

APPENDIX F

DELTA LEVEE SEISMIC RISK ASSESSMENT

DELTA LEVEE SYSTEM INTEGRITY PROGRAM

CALFED
Bay-Delta Program

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Foreword

This paper provides a description of the CALFED Bay-Delta Program's approach to seismic risk assessment for the Delta. The plan will build upon existing seismic risk analysis, identify the risk to Delta resources during catastrophic seismic events and develop recommendations to improve stability of Delta levees to protect Delta resources in the event of a disaster.

This element of the Program, like all components of the Program's alternatives, is being developed and evaluated at a programmatic level. More focused analysis and environmental documentation of specific targets and actions will occur in subsequent refinement efforts.

Introduction

The goal of this assessment is to improve the understanding of the risk to Delta levees from earthquakes and to develop a workplan to improve the stability of Delta levees. This assessment will build upon current Delta seismic risk studies and develop recommendations for additional specific actions. These recommendations will be closely integrated with Ecosystem Restoration Program Plan and Delta conveyance actions to simultaneously reduce system vulnerability, increase ecosystem quality, and protect water quality and water supply reliability.

Background

Earthquakes can cause levees to fail by slumping or liquefaction of underlying soils. To date, there have been no known Delta levee failures or island inundations as a result of seismic events. However, there are several active faults located sufficiently close to the Delta to present a threat to Delta levees.

In 1992, the Department of Water Resources, Division of Engineering completed the "Phase I Report, Seismic Stability Evaluation of the Sacramento-San Joaquin Delta Levees." Subsequently, the Department took several actions to reduce some of the unknowns which influence the evaluation of levee stability during earthquake shaking. The Department:

- Selected four different sites in the Delta to place new surface and subsurface accelerometers;
- Performed Geologic Investigation and Shear Wave Velocity Testing at selected sites;
- Installed surface and subsurface strong motion instruments at the selected sites;
- Installed a strong motion instrument on rock near the western side of the Delta;
- Performed geotechnical laboratory studies to define the static site characteristics of the accelerometer locations; and
- Performed geotechnical laboratory studies to define the dynamic response characteristics of organic soils.

Seismic Risk Assessment Approach

The seismic risk assessment will address the following issues through refinement, and implementation of the objectives, targets, and actions identified in Table 1.

Issues to be addressed

- Performance of existing levee system during seismic event
- Recovery actions and accessibility following a seismic event

Implementation Objective	Target	Action
Enhance understanding of how Delta levees react to earthquakes.	Perform analysis of recent seismic data.	Prepare updated seismic ground motion mapping, and update seismic risk assessments. Perform dynamic testing of levee material properties, and levee stability analysis.
Improve performance of the Delta levee system during an earthquake.	Improve stability of Delta levees by cost-effective measures to improve performance during an earthquake	Modify levee cross sections by raising levee height, widening levee crown, flattening levee slopes, and/or constructing stability berms.
Establish an implementation plan for seismic actions.	Identify areas critical for improving seismic performance of Delta levees.	Develop a phasing sequence for implementation of proposed seismic actions.

To define further the relative risk of catastrophic events and the performance of Delta levees, the Department of Water Resources' Seismic Investigation may be continued. This investigation consists of installing strong-motion accelerometers at three to four levee sites in the Delta; creating a geologic model for deeper soil deposits; ongoing field and laboratory testing to better determine the static and dynamic properties of organic soils; field and laboratory testing to better determine liquefaction potential; and investigation of the potential activity of the Coast Range-Sierra/Nevada Boundary Zone.

The following draft questions are related to the performance of the Delta levee system during seismic events. There are several policy level and technical questions to focus CALFED discussion and assist with future decisions on proposed alternatives. The technical questions will be addressed in a report being produced by the Department of Water Resources Division of Engineering. This report will be presented to the Consulting Board to the Department of Water Resources Sacramento-San Joaquin Levees currently under contract to DWR's Division of Engineering. The seismic susceptibility sub-team will prepare a workplan and summary report using this technical report and suggestions from the consulting board. The workplan and recommendations of the sub-team will be used to develop specific actions for Delta levee seismic performance. These recommendations will be closely integrated with Ecosystem Restoration Program Plan and Delta conveyance actions to simultaneously reduce system vulnerability, increase ecosystem quality, and protect water quality and water supply reliability.

Preliminary Questions for Agencies/Stakeholders

1. What is an acceptable risk for reliance on the Delta levee system for water supply?
2. What is an acceptable risk for continued investment of public funds for infrastructure, environmental resources, and other public resources?
3. What method would you recommend to calculate an overall risk of failure from all occurrences including flood, seismic, other forces? What approach would you recommend for presentation of the results?
4. What method would you use in assessing recommended actions and making decisions for implementation?

Preliminary Technical Questions¹

- 1) What is the potential for the occurrence of a seismic event which could produce a level and duration of movement likely to produce levee failure in the Delta?

¹ DWR, Division of Engineering will prepare initial report addressing these questions for review by Consulting Board to the Department of Water Resources Sacramento-San Joaquin Levees. The Seismic Susceptibility Sub-Team will use this report in developing a workplan and report for CALFED.

1.1) What is the magnitude of an event likely to produce levee failure in the Delta?

1.2) What is the likely regional distribution of an event likely to produce levee failure in the Delta?

2) What are reasonable, cost effective actions which could be undertaken to improve the stability of the Delta Levee system under seismic events?

2.1) What regions of the Delta, in order of priority, require improvements?

2.2) What are recommended actions, in order of priority, for these regions?

3) What are the elements of a program which can identify outstanding Delta levee seismic issues which need to be addressed? Can these elements fit within our adaptive management approach?

3.1) In what order of priority should these actions be undertaken?

Phasing Sequence

Program staff will work with stakeholders, the public, and state and federal agencies to build upon existing seismic information and activities to prepare an implementation plan. This plan will identify outstanding issues requiring subsequent action, then coordinate and implement recommendations with other program actions.

The following activities have been identified for completion by the Department of Water Resources Division of Engineering:

- Refine the seismic stability evaluations of Delta Levees based on new information.
- Prepare report to address technical seismic questions.
- Convene Consulting Board to Department of Water Resources.

The following activities have been identified as potentially needing additional work to provide information in the seismic assessment process:

- Updating seismicity risk evaluation of the Delta by region. The USGS has been tentatively identified as the agency to complete this task.
- Updating seismic probabilistic analysis for the Delta by region. The USGS has been tentatively identified as the agency to complete this task.