFCA Natomas Levee Improvement Program Landside Improvements Project, pursuant to 16 U.S.C. 470f, and that the Corps has taken into account the effects of the undertaking on Historic Properties. This Programmatic Agreement is limited in scope to the undertaking defined herein and is entered into solely for that purpose.

CONSULTING PARTIES:

U.S. ARMY CORPS OF ENGINEERS, SACRAMENTO DISTRICT

By: Thomas C. Chapman Date: 10 Apr 08

Title: COL Thomas Chapman, District Engineer, Sacramento District, U.S. Army Corps of Engineers

SACRAMENTO AREA FLOOD CONTROL AGENCY

By: Stein M. Buer Date: 4/11/08

Title: Stein M. Buer, Executive Director, Sacramento Area Flood Control Agency

CALIFORNIA STATE HISTORIC PRESERVATION OFFICER

By: Stephen D. Mikesell Jr. Date: 5/1/08

Title: Milford Wayne Donaldson, F.A.I.A., California State Historic Preservation Officer

CONCUR:

CENTRAL VALLEY FLOOD PROTECTION BOARD

By: Jay S. Punia Date: 6/23/08
Title: Jay S. Punia, Executive Officer, Central Valley Flood Protection Board

By: JAY S. PUNIA Date: 6/23/08
Title: Executive Officer, CVFPB

Attachment A: Project Description Summary
Attachment B: "Cultural Resources Inventory Reports, Part 1 – Natomas Levee Improvement Program Landside Improvements Project, Sacramento and Sutter Counties, California" (report).

ATTACHMENT A

Project Description Summary