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Final Independent External Peer Review Report for the Engineering and Economic Reevaluation of the Geotechnical, Hydrological, Hydraulic, and Economic Aspects of Flood Risk Reduction Report, American River Common Features

Prepared by
Battelle Memorial Institute

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Flood Risk Management
Planning Center of Expertise
Sacramento District

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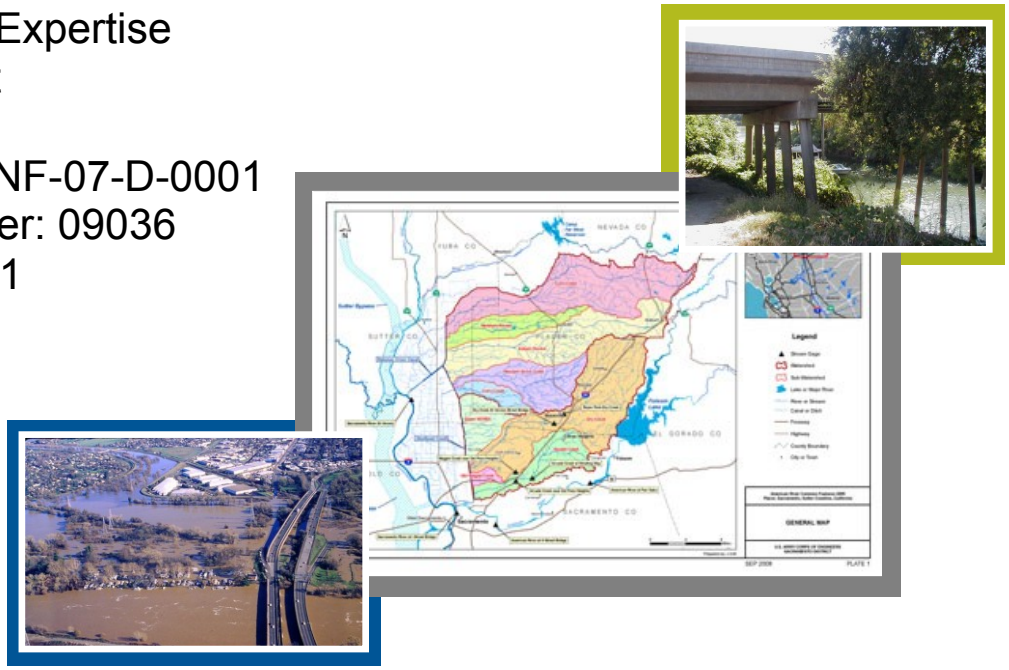

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SHORT TERM ANALYSIS SERVICE (STAS)

on

Final Independent External Peer Review Report
for the
Engineering and Economic Reevaluation of the Geotechnical, Hydrological, Hydraulic,
and
Economic Aspects of Flood Risk Reduction Report, American River Common Features

by

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FINAL
INDEPENDENT EXTERNAL PEER REVIEW REPORT

of the
Engineering and Economic Reevaluation of the Geotechnical, Hydrological, Hydraulic, and Economic Aspects of Flood Risk Reduction Report, American River Common Features

EXECUTIVE SUMMARY

The American River Common Features project (Common Features) is being developed to provide flood risk management to the City of Sacramento, including the Natomas Basin and areas along the north and south sides of the American River. A fast-growing region in the country's most populous state, the Greater Sacramento area encompasses the floodplains of two major rivers—the Sacramento and the American —as well as additional rivers and tributaries that drain the Sierra Nevada mountains. Expanding urban centers lie in floodplains where flooding could result in extensive loss of life and billions of dollars in damages.

Authorized in 1996, the Common Features project consists primarily of levee creation and modification, in addition to flood warning systems and pumping capabilities. However, since authorization, increased understanding of under seepage and through seepage problems that jeopardize levee stability have substantially increased project costs. Consequently, a general engineering and economic reevaluation is necessary to determine if the alternative proposed is still viable and justified and if there is another alternative that may be more effective. The American River Watershed Common Features Project General Reevaluation Report (GRR) includes flood risk management to the City of Sacramento and the Natomas Basin. The purpose of the GRR is to develop analysis tools that consider the flood protection system as a whole and identify a comprehensive plan that will lower the risk of flooding in and around Sacramento. The objective of this study is to reevaluate the currently authorized plan, as well as to develop and evaluate other viable alternatives, including a locally-preferred plan.

In accordance with the Water Resources Development Act (WRDA) 2007 (Public Law 110-114), Section 2034 dated November 8, 2007, the USACE is conducting an independent external peer review (IEPR) of the Engineering and Economic Reevaluation of the Geotechnical, Hydrological, Hydraulic, and Economic Aspects of Flood Risk Reduction Report, American River Common Features ("Common Features GRR"). At this stage, the focus of the IEPR is on the investigations to identify and document the existing hydrologic, hydraulic, geotechnical, and economic conditions of the general reevaluation. Battelle, as a 501(c)(3), non-profit science and technology organization with experience in establishing and administering peer review panels for USACE, was engaged to coordinate the IEPR of the Common Features GRR. Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses. The IEPR will be external to the agency and conducted following guidance described in the Department of the Army, USACE, guidance Peer Review of Decision Documents (EC 1105-2-410) dated August 22, 2008, CECW-CP Memorandum dated March 30, 2007, and the Office of Management and Budget's Final Information Quality Bulletin for Peer Review released December 16, 2004.

This final report details the IEPR process, describes the panel members and their selection, and summarizes final comments of the IEPR panel on the existing geotechnical, hydrologic, and hydraulic conditions and Without Project National Economic Development Damages of the Common Features GRR project as described in the review documents. The results of this IEPR report will be taken into consideration prior to conducting the Common Features GRR alternative analysis. This approach seeks to minimize the risk of having to repeat the substantial GRR analytical efforts should the IEPR panel find significant deficiencies or erroneous conclusions.

Five panel members were selected for the IEPR from 20 identified candidates. Corresponding to the technical content of the Common Features GRR, the areas of technical expertise of the five selected peer reviewers were geotechnical engineering, hydraulic engineering, and economics. It was also emphasized that all three geotechnical peer reviewers should be familiar with geotechnical engineering practices used in California, and that all reviewers be active in their related professional societies.

The peer reviewers were provided an electronic version of the Common Features GRR documents, along with a charge that solicited their comments on specific sections of the documents that were to be reviewed. Panel members conducted reviews of appendices within their own discipline (e.g., the economics panel member reviewed the Economics Appendix), and all panel members reviewed The American River Watershed Common Features Project GRR F3 Pre-Conference Documentation main report (Common Features GRR main report) Chapter 1 – Study Information and Chapter 2 – Problem Identification. Table ES-1 summarizes the review documents, number of charge questions, and specific panel members who were asked to respond to the charge.

Table ES-1. Common Features GRR Review Documents and Charge Question Summary

Review Document	No. of Charge Questions	Panel Members Tasked with Review (No. of Reviewers)
American River Watershed Common Features Project General Reevaluation Report F3 Pre-Conference Documentation main report Chapter 1 – Study Information Chapter 2 – Problem Identification	15	All (5)
Appendix C: Synthetic Hydrology Technical Documentation (previously Appendix A) Appendix D: Hydraulic Technical Documentation F3 Milestone	42	Hydrology and Hydraulic Engineering (1)
Appendix E: Economics Working Draft	32	Economics (1)
Appendix F: Geotechnical Risk Base Analysis F3 Existing Conditions Geotechnical Report For American River Common Features	87	Geotechnical Engineering (3)

More than 340 individual comments were received from the IEPR panel in response to the charge questions. The IEPR panel and Battelle were briefed by the Common Features GRR Project Development Team during two kick-off meetings held at the USACE Sacramento District prior to the start of the review. There was no communication between the IEPR panel and the authors of the Common Features GRR during the peer review process.

Following the individual reviews of the Common Features GRR documents by the IEPR panel members, four panel review teleconferences by document and discipline were conducted to review key technical comments, discuss charge questions for which there were conflicting responses, and reach agreement on the final comments to be provided to USACE. The final comments were documented according to a four-part format that included description of: (1) the nature of the comment; (2) the basis for the comment; (3) significance of the comment (high, medium, and low); and (4) recommendations on how to resolve the comment.

The IEPR panel identified 40 final comments, ranked according to high, medium, and low significance. Although all panel members agreed upon the comments listed for the Common Features GRR main report, the panel members' reviews were focused on documents within their own disciplines. In total, as shown in Table ES-2, 15 comments were identified as having high significance, 19 as having medium significance, and 6 as having a low level of significance. Tables ES-3, ES-4, ES-5, and ES-6 summarize final comments by document or discipline and by level of significance. Note that one issue affecting the Common Features GRR main report, Hydrology and Hydraulic Engineering, and Economics documents was addressed in three separate but related comments: MR04, HH05, and E01, respectively. This issue was treated as three separate comments due to differences in how similar material was presented in the individual documents and the way the review was structured. Detailed information on each comment is contained in Appendix A of this report.

Table ES-2. Final Panel Comments Summarized by Document/Discipline and Significance Rating.

Document/Discipline	Total No. of Final Comments	No. of Comments by Significance Rating		
		High	Medium	Low
Common Features GRR main report	8	5	3	0
Hydrology and Hydraulic Engineering	15	6	6	3
Economics	8	3	4	1
Geotechnical Engineering	9	1	6	2
Total	***40***	***15***	***19***	***6***

The IEPR panel members generally agreed on their "assessment of the adequacy and acceptability of the economic [and] engineering…methods, models, and analyses used" in the reports. The following statements provide a broad overview of the panel's findings, which are described in more detail in the individual Final Panel Comments located in Appendix A of this report. Note that one issue affecting the Common Features GRR main report, Hydrology and Hydraulic Engineering, and Economics documents was addressed in three separate but related comments: MR04, HH05, and E01, respectively. This issue was treated as three separate comments due to differences in how similar material was presented in the individual documents and the way the review was structured.

Engineering

Hydrology and Hydraulic Engineering

The Hydrology and Hydraulic Engineering documents provide a good base from which to build the project and begin building the alternative formulation. The methods, models, and analyses appear to be appropriate and acceptable with respect to the engineering and aspects of the project. For example, the project team did a good job utilizing the available data and the approach used to create an interaction between the HEC-RAS and FLO-2D models was particularly well thought out. However, the documents do not appear to adequately describe the interaction between the HEC-RAS and FLO-2D models to produce frequency-damage relationships for use in the economic analyses. Other critical issues relate to the documentation of the hydrologic methods used, the selection of breach locations, the analysis of the Natomas Basin, confusion over the various without-project conditions, and lack of documentation of any "future without-project conditions;" all of which are critical to effective plan formulation process and identification of the proper National Economic Development (NED) Plan.

Geotechnical Engineering

Although the purpose of the geotechnical engineering documents reviewed for the F3 Milestone (Appendix F: Geotechnical Risk Base Analysis and F3 Geotechnical Report of Existing Conditions for American River Common Features) was not clearly stated as it relates to the GRR process, the documents were generally well done and included a massive data review. The engineering methods, models, and analyses were reasonably state of practice and appropriate for establishing the existing conditions of the levee system as a whole. However, the two geotechnical documents, F3 Existing Conditions Geotechnical Report and Appendix F: Geotechnical Risk Based Analysis, were written as completely independent documents. Appendix F should rely on the background information provided in the F3 Existing Conditions

Geotechnical Report. The examination of typical or worst case cross sections does not extrapolate into the levee reaches or provide an overall evaluation of the project, and the impacts of seismic vulnerabilities were not adequately discussed.

Economics

Some questions about the methodologies used in the Economics Appendix will require further explanation. The analysis utilized seven flood frequencies rather than the eight frequencies typically used in damage assessments, making it difficult to assess the reasonableness and accuracy of the results. In addition, the sensitivity analysis for the levee probability curves was insufficient. Until more detail is provided on the methodologies and assumptions that were included in the economic analysis, its adequacy and acceptability with respect to USACE guidance cannot be fully assessed.

Table ES-3. Overview of Eight Common Features GRR Main Report Final Comments Identified by the Common Features GRR IEPR Panel.

Significance – High	
MR01	Inadequate specific justification is provided for why the general reevaluation is needed.
MR02	It is unclear to what extent the existing flood control project is being considered as a comprehensive system and how recently completed and planned projects by local sponsors are being integrated.
MR03	The forum to identify public concerns appears to have been limited and the public concerns identified in the report do not appear to fully characterize potential significant issues.
MR04	The differences between the without-project condition and no-action condition need to be clearly described.
MR05	A discussion of seismic vulnerability and seismically induced levee failure needs to be included.
Significance – Medium	
MR06	In the discussion of levee overtopping, the source for the provision for only one foot of freeboard to account for climate change and static settlement should be identified.
MR07	The economic, hydrologic, and hydraulic analyses should use the eight flood frequencies: 2-year, 5-year, 10-year, 25-year, 50-year, 100-year, 250-year and 500-year.
MR08	The American River Watershed Common Features Project General Reevaluation Report (GRR) main report needs to explain better how the no-action could be affected by other projects that will be built.

Table ES-4. Overview of 15 Hydrology and Hydraulic Engineering Final Comments Identified by the Common Features GRR IEPR Panel.

Significance – High	
HH01	The hydrologic method "Synthetic Flood Runoff Centering" is not widely known or used and publically-available documentation is limited.
HH02	Not enough information has been provided about potential breach locations.
HH03	Additional information is needed regarding the creation of the frequency-damage relationship for use in the HEC-FDA model.
HH04	Additional discussion and presentation of results is needed related to the Natomas area.
HH05	The specific differences in the F3 Milestone conditions Without Project 1 (WO1), Without Project 3 (WO3), and No Action 3 (NA3) are not described in Appendix D: Hydraulic Technical Documentation F3 Milestone.
HH06	The "future without-project" conditions should be documented, even if conditions are the same as "existing without-project" conditions.
Significance – Medium	
HH07	Verification of the unsteady models should be performed using data from an additional event, such as the 1986 flood-of-record, to demonstrate the accuracy of the HEC-RAS model.
HH08	More detail on the use of geotechnical fragility curves and geotechnical data to develop levee breach scenarios and trigger elevations for the hydraulic models is needed.
HH09	The description of floodplain hydraulics and floodplain delineation needs more detail.
HH10	An interior flood analysis should be completed before alternative formulation as it may have an effect on alternative selection.
HH11	Additional consideration should be given to the assumptions in the FLO-2D model related to roadways, soundwalls, and rainfall.
HH12	Clarification is needed regarding the presentation of the water surface elevations both inside and outside the levees related to the FLO-2D and HEC-RAS models, respectively.
Significance – Low	
HH13	If available, additional data beyond 2000 should be incorporated as it would affect/enhance the method used to create the downstream boundary condition.
HH14	The American River Watershed Common Features Project General Reevaluation Report (GRR) Appendix D would benefit from review by a technical editor as several statements are need to be clarified.
HH15	Additional information is needed to evaluate the assumption of instantaneous failure in levee breaches.

Table ES-5. Overview of Eight Economics Final Comments Identified by the Common Features GRR IEPR Panel.

Significance – High	
E01	The Economics Appendix should indicate which of the three without-project/no-action conditions will be used to develop the National Economic Development Plan.
E02	The decrease in the single occurrence damages for the 100- and 200-year events and the increase in the 500-year event for Without Project 3 condition (WO3) as compared to Without Project 1 condition (WO1) needs further explanation.
E03	Detailed information is needed to justify the selection and use of the HEC-FDA Model Version 1.3 the current version 1.2.4.
Significance – Medium	
E04	The levee failure probability curve needs to be better explained and a sensitivity analysis needs to be conducted.
E05	The analysis of the uncertainty of the stage discharge variable, which affects the EAD, is missing.
E06	It is unclear whether uncertainty was considered in the analysis for nonresidential structures.
E07	It is unclear which water surface elevations relate to no upstream failures and upstream failures.
Significance – Low	
E08	A more detailed explanation of the allocation of vehicle types by category and numbers of vehicles is needed.

Table ES-6. Overview of Nine Geotechnical Engineering Final Comments Identified by the Common Features GRR IEPR Panel.

Significance – High	
G01	The consequences of higher flood levels on flood protection either during or following a major earthquake need to be further addressed.
Significance – Medium	
G02	The American River Watershed Common Features Project General Reevaluation Report (GRR) and appendices would benefit from a review by a technical editor.
G03	The Geotechnical Risk-Based Analysis should be integrated into the updated F3 Existing Conditions Geotechnical Report for American River Common Features.
G04	The methodologies for how key hazards and failure modes are accounted for in the geotechnical risk and uncertainty analysis, and for assessing the subjective expert opinions, are not clearly described.
G05	The descriptions of the existing improvements are not clearly presented in the F3 Existing Conditions Geotechnical Report for American River Common Features.
G06	The basis for selecting the analysis cross sections is not clearly explained and the mixture of representative with worst case cross sections make it difficult to interpret how the varying factors of safety were obtained.
G07	The selection of a 100-year return period for the erosion vulnerability analysis is inconsistent with the 200-year protection criterion used for other aspects of levee design.
Significance – Low	
G08	The purpose and intended use of the F3 Existing Conditions Geotechnical Report for American River Common Features has not been clearly identified.
G09	Descriptions of the various levee areas are not uniform or systematic, making identification of the pertinent data cumbersome.

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1. INTRODUCTION

1.1 Background of Report Reviewed

The American River Common Features project (Common Features) is being developed to provide flood risk management to the City of Sacramento, including the Natomas Basin and areas along the north and south sides of the American River. A fast-growing region in the country's most populous state, the Greater Sacramento area encompasses the floodplains of two major rivers—the Sacramento and the American —as well as additional rivers and tributaries that drain the Sierra Nevada mountains. Expanding urban centers lie in floodplains where flooding could result in extensive loss of life and billions in damages.

Authorized in 1996, the Common Features project consists primarily of levee creation and modification, in addition to flood warning systems and pumping capabilities. However, since authorization, increased understanding of under seepage and through seepage problems that jeopardize levee stability have substantially increased project costs. Consequently, a general engineering and economic reevaluation is necessary to determine if the alternative proposed is still viable and justified and if there is another alternative that may be more effective. The American River Watershed Common Features Project General Reevaluation Report (GRR) includes flood risk management to the City of Sacramento and the Natomas Basin. The purpose of the GRR is to develop analysis tools that consider the flood protection system as a whole and identify a comprehensive plan that will lower the risk of flooding in and around Sacramento. The objective of this study is to re-evaluate the currently authorized plan, as well as to develop and evaluate other viable alternatives, including a locally-preferred plan.

In accordance with the Water Resources Development Act (WRDA) 2007 (Public Law 110-114), Section 2034 dated November 8, 2007, the USACE is conducting an independent external peer review (IEPR) of the Engineering and Economic Reevaluation of the Geotechnical, Hydrological, Hydraulic, and Economic Aspects of Flood Risk Reduction Report, American River Common Features ("Common Features GRR"). Battelle, as a 501(c)(3) non-profit science and technology organization with experience in establishing and administering peer review panels for USACE, was engaged to coordinate the IEPR of the Common Features GRR. Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses. The IEPR will be external to the agency and conducted following guidance described in the Department of the Army, USACE, guidance Peer Review of Decision Documents (EC 1105-2-410) dated August 22, 2008, CECW-CP Memorandum dated March 30, 2007, and the Office of Management and Budget's Final Information Quality Bulletin for Peer Review released December 16, 2004.

This final report details the IEPR process, describes the panel members and their selection, and summarizes final comments of the IEPR panel on the existing geotechnical, hydrologic, and hydraulic conditions and Without Project National Economic Development Damages of the Common Features GRR project as described in the review documents. The results of this IEPR report will be taken into consideration prior to conducting the Common Features GRR alternative analysis. This approach seeks to minimize the risk of having to repeat the substantial GRR analytical efforts should the IEPR panel find significant deficiencies or erroneous

conclusions. Detailed information on the final comments of the IEPR panel is provided in Appendix A.

1.2 Purpose of Independent External Peer Review

To help ensure that USACE documents are supported by the best scientific and technical information, a peer review process has been implemented by USACE that utilizes Independent External Peer Review (IEPR) to complement the Agency Technical Review (ATR), as described in the Department of the Army, U.S. Army Corps of Engineers, guidance Peer Review of Decision Documents (EC 1105-2-410) dated August 22, 2008; and CECW-CP Memorandum dated March 30, 2007.

The purpose of peer review, in general, is to strengthen the quality and credibility of the USACE decision documents in support of its Civil Works program. Independent external peer review provides an independent assessment of the economic, engineering, and environmental analysis of the project study. This specific IEPR was limited to a review of the economic and engineering analyses describing the existing conditions of the project study. In particular, this IEPR addresses the overall adequacy of the scope and structure of the report; the technical soundness of the report's assumptions, methods, analyses, and calculations; and the need for additional data or analyses to describe conditions without a project so that the impacts of project alternatives can be defined.

In this case, the IEPR of the Common Features GRR was conducted and managed using contract support from Battelle, which is an Outside Eligible Organization (OEO), eligible under 501(c)(3). Battelle is an independent, objective science and technology organization with experience conducting IEPRs, which ensured a high degree of flexibility and responsiveness to meet USACE deadlines.

2. METHODS

This section describes the methodology followed in selecting independent external peer reviewers, and in planning and conducting the IEPR. The IEPR was conducted following procedures described in USACE's guidance cited above (Section 1.2 of this report) and in accordance with the Office of Management and Budget's Final Information Quality Bulletin for Peer Review, released December 16, 2004. Supplemental guidance on evaluation for conflicts of interest used the National Academies' Policy on Committee Composition and Balance and Conflicts of Interest for Committees Used in the Development of Reports, dated May 12, 2003.

2.1 Planning and Schedule

Table 1 defines the schedule followed in performing the IEPR.

Table 1. Common Features GRR IEPR Schedule by Task.

Task	Action	Due Date
	Notice to Proceed	January 31, 2009
	Review Documents available – all with the exception of the *F3 Existing Conditions Geotechnical Report*	January 31, 2009
	Review Document available - *F3 Existing Conditions Geotechnical Report*	March 27,2009
Task 1	Submit draft Work Plan	February 16, 2009
	Submit final Work Plan (including final charge)	March 2, 2009
	Submit revised final Work Plan	April 23, 2009
Task 2	Recruit and screen up to 10 potential peer reviewers; prepare summary information	February 16, 2009
Task 3	Submit Draft Charge	February 16, 2009
	USACE provides comments on Draft Charge and Work Plan	February 23, 2009
	Submit Final Charge (included in final Work Plan)	March 2, 2009
	USACE approves Final Charge and final Work Plan	March 4, 2009
	Submit Draft Charge for the *F3 Existing Conditions Geotechnical Report*	April 7, 2009
	USACE provides comments on Draft Charge for the *F3 Existing Conditions Geotechnical Report*	April 15, 2009
	Submit Final Charge for *F3 Existing Conditions Geotechnical Report*	April 17, 2009
	USACE approved Final Charge for the *F3 Existing Conditions Geotechnical Report*	April 19, 2009
Task 4	Select no more than 10 external peer reviewers	March 2, 2009
	Submit list of selected peer reviewers	March 3, 2009
	Complete subcontracts for peer reviewers	March 17, 2009
Task 5	Kick-off Meeting	March 23, 2009
	Economics Kick-off Meeting	April 24, 2009
Task 6	Review documents and Final Charge sent to peer reviewers	March 18, 2009
	Review document – *F3 Existing Conditions Geotechnical Report*- and Final Charge sent to peer reviewers	April 19, 2009
	External peer reviewers complete their review	April 29, 2009
	Collate comments from peer reviewers	May 1, 2009
	Convene panel review teleconference	May 4, 2009
Task 7	Prepare final panel comments	May 20, 2009
	Submit final peer review report	June 10, 2009
Task 8	Input final panel comments to DrChecks	June 12, 2009
	USACE provides clarifying questions	June 25, 2009
	Teleconference with USACE and panel to discuss clarifying questions	June 30, 2009
	USACE inputs response to Final Comments in DrChecks (*i.e.*, Evaluator)	July 14, 2009
	Peer reviewers respond to USACE comments; Battelle posts panel responses in DrChecks (*i.e.*, BackCheck); Battelle closes out DrChecks	July 30, 2009

2.2 Identification and Selection of Independent External Peer Reviewers

Battelle initially identified approximately 20 potential peer reviewers, confirmed their availability, evaluated their technical expertise, and inquired about potential conflicts of interest. Of those initially contacted, 15 independent peer review candidates confirmed their interest and availability. The remaining five candidates declined either due to the schedule and anticipated level of effort, disclosed conflicts of interest, or because they did not possess the technical expertise being sought.

Corresponding to the technical content of the Work Plan and the overall scope of the Common Features GRR, the technical expertise areas for which the peer reviewers were evaluated focused on three key areas: geotechnical engineering, hydraulic engineering, and economics. It was also emphasized that the geotechnical peer reviewers (three in total) should be familiar with geotechnical engineering practices used in California, and that all reviewers be active in their related professional societies.

The peer reviewers were also screened for the following potential exclusion criteria or conflicts of interest.[a] Participation in previous USACE technical peer review committees and other technical review panel experience was also considered, as follows:

- Involvement in any part of the American River Common Features Project, including, but not limited to, producing the Common Features General Reevaluation Report, supporting appendices, related technical data, and models pertaining to the Report.
- Current employment by the USACE.
- Current or previous employment or affiliation with other project sponsors, including the State of California Central Valley Flood Protection Board (CVFPB–formerly known as The Reclamation Board) and the Sacramento Area Flood Control Agency (SAFCA).
- Current or future interests in the subject project or future benefits from the project.
- Current personal or firm involvement with other USACE projects, notably if those projects/contracts are with the Sacramento District or South Pacific Division. If yes, provide title/description, dates, and location (USACE district, division, Headquarters, ERDC, etc.), and position/role.
- Previous employment by the USACE as a direct employee or contractor (either as an individual or through your firm) within the last 10 years, notably if those projects/contracts were with the Sacramento District or South Pacific Division. If yes, provide title/description, dates employed, and place of employment (district, division, Headquarters, ERDC, etc.), and position/role.

[a] Note: Battelle will be evaluating whether scientists in universities and consulting firms that are receiving USACE-funding have sufficient independence from USACE to be appropriate peer reviewers. See the OMB memo p. 18, "….when a scientist is awarded a government research grant through an investigator-initiated, peer-reviewed competition, there generally should be no question as to that scientist's ability to offer independent scientific advice to the agency on other projects. This contrasts, for example, to a situation in which a scientist has a consulting or contractual arrangement with the agency or office sponsoring a peer review. Likewise, when the agency and a researcher work together (e.g., through a cooperative agreement) to design or implement a study, there is less independence from the agency. Furthermore, if a scientist has repeatedly served as a reviewer for the same agency, some may question whether that scientist is sufficiently independent from the agency to be employed as a peer reviewer on agency-sponsored projects."

- Previous experience conducting technical peer reviews. If yes, provide client/agency and duration of review (approximate dates).
- A significant portion (i.e., greater than 50%) of personal or firm revenues within the last three years came from USACE contracts.
- Any publicly documented statement made advocating for or against the subject project.
- Any other perceived conflict of interest (COI) not listed, such as:
  - Repeatedly served as USACE technical reviewer
  - Paid or unpaid participation in litigation related to the work of the USACE
  - Any other perceived COI not listed
- Participation in relevant prior studies discussed in the detailed project history:
  - American River Watershed Investigation, California, Feasibility Report, December 1991.
  - American River Watershed Investigation, California, Chief of Engineers' Report, 29 June 1992.
  - American River Watershed Project, California, Supplemental Information Report, March 1996.
  - American River Watershed, California, Chief of Engineers' Report, 27 June 1996.
  - Supplemental Information Report, American River Watershed Project, California, Main Report and SEIS/EIR Addendum, 18 August 1997.
  - Project Cooperation Agreement between the Department of the Army and the State of California for Construction of the American River Watershed (Common Features), California Project, 13 July 1998.
  - American River Watershed Project, California (Common Features), Information Paper, 16 August 2000.
  - American River Watershed Project (Common Features), California, Second Addendum to the Supplemental Information Report, March 2002.
  - American River (Common Features) Project, California, Project Cooperation Agreement (Contract 460000065 I), Amendment No. 1, 13 June 2003.
  - Memorandum, CESPK-PM-C, Subject: American River Watershed (Common Features), California Project, Pocket and Pioneer Reservoir Levee Improvement Areas--Information Paper, 07 April 2007.
  - Memorandum for Record, CESPK-OC, Inclusion of Levee Repair within the Sacramento Pocket and Pioneer Sites under the American River CF Project, 17 April 2006.
  - American River Watershed Project, Folsom Modification and Folsom Dam Raise Post Authorization Report and Engineering Documentation Report, March 2007.
  - American River Watershed Project, Folsom Modification and Folsom Dam Raise Economic Reevaluation Report, Draft June 2007.
- Participation in major flood risk management initiatives active in Northern California and in the Sacramento Watershed (all of these efforts direct influence the Common Features Project):
  - American River Watershed Program
  - Delta CALFED Program

- Sacramento River Flood Control Project
- Sacramento River Bank Protection Project
- Sacramento and San Joaquin River Basins Comprehensive Study
- FloodSAFE California
- SAFCA Development Impact Fee
- SAFCA Natomas Levee Improvement Project
- Central Valley Flood Protection Plan
- California's Public Law 84-99 Eligibility Retention and Flood System Improvement Framework.

In selecting final peer reviewers from the list of potential peer review candidates, an effort was made to select experts who best fit the expertise areas and criteria described above. Based on these considerations, five peer reviewers were selected from the potential list, with credentials from academic institutions or as independent engineering consultants. Battelle established subcontracts with the peer reviewers when they indicated their willingness to participate and confirmed the absence of conflicts of interest through a signed conflict of interest form. Section 3 of this report provides the names and biographical information of the selected peer reviewers.

2.3 Preparation of the Charge and Conduct of the Peer Review

A peer review charge was developed to assist the IEPR panel members, which included specific questions and discussion points on the Common Features GRR that the panel members were instructed to use to guide their review. The draft charge was prepared by Battelle with guidance provided in USACE's guidance Peer Review of Decision Documents (EC 1105-2-410) and the Office of Management and Budget's Final Information Quality Bulletin for Peer Review, released December 16, 2004. A draft charge was submitted to the USACE for consideration and evaluation, and finalized by Battelle after minor clarifications were incorporated. The final charge was revised to include questions pertaining to the F3 Geotechnical Report For American River Common Features (F3 Existing Conditions Geotechnical Report), which was available approximately two months after the initial set of review documents was made available.

The final charge included general guidance for the reviewers on the conduct of peer review (provided in Appendix B of this final report). The charge consisted of 176 total questions/discussion points. Table 2 summarizes the review documents, number of charge questions/discussion points, and specific panel members who were asked to respond to the charge.

Table 2. Common Features GRR Review Documents and Charge Question Summary

Review Document	No. of Charge Questions	Panel Members Tasked with Review (No. of Reviewers)
American River Watershed Common Features Project General Reevaluation Report F3 Pre-Conference Documentation main report Chapter 1 – Study Information Chapter 2 – Problem Identification	15	All (5)
Appendix C: Synthetic Hydrology Technical Documentation (previously Appendix A) Appendix D: Hydraulic Technical Documentation F3 Milestone	42	Hydrology and Hydraulic Engineering (1)
Appendix E: Economics Working Draft	32	Economics (1)
Appendix F: Geotechnical Risk Base Analysis F3 Existing Conditions Geotechnical Report For American River Common Features	87	Geotechnical Engineering (3)

The IEPR panel members were provided an electronic version of the review documents and charge. A full list of the Common Features GRR documents that were reviewed by the IEPR panel is provided in the charge in Appendix B of this report. The IEPR panel members were instructed to address the charge questions/discussion points within comment-response form tables provided by Battelle for the Common Features GRR main report and their respective disciplines. In addition, USACE held a panel kick-off meeting in Sacramento at the USACE Sacramento District during which Battelle and the engineering panel members received an overview of the project; a second kick-off meeting was held for the economics panel member.

Except for during the panel kick-off meetings, there was no communication between the IEPR panel and the authors of the Common Features GRR during the peer review process. Communication between Battelle and the reviewers, and among the reviewers, was conducted as needed.

2.4 Review of Individual Panel Comments

In response to the charge questions, more than 340 individual comments were received from the IEPR panel members. Battelle reviewed these individual comments to identify overall recurring themes, potential areas of conflict, and other impressions of the report. Based on this review, Battelle developed a preliminary list of 89 overall comments and discussion points, including 53 negative comments, 30 overall neutral or positive comments, and six comments that were conflicting among the various reviewers. Each reviewer's individual comments were presented to the full IEPR panel. For the Common Features GRR main report and geotechnical engineering documents, the individual comments from all IEPR panel members and geotechnical peer reviewers, respectively, were merged.

2.5 Independent Peer Review Panel Teleconference

Battelle facilitated teleconference discussions with the IEPR panel to allow the exchange of technical information among the panel experts, many of whom are from diverse scientific backgrounds. This information exchange ensured that this IEPR report accurately represented the panel's assessment of the project and of the panel and avoided isolated opinions. Four panel teleconferences were conducted. Panel members participated in one panel teleconference for their specific document/discipline and one teleconference with all five panel members to discuss the Common Features GRR main report. Each panel review teleconference consisted of a thorough discussion of the overall negative comments, neutral/positive comments, and comments that appeared to be conflicting among reviewers. During the teleconference, panel members were able to ascertain and confirm the importance of the comments to the individual panel members or subset of the IEPR panel (during discipline-specific discussions) and the IEPR panel (during Common Features GRR main report discussions), add any missing issues of high-level importance to the IEPR panel, and resolve whether to "agree to disagree" on the conflicting comments and to merge those individual comments with similar foundations into one "Final Panel Comment." The main goal of the teleconferences was to identify which issues should be carried forward as Final Panel Comments and decide which panel member should serve as the lead author for the development of those final comments.

The panel discussions resulted in 40 overall Final Panel Comments. The Common Features GRR main report review and the Economics review teleconferences resulted in eight final comments each; the Hydrology and Hydraulic Engineering review teleconference resulted in 15 final comments; and the Geotechnical Engineering review teleconference resulted in nine final comments. Following the discussions, a summary memorandum documenting each final comment identified by the panel (and organized by level of significance) was prepared by Battelle and distributed to the IEPR panel. The memorandum provided detailed guidance on the approach and format to be used in the development of the final panel comments for the Common Features GRR and is further described in Section 2.6 below.

In addition to identifying which issues should be carried forward as final panel comments to USACE, the geotechnical engineering panel members discussed responses to six specific charge questions where there appeared to be disagreement among the three reviewers. The conflicting comments were resolved based on professional judgment of the panel members and the comment was either incorporated into the final comments or determined to be a non-significant issue (i.e., either a true disagreement did not exist, or the issue was not important enough to include as a final comment).

2.6 Preparation of Final Comments

A memorandum was distributed to the IEPR panel providing detailed guidance on the approach and format to be used in the development of the Final Panel Comments. A summary of the directive is provided below:

- Lead Responsibility: For each Final Panel Comment, one of the panel members was identified as the lead author responsible for coordinating the development of the final comment and submitting it to Battelle. (For Hydrology and Hydraulic Engineering and Economics comments, the lead responsibility was assigned by default to the respective panel member.) Lead assignments were modified by Battelle at the direction of the IEPR panel. To assist each lead in the development of the final comments, Battelle distributed merged individual comments in the comment-response form table, a summary detailing each draft final comment statement (in the memorandum), an example final comment following the four-part structure described below, and a template for the preparation of the final comments.

- Directive to the Lead: Each lead was encouraged to communicate directly with other reviewers, as needed, to contribute to a particular panel comment. If a significant comment was identified that was not covered by one of the original 40 Final Panel Comments, the appropriate lead was instructed to draft a new panel comment.

- Format for Final Comments: Each Final Panel Comment was presented as part of a four-part structure, including:
    1. Nature of comment (i.e., succinct summary statement of concern)
    2. Basis for comment (i.e., details regarding the concern)
    3. Significance (high, medium, low; see description below)
    4. Recommendation for resolution (see description below).

- Criteria for Significance: The following were used as criteria for assigning a significance level to each Final Panel Comment:
    - High: Describes a fundamental problem with the project that could affect the recommendation or justification of the project
    - Medium: Affects the completeness or understanding of the reports/project
    - Low: Affects the technical quality of the reports but will not affect the recommendation of the project.

- Guidance for Developing the Recommendation: The recommendation was to include specific actions that the USACE should consider to resolve the comment (e.g., suggestions on how and where to incorporate data into the analysis, how and where to address insufficiencies, areas where additional documentation is needed).

As a result of this process, 40 Final Panel Comments were prepared. Battelle reviewed and edited all Final Panel Comments for clarity and adherence to the requested format. The Final Panel Comments were assembled and are presented in Appendix A.

3. PANEL DESCRIPTION

Potential peer review candidates were identified through Battelle's Peer Reviewer Database, targeted Internet searches using key words (e.g., technical area, geographic region), search of websites of universities or other compiled expert sites, and through referrals from candidates who declined. Battelle prepared a recommended list of potential panel members, who were screened for availability, technical background, and conflicts of interest, and provided the list to USACE for feedback on potential COI. The final list of peer reviewers was determined by Battelle.

An overview of the credentials of the five reviewers selected for the IEPR panel and their qualifications in relation to the technical evaluation criteria is presented in Table 3. More detailed biographical information regarding each candidate and his technical area of expertise is presented in the text that follows the table.

Table 3. Common Features GRR Independent External Peer Report Panel: Technical Criteria and Areas of Expertise

Technical Criteria/ Primary Areas of Expertise	Totals	Nicholson	Baecher	Rudolph	Yung	Kelsoe
Registered professional with 10 years experience (e.g., PE or other)	**5**	X	X	X	X	X
Ph.D.	**2**	X	X			
Active participation in related professional societies	**5**	X	X	X	X	X
All Geotechnical Panel Members						
Experience in geotechnical studies and design of flood control works such as dams, levees, floodwalls, and closure structures.	**3**	X	X	X		
Familiar with geotechnical practices used in California	**3**	X	X	X		
General Geotechnical Expertise						
Site investigation and planning and implementation including:	**3**	X	X	X		
Subsoil investigation	**3**	X	X	X		
In situ soil testing	**2**	X		X		
State of the art static and dynamic laboratory testing on disturbed and undisturbed soil samples	**3**	X	X	X		
Evaluation of flood control structures such as static and dynamic slope stability evaluation	**3**	X	X	X		
Evaluation of seepage through earthen embankments and underseepage through the foundation of the flood control structures, including, dam and levee embankments, floodwalls, and closure structures	**3**	X	X	X		
Settlement evaluation of flood control structures	**3**	X	X	X		
Design and remediation of flood control structures and foundations, including foundation soil improvement, such cut-off walls and grouting practice	**3**	X	X	X		
Geotechnical Risk Analysis						
Geotechnical risk analysis	**1**		X			
Application of probabilistic methods to geotechnical aspects of flood damage reduction planning studies	**1**		X			
Geotechnical Seismic Analysis						
Liquefaction evaluations of sites and earth structures, particularly flood control structures	**2**	X		X		

Table 3. Common Features GRR Independent External Peer Report Panel, continued

Technical Criteria/ Primary Areas of Expertise	Totals	Nicholson	Baecher	Rudolph	Yung	Kelsoe
Hydraulic Engineer						
Large public works projects	1				X	
Extensive background in hydraulic theory and practice	1				X	
Familiar with USACE application of risk and uncertainty analysis in flood damage reduction studies	1				X	
Familiar with standard USACE hydrologic and hydraulic computer models					X	
Economics						
Water resource economic evaluation or review	1					X
Experience directly working for or with USACE	1					X
Experience with the Hydrologic Engineering Center Flood Damage Analysis (HEC-FDA) software developed by the USACE.	1					X
Experience in reviewing federal water resource economic documents justifying construction efforts.	1					X

Gregory Baecher, Ph.D.
Role: This reviewer was chosen primarily for his expertise in the area of geotechnical risk analysis.
Affiliation: University of Maryland

Greg Baecher is the Glenn L Martin Institute Professor of Engineering at the University of Maryland. He holds a B.S., Civil Engineering, from University of California Berkeley, and Sc.M. and Ph.D. degrees from Massachusetts Institute of Technology. Dr. Baecher is a geotechnical engineer by training, but has spent much of his career as an active consultant to government and industry on risk and reliability of constructed facilities, especially in water resources development, dam safety, and national security. His areas of expertise include water resources engineering and policy, risk and safety analysis, flood risk management, environmental impacts of dams and water projects, natural hazards, and infrastructure security. He has served as a peer reviewer for the Sabine-Neches Waterway (SNWW) Channel Improvement Plan (CIP) Draft Feasibility Report, Draft Environmental Impact Statement, and Supporting Documentation. Dr. Baecher is a member of the National Academy of Engineering, has authored several National Research Council (NRC) reports pertaining to risk analysis and water resource policy, has served on numerous NRC committees, and is currently the Chairman of the NRC's Committee on Geotechnical and Geological Engineering. He is co-author with J. T. Christian of *Reliability and Statistics in Geotechnical Engineering* (Wiley 2003), with D.N.D. Hartford of *Risk and Uncertainty in Dam Safety* (Thos. Telford 2004), with K. Frolov of *Protection of Civil Infrastructure from Acts of Terrorism* (Springer 2006), and with P. A. Zielinski and D.N.D. Hartford of the forthcoming *Risk Evaluation in Dam Safety* (Thos. Telford forthcoming). Dr. Baecher is recipient of the ASCE Middlebrooks and State-of-the-Art Awards, and was elected to the U.S. National Academy of Engineering in 2006.

Darrell J. Kelsoe
Role: This reviewer was chosen primarily for his expertise in the area of economics.
Affiliation: Brown and Gay Engineers, Inc.

Darrell Kelsoe serves as Manager of the Economics Division with Brown and Gay Engineers, Inc. and has over 25 years of professional experience in economics and financial models. He has extensive experience in flood damage reduction projects with the USACE, including acting as the lead economist for the White Oak Bayou, Brays Bayou, Buffalo Bayou, and Halls Bayou Flood Damage Reduction Projects. He has a working knowledge of the USACE planning process relative to the Principles and Guidelines and the federal objective related to water land resources projects. His technical expertise includes six years of risk-based analysis using the HEC-FDA modeling program, financial analysis, appraisals, land use analysis, and social impacts. He has computed inundation benefits, location benefits, and recreation benefits for urban flood damage reduction projects. For the White Oak Bayou Flood Damage Reduction Study, Mr. Kelsoe prepared the structure inventory for over 25,000 residential and nonresidential structures and utilized the HEC-FDA program to perform risk-based analysis. Additionally, he was the principal economist for the Dallas Floodway Extension Feasibility Study for which he performed a statistical analysis to validate the use of DCAD as a secondary data source as well as assisted in the development of depth-damage curves for large commercial structures.

Peter Nicholson, PhD., P.E.
Role: This reviewer was chosen primarily for his expertise in the area of general geotechnical engineering.
Affiliation: University of Hawaii at Manoa

Peter Nicholson currently serves as a professor and graduate chair for the Department of Civil and Environmental Engineering at the University of Hawaii at Manoa, where he has been the senior faculty member for the geotechnical program for 17 years. Dr. Nicholson is in charge of the geotechnical testing laboratories; conducting research in the areas of advanced laboratory soils testing, dynamic liquefaction, and dynamic soil failures. He also provides consulting services for various geotechnical/civil engineering firms and government agencies on earth structures, slope stability and seepage analysis problems including static and dynamic soil testing, static and dynamic stability analyses, liquefaction evaluations of sites and earth structures, state-of-the-art laboratory testing and analyses of soil samples, design of field instrumentation for embankments, dams and reservoirs, site investigation planning and implementation, dam safety and levee evaluations, and remedial geotechnical recommendations. Under previous employment at a firm in California, he conducted field engineering, site inspections, static and dynamic analyses of dams and levees, remedial designs for foundations and earth structures, slope and embankment design, and design and implementation of automated field monitoring techniques. Dr. Nicholson served as the team leader for the ASCE Levee Assessment Team deployed to New Orleans in the aftermath of Hurricanes Katrina and Rita. He is the immediate past chair of the Embankment, Dams & Slopes Committee for the American Society of Engineers (ASCE) Geo-Institute and has been an active member of the Association of State Dam Safety Officials (ASDSO). Dr. Nicholson holds M.S. and Ph.D. degrees in civil/geotechnical engineering from Stanford University. He is a licensed Professional Engineer in Hawaii, with more than 20 years' experience in design, inspection, and assessment of dams and levees in Utah, California, and Hawaii.

R. William Rudolph, P.E., G.E.
Role: This reviewer was chosen primarily for his expertise in the area of geotechnical seismic analysis.
Affiliation: Independent Consultant

Bill Rudolph has been serving as Principal Engineer and Project Manager on a wide variety of geotechnical engineering projects throughout California and the West for the past 30 years. He specializes in port and harbor facilities; flood control; earth-fill dams and levees; water resources; dredging and environmental restoration projects; and mass transit, bridge, and highway improvements. Mr. Rudolph has provided consulting services to more than 150 small, earth-fill dams and reservoirs including site selection, geologic and seismic assessment, material sources and design alternatives, and supervised the construction management of many of these projects. His relevant experience includes providing engineering analysis of side slope stability (static and seismic), seismic-induced slope deformation, liquefaction, long term dewatering, and subsurface drainage for a flood control detention basin. He has also conducted a geotechnical investigation and design of a regional dredge disposal facility. Investigation included extensive in-situ testing supplemented by laboratory testing, in accordance with FEMA and USACE guidelines. He also managed a probabilistic seismic hazard assessment of levee stability. For a

harbor in California, Mr. Rudolph is evaluating the static and seismic waterfront slope stability and is assessing the liquefaction potential, including estimates of liquefaction-induced settlement. He is a member of ASCE and the Association of Soil and Foundation Engineers. He continues to be involved with the Oakland International Airport levee project on the seismic stabilization of the airport levee, including the use of ground improvement for levee strengthening and liquefaction mitigation.

Andrew C. Yung, P.E
Role: This reviewer was chosen primarily for his expertise in the area of hydraulic engineering.
Affiliation: Dodson & Associates, Inc.

Andy Yung is the Chief Hydrologist and a Vice President of Dodson & Associates, Inc. He has over 21 years of experience as an engineer, planner, and hydrologist and a Bachelor of Civil Engineering, from Georgia Tech. In his 13 years with Dodson, Mr. Yung has managed a wide range of engineering projects involving hydrology, hydraulics, master drainage studies, channel modification and hydraulic structure designs, watershed impact analyses, detention facility designs, and dam safety analyses. He has also served as the team leader for the Independent Technical Review (ITR) of several federal flood damage reduction studies currently under way in Houston, Texas. These studies were authorized under Section 211(f) of WRDA 1996. Mr. Yung personally reviewed the Hydrology & Hydraulics and Alternative Formulation as part of the ITR for these locally initiated federal flood control studies on Brays Bayou, Hunting Bayou, and White Oak Bayou and has also provided review and support services on the Buffalo Bayou and Halls Bayou federal projects. He is very familiar with HEC-HMS, HEC-RAS, HEC-DSS, and HEC-SSP. Prior to joining Dodson, Mr. Yung was employed as a Senior Engineer with the Harris County Flood Control District (HCFCD), Planning Department in Houston, Texas and served as the HCFCD's Project Manager for the USACE federal flood damage reduction study on Cypress Creek. For a previous employer, Mr. Yung provided engineering design support for numerous public and private water resource/stormwater facilities and provided review support for the National Flood Insurance Program. In addition to flood risk assessment projects, Mr. Yung inspected the Grant Lake and Lake Wilderness dams for state and federal safety requirements and provided predictive tools for the HCFCD for real-time flood prediction. Mr. Yung is a licensed Professional Engineer in the states of Texas, Georgia, and Louisiana, a national Certified Floodplain Manager, and a member of the Association of State Flood Plain Managers, Texas Floodplain Managers Association, and the Association of State Dam Safety Officials.

4. RESULTS – SUMMARY OF PEER REVIEW COMMENTS

The IEPR panel members generally agreed on their "assessment of the adequacy and acceptability of the economic, [and] engineering…methods, models, and analyses" described in Chapters 1 and 2 of the Common Features GRR main report, which was reviewed by all panel members. The following statements provide a broad overview of the panel's findings on each discipline and the associated appendices; the panel's findings are described in more detail in the individual Final Panel Comments. Table 4 summarizes the number of comments for each document or discipline by significance level.

Hydrology and Hydraulic Engineering
The Hydrology and Hydraulic Engineering documents provide a good base from which to build the project and begin building the alternative formulation. The methods, models, and analyses appear to be appropriate and acceptable with respect to the engineering and aspects of the project. For example, the project team did a good job utilizing the available data and the approach used to create an interaction between the HEC-RAS and FLO-2D models was particularly well thought out. However, the documents do not appear to adequately describe the interaction between the HEC-RAS and FLO-2D models to produce frequency-damage relationships for use in the economic analyses. Other critical issues relate to the documentation of the hydrologic methods used, the selection of breach locations, the analysis of the Natomas Basin, confusion over the various without-project conditions, and lack of documentation of any "future without-project conditions;" all of which are critical to effective plan formulation process and identification of the proper National Economic Development (NED) Plan.

Economics
Some questions about the methodologies used in the Economics Appendix will require further explanation. The analysis utilized seven flood frequencies rather than the eight frequencies typically used in damage assessments, making it difficult to assess the reasonableness and accuracy of the results. In addition, the sensitivity analysis for the levee probability curves was insufficient. Until more detail is provided on the methodologies and assumptions that were included in the economic analysis, its adequacy and acceptability with respect to USACE guidance cannot be fully assessed.

Geotechnical Engineering
Although the purpose of the geotechnical engineering documents reviewed for the F3 Milestone (Appendix F: Geotechnical Risk Base Analysis and F3 Geotechnical Report of Existing Conditions for American River Common Features) was not clearly stated as it relates to the GRR process, the documents were generally well done and included a massive data review. The engineering methods, models, and analyses were reasonably state of practice and appropriate for establishing the existing conditions of the levee system as a whole. However, the two geotechnical documents, F3 Existing Conditions Geotechnical Report and Appendix F: Geotechnical Risk Based Analysis, were written as completely independent documents. Appendix F should rely on the background information provided in the F3 Existing Conditions Geotechnical Report. The examination of typical or worst case cross sections does not extrapolate into the levee reaches or provide an overall evaluation of the project; the impacts of seismic vulnerabilities were not adequately discussed.

The IEPR panel identified 40 final comments, ranked according to high, medium, and low significance. Although all panel members agreed upon the comments listed for the Common Features GRR main report, the panel members' reviews were focused on documents within their own disciplines. In total, as shown in Table 3, 15 comments were identified as having high significance, 19 as having medium significance, and six comments as having a low level of significance. Tables 5, 6, 7, and 8 summarize final comments by document or discipline and by level of significance. Note that one issue affecting the Common Features GRR main report, Hydrology and Hydraulic Engineering, and Economics documents was addressed in three separate but related comments: MR04, HH05, and E01, respectively. This issue was treated as

three separate comments due to differences in how similar material was presented in the individual documents and the way the review was structured. The final IEPR comments in their entirety are included in Appendix A.

Table 4. Final Panel Comments Summarized by Document/Discipline and Significance Rating.

Document/Discipline	Total No. of Final Comments	No. of Comments by Significance Rating		
		High	Medium	Low
Common Features GRR main report	8	5	3	0
Economics	8	3	4	1
Hydrology and Hydraulic Engineering	15	6	6	3
Geotechnical Engineering	9	1	6	2
Total	***40***	***15***	***19***	***6***

Table 5. Overview of Eight Common Features GRR Main Report Final Comments Identified by the Common Features GRR IEPR Panel.

Significance – High	
MR01	Inadequate specific justification is provided for why the general reevaluation is needed.
MR02	It is unclear to what extent the existing flood control project is being considered as a comprehensive system and how recently completed and planned projects by local sponsors are being integrated.
MR03	The forum to identify public concerns appears to have been limited and the public concerns identified in the report do not appear to fully characterize potential significant issues.
MR04	The differences between the without-project condition and no-action condition need to be clearly described.
MR05	A discussion of seismic vulnerability and seismically induced levee failure needs to be included.
Significance – Medium	
MR06	In the discussion of levee overtopping, the source for the provision for only one foot of freeboard to account for climate change and static settlement should be identified.
MR07	The economic, hydrologic, and hydraulic analyses should use the eight flood frequencies: 2-year, 5-year, 10-year, 25-year, 50-year, 100-year, 250-year and 500-year.
MR08	The American River Watershed Common Features Project General Reevaluation Report (GRR) main report needs to explain better how the no-action could be affected by other projects that will be built.

Table 6. Overview of 15 Hydrology and Hydraulic Engineering Final Comments Identified by the Common Features GRR IEPR Panel.

Significance – High	
HH01	The hydrologic method "Synthetic Flood Runoff Centering" is not widely known or used and publically available documentation is limited.
HH02	Not enough information has been provided about potential breach locations.
HH03	Additional information is needed regarding the creation of the frequency-damage relationship for use in the HEC-FDA model.
HH04	Additional discussion and presentation of results is needed related to the Natomas area.
HH05	The specific differences in the F3 Milestone conditions Without Project 1 (WO1), Without Project 3 (WO3), and No Action 3 (NA3), are not described in Appendix D: Hydraulic Technical Documentation F3 Milestone.
HH06	The "future without-project" conditions should be documented, even if conditions are the same as "existing without-project" conditions.
Significance – Medium	
HH07	Verification of the unsteady models should be performed using data from an additional event, such as the 1986 flood-of-record, to demonstrate the accuracy of the HEC-RAS model.
HH08	More detail on the use of geotechnical fragility curves and geotechnical data to develop levee breach scenarios and trigger elevations for the hydraulic models is needed.
HH09	The description of floodplain hydraulics and floodplain delineation needs more detail.
HH10	An interior flood analysis should be completed before alternative formulation as it may have an effect on alternative selection.
HH11	Additional consideration should be given to the assumptions in the FLO-2D model related to roadways, soundwalls, and rainfall.
HH12	Clarification is needed regarding the presentation of the water surface elevations both inside and outside of the levees related to the FLO-2D and HEC-RAS models, respectively.
Significance – Low	
HH13	If available, additional data beyond 2000 should be incorporated as it would affect/enhance the method used to create the downstream boundary condition.
HH14	The American River Watershed Common Features Project General Reevaluation Report (GRR) Appendix D would benefit from review by a technical editor as several statements need to be clarified.
HH15	Additional information is needed to evaluate the assumption of instantaneous failure in levee breaches.

Table 7. Overview of Eight Economics Final Comments Identified by the Common Features GRR IEPR Panel.

Significance – High	
E01	The Economics Appendix should indicate which of the three without-project/no-action conditions will be used to develop the National Economic Development Plan.
E02	The decrease in the single occurrence damages for the 100- and 200-year events and the increase in the 500-year event for Without Project 3 condition (WO3) as compared to Without Project 1 condition (WO1) needs further explanation.
E03	Detailed information is needed to justify the selection and use of the HEC-FDA Model Version 1.3 the current version 1.2.4.
Significance – Medium	
E04	The levee failure probability curve needs to be better explained and a sensitivity analysis needs to be conducted.
E05	The analysis of the uncertainty of the stage discharge variable, which affects the EAD, is missing.
E06	It is unclear whether uncertainty was considered in the analysis for nonresidential structures.
E07	It is unclear which water surface elevations relate to no upstream failures and upstream failures.
Significance – Low	
E08	A more detailed explanation of the allocation of vehicle types by category and numbers of vehicles is needed.

Table 8. Overview of Nine Geotechnical Engineering Final Comments Identified by the Common Features GRR IEPR Panel.

Significance – High	
G01	The consequences of higher flood levels on flood protection either during or following a major earthquake need to be further addressed.
Significance – Medium	
G02	The American River Watershed Common Features Project General Reevaluation Report (GRR) and appendices would benefit from a review by a technical editor.
G03	The Geotechnical Risk Based Analysis should be integrated into the updated F3 Existing Conditions Geotechnical Report for American River Common Features.
G04	The methodologies for how key hazards and failure modes are accounted for in the geotechnical risk and uncertainty analysis, and for assessing the subjective expert opinions, are not clearly described.
G05	The descriptions of the existing improvements are not clearly presented in the F3 Existing Conditions Geotechnical Report for American River Common Features.
G06	The basis for selecting the analysis cross sections is not clearly explained and the mixture of representative with worst case cross sections make it difficult to interpret how the varying factors of safety were obtained.
G07	The selection of a 100-year return period for the erosion vulnerability analysis is inconsistent with the 200-year protection criterion used for other aspects of levee design.
Significance – Low	
G08	The purpose and intended use of the F3 Existing Conditions Geotechnical Report for American River Common Features has not been clearly identified.
G09	Descriptions of the various levee areas are not uniform or systematic, making identification of the pertinent data cumbersome.

Appendix A

Final Panel Comments
of the
Engineering and Economic Reevaluation of the Geotechnical, Hydrological, Hydraulic, and Economic Aspects of Flood Risk Reduction Report, American River Common Features

Comment MR01:
Inadequate specific justification is provided for why the general reevaluation is needed.
Basis for Comment:
The introductory section of the American River Watershed Common Features Project General Reevaluation Report (GRR) main report seems brief and generic. While an 11-page project history is provided in Appendix B, a better summary of the changes that have occurred over the authorization history that necessitate this reevaluation would be useful at the beginning of the main body of the report. The summary should better outline the flooding problems, and orient the brief history of projects and previous studies specifically toward the way that they lead to the Common Features reevaluation study. For example, Figure 1-1 of Appendix B could serve a useful role in the main report narrative. The Summary section and Chapter 1 of the main report list relevant prior projects, but this list is terse and doesn't give the uninformed reader much sense of how that history affects the Common Features project. For example, additional information would be helpful to define why the GRR is being done (e.g., authorized plan was unacceptable to the public/local sponsor, updates to economics made authorized project non-viable, need to include other projects in combination with authorized project, changes to the project area made authorized plan difficult to construct, etc.). It appears that the need is addressed but could be expanded to include what has evolved (updated understanding of the existing conditions, seismic hazard, updated flood expectations, etc.) necessitating the need for reevaluation. Also for example, the section Study Authority explains what was authorized, but not why it was authorized. A straightforward explanation of how the project has evolved would go far to explain the need for the reevaluation study. There is a need to explain that the basic goal of "flood damage reduction" has not changed. However, as more information regarding site conditions and past performance has become available, there has been a need to re-evaluative geotechnical and hydrologic risks. In addition, environmental objectives relative to vegetation retention for habitat protection have evolved, as has the consideration of seismic vulnerability. These factors have necessitated the re-analysis of alternatives to address the updated project objectives. Note, the main report cites Appendix A for the project history; obviously this should be Appendix B (see pp. S-2, S-3, 1-6) and is probably a holdover from an earlier draft of the report.
Significance – High:
This section provides the rationale for the whole rest of the study report and needs to be solid to avoid questions arising about the purpose of the effort.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: • Add additional—not necessarily long—discussion in Chapter 1 (and the Summary) of

how the history of flooding problems and the history of projects have led to the need for the Common Features Project.

- Describe in words how the history of authorizations has led to the current effort.

Comment MR02:
It is unclear to what extent the existing flood control project is being considered as a comprehensive system and how recently completed and planned projects by local sponsors are being integrated.
Basis for Comment
Following Katrina, the Chief of Engineers 12 Actions for Change need to be considered on all projects. The first set of these actions is collected under the title, "Effectively Implement a Comprehensive Systems Approach: Comprehensively design, construct, maintain and update engineered systems to be more robust, with full stakeholder participation." The life cycle of the system includes design, construction, operation and maintenance, and inspection. Portions of the system are operated and maintained by USACE, and portions may eventually be turned over to non-Federal sponsors. All of the system must interface with projects designed, built, and maintained by others. The No-Action Plan is described as: > With the No-Action Plan, it is assumed that no additional features would be implemented by the Federal Government or by local interests to achieve the planning objectives, over and above those elements of the Common Features project that will have been implemented prior to reauthorization of the project. These elements include those improvements authorized in WRDA 1996 and WRDA 1999. These consist of various improvements to specifically identified levee reaches, along with gates and pumps on a particular drain structure, and gauges, clearly listed in Chapter 1 of the American River Watershed Common Features Project General Reevaluation Report (GRR) main report. A map of these improvements would be helpful. The No-Action Plan also includes "non-Federal features constructed in anticipation of potential credit." A listing and map of these would be helpful. The existing flood control project is not discussed in terms of consideration as a comprehensive system, but should be for clarity to conform with the 12 Actions. While the study appears to do a good job of treating the project in considering various risk-reduction tools, and the way structural and non-structural measures interrelate, the main report does not appear to address the various components of the project as a single whole. It does not specifically call out the Common Features as a single, integrated flood-hazard damage reduction system, but seems to treat them as independent improvements to independent reaches of river. It is confusing to say that the study area includes the Sacramento and American River Watersheds. Is not the study area just the American River Common Features project area? One can see that the hydrologic input to the system is from the larger watershed, but the focus of the study is on the American River and Natomas/Sacramento area.
Significance – High
Implementing a comprehensive systems approach to projects is mandated by the Office of the

Chief of Engineers and needs to be addressed in the Common Features GRR main report.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: • Extensive changes to the report are not required, but the issue of viewing the project as a comprehensive system requires a dedicated section in the main report narrative. This should bring together aspects of the planning phase risk analysis, with performance issues from the geotechnical report, and with potential flood damages. • A map of improvements authorized by WRDA 1996 and 1999 would be helpful. • A specific list and map of non-Federal improvements considered under the No-Action Plan would be helpful.

Comment MR03:
The forum to identify public concerns appears to have been limited and the public concerns identified in the report do not appear to fully characterize potential significant issues.
Basis for Comment:
Public involvement at the feasibility phase appears to have been limited to four public meetings in March 2009, which were attended by a total of 46 people. The range of public concerns raised in this forum appears to be quite limited, when considered relative to typical concerns associated with similar projects. Anecdotal comments commonly heard in the community regarding public concerns specific to elements of the Common Features Project have not been identified. These include issues relative to traffic, noise, public access, private property acquisition, cultural resources, terrestrial biological resources, and water quality. Similar issues, as well as others, have been raised in public processes for related projects including the Sacramento Areas Flood Control Agency (SAFCA) Natomas Levee Improvement Program Landside Improvements Project and are likely relevant to the Common Features project. The panel members are not familiar with the specific legal requirements for public involvement at this stage of the project, nor is the panel suggesting that the process did not meet applicable minimum requirements. The panel suggests that there is more to be done to vet public concerns at this stage, to avoid significant issues unexpectedly surfacing in the future such as during the public comment period of the EIS.
Significance – High
Public concerns are significant inputs to the establishment of planning objectives and constraints. Public input and acceptance could potentially impact the justification of the project.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include additional discussion of public concerns based on broader sources of public input. This could include pubic comments relative to related concurrent or past studies and programs. Additional public meetings should be considered.

Comment MR04:
The differences between the without-project condition and no-action condition need to be clearly described.
Basis for Comment:
According to the American River Common Features General Reevaluation Report (GRR) main report (page S-7), the without-project condition is "the most likely condition expected during the period of analysis in the absence of a proposed project." In this case, it assumes that none of the Common Features elements have been constructed, but that other authorized projects that affect the American River watershed are in place. Such projects include the following: • The Joint Federal Project at Folsom Dam • Folsom Dam Raise Project • North Area Local Project. However, the specific cut-off date or inclusive list of projects that are assumed to be included in the without-project condition has not been provided. The no-action condition is defined in the main report as "what would result if no action is taken from this point forward since several authorized project features have already been constructed." With active construction in the area, the no-action condition will change depending on what cut-off date defines "this point."
Significance – High
Alternative plans for the Common Features project will be compared to the without-project condition. A clear definition of the without-project condition and what it includes is critical for the alternative analysis.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: • An explanation of the without-project condition and projects assumed to be included, • An explanation of what cut-off date or completion of projects defines the no-action condition, • Consistency throughout the main report and appendices in defining the without-project conditions and no-action conditions.

Comment MR05:
A discussion of seismic vulnerability and seismically induced levee failure needs to be included.
Basis for Comment:
Chapter 2 of the American River Watershed Common Features Project General Reevaluation Report (GRR) main report does not discuss seismic vulnerability and resulting seismically induced levee failure in the description of Flooding Risks. The F3 Existing Conditions Geotechnical Report identifies liquefaction and seismic deformation as a significant concern relative to levee stability. The F3 Existing Conditions Geotechnical Report for American River Common Features (F3 Existing Conditions Geotechnical Report) states that: > Based on liquefaction and seismic deformation analyses from this study and a review of the subsurface information contained on the Plans and Profiles prepared for this study, many locations appear to be vulnerable to seismic loading and may not provide adequate flood protection following an earthquake. Liquefaction of several of the saturated layers appears to be the major cause of potential seismic distress in the area. The results indicate that 17 of the 23 analyzed sections present a risk for "flow" failure for the 200-yr event, 5 of the analyzed sections are expected to show negligible deformations, and 1 is expected to show non-negligible deformations. The large amount of flow failures in the analyzed sections are in part due to the selection of "problem" areas as analyses sections. > Nevertheless, the widespread, loose sandy and soft silty Holocene alluvial sediments of the area are highly susceptible to liquefaction. Consequently, widespread seismic damage to the flood control system following a 200-yr return period event appears likely. Seismic vulnerability of the levee system is a significant component of the flooding risk associated with the existing conditions. The F3 Existing Conditions Geotechnical Report concludes that seismic distress could cause widespread damage to the flood control systems. The potential for seismic damage compounds the risk of flooding associated with inadequate levee height, seepage, stability, and erosion. Accordingly, seismic damage should be considered in combination with these mechanisms to fully address the viability of the levee system to provide flood protection. Seismic vulnerability will also need to be considered in the future evaluation of projects alternatives. Improvements will either need to be designed to mitigate the risk of seismic damage or its consequences. As a result, seismic vulnerability should be discussed in the Common Features GRR main report as a potential flooding risk.
Significance – High
Consideration of seismic vulnerability will be a key issue in the evaluation of design alternatives and/or operation and maintenance strategies for the completed project. It will affect the overall evaluation of risk, as well as project costs.
Recommendations for Resolution:

To resolve these concerns, the report would need to be expanded to include consideration of seismic vulnerability in the discussion of Flooding Risks.

Comment MR06:
In the discussion of levee overtopping, the source for the provision for only one foot of freeboard to account for climate change and static settlement should be identified.
Basis for Comment:
In Chapter 2 (2-9) of the American River Watershed Common Features Project General Reevaluation Report (GRR) main report it is stated that "The State has established a preliminary draft of a standard for urban flood protection in California. This standard would require levees to have a top elevation equal to the mean 200-year water surface profile, plus three feet of freeboard, plus an allowance for wave run-up, plus one foot to account for climate change." It is not clear where this standard came from, how it was derived, or what (if any) analyses were used. The panel questions whether this level of additional freeboard is conservative enough. Other references are made to the "standard as defined by the State of California" (page 2-19, bullet #7), but it is not clear as to the source of the decision made for the one foot of freeboard for climate change. Additionally, there does not appear to be any accounting for loss of freeboard resulting from static settlement. In other recent decisions regarding this additional freeboard for climate change and settlement (i.e., New Orleans area levees), larger allowances were made for future loss of freeboard. While the New Orleans area also has a history of continued subsidence, there appears to be no justification for the significantly lower level of freeboard for Sacramento and whether it is conservative enough. Chapter 3 of the main report discusses "strategy, measures and evaluation" for seepage, erosion. and stability, but does not specifically address this type of systematic approach for details of overtopping susceptibility.
Significance – Medium
For a potentially life threatening system such as this, a more conservative level of freeboard may be appropriate. This level of freeboard could have significant impact on the level of safety with respect to overtopping and could affect design.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: • A discussion of where this one foot of freeboard criterion came from or how it was derived. • Address why one foot of freeboard is a suitable criterion to account for climate change and static settlement • Comment on whether any settlement analyses were made or reviewed to estimate possible crest height settlements, especially where possible raises may be implemented or additional loads applied due to improvements.

Comment MR07:
The economic, hydrologic, and hydraulic analyses should use the eight flood frequencies: 2-year, 5-year, 10-year, 25-year, 50-year, 100-year, 250-year and 500-year.
Basis for Comment:
In Section 4.2 of the HEC-FDA User's Manual, it states, "In FDA, a water surface profile set must consist of eight flood events." It is also the review panel's experience that eight flood frequency events are required to run the HEC-FDA model. It is noted that the number of frequencies analyzed changed from eight frequencies in the Common Features General Reevaluation Report (GRR) Appendix C: Synthetic Hydrology Technical Documentation to seven frequencies in Appendix D: Hydraulic Technical Documentation F3 Milestone and Appendix E: Economics Working Draft. It appears that the 5-year (or 20%-probability) event was omitted. Whether the 200-year or 250-year event is more appropriate is subject to the input criteria for HEC-FDA. According to the HEC-FDA User's Manual, the eight default water surface profiles used on HEC-FDA are the 50%, 20%, 10%, 4%, 2%, 1%, 0.4%, and 0.2% probability events.
Significance – Medium
If the review team is correct in its understanding that the levee breaches begin at the toe of the levees, then inclusion of higher frequency events (such as the 20%-probability) become more critical.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include the analysis of eight flood frequency events in the hydrologic, hydraulic, and economic analyses.

Comment MR08:
The American River Watershed Common Features Project General Reevaluation Report (GRR) main report needs to explain better how the No-Action Plan could be affected by other projects that will be built.
Basis for Comment
A primary concern of the Common Features GRR main report is how Federally authorized and non-Federal local projects will affect the No-Action Plan. Only Federally authorized projects are explicitly addressed. Presumably, the non-Federal projects could also have significant impacts. Table 3-10 of the main report lists "authorized project and locally constructed measures" for levee improvements, but it does not indicate which are federal and which are local. One might be able to determine from this table the set of improvements authorized by the WRDA1996 and WRDA1999 that are cited in Chapter 1, but it would be better if the distinctions were made in the table itself. It appears from Chapter 3 that the principal non-Federal levee improvements are in Natomas, and involve both direct levee improvements and the construction of set-back levees. In addition, some level of non-Federal activity appears to include long-term vegetation management and various public outreach or communication activities. The various concurrent Federal programs, projects and studies are referenced. Some of the non-Federal programs, projects and studies are alluded to. However, the report should more clearly outline the interdependence and potential conflicts between these efforts, as well as any opportunities to meet common goals. The stated requirement that the Common Features Project "not do anything that limits future options or otherwise adversely affects the development of the comprehensive Central Valley Flood Protection Plan" needs more explanation.
Significance – Medium
The completeness of the report is compromised by not explaining how non-Federal projects will affect the No-Action Plan. The significance could increase to high significance during alternative plan formulation.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: • Other and especially non-Federal projects that could or will affect the No-Action condition need to be specifically detailed, to the extent possible. • The effects of these other projects on the No-Action Plan conditions should be explicitly described, if possible. • Table 3-10 should be updated to indicate Federal and non-Federal projects.

Comment HH01:
The hydrologic method "Synthetic Flood Runoff Centering" is not widely known or used and publically-available documentation is limited.
Basis for Comment:
The text of the American River Watershed Common Features Project General Reevaluation Report (GRR) Appendix C: Synthetic Hydrology Technical Documentation (Appendix C) (pages 5-12) seems to assume that the reader is familiar with the hydrologic method used. However, the method employed appears to be one that is not widely known. A member of the panel, researched this method in an extensive hydrologic library and found no hydrology textbooks that refer to the "Synthetic Flood Runoff Centering" method. The panel member also searched EM 1110-2-1415 (Hydrologic Frequency Analysis) and EM 1110-2-1419 (Hydrologic Engineering Requirements for Flood Damage Reduction Studies), but found no references to this method, indicating to the panel member that this may be a local Sacramento District method. Lastly, the panel member has read the section on "Synthetic Flood Runoff Centering" in Appendix B to the Sacramento and San Joaquin River Basins Comprehensive Study from the USACE-SPK website, but the method remains unclear.
Significance – High
Hydrology serves as the basis for all hydraulics work that follows; therefore, without a better description of the hydrologic method, it is difficult to evaluate the adequacy of various storm centerings (Sacramento Mainstream, Shanghai Bend-Yuba River, and American River), the development of historical flood hydrographs and comparisons to observed results, and the use of the three primary storm centerings for developing inflow hydrographs.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include a brief step-by-step overview at the beginning of Appendix C regarding how the method was developed and how it is applied.

Comment HH02:
Not enough information has been provided about potential breach locations.
Basis for Comment:
There does not appear to be any direct identification of levee breach locations in the American River Watershed Common Features Project General Reevaluation Report (GRR) Appendix D: Hydraulic Technical Documentation F3 Milestone (Appendix D) or why various locations were selected. Correlation between the distress areas on the maps in Appendix F and the breach locations in the HEC-RAS model are difficult to determine. In addition, the status of the erosion study was not given. The text of Appendix D (page 3) states only that "…additional erosion issues on the American River need to be investigated…" In order to analyze/model specific potential breach locations in the levees due to erosion, it would be necessary to have some preliminary indication of the location of these sites.
Significance – High
Depending on the assumptions about the locations of the levee breaches, results of the hydraulic model and subsequent damages behind the levees cannot be properly evaluated in terms of reasonableness for "without-project" conditions and "no-action" alternatives.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: • Additional detail in the text of Appendix D regarding the potential breach locations, including an exhibit identifying the locations used in the HEC-RAS model; and • Why particular breach locations were selected.

Comment HH03:
Additional information is needed regarding the creation of the frequency-damage relationship for use in the HEC-FDA model.
Basis for Comment:
The stage-frequency data are created from the HEC-RAS model. The stage-damage data are created from the FLO-2D model. However, the stage in HEC-RAS, which represents the stage on the riverside of the levee, does not equal the stage in FLO-2D, which represents the stage inside of the levee. Therefore, there must be some description of the correlation between the differing stages (FLO-2D vs. HEC-RAS) in order to derive the frequency-damage relationship. This should be defined in the text of American River Watershed Common Features Project General Reevaluation Report Appendix D: Hydraulic Technical Documentation F3 Milestone (Appendix D) and repeated in Attachment 2 to Appendix D.
Significance – High
It is imperative to both the hydraulic and economic analyses that the frequency-damage relationship and its derivation be defined completely to avoid over- or under-estimation of damages resulting from various frequency flood events analyzed.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include an overview of the correlation/connection between the HEC-RAS, FLO-2D, and HEC-FDA models, which provides clarity regarding the relationship between stage-frequency (from HEC-RAS) and stage-damage (from FLO-2D).

Comment HH04:
Additional discussion and presentation of results is needed related to the Natomas area.
Basis for Comment:
Although the area of inundation is described in Tables 2-1 and 2-2 of the American River Watershed Common Features Project General Reevaluation Report (GRR), there do not appear to be any flood profiles or exhibits/plates illustrating the floodplain within the Natomas area. Nor does there appear to be any discussion of the modeling results for the Natomas basin. Given the potential risk to this area associated with a levee breach, additional information related to the presentation of results is necessary to highlight the risks and potential damages involved.
Significance – High
To omit the results of the analysis of this high damage area will likely cause a significant under-estimation of damage and will likely affect the alternative formulation process.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include additional discussion and exhibits illustrating the results of the analysis in the Natomas basin.

Comment HH05:
The specific differences in the F3 Milestone conditions Without Project 1 (WO1), Without Project 3 (WO3), and No Action 3 (NA3) are not described in Appendix D: Hydraulic Technical Documentation F3 Milestone.
Basis for Comment:
Although it is explained in Appendix D: Hydraulic Technical Documentation F3 Milestone (Appendix D) that several without-project conditions and no-action conditions are being considered, the specific differences between each condition have not been described. Given that work in the project area has been authorized, completed, or ongoing, it will be important to specifically identify what each without-project and no-action condition includes.
Significance – High
Establishing the correct without-project condition is necessary for alternative formulation and will affect the calculation of National Economic Development Plan.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: • An explanation of the differences between the various without-project conditions that is consistent in the Common Features GRR main report and appendices. • An explanation of the impacts of using one without-project condition over another for comparison in alternative formulation. • A clear statement explaining which one is to be the "most likely" without-project condition used as the basis for alternative formulation.

Comment HH06:
The "future without-project" conditions should be documented, even if conditions are the same as "existing without-project" conditions.
Basis for Comment:
Analysis of "future without-project" conditions are a necessary part of the planning process. ER 1105-2-100 (paragraph 2-4(b)(1)) states, "Proper definition and forecast of the future without-project condition are critical to the success of the planning process. The future without-project condition constitutes the benchmark against which plans are evaluated." Therefore, some discussion of the "future without-project conditions" is expected in the American River Watershed Common Features Project General Reevaluation Report (GRR) Appendix D: Hydraulic Technical Documentation F3 Milestone (Appendix D). Page 1-5 of the Common Features GRR main report states, "The area has undergone very rapid development since 1998." With this in mind, it is likely that the "future without-project" conditions will differ from "existing without-project" conditions as development continues, and the differences and effects on the hydraulic analysis should be documented.
Significance – High
Given ER 1105-2-100's note of the critical nature of analyzing "future project" conditions, the alternative formulation process will be affected by the omission of this analysis.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include a discussion of "future without project" conditions in both the Common Features GRR main report and Appendix D, and an analysis of these conditions, if necessary.

Comment HH07:
Verification of the unsteady models should be performed using data from an additional event, such as the 1986 flood-of-record, to demonstrate the accuracy of the HEC-RAS model.
Basis for Comment:
Calibration to additional flood events (in addition to the 1997 event) will likely produce a model that more accurately reflects existing conditions in the study area. Therefore, it is expected that the additional calibration will reduce the sensitivity/differences of both the HEC-RAS and FLO-2D models to varying flood events. If only one storm is available for calibration, then calibration to that single event would necessarily be considered adequate. However, in this case, there seems to be a significant amount of data available relating to the 1986 flood-of-record, so this additional event could be used to support and verify the results of the calibration effort.
Significance – Medium
Given the critical nature of the American River Watershed Common Features Project General Reevaluation Report (GRR), the more reflective that the hydrologic and hydraulic models can be for reproducing observed results, the better the understanding and evaluation of alternatives under various flood conditions will be.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include verification of the model calibration effort using the 1986 flood-of-record. In addition, the text should cite the version of HEC-RAS used since differing versions can produce differing results during calibration and analysis.

Comment HH08:
More detail on the use of geotechnical fragility curves and geotechnical data to develop levee breach scenarios and trigger elevations for the hydraulic models is needed.
Basis for Comment:
From the review of American River Watershed Common Features Project General Reevaluation Report (GRR) Appendix D: Hydraulic Technical Documentation F3 Milestone (Appendix D), it is not clear at what elevation the levees are failing in the hydraulic analysis. It appears that they are failing at the toe of the levee. However, while there is discussion of the fragility curves in this appendix, there are no diagrams to assist the reader in understanding. Additionally, if the bottom elevation of the fragility curve represents the toe of the levee, and this becomes the trigger elevation, it is difficult to see how the breach inundation would differ from a "no levee" scenario (with the exception that the width of the opening might constrain flow from entering the floodplain in an unobstructed manner).
Significance – Medium
More information regarding the levee fragility is necessary to better understand at which elevation the levee is failing in the hydraulic analysis and why.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include a typical fragility curve under Section 2.4.1 of Appendix D. While there are fragility curves in the geotechnical risk-based analysis appendix (Appendix F), a graphic in Appendix D should label critical points along the curve. For example, it would be helpful to know what the bottom elevation of the fragility curve physically represents.

Comment HH09:
The description of floodplain hydraulics and floodplain delineation needs more detail.
Basis for Comment:
Several observations support this comment: • Attachment 1 to American River Watershed Common Features Project General Reevaluation Report (GRR) Appendix D: Hydraulic Technical Documentation F3 Milestone (Appendix D) does not provide enough detail relating to how the calibration of the HEC-RAS model was performed. So it is difficult to determine whether the approach utilized reasonably acceptable practices for calibration. • Section 2.1 of Attachment 1 states, "The work documented in this report does not include documentation of n-yr synthetic runs…" This work needs to be documented somewhere within the body of Appendix D or Attachment 1 for clarity and the understanding of the reader. • While it may not be necessary to include reaches in the hydraulic model that represent the tributaries, tributary hydrographs should be included as boundary conditions in the hydraulic model, if for no other reason than to analyze the potential for levee failure on the north and east sides of the Natomas basin along the Natomas Cross Canal (NCC) and the Natomas East Main Drainage Canal (NEMDC), respectively. • Inclusion of the average difference between observed and calculated water surface elevations and the standard deviation for the profiles on Figures 4 and 5 of Attachment 1 would assist in the evaluation of the calibration effort. • According to Section 6 of Attachment 1, the HEC-RAS ground data is on NGVD29. However, according to Section 1.3 of Attachment 2 to Appendix D, the FLO-2D ground data is on NAVD88. The datum should be the same between the two models to maintain continuity and consistency in elevations. • According to Section 6 of Attachment 1, other additional effort (other than the datum adjustment) is needed to complete "Without Project" conditions modeling. • The plates provided in both the Common Features GRR main report and Attachment 2 to Appendix D appear to indicate that WO3 has a smaller inundation area than NA3. This would seem counter-intuitive if NA3 assumes that some flood control features have already been built.
Significance – Medium
More detailed information is needed to avoid confusion to the reader and to ensure consistency in the technical appendices.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include additional detail/descriptions related to the modeling and mapping of the "without project" conditions floodplain inundation areas.

Comment HH10:
An interior flood analysis should be completed before alternative formulation as it may have an effect on alternative selection.
Basis for Comment:
Given the magnitude of the potential flooding problem resulting from levee breaching, the interior flood analysis is not expected to produce significant differences in results for "without-project" or "no-action" conditions. However, the interior flood analysis should be addressed for completeness before proceeding to alternative formulation. This will create a true comparison to "without-project" and "no-action" conditions for each alternative considered.
Significance – Medium
For the purposes of completeness in the analysis this comment was given a significance of "Medium."
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include documentation of an interior flood analysis for the "without-project" conditions and the "no-action" alternatives.

Comment HH11:
Additional consideration should be given to the assumptions in the FLO-2D model related to roadways, soundwalls, and rainfall.
Basis for Comment:
In Attachment 2 to American River Watershed Common Features Project General Reevaluation Report (GRR) Appendix D: Hydraulic Technical Documentation F3 Milestone (Appendix D), Section 1.3 lists several assumptions associated with the terrain grid used for the FLO-2D model. The 400-ft x 400-ft grid cell size is rather large. However, it may work well considering the relatively flat terrain of the study area. The fact that the streets are not modeled may be okay, but consideration should be given to any roadways that are elevated above natural grade causing obstructions to flow within the prospective breach inundation areas (this comment excludes highways covered in Section 1.5 of Attachment 2). Likewise, soundwalls should also be considered as potential obstructions to flow and may need to be evaluated as such within the FLO-2D model. The roadway and soundwall assumptions could have a significant effect on the amount and location of damage estimates calculated for various frequency events. Lastly, if the existing interior pump stations are assumed to be non-functional, and we assume that 4 in. of rain represents the 100-year 24-hour event (from NOAA Atlas 2 for California), which falls over the approximately 90 square miles of the Natomas Basin for example, an additional 19,200 acre-feet of runoff could be generated under saturated conditions. Given that estimated volume, the assumption of no rainfall on the floodplain may significantly underestimate the damages created by the floodplain. This assumption should be further examined.
Significance – Medium
The assumptions as stated in Attachment 2 may lead to underestimates of damages in some areas and overestimates of damages in other areas affecting formulation of alternatives to reduce damages.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include documentation of the sensitivity of each of these assumptions related to roadways, soundwalls, and rainfall.

Comment HH12:
Clarification is needed regarding the presentation of the water surface elevations both inside and outside of the levees related to the FLO-2D and HEC-RAS models, respectively.
Basis for Comment:
According to Figures 1-12 and 1-13 in Attachment 2 to American River Watershed Common Features Project General Reevaluation Report (GRR) Appendix D: Hydraulic Technical Documentation F3 Milestone (Appendix D), it would appear that the water surface elevations inside the leveed areas (from FLO-2D) are greater than the external water surface elevations along the rivers (from HEC-RAS). This could create a back pressure situation on the levees which might need to be considered. In addition (from Section 1.13 and Figures 1-12 and 1-13), it is not clear why the FLO-2D elevations are greater than the HEC-RAS elevations upstream of Mile 7 (Figure 1-12) and Mile 9 (Figure 1-13) or if these are the breach locations. If they are the breach locations, then it would seem impossible to have higher elevations in FLO-2D upstream of these points if there are no other sources of inflow other than the levee breaches.
Significance – Medium
This clarification is needed as it affects both the completeness and understanding of the hydraulic analysis and the interaction between the HEC-RAS and FLO-2D models.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: • An explanation regarding why the interior water surface elevations are higher than the riverside water surface elevations in Figures 1-12 and 1-13' • The potential effects of back pressure on the levees, as necessary' • An indication of where the levee breaches are occurring in relation to the water surface profiles in Figures 1-12 and 1-13.

Comment HH13:
If available, additional data beyond 2000 should be incorporated as it would affect/enhance the method used to create the downstream boundary condition.
Basis for Comment:
The methodology used to derive the downstream boundary condition appears to be reasonable. According to the text of American River Watershed Common Features Project General Reevaluation Report (GRR) Appendix D: Hydraulic Technical Documentation F3 Milestone (Appendix D), Section 2.2.2, the stage-frequency data was taken from a 1992 report, which was supplemented with 11 years of additional data. The 1997 event was covered in this additional timeframe. However, since the report was drafted in 2009, it is possible the subsequent nine years could affect the stage-frequency curve used to create the downstream boundary condition.
Significance –Low
While this additional information could affect the technical quality of the report, it is unlikely to impact recommendations in the report.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include a sensitivity analysis to determine the effects of the additional nine years of data on the downstream stage-frequency relationship.

Comment HH14:
The American River Watershed Common Features Project General Reevaluation Report (GRR) Appendix D appendices would benefit from review by a technical editor as several statements need to be clarified.
Basis for Comment:
Examples of confusing statements: • On Page 6 of Attachment 1, Appendix D: Hydraulic Technical Documentation F3 Milestone (Appendix D), Section 3.1 states, "The model was calibrated to the 1997 flood event using gage data only and therefore serves primarily as a good flood routing model and not for [the] purpose of producing detailed water surface profiles." This statement seems confusing and perhaps counter-intuitive. • On Page 9 of Attachment 1, Appendix D, Section 4.1.1 states, "…not a lot of time was spent at this phase of modeling to try and match highwater marks. Recreating the correct flow and stage at Verona was considered the most critical item to calibrate to." This statement seems confusing. In an unsteady flow model, the flow and stage conditions at a certain point would be highly dependent on what is happening both upstream and downstream of that point. So, to match stage and flow upstream at Verona without matching high water marks downstream may yield a model which produces erroneous results downstream. • Table 2-1 of the Common Features GRR main report indicates that approximately 58,000 acres of the Natomas area is inundated due to the 100-, 200-, and 500-year floods. Table 1-17 in Attachment 2 to Appendix D appears to show only 56,000 acres. In addition, the text above Table 2-1 seems to indicate that the table represents the "no action" condition. However, the title on Table 1-17 indicates that it represents "Without Project 1" conditions. No other tables in Attachment 2 show any inundation in the Natomas area. The data provided appears to be confusing.
Significance –Low
This comment is aimed at the technical quality of the reports, but will not likely affect the recommendations in the final study.
Recommendations for Resolution:
To resolve these concerns, the report should be reviewed by a technical editor to address conflicting information in the report.

Comment HH15:
Additional information is needed to evaluate the assumption of instantaneous failure in levee breaches.
Basis for Comment:
Additional information is needed to evaluate the assumption of instantaneous failure identified in Section 2.4.2 of Attachment 1 to the American River Watershed Common Features Project General Reevaluation Report (GRR) Appendix D: Hydraulic Technical Documentation F3 Milestone (Appendix D),. Specifically, the computational timestep used in HEC-RAS model and the failure time for each levee breach should be documented and compared. If the expected failure time is longer than the computational timestep, then an instantaneous failure assumption may not be reasonable and the volume of water entering the levee breach may be too high to be realistic. If the computational timestep is too long, then the flow hydrograph in the river may be too coarse, thus missing critical peaks along the river resulting in volumes entering the levee breach which are too low.
Significance –Low
Given the duration of the floodwave on the Sacramento and American Rivers, it is not likely that this additional information will affect the recommendations of final study, but should be documented.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include information from the sensitivity analysis (mentioned in Section 2.4.2) relating the computational time step in HEC-RAS and the failure time for the levee breaches.

Comment E01:
The Economics Appendix should indicate which of the three without project/no action conditions will be used to develop the National Economic Development Plan.
Basis for Comment:
According to the American River Common Features General Reevaluation Report Working Draft Appendix E- Economics (Economics Appendix), Without Project 1 condition (WO1) is with no Common Features; Without Project 3 condition (WO3) includes Folsom Dam Modifications, and a 3.5 foot raise; and No-Action 3 condition (NA3) includes portions of the Common Features having been completed, Folsom Dam Modifications, and a 3.5 foot raise. The Common Features GRR main report lists only one without-project condition, which appears to be most consistent with what is defined as WO3 in the Economics Appendix. However, the Economics Appendix does not explain the differences between the without-project conditions and the no-action condition nor does it describe the overall impact of the difference for each condition. It is important to define which without project condition will be compared to the with project condition for component analysis, alternate plan formulation, and ultimately the National Economic Development Plan (NED).
Significance – High
Establishing the correct Without Project condition is necessary for alternative formulation. Without the correct Without Project Conditions, it is possible that the NED Plan will be defined incorrectly.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: • An explanation of the differences between the various without project conditions that is consistent in the Common Features GRR main report and appendices, • An explanation of the impacts of using one without project condition over another for comparison in alternative formulation, and • A clear statement explaining which one is to be the “most likely” without project condition used as the base for alternative formulation.

Comment E02:
The decrease in the single occurrence damages for the 100- and 200-year events and the increase in the 500-year event for Without Project 3 condition (WO3) as compared to Without Project 1 condition (WO1) needs further explanation.
Basis for Comment:
According to the American River Common Features General Reevaluation Report Working Draft Appendix E- Economics (Economics Appendix), WO1 is defined as it would be in 2010 with no Common Features. The single occurrence damages are $20.2 million in the 100-year, $30.7 million in the 200-year, and $43.1 million in the 500-year event. The WO3 is defined as Folsom Dam modifications and a 3.5-foot dam raise. This plan is well upstream of the American River Study area. Comparing the WO3, which has single occurrence damages of $18.1 million in the 100-year, $30.5 million in the 200-year and $62 million in the 500-year, indicates that the amount of single occurrence damages decreases in the 100 and 200-year events but increases in the 500-year event by almost $19 million. This increase is not mentioned in the Economics Appendix and could result in overestimated damages, and thus affect the plan formulation.
Significance – High
An increase in Water Surface Profiles (WSP) in the lower frequency events could affect the damages and lead to over estimating the damages. Over estimating the damages could affect the benefits in the component analysis, alternative analysis, and the plan formulation.
Recommendations for Resolution:
Due to the large increase in single-occurrence damages and expected annual damages (EADs), further explanation should be included as to why these damages increased in the lower frequencies. This should be in the form of a table and narrative discussion.

Comment E03:
Detailed information is needed to justify the selection and use of the HEC-FDA Model Version 1.3 the current version 1.2.4.
Basis for Comment:
The model used in the American River Common Features General Reevaluation Report Working Draft Appendix E- Economics (Economics Appendix), HEC-FDA version 1.3, is different from the most current version that is publically available, HEC-FDA 1.2.4. The Economic Appendix did not describe how or why the model was developed and/or selected for the American River Common Features Project, although it appears that HEC-FDA 1.3 was developed specifically for the American River study. It has several unique features that are not in the version 1.2.4. Specifically, only 7 flood frequencies were included in the model instead of the normal 8 flood frequencies. The flood frequencies should be the 2-year, 5-year, 10-year, 25-year, 50-year, 100-year, 250-year and 500-year. As also discussed in Comment MR07, Section 4.2 of the HEC-FDA User's Manual, it states, "In FDA, a water surface profile set must consist of eight flood events." With the levee probability curve used in the model, the higher frequency flood events (5-year) should have higher damages; however, due to the current model only having 7 frequencies, these damages have been omitted. This could underestimate the damages and affect plan formulation. The Economic Appendix also does not indicate whether the model has been certified.
Significance – High
The HEC-FDA model version 1.3 uses only 7 flood frequencies and omits the 5-year flood frequencies, which could underestimate the damages and affect plan formulation.
Recommendations for Resolution:
To resolve these concerns, the Economics Appendix would need to be expanded to include: • Run the Without Project 1 condition, Without Project 3 condition, and No Action 3 condition with the standard HEC-FDA model version 1.2.4 with 8 frequencies. • Revise the Economic Appendix and Common Features GRR main report with the 8 frequencies included and explain the results. • Based on the HEC-FDA model version 1.2.4 model results with 8 frequencies, prepare a Capital Investment, Single Occurrence, and Expected Annual Damages tables that show the dollar amounts by each flood frequency. • An explanation of how the model was developed and why. • Explain if the model has been certified.

Comment E04:
The levee failure probability curve needs to be better explained and a sensitivity analysis needs to be conducted.
Basis for Comment:
An explanation of where the probability of levee failure was mentioned in the American River Common Features General Reevaluation Report Working Draft Appendix E- Economics (Economics Appendix); however, the document did not include a discussion of how significant this levee failure probability curve is to estimating the damages. For instance, the levee failure probability curve at River Mile 2.5 indicates a 67% chance of failure at 6 feet from the top of the levee. There is no discussion or analysis showing the damages with and without the levee probability curves and damages with the levee probability curve at each potential failure point independently to assess the most vulnerable location and damages.
Significance – Medium
Since most of the damages relied upon the levee failure probability curves, a more extensive analysis of the curves should be performed to elucidate the magnitude and uncertainty of the associated damages.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: • A more detailed sensitivity analysis showing the damages with and without the levee probability curves • Damages with the levee probability curve at each of the indicated River Miles • A discussion to more accurately indicate how important the levee probability curves are and how much damage they are estimating.

Comment E05:
The analysis of the uncertainty of the stage discharge variable, which affects the EAD, is missing.
Basis for Comment:
The stage discharge uncertainty is the most significant uncertainty that affects the amount of damages between the structure uncertainty, first floor elevation uncertainty and the stage discharge uncertainty. The report does not mention the stage discharge or the Stage Exceedance Probability which could dramatically affect the Expected Annual Damages (EAD). Using a high stage discharge could over estimate the amount of damages and affect plan formulation.
Significance – Medium
The stage discharge uncertainty is important to the HEC-FDA model in determining overall EADs. These damages could be under or overestimated if the uncertainty associated with the stage discharge is unknown.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: • A table and an analysis describing the stage discharge uncertainty and how it affects the EAD. • A table to show the EADs with and without uncertainty by reach with a narrative discussion of the differences.

Comment E06:
It is unclear whether uncertainty was considered in the analysis for nonresidential structures.
Basis for Comment:
Based on Section 3.13 of the American River Common Features General Reevaluation Report Working Draft Appendix E- Economics (Economics Appendix), "The nonresidential structure depth damage functions were taken from prior studies that did not estimate any uncertainty parameters." This indicates that nonresidential depth-damage curves without uncertainty were used in the HEC-FDA model, which means no risk based analysis was used. According to the Planning Guidance Notebook ER 1105-2-100, page 3-11 (2) Project Performance and Risk Frame Work (a) "Flood damage reduction studies are conducted using a risk-based analytical framework." Not using a risk based analysis contradicts USACE Guidance. However, Section 3.14 indicates that depth-damage functions with uncertainty were used. There appears to be an inconsistency in the Economics Appendix.
Significance – Medium
According to USACE Guidance, all studies must use a risk-base analysis and it is not clear from the Economics Appendix whether a risk based analysis approach was employed for the American River Common Features Project.
Recommendations for Resolution:
To resolve these concerns, the Economics Appendix would need to be expanded to include a discussion of the different types of nonresidential depth-damage curves used and an explanation of the uncertainty associated with each curve.

Comment E07:
It is unclear which water surface elevations relate to no upstream failures and upstream failures.
Basis for Comment:
Chapter 12 of the American River Common Features General Reevaluation Report Working Draft Appendix E- Economics (Economics Appendix) assumes that no levees upstream of the study area are expected to affect the analysis. Table 12-1 shows the difference in water surface profiles (WSP) of no upstream failures versus upstream failures. It is unclear what is being communicated in Table 12-1. It appears that three different locations were selected instead of all the cross sections as the Economics Appendix suggests, and that the table reports the average and maximum differences in WSPs at these three locations for each flood frequency. Neither the table nor the narrative explains the significance of the differences, the reasoning behind selection of the locations, or why the different frequencies were selected. According to Table 12-2 on page 12-9, the total EAD's range from an 84% to 36% decrease in damages if the upstream levees fail. According to the table, the Natomas area has a high Annual Exceedance Probability of 38.54% not to fail or 61.46% to fail, indicating a high probability of failure. This needs to be discussed and is contradictory to the assumption that no upstream failures are expected to affect the analysis.
Significance – Medium
The damages could be overestimated based on upstream levee failures.
Recommendations for Resolution:
To resolve these concerns, the Economics Appendix would need to be expanded to include: • A discussion on the amount of damages and annual exceedance probilities by each damage area • Given the high probability of upstream levee failure in the Natomas area, the Economics Appendix should address and include upstream levee failures.

Comment E08:
A more detailed explanation of the allocation of vehicle types by category and numbers of vehicles is needed.
Basis for Comment:
The American River Common Features General Reevaluation Report Working Draft Appendix E- Economics (Economics Appendix) (Section 3.10), page 3-10 does not discuss how the different categories and number of vehicles (sedans, pickups, SUV, etc.) were estimated in each category. The type of curve used and allocation of each vehicle could potentially under/over estimate the amount of vehicle damage which could affect the plan formulation.
Significance – Low
Based on the type of vehicle and category determines the depth-damage curve used. Using a curve not applicable for the type and category could over or under estimate the vehicle damages.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: • Provide a table and a discussion on the allocation of vehicles by type and category. The table should also include the number of vehicles and the amount of damages by each category.

Comment G01:
The consequences of higher flood levels on flood protection either during or following a major earthquake need to be further addressed.
Basis for Comment:
Seismic vulnerability of the levee system is a significant concern. The American River Watershed Common Features Project General Reevaluation Report F3 Existing Conditions Geotechnical Report (F3 Existing Conditions Geotechnical Report) concludes that : "*widespread seismic damage to the flood control system following a 200-yr return period event appears likely"* The F3 Existing Conditions Geotechnical Report considered the seismic vulnerability of various levee sections at "typical summer and winter" water levels, which are below the landside toe elevations. As a result, the analyses consider potential liquefaction of the underlying foundation soils, but not the levees themselves. It is logical that if a levee is seismically compromised due to foundation failure at the typical summer and winter water levels, then it will also be compromised at higher water levels. In the cases where the analyses indicate that the levees will not be compromised at the lower water levels, it is possible that the levees may be seismically comprised at higher water levels, as sand levees become saturated which makes them subject to liquefaction. The geotechnical risk analyses do not address flooding risks if an earthquake occurs during a period when water levels exceed the landside toe elevations. While the risk of concurrent occurrences of high water and a seismic event may be low, the risk of high water levels following significant seismic damage and before repairs can be made is likely significant and should be considered in more detail. In addition, the potential for seismic damage that could compromise the flood control system for seismic events having shorter return periods than 200-years is not addressed.
Significance – High
Consideration of seismic vulnerability will be a key issue in the evaluation of design alternatives and/or operation and maintenance strategies for the completed project. It will impact the overall evaluation of risk as well as project costs.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: • Consideration of seismic vulnerability at higher water levels • Risk of flooding considering higher water levels following a seismic event and how long it may take to restore the system following seismic damage to the levees • Consideration of seismic vulnerability for earthquake events with return periods less than 200-years.

Comment G02:
The American River Watershed Common Features Project General Reevaluation Report (GRR) and appendices would benefit from a review by a technical editor.
Basis for Comment:
There appears to be a lack of consistency in the use of certain terminology and language, particularly between the Geotechnical Risk Base Analysis, F3 Existing Conditions Geotechnical Report for American River Common Features (F3 Existing Conditions Geotechnical Report), and the Common Features GRR main report. Some examples include: • Terms used to describe key soil layers in the text (e.g., blanket(s)), • Descriptions of individual sections/reaches/locations do not follow a systematic approach (e.g., locations, geomorphological features, subsurface conditions, historical distress/problems, etc.) • Inconsistent coordination of locations of 'critical reaches' vs. 'critical sections/locations' • Descriptions of 'representative', 'worst case', and "non-critical' sections should be clearly distinguished. In the Geotechnical Risk Base Analysis (Risk & Uncertainty), a number of terms are confusing: • The term, "judgmental probability" is somewhat non-intuitive given the meaning that it appears to have, which is the evaluation of performance of a levee reach as a function of its maintenance history. There is nothing methodologically incorrect, just that the term to describe this particular mode of failure might have been better chosen. The term, *judgmental probability* is a poor choice as it has well-defined (and different) meanings in the literature of probability and risk analysis. • The term "levee units" is treated as singular rather than plural throughout the report, and it is not clear why that should be. There are frequent mismatches of plural v. singular articles throughout. • Typo: p.3. *EM 1110-0-1519 "Risk-Based Analysis for Flood Damage Reduction Studies", USACE, 1 August 1996.* Should be, EM 1110-2-1619 "Risk-Based Analysis for Flood Damage Reduction Studies", USACE, 1 August 1996. • Typo: p.3. *"Reliability-Based Design in Civil Engineering" Milton E. Harr, 1987.* Should be, "Reliability-Based Design in Civil Engineering" Milton E. Harr, McGraw-Hill, NY, 291pp., 1987. • The term, "judgment based risk assessment" is confusing. All risk assessments used in planning studies are "judgment-based." The meaning here seems to refer to specific modes of failure (poor maintenance, erosion, etc.) rather than how the probabilities themselves were determined. This is somewhat counter to common use of the term. Some typos from the F3 Existing Conditions Geotechnical Report report include: • Sec. 2.4.3, Pg. 2-5: Para 2, Levee heights between 15 and 5 feet. Please verify accuracy. • Improvements don't include erosion protection…

• Figure 8.3 – Title appears to be incorrect. Should read "Stability" rather than "Seepage"
Significance – Medium
The inconsistencies in terminology and language used in the report may cause some confusion that could lead to misunderstanding of some of the findings and results.
Recommendations for Resolution:
To resolve these concerns, the report would need to be edited such that: • Terminology and language is consistent throughout. This would result in better clarity of the report, enable improved understanding of the various components and clear up potential confusion. • Editing of the language to simplify long run-on sentences and correct grammatical errors would improve the readability of the report further aiding in the understanding of the problem settings, results and conclusions being conveyed. • Corrections (or response) to perceived typos should be addressed.

Comment G03:
The Geotechnical Risk Based Analysis should be integrated as part of the updated F3 Existing Conditions Geotechnical Report for American River Common Features.
Basis for Comment:
The Geotechnical Risk Based Analysis appears to have been prepared prior to the completion of the F3 Existing Conditions Geotechnical Report for American River Common Features. (F3 Existing Conditions Geotechnical Report). For this reason, there are instances of inconsistencies between the two reports including: • Soil properties • Analysis sections • Methods of analysis • Interpretation of analysis results • Identification of critical reaches • Modes of failure considered In addition, there is redundancy between the Geotechnical Risk Based Analysis and the F3 Existing Conditions Geotechnical Report. This redundancy is not necessary to communicate the relevant information and leads to inconsistency. The Geotechnical Risk Based Analysis needs to be update to be consistent with F3 Existing Conditions Geotechnical Report. The Risk Based Analysis would be more concise and technically consistent if it relies on the F3 Existing Conditions Geotechnical Report where possible and solely addresses the risk analysis results.
Significance – Medium
A concise assessment of Geotechnical Risk is necessary to communicate a clear understanding of the project.
Recommendations for Resolution:
To resolve these concerns, the Geotechnical Risk Based Analysis Report would need to be integrated as an appendix of the F3 Existing Conditions Geotechnical Report. Once the F3 Existing Conditions Geotechnical Report has been updated, based on the review comments, the risk based report should be updated to: • Reference the F3 Existing Conditions Geotechnical Report text for describing the project history, existing conditions and analysis cross sections • Rely on the plans, profiles, sections, other figures and plates in the F3 Existing Conditions Geotechnical Report rather that duplicate these exhibits • Reference USACE guidance rather than specifically describing methodology.

Comment G04:
The methodologies for how key hazards and failure modes are accounted for in the geotechnical risk and uncertainty analysis, and for assessing the subjective expert opinions, are not clearly described.
Basis for Comment
The methods used in this report faithfully follow USACE guidance as promulgated in ETL 1110-2-547, and ETL 1110-2-556. One might question that guidance, at least in part, but modification of the guidance is not an issue for this review, or is it an issue for the project team. The methodology focuses on three failure modes: under-seepage, geotechnical stability, and miscellaneous causes of failure (here called "judgmental probability of failure", including poor maintenance, erosion, internal piping of the levee body, etc.). That seems a reasonable simplification. The term, "judgmental probability" is a poor choice as it has well-defined (and different) meanings in the literature of probability and risk analysis. The methodologies for calculating under-seepage and strength stability reliability are clearly described, but that for assessing the subjective expert opinions concerning "judgmental probabilities" of failure is not. A better description given of how the judgmental probabilities were arrived at is needed (was the process a formal elicitation, were numbers simply asked for from the experts, etc.). The judgmental probabilities include important considerations in levee reliability, including erosion due to hydraulic conditions in the channel, maintenance, vegetation, and encroachments and penetrations. Information of some of these things is provided in the Geotechnical Exiting Conditions report but not reflected in the probabilistic analysis except as interpreted by expert judgment. This is not to say that the approach taken is inadequate, only that it needs to be more fully documented. On the other hand, key hazards have not been clearly described and put into context as to if and how they are accounted for in the risk and uncertainty analysis. The hazards include: through seepage leading to internal erosion failure, under seepage leading to piping failure and pore pressures that must be accounted for in landside steady state seepage stability analyses, rapid drawdown failures on the waterside, waterside erosion leading to loss of freeboard, insufficient height leading to overtopping and crest erosion, seismic deformation including lateral spreading (limited deformation with or without loss of freeboard) and lateral flows (extensive lateral movements effecting entire levee and foundations).
Significance – Medium:
In general, the risk and uncertainty analysis has been performed according to USACE guidance. However, key hazards need to be better defined.
Recommendations for Resolution:
To resolve these concerns, the report would need to be edited such that: • The term "judgmental probability" seems inaccurate for what is intended by that term,

and a different term for the failure modes in question should be considered.

- Key hazards for the R&U analysis should be better defined.

Comment G05:
The descriptions of the existing improvements are not clearly presented in the F3 Existing Conditions Geotechnical Report for American River Common Features.
Basis for Comment:
It is difficult to distinguish between the pre and post 1996 and 1999 WRDA improvements since many of the post 1996 and 1999 WRDA improvements are discussed in the text as well as shown on the plans. It would be helpful if the improvements were all dated. Plate 2 shows most of the improvements discussed in the text of the report, but it is not clear that all improvements identified in the text of the report are shown on Plate 2. There is only one mention of erosion protection improvements in the text for the NEMDC East and no mention of these improvements in any other sections (e.g., Sect. 2.4.3). The erosion protection improvements, however, are included as a general bullet item under Sect. 2.2. (2-3) The information regarding past performance and improvements presented in the F3 Existing Conditions Geotechnical Report is a brief summary of a GIS data base which is an ongoing work product of the California Dept. of Water Resources levee evaluation project. More details regarding past performance and improvements would be very helpful in communicating project needs and the future evaluation of alternatives. Additional information either added directly in this report or by reference to a more complete document prepared by the DWR would be necessary to more clearly define past performance and improvements.
Significance – Medium
The lack of clarity with regard to which improvements are to be considered 'existing' at the time specified for the general reevaluation report (pre WRDA) is necessary for purposes of properly evaluating 'existing conditions.'
Recommendations for Resolution:
To resolve these concerns, the report would need to be revised to include: • Clear identification of which improvements were in place on the date to be used for the 'existing conditions'. • Review all improvements made (both pre and post WRDA) and ensure that they are included on Plate 2, preferably with completion dates for all. • Expand and/or revise details of performance with regard to improvements made to aid in assessing/evaluating project needs and evaluating future alternatives.

Comment G06:
The basis for selecting the analysis cross sections is not clearly explained and the mixture of representative with worst case cross sections make it difficult to interpret how the varying factors of safety were obtained.
Basis for Comment:
The F3 Existing Conditions Geotechnical Report for American River Common Features (F3 Existing Conditions Geotechnical Report) does not clearly describe the preliminary nature of the investigation and analyses to support the pre-design phase. The purpose and scope relate to the development and analysis of "representative" cross sections intended to identify "worst" case locations based on existing data and information regarding past performance. It seems that a preliminary assessment of the flood control project as a whole is required. The purpose of the cross-sections and the preliminary analyses as they relate to the objectives of the GRR is not well described. The selection of the analysis cross sections is not clearly explained and appears to be based on judgment from review of the plan and profiles (which incorporate the geomorphic mapping and boring information) as well as the interpretation of result of past analyses including seepage and stability. Judgment has been used to identify both "worst" case and less critical sections to represent a range of geotechnical conditions. This needs to be better explained. The area descriptions in Section 2 of the F3 Existing Conditions Geotechnical Report are inconsistent. Some descriptions describe the construction method while others do not. Some sections discuss the type of embankment soils as either clayey or granular soils. Some sections describe the underlying strata while others do not. More complete descriptions, referencing typical cross sections would be helpful in understanding the existing levee system. The panel suggests blending together the Area Descriptions with the descriptions of the profiles presented in sections 3.4.3 through 3.4.9 . On first look it appears that the pertinent worst case sections have been analyzed. However, a better explanation of how the selected cross sections relate to the Plan and Profile discussions presented in sections 3.4.3 through 3.4.9 would be useful in evaluating the applicability of the various sections and analysis results to the levee units. Interpretative cross sections that clearly show the range of geometry and subsurface conditions for each levee unit would be useful in evaluating the selection of cross sections for analysis. These interpretative cross sections should show the difference between levees with landside blankets of varying thickness and the absence of the blankets at Paleo-channel, varying levee slopes and adjacent channel configurations, the presence or absence or toe ditches, and other pertinent features. All of the resulting probabilities of failure under full water load are exceptionally high. The implication is that at least one reach and probably many will fail in a large flood. Is this reflected in historical performance of the Sacramento and American River levees? An interesting result in the final probabilities is that about ½ the critical reaches studied have probabilities of stability failure under full water load of essentially zero, while the other ½ has probabilities of essentially 1.0. One can see why this should be so in reviewing the respective cross sections, but it is remarkable nonetheless. The variations of probability of failure by

seepage and judgmental causes is less extreme.
Significance – Medium:
The selection of representative and worst cross sections needs to be justified. It is not obvious that the chosen cross sections are inappropriate, but their selection is not well explained.
Recommendations for Resolution:
To resolve these concerns, the report would need to be edited to explain the rationale for selecting the representative and worst-case cross sections.

Comment G07:
The selection of a 100-year return period for the erosion vulnerability analysis is inconsistent with the 200-year protection criterion used for other aspects of levee design.
Basis for Comment:
It is not clear that the use of 100-year return period flow velocities is appropriate for the question of erosion vulnerability. Most of the other anayses in the report usea 200-year return period flow, for example, for overtopping and levee reliability calculations. It is possibly that the 100-year flows are more critical for erosion than is the 200-year flow. If this is the case, it should be so stated. Otherwise justification is needed for why a different return period flow is used for erosion than is used for other analyses. This appears to be a state-of-practice approach to modeling erosion due to stream velocity and wave.
Significance – Medium:
This is a matter of clarifying why a certain load criterion was selected.
Recommendations for Resolution:
To resolve these concerns, the report would need to be edited to document the reason for using 100-year return period stream velocities for assessing erosion potential when most of the other analyses are performed using 200-year return period discharges.

Comment G08:
The purpose and intended use of the F3 Existing Conditions Geotechnical Report for American River Common Features has not been clearly identified.
Basis for Comment:
The F3 Existing Conditions Geotechnical Report for American River Common Features (F3 Existing Conditions Geotechnical Report) statement of purpose is as follows: *"This Report addresses geotechnical engineering evaluations for the "F3 Existing Conditions" in the American River Common Features Project area in northern Sacramento County and Southern Sutter County."* It would be helpful for the report to clarify that the purpose of the report is to support a general reevaluation study of the authorized American River Common Features Project. Additional description of how this report is to be used in the General Reevaluation Report process would be helpful to the reader.
Significance – Low
Addressing this comment will lead to a better understanding of the scope and purpose of the geotechnical input provided at this phase as it relates to the General Reevaluation Report.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include a more complete description of the purpose of the F3 Existing Conditions Geotechnical Report as it relates to the General Reevaluation Report.

Comment G09:
Descriptions of the various levee areas are not uniform or systematic, making identification of the pertinent data cumbersome.
Basis for Comment:
The information for the various levee areas (units) does not follow a uniform, systematic description. This makes it cumbersome to identify if all of the pertinent data are contained. Some of the descriptions (e.g., historical distress/problems) are vague and must be interpreted from the description of soil types (Sections 2-1 thru 2-8) in the F3 Existing Conditions Geotechnical Report for American River Common Features (F3 Existing Conditions Geotechnical Report). The area descriptions in Section 2.4 of the F3 Existing Conditions Geotechnical Report are not consistent. Some descriptions describe the construction method while others do not. Some sections discuss the type of embankment soils (construction materials, typically as either clayey or granular soils), while others do not. Some sections describe the underlying strata while others do not. More complete descriptions, referenced to typical cross sections would be helpful in understanding the existing levee system. A comprehensive (complete) description of each levee including a list of each item of interest would better addresses the existing conditions.
Significance – Low
While not critical to the report outcome or future planning or design decisions, more complete, consistent and organized descriptions of the various levee areas would provide a clearer comprehensive outline which would be easier to follow.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: • Reorganize the description of each area (unit) in a systematic manner so that each is uniform in presentation and can more easily be assessed and compared. • Blending together the Area Descriptions with the descriptions of the profiles presented in Sections 3.4.3 through 3.4.9 (3-9 thru 3-7). Or at least providing clear cross referencing between area descriptions and selected cross sections.

Appendix B

Charge to the Independent External Peer Review Panel

of the
Engineering and Economic Reevaluation of the Geotechnical, Hydrological, Hydraulic, and Economic Aspects of Flood Risk Reduction Report, American River Common Features

Charge to the Peer Reviewers for the Independent External Peer Review of the Engineering and Economic Reevaluation of the Geotechnical, Hydrological, Hydraulic, and Economic Aspects of Flood Risk Reduction Report, American River Common Features

Final Charge

BACKGROUND

The American River Common Features project (Common Features) is being developed to provide flood risk management to the City of Sacramento, including the Natomas Basin and areas along the north and south sides of the American River. A fast-growing region in the country's most populous state, the Greater Sacramento area encompasses the floodplains of two major rivers—the Sacramento and the American—as well as additional rivers and tributaries that drain the Sierra Nevada mountains. Expanding urban centers lie in floodplains where flooding could result in extensive loss of life and billions in damages.

Authorized in 1996, the Common Features project consists primarily of levee creation and modification, in addition to flood warning systems and pumping capabilities. However, since authorization, increased understanding of under seepage and through seepage problems that jeopardize levee stability have substantially increased project costs. Consequently, a general engineering and economic reevaluation is necessary to determine if the alternative proposed is still viable and justified and if there is another alternative that may be more effective. The Common Features Project General Reevaluation Report (GRR) includes flood risk management to the City of Sacramento and the Natomas Basin. The purpose of the GRR is to develop analysis tools that consider the flood protection system as a whole and identify a comprehensive plan that will lower the risk of flooding in and around Sacramento. The objective of this study is to re-evaluate the currently authorized plan as well as to develop and evaluate other viable alternatives, including a locally-preferred plan.

In compliance with WRDA 2034 (Public Law 110-114), Section 2034, and the importance of this project, an independent external peer review (IEPR) of the Common Features GRR will be conducted. Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses. The IEPR will follow the procedures described in the Department of the Army, USACE, guidance Peer Review of Decision Documents (EC 1105-2-410) dated August 22, 2008, CECW-CP Memorandum dated March 30, 2007, and the Office of Management and Budget's Final Information Quality Bulletin for Peer Review released December 16, 2004.

DOCUMENTS PROVIDED

The following documents will be provided to the peer reviewers:

- Engineering and Economic Reevaluation of the Geotechnical, Hydrological, Hydraulic, and Economic Aspects of Flood Risk Reduction Report ("Common Features GRR"), and
- EC 1105-2-410, Peer Review of Decision Documents.

SCHEDULE

1.	Common Features GRR review documents distributed to IEPR panel with charge	March 20, 2009*
2.	Common Features *F3 Existing Conditions Geotechnical Report* review document distributed to IEPR panel with revised final charge	April 19, 2009
3.	Kick-off meeting (Engineering Panel Members) (Economics Panel Member)	March 23, 2009 April 24, 2009
4.	IEPR panel submits individual comments in response to charge to Battelle	April 29, 2009
5.	Battelle distributes summary of key issues/themes in individual comments to IEPR panel	May 1, 2009
6.	Panel review teleconference to confirm key issues, determine final comments, and assign responsibility for final comments	May 4, 2009
7.	IEPR panel prepares final comments focused on key issues using formatted structure and submits to Battelle	May 20, 2009
8.	IEPR panel reviews and submits comments on Final IEPR Report prior to submission to USACE (if time allows)	June 9, 2009
9.	Battelle submits Final IEPR Report	June 10, 2009
10.	Battelle posts final panel comments on DrChecks	June 12, 2009
11.	USACE provides clarifying questions	June 25, 2009
12.	Teleconference with USACE to discuss clarifying questions and comments	June 30, 2009
13.	USACE provides official responses ("Evaluator comments") to final panel comments in DrChecks	July 14, 2009
14.	IEPR panel provides responses ("BackCheck comments")	July 30, 2009
15.	Battelle posts BackCheck Comments on DrChecks; Battelle closes out DrChecks	July 30, 2009

* With the exception of the Existing Conditions Geotechnical Report.

CHARGE FOR PEER REVIEW

Members of this peer review are asked to determine whether the technical approach and scientific rationale presented in the Common Features GRR are credible and whether the conclusions are valid. The reviewers are asked to determine whether the technical work is adequate, competently performed, properly documented, satisfies established quality requirements, and yields scientifically credible conclusions. The panel is being asked to provide feedback on the economic, engineering, and geotechnical methods, models and analyses. The peer reviewers are not being asked whether they would have conducted the work in a similar manner. It should be noted that this IEPR is taking place before the Common Features GRR has been finalized.

At this stage, the focus of review is the investigations to identify and document existing geotechnical, hydrologic, hydraulic, and economic conditions. These investigations describe conditions without a project so that the impacts of project alternatives can be defined.

Specific questions for the peer reviewers, by report section or Appendix, are included following the general charge guidance, which is provided below.

General Charge Guidance

1. Please answer the scientific and technical questions listed below and conduct a broad review of the Common Features GRR. Please focus on your areas of expertise and technical knowledge.
2. Identify, explain, and comment on assumptions that underlie economic, engineering, or environmental analyses.
3. Evaluate the soundness of models and planning methods as applicable and relevant to your area of expertise. Comment on whether models explain past events and how models will be validated.
4. Evaluate whether the interpretations of analysis and conclusions are reasonable.
5. Please focus the review on scientific information, including factual inputs, data, the use and soundness of models, analyses, assumptions, and other scientific and engineering matters that inform decision makers.
6. If appropriate, you can offer opinions as to whether there are sufficient analyses upon which to base a recommendation for construction, authorization, or funding.
7. Please **do not** make recommendations on whether a particular alternative should be implemented, or whether you would have conducted the work in a similar manner. Also please **do not** comment on or make recommendations on policy issues and decision making.
8. If desired, IEPR panel members can contact each other. However, IEPR panel members **should not** contact anyone who is or was involved in the project, prepared the subject documents, or part of the USACE review process.
9. Please contact the Battelle project manager (Karen Johnson-Young, johnson-youngk@battelle.org) for requests or additional information.

10. In case of media contact, defer all inquiries to USACE and notify the Battelle project manager immediately.
11. Your name will appear as one of the panelists in the peer review. Your comments will be included in the final IEPR report, but will remain anonymous.
12. Upon the expiration or termination of your subcontract, you agree to not disclose any data, reports or other information furnished by Battelle or developed by you during this project without Battelle's prior written approval.

Please submit your comments in electronic form to Karen Johnson-Young, johnson-youngk@battelle.org, no later than Wednesday, April 29, 2009, 6:00 PM EDT.

Engineering and Economic Reevaluation of the Geotechnical, Hydrological, Hydraulic, and Economic Aspects of Flood Risk Reduction Report,
American River Common Features

Final Charge Questions
Main Report, Appendices C, D, E, and F, and
F3 Existing Conditions Geotechnical Report for American River Common Features

MAIN REPORT: AMERICAN RIVER WATERSHED COMMON FEATURES
PROJECT GENERAL REEVALUATION REPORT
F3 PRE-CONFERENEC DOCUMENTATION

1. STUDY INFORMATION

Study Authority

No questions

Purpose and Scope

1. Please comment on the completeness and clarity of the study purpose and scope.

2. Please comment on whether the need for the general reevaluation study, goals, and objectives of the project has been adequately addressed.

3. Please comment on whether the existing flood control project has been considered as a comprehensive system.

Location and Description of the Study Area

1. Please comment on whether sufficient background information is included in this section or if additional information should be included.

History of the Project and Prior Reports

1. Please comment on whether sufficient historical information has been provided in this section or if additional information should be included.

Watershed Planning

1. Please comment on whether the problems, opportunities, parameters and/or conclusions associated with other major projects within the watershed are clearly outlined.

2. Please comment on the sensitivity of the hydraulic models to the implementation of the "Preferred Alternative" in Phase III of the Delta CALFED program.

Planning Process and Report Organization

No questions

2. PROBLEM IDENTIFICATION

Public Concerns

1. Please comment on the viability of the public's concerns about new study alternatives.

Problems and Opportunities

1. Please comment on the use of the 1986 flood as the flood of record.

2. Please comment on the completeness, accuracy, and consistency of the levee stability discussion.

3. Please comment on the completeness, accuracy, and consistency of the levee overtopping discussion.

4. Please comment on the consideration of vegetation and maintenance of vegetation during the hydraulic analysis.

5. Please comment on the completeness, accuracy, and consistency of the Folsom Dam releases discussion.

6. Please comment on the locations of levee overtopping/failure for use in the FLO-2D evaluation.

7. Please comment on the completeness, accuracy, and consistency of this section with regards to the Geotechnical Risk Based Analysis (Appendix F).

GRR APPENDIX C: SYNTHETIC HYDROLOGY TECHNICAL DOCUMENTATION

1. Please comment on using 2007 as the existing conditions for the modeling of the water surface profiles.

2. Please explain whether or not the decision to use a 30-day duration for the synthetic flood hydrographs is based on sound hydrologic assumptions for the project area?

3. Please explain whether the methods used for centering the Sacramento Mainstream, the Shanghai Bend-Yuba River, and the American River are compatible.

4. The development of the historical flood hydrographs for the Natomas tributaries was based on a broad variety of data for six different large storm events. Please comment on whether the manipulation of these data was accomplished using best engineering methods. How do the hydrograph results line up with historically observed results, especially within the Natomas Cross-Canal and Natomas East Main Drainage Canal (or Steelhead Creek)?

GRR APPENDIX D: HYDRAULIC TECHNICAL DOCUMENTATION F3 MILESTONE

1. GENERAL

1.1 Background

1. Has sufficient information from the subsurface investigations and geotechnical analysis been included in the identified levee distress areas and incorporated in the associated hydraulic analysis? Please comment on the levees' reliability ranking system.

2. Please comment as to the study status needed to quantify the current erosion problems and to identify potential remediation measures for the American River levees and its impact on levee reliability results.

3. Please comment on the assumption that erosion is responsible for lowering the standard of levee failure along the American River.

1.2 Location

1. Please comment on whether the study location and boundary conditions are adequately described.

1.3 Study Approach

1. Please comment on whether sufficient data have been included to identify the critical reaches of each levee system.

2. Please comment on whether data are available to support the influence of backwater from the Sacramento-San Joaquin Delta on water elevations in Sacramento.

2. CHANNEL HYDRAULICS

2.1 UNET to HEC-RAS Conversion

1. Please comment on the use of the 1997 flood event for model calibration.

2. Why or why not is the methodology used for the UNET conversion to HEC-RAS appropriate?

2.2 Hydraulic Model Inputs

2.2.1 Hydrology

1. Please comment on the use of the three primary storm centerings for developing the inflow hydrographs.

2.2.2 Downstream Boundary Conditions

1. Please comment on the completeness and validity of the methodology used to improve the downstream condition for the study. Are the adjustments to the 1997 stage hydrographs using 1992 data based on the most reliable approach, given the amount of available flood data?

2.3 No Levee Failure Runs

No questions

2.4 Levee Failure Runs (Project Area)

1. Are the F3 Milestone project conditions of WO1, (Without Project 1), WO3 (Without Project 3), and NA3 (No Action 3) the most suitable for comparison purposes? Is each scenario adequately described?

2.4.1 Use of Geotechnical Fragility Curves in Hydraulic Model

1. Please comment on the detail provided in the explanation of incorporating fragility curves.
2. Please comment on the use of geotechnical data for the development of levee breach scenarios and trigger elevations.

2.4.2 Levee Breach Parameters

1. In light of data from other failure events, please comment on the use of a 1,000-foot breach parameter.

2.5 Water Surface Profiles

1. Please comment on whether the method used to determine water surface profiles is compatible with geotechnical data and recent State-supported flood elevation calculations.

2.6 Wind-Wave

1. Please comment on the statement that "the possibility of levee breach due to wind-wave action is small compared to other issues currently being considered."

3. FLOODPLAIN HYDRAULICS & FLOODPLAIN DELINEATION

1. Please comment on the general soundness of the models and planning methods.

2. Please comment on the reasonableness of the analysis' interpretations and resultant conclusions.

4. RISK ANALSYIS

4.1 Hydraulic Inputs

1. Please comment on the methodology used to generate input values for the American and the Sacramento Rivers.

4.2 Uncertainty

No questions

4.3 Considerations and Assumptions

1. Please comment on whether the underlying assumptions for triggering levee failure are clearly defined and based on the most recent geotechnical and flood flow data.

4.4 Sensitivity – Upstream Levee Performance

1. Please comment on whether a method of analyzing the causes and mechanisms of levee failure was used to predict levee reliability.
2. Please comment on the use of the FDA model to measure levee performance.

5. SEDIMENTATION AND DYNAMIC STABILITY ANALYSIS

1. Please comment on the sediment impact assumptions on levee reliability within the American River and Sacramento River systems.

6. INTERIOR FLOODING

1. Please comment as to the weight and timeliness of the pending interior flood analysis.

APPENDIX D, ATTACHMENT 1: Sacramento Basin HEC-RAS Phase I Model Development

General

1. Please comment on whether the model calibration from the Sacramento and San Joaquin River Basins Comprehensive Study (Comp Study) - UNET to HEC-RAS was completed using best acceptable practices. Will the number of calibrations used in the modeling study affect real data output and corresponding results?

2. Please comment on whether the limits of using a 1-D model versus a 2-D model at weir locations are easily defined?

Model Development

1. Please comment on whether the Natomas Cross Canal (NCC) and the Natomas East Main Drainage Canal (NEMDC) tributaries should be added to the analysis.

2. Please comment on how, if at all, the vertical datum conversions will affect the sensitivity of the modeling results.

3. Do you agree with the method used to eliminate discrepancies between the RAS river stages and the adjacent FLO-2D floodplain stages?

4. Can top of levee data be easily reconciled or verified?

Model Verification

1. Please comment on the model methodology with regards to levee reliability.

APPENDIX D, ATTACHMENT 2: FLO-2D Floodplain Mapping Documentation

FLO-2D Modeling

1. In your professional judgment, is the calibrated HEC-RAS model of the project area fully documented? Will the number of calibrations used in the HEC-RAS model affect the sensitivity of the FLO-2D model results?

2. In Figure 1.1, FLO-2D Modeling, economic impact subareas are delineated. Please comment on whether these areas are also compared to the flood risk analyses.

Modeling Assumptions

1. Please comment on the reasonableness of the model assumptions.

Grid Generation

1. Please comment on whether the methodology used to rectify the projection of USGS and LIDAR data to the FLO-2D grid system was completed using best acceptable practices.

Levees

1. In Section 1.5, assumptions are made regarding the inclusion or exclusion of levee features from the analysis. Are these same assumptions valid for the HEC-RAS study?

FLO-2D Calibration

1. How will the 500-year "without project flow" condition used to calibrate the HEC-RAS unsteady state for the American River to the FLO-2D water surface affect the outflow results during the next project phase?

2. According to the data presented in Figure 1-12, downstream of mile 7 shows no further flow from the American River into the north floodplain "due to ponding behind the levees from upstream breakouts." What, if any, significance would this ponding place on the hydraulic analysis?

GRR APPENDIX E: ECONOMICS WORKING DRAFT

1. INTRODUCTION

1. To what extent are the purpose, context, and role of this economic analysis clearly explained?

2. ECONOMIC ANALYSIS IN PRIOR REPORTS

1. To what extent are the history of the economic analysis and current status of the analysis clearly explained?

2. At the overview level, to what extent is the analysis consistent with standard economic analysis assumptions and practices? Is further explanation of the prior economic analyses required in this historic overview discussion?

3. ECONOMIC METHODOLOGIES

1. From an overall perspective, please comment on whether all significant economic benefits and costs of the project are likely to be included using the economic methodology described.

2. From an overall perspective, please comment on whether the sources of economic data, assumptions, and calculations of benefits and costs are adequately described and justified. Please comment on whether sensitivity analysis has been adequately addressed.

3.1 Without Project and No Action Conditions

1. Discuss whether the alternatives and sequencing are sufficiently described and clarified to explain the synergies and tradeoffs among alternatives.

2. To what extent is the purpose of the multiple "without project conditions" and "no action conditions" explained? Does this provide value for comparative economic analyses? Is the significance of the various comparisons and respective analytical basis adequately explained?

3.2 Floodplain Economic Inventory Update

No questions

3.3 Hydrologic Data Update

No questions

3.4 Floodplain Hydrologic Model Update

No questions

3.5 Geotechnical Input Update

No questions

3.6 Flood Damage Model Update

No questions

3.7 Consistency with Regulations and Policy

1. Please comment on whether the described approach is appropriate, necessary, and sufficient for the economic analyses performed.

3.8 Price Level, Period of Analysis, and Discount Rate

1. Please comment on the appropriateness of the period of analysis and the discount rate selected.
2. Please comment on the appropriateness of applying the Federal discount rate to constant prices (no inflation included).

3.9 Major Assumptions

1. Please comment on the adequacy and appropriateness of the major assumptions. Are key assumptions missing?

3.10 Automobile Losses

1. Please comment on whether the approach used to value automobile losses is reasonable and appropriate.

3.11 Other NED Damage Categories

1. Please comment on whether significant NED damage or loss categories are missing.
2. Please comment on whether there are other significant NED benefits from flooding that could offset damages.

3.12 Agricultural Losses

No questions

3.13 Economic Uncertainties

1. Please comment on whether the approach used to address uncertainties is appropriate.
2. Please comment on whether uncertainties need to be addressed in other NED categories in addition to the automobiles, structures, and their contents.

3.14 Without Project Depths and Damage Functions

1. Please comment on the depth-damage functions approach to estimate damage and whether the use of the multiple depth-damage functions is adequately explained and justified.

4. ECONOMIC INVENTORY UPDATE AND VALUATION OF STRUCTURES

1. Please comment on whether the valuation approach is clear, appropriate and sufficient.
2. Please comment on whether the results appear to be reasonable.

4.1 Study Area – Economic Impact Areas

No questions

4.2 Floodplain Inventory Base Data and Supplemental Field Inventory
No questions

4.3 Valuation of Structures
No questions

4.4 Nonresidential Content Valuation
No questions

4.5 Residential Content Valuation
No questions

4.6 Inventory Valuation by Without Project Floodplain
No questions

5. EMERGENCY COSTS – OTHER NED CATEGORIES
No questions

6. WITHOUT PROJECT 1 CONDITIONS
6.1 Floodplains – Without Project 1 Conditions
1. Please comment on whether this section provides an adequate presentation of the expected single event losses to structures, contents, and automobiles.

2. Please comment on any inconsistencies between the results and the described analytical method.

6.2 Single –Event Damages
No questions

6.3 FDA Model Results –Without Project 1 Conditions
No questions

7. WITHOUT PROJECT 2 CONDITIONS
No questions

8. WITHOUT PROJECT 3 CONDITIONS
1. Please comment on whether this section provides an adequate presentation of the expected single event losses to structures, contents, and automobiles.

2. Please comment on any inconsistencies between the results and the described analytical method.

8.1 Floodplains – Without Project 3 Conditions
No questions

8.2 Single –Event Damages
No questions

8.3 FDA Model Results –Without Project 3 Conditions
No questions

9. NO ACTION 1 CONDITIONS
No questions

10. NO ACTION 2 CONDITIONS
No questions

11. NO ACTION 3 CONDITIONS
1. Please comment on whether this section provides an adequate presentation of the expected single event losses to structures, contents, and automobiles.

2. Please comment on any inconsistencies between the results and the described analytical method.

11.1 Floodplains – No Action 3 Conditions
No questions

11.2 Single-Event Damages
No questions

11.3 Comparison of Without and No Action Conditions
No questions

11.4 FDA Model Results – No Action 3 Conditions
No questions

12. SENSITIVITY TO UPSTREAM LEVEE ASSUMPTIONS
1. Is the issue of upstream levee reliability adequately described?

2. Discuss whether the sensitivity analysis adequately informs the economic analysis.

13. SUMMARY OF WITHOUT AND NO ACTION CONDITIONS
1. Discuss whether the approach of providing estimated annual damages from the least damages existing condition (multiple upstream levee failures in multiple basins) to the most damages existing condition (no upstream levee failures) is appropriate and sufficient to inform the economic analysis.

2. Discuss whether the comparisons of various “without conditions” and the various “with project alternatives” adequately clarify the role, dependence, and economic contribution of each phase and enable appropriate benefit cost analysis.

13.1 Summary of Without and No Action Conditions
No questions

14. PRELIMINARY WITH PROJECT CONDITIONS

14.1 Flood Damage Reduction Alternatives

1. Are the constraints used to select alternatives for analysis clearly stated and reasonable?

2. Does the analysis clearly show the benefits attributable solely to the project being reevaluated?

14.2 Environmental Operating Principles

No questions

14.3 Hydrologic, Hydraulic, and Geotechnical Data

No questions

14.4 HEC-FDA Model Results – With Project Conditions

1. Comment on the assumptions and modeling results for analyzing the probability curves for levee failure and corresponding annual benefits.

14.5 Equivalent Annual Benefits (Existing and Future Conditions)

No questions

14.6 Project Performance

No questions

15. BENEFIT-COST ANALYSIS

No questions

16. REGIONAL ECONOMIC DEVELOPMENT (RED) ANALYSIS

No questions

17. OTHER SOCIAL EFFECTS (OSE) ANALYSIS

No questions

GRR APPENDIX F: GEOTECHNICAL RISK BASE ANALYSIS

GENERAL

1. Please comment on the organization and structure of the report.

2. Please comment on the criteria used to determine the critical reach within each levee unit.

3. Please comment on how the critical reaches relate to the Levee Distress Extents map shown in Plate 4 of the GRR.

4. Please comment on whether the longitudinal extent of the critical levee reaches has been appropriately delineated.

5. Please comment on whether the variations in surface and subsurface conditions have been adequately documented.

6. Please comment on the inclusion of maps and section diagrams in the appendix.

1. INTRODUCTION

1. Please comment on whether or not the primary goal of the geotechnical evaluation has been met, as stated in the second paragraph of the Introduction.

2. SOURCES OF INFORMATION

1. Have all key sources of available subsurface and geomorphologic information been accessed, reviewed and identified?

3. COMMON FEATURES LEVEES DESCRIPTION

1. Are the geographical locations of the levee units and the agencies responsible for their maintenance clearly identified?

2. Please comment on whether the existing conditions of the surface, subsurface, and performance and reliability have been thoroughly and systematically described using text and illustrations?

4. FOUNDATION CONDITIONS

4.2 Geomorphologic Features

1. Please comment on the discussion of former channels, meanders, oxbows and point bars with regards to levee stability and critical reach identification.

4.3 Levee and Foundation Geotechnical Conditions

1. Please comment on whether the foundation conditions have been adequately and accurately described in terms of stratigraphic profile, soil layers, and groundwater characteristics.

5. GEOTECHNICAL RISK AND UNCERTAINTY ANALYSES

5.1 General

1. Please comment on the general method used for determination of risk and uncertainty of the existing conditions of the levees.

5.2 Underseepage Reliability

1. Please comment on the general method for determination of probability of failure due to underseepage through the levee foundation of the existing conditions of the levees.

5.3 Slope Stability Reliability

1. Please comment on the general method for determination of probability of failure due to instability of the levee slopes of the existing conditions of the levees.

5.4 Judgment Base Reliability Analysis

1. Please comment on the general method for determination of other factors contributing the probability of failure of the existing levees such as erosion, encroachments, vegetation, and utility penetrations.

5.5 Combined Reliability Analysis

1. Please comment on the determination of the cumulative effect of all factors contributing to probability of failure of the existing levees.

5.6 Results of the Reliability Analysis

1. Please comment on the resulting probability of failure for different reaches throughout the system.

F3 EXISTING CONDITIONS GEOTECHNICAL REPORT FOR AMERICAN RIVER COMMON FEATURES

1. INTRODUCTION

1.1 Program Overview

1. Please comment on the completeness of project element identification.

1.2 Purpose and Scope

1. Please comment on the completeness and clarity of the study purpose and scope, and whether the report's intended use has been appropriately described.
2. Please comment on the completeness of available information and any implications data availability might have on the project.
3. Does the work conducted fulfill the stated purpose and scope?

2. EXISTING CONDITIONS

2.1 Description of the ARCF Levee System

1. Please comment on the clarity of the descriptions of the existing levee system that protects the City of Sacramento.

2.2 LEVEE PAST PERFORMANCE AND IMPROVEMENTS

1. Please comment on whether the information of the existing improvements is clearly and comprehensively described in the report as well as on the plans and profiles, including stability berms, slurry cut-off walls, slope protection, levee reconstruction and any other improvements.

2. Please comment of whether the levees past performance is clearly described and distress areas are shown on the plans.

2.4 Area Descriptions

1. Please comment on whether the information provided for each of the levee areas is comprehensive, including i) location and extent, ii) geometry and levee construction material characteristics, iii) foundation stratigraphy and hydrogeology characteristics, iv) history and performance criteria, v) improvements and reasons for having conducted the improvements, vi) known or recognized geohazards or residual geotechnical concerns.

3. SUBSURFACE INTERPRETATION

1. Please comment on i) whether the basis for selecting each of the 23 analysis cross sections is adequately explained, ii) if the number of cross sections is sufficient, and iii) whether the sections represent the general case or worst case scenarios. Please comment on the possibility that there might be more than one worst case scenario along some levee units.

2. Please comment on the extent to which the quality and utility of data from prior geotechnical investigations have been evaluated.

3. Please explain whether sufficient information is currently available to accurately estimate the impact of geotechnical considerations at the pre-design phase.

4. Please comment on whether sufficient data have been acquired in the area of critical project features.

3.1 Updated Geomorphology Study

1. Please comment on whether the conceptual model considered in the geomorphologic study is adequate.

2. Please comment whether the geomorphologic study covers all of the common features study area.

3.2 Past Analyses

1. To what extent is it clear how the results of past seepage and stability analyses are i) incorporated into the present study, or ii) used to focus or direct the present study?

3.4 Plans and Profiles

1. Please comment on the completeness of the description of existing conditions provided in Section 2.4 and the subsurface interpretation in Section 3.4 used as input for selecting critical cross-sections.

2. Please describe whether the utility of the profiles is clearly stated and if the profiles are fit-for-purpose in terms of content and level of detail.

3.5 Analysis Cross Sections

1. Is the basis for selecting 'worst' case locations reasonable and have all such 'worst' case locations been identified?

2. Are the selected cross sections for geotechnical analyses representative for each reach?

3.5.1 Characterization Process Details

1. Please comment on whether the characterization process used is appropriate for the intended use of the cross-sections.

2. Please comment on whether the distinction between identification of the generalized representative case and the 'worst' case(s) is clear.

3.6 Height Deficiencies

1. Comment on whether the impact of isostatic uplift and eustatic sea level risk should be taken into consideration.

4. SEEPAGE ANALYSIS

1. Comment on the factors and methodology used in the seepage analysis.

4.3 Definitions and Criteria

4.3.2 Criteria

1. Please comment on the clarity of the introductory paragraph, especially with respect to the terms 'criteria' and 'recommendation.'

4.4 Material Properties

1. Is the accuracy of the input parameters appropriate? If not, please explain. Should sensitivity analyses be conducted?

4.4.1 Anisotropy

1. Is the basis for the assumed Kh/Kv values for the foundation and levee materials appropriate?

4.5 Seep Analysis Approach

1. Is the model geometry adequate? Please explain.
2. Are the permeabilities and boundary conditions adequate? Please explain.
3. Are the seepage results clearly illustrated and summarized? Please explain.

5. STABILITY ANALYSIS

1. Comment on the factors and methodology used in conducting the levee slope stability analysis.

5.4 Material Properties

1. Are the correlations and criteria for selection of strength parameters adequate?
2. Is the selection of the input parameters for each loading condition appropriate? If not, please explain.
3. Are the analysis methods appropriate? If not, please explain.
4. Are the analysis approach and methodology appropriate? If not, please explain.
5. Are the analysis results clearly illustrated, discussed and summarized?

6. SEISMIC ANALYSIS

1. This section provides an assessment of the ability of the levees to continue to provide flood protection following an earthquake. Please comment on whether the methodology utilized is appropriate for this purpose. Have all critical contributory factors been taken into account? If not, which are missing?
2. Is the accuracy of the input parameters appropriate? If not, please explain. Should sensitivity analyses be conducted?
3. Please comment on whether the potential for foundation displacement along earthquake faults beneath the levee system should be taken into account

6.2 Seismic Loading Conditions

1. Please comment on whether the use of the 200-year return period event is appropriate.

6.3 Water Levels

1. Is the justification provided for not modeling the high flood level appropriate? Why or why not?

6.4 Liquefaction-Triggering Analyses

1. Is the liquefiability of the levee foundation accurately analyzed?
2. Please comment on the degree and extent of potential damage to levees contributed by liquefaction during an earthquake.

6.5 Seismic Slope Stability Analyses

1. Are the seismic shear strengths used for the analysis adequate? If not, please explain.
2. Are the parameters used in the seismic analysis adequate? If not, please explain.
3. Are the methods for seismic analyses and vulnerability assessment adequate?
4. Please comment on the degree and extent of potential damage to levees contributed by slope instability during an earthquake.

6.6 Deformation Analyses and Vulnerability Assessment

1. Please comment on the methodology used to assess the ability of the levees to continue to provide flood protection following an earthquake.

6.7 Vulnerability Evaluation Results

1. Are the results of the seismic evaluation clearly provided?
2. Please comment on the degree and extent of the ability of the levees to continue to provide flood protection following an earthquake.
3. Please comment on whether all of the prior steps up to this point have appropriately worked towards identifying and analyzing the weakest links.
4. Please comment on the distinction between failure and "non-negligible deformations."
5. Please comment on whether it is clearly documented which sections were levee problem areas, versus those that were representative generalized sections.
6. Deformation analyses indicate that 17 of the 23 analyzed sections present a risk of failure due to liquefaction. Please comment on the degree of conservatism incorporated into the results due to the methodology used.
7. Please comment on the utility of the results in helping to establish a vulnerability hierarchy to direct resources to those elements of the flood control system that are the least robust in an earthquake. Would additional information or analyses be needed in order to do this?
8. Simultaneous or sequential occurrence of interactive climatic and geologic hazards may produce cumulative effects (for example, seismic movements during a period of heavy rainfall leading to landslides); to what extent have these risks been taken into account?

7. EROSION

7.1 General

1. Comment on the factors and methodology used in evaluating surface erosion potential.
2. Is the accuracy of the input parameters appropriate? If not, please explain. Should sensitivity analyses be conducted?

7.2 Loading Conditions

1. Are the loading conditions used for the erosion vulnerability adequate?
2. Please comment on the appropriateness of the 100-year return period.

7.3 Procedure

1. Please comment on whether the procedure used is appropriate in achieving the desired result.

7.8 Erosion Analyses Results

1. Comment on the areal distribution of the potential for erosion and the correlation between the theoretical results with the real-world observations; how intuitive is this correlation?

8. CONCLUSIONS AND RECOMMENDATIONS

1. The stated final task in the scope of work (see Section 1.2) was to develop conclusions and recommendations regarding levee performance; to what extent has this been accomplished?
2. Comment on whether differences and data gaps were identified in the report; to what extent has 'good agreement' been demonstrated?
3. Please comment on the overall degree of conservatism employed in the analyses.
4. Comment on whether any conclusions can be drawn from the overlapping areal distribution of deficiencies (height, seepage, stability and erosion).
5. Please discuss to what extent application of the 23 cross section analyses to the whole levee system is appropriate; to what degree can the cross sections be assumed to be representative of specific levee reaches?
6. Please comment on the utility of the results in helping to establish a hierarchy to direct resources to those elements of the flood control system that are the least robust. What additional information or analyses might be needed in order to do this?
7. Comment on how the selection and accuracy of input parameters might affect the results and whether sensitivity analyses should be performed to gauge the fragility of the results.
8. Please comment on whether there are indications that additional work might be needed as a result of this study