Delta Risk Management Strategy (DRMS) Phase 1

Risk Analysis Report

Final

Prepared by:
URS Corporation/Jack R. Benjamin & Associates, Inc.

Prepared for:
California Department of Water Resources (DWR)

December 2008

December 5, 2008

Sean Bagheban
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Department of Water Resources
1416 9th Street, Suite 1601
Sacramento, CA 95814

Subject: Delta Risk Management Strategy
Phase 1 Final Risk Analysis Report

Dear Mr. Bagheban:

We are enclosing the final Phase 1 Risk Analysis Report for the Delta Risk Management Strategy (DRMS) project. Members of the Steering Committee and agency staff reviewed the draft DRMS technical memoranda and the April 24, 2007, draft of the Risk Analysis Report. After their comments were incorporated, the CALFED Science Program Independent Review Panel (IRP) reviewed the June 26, 2007, draft of the report and provided comments in August 2007. These IRP comments were incorporated and then the July 2008 revised draft was provided to the IRP so that its members could verify that their comments had been addressed. The IRP provided a second round of comments on the Risk Analysis Report in October 2008. This final Risk Analysis Report incorporates the editorial comments provided in Appendix 3 of the October 2008 IRP comments. Please note that these comments conclude that the DRMS Phase 1 Risk Analysis Report is "appropriate for use in DRMS Phase 2 and serves as a useful tool to inform policymakers and others concerning possible resource allocations and strategies for addressing risks in the Delta" (transmittal letter for October IRP comments from Cliff Dahm, Lead Scientist, CALFED Science Program [see Appendix B]).

This report was prepared by the undersigned and the DRMS team members listed in Section 1.4. Internal peer review was provided in accordance with URS' quality assurance program, as outlined in the DRMS project management plan.

Sincerely,

URS Corporation

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Preamble

In response to Assembly Bill (AB) 1200 (Laird, chaptered, September 2005), the California Department of Water Resources (DWR) authorized the Delta Risk Management Strategy (DRMS) project to perform a Risk Analysis of the Sacramento–San Joaquin Delta (Delta) and Suisun Marsh (Phase 1) and to develop a set of improvement strategies to manage those risks (Phase 2).

AB 1200 amends Section 139.2 of the Water Code to read: "The department shall evaluate the potential impacts on water supplies derived from the Sacramento–San Joaquin Delta based on 50-, 100-, and 200-year projections for each of the following possible impacts on the Delta:

1. Subsidence
2. Earthquakes
3. Floods
4. Changes in precipitation, temperature, and ocean levels
5. A combination of the impacts specified in paragraphs (1) to (4) inclusive."

AB 1200 also amended Section 139.4 to read: "(a) The Department and the Department of Fish and Game shall determine the principal options for the Delta. (b) The Department shall evaluate and comparatively rate each option determined in subdivision (a) for its ability to do the following:

1. Prevent the disruption of water supplies derived from the Sacramento–San Joaquin Delta.
2. Improve the quality of drinking water supplies derived from the Delta.
3. Reduce the amount of salts contained in Delta water and delivered to, and often retained in, our agricultural areas.
4. Maintain Delta water quality for Delta users.
5. Assist in preserving Delta lands.
6. Protect water rights of the 'area of origin' and protect the environments of the Sacramento–San Joaquin river systems.
7. Protect highways, utility facilities, and other infrastructure located within the Delta.
8. Preserve, protect, and improve Delta levees.…"

To meet the requirements of AB 1200, the DRMS project has been divided into two parts. Phase 1 involves the development and implementation of a Risk Analysis to evaluate the impacts of various stressing events on the Delta. Phase 2 evaluates the risk reduction potential of alternative options and develops risk management strategies for the long-term management of the Delta.

As part of the Phase 1 work, 12 technical memoranda (TMs), which address individual topical areas, and one risk report have been prepared. The TMs and the topical areas covered in the Phase 1 Risk Analysis are as follows:

1. Geomorphology of the Delta and Suisun Marsh
2. Subsidence of the Delta and Suisun Marsh
3. Seismology of the Delta and Suisun Marsh

4. Climate Change in the Delta and Suisun Marsh
5. Flood Hazard of the Delta and Suisun Marsh
6. Wind-Wave Hazard of the Delta and Suisun Marsh
7. Levee Vulnerability of the Delta and Suisun Marsh
8. Emergency Response and Repair of the Delta and Suisun Marsh Levees
9. Hydrodynamics, Water Quality, and Management and Operation of the Delta and Suisun Marsh (Water Analysis Module)*
10. Ecosystem Impacts to the Delta and Suisun Marsh
11. Impact to Infrastructure of the Delta and Suisun Marsh
12. Economic Consequences to the Delta and Suisun Marsh

*Two separate topical areas—the Hydrodynamics topical area and the Water Management topical area—were combined into one TM because of the strong interaction between them. The resulting TM is referred to as the Water Analysis Module (WAM).

The work products described in all of the TMs are integrated in the DRMS Risk Analysis. The results of the Risk Analysis are presented in the attached technical report, which is referred to as:

13. Risk Analysis Report

Taken together, the Phase 1 TMs and the Risk Analysis Report constitute the full documentation of the DRMS Risk Analysis.

The Business-as-Usual Delta and Suisun Marsh: Assumptions and Definitions

To carry out the DRMS Phase 1 analysis, it was important to establish some assumptions about the future "look" of the Delta. To address the challenge of predicting the impacts of stressing events on the Delta and Suisun Marsh under changing future conditions, DRMS adopted the approach of evaluating impacts absent major future project implementation in the Delta as a baseline. Thus, the Phase 1 work did not incorporate or examine proposals for Delta improvements. Rather, Phase 1 identified the characteristics and problems of the current Delta (as of 2005), with its practices and uses. This approach, which allows for consideration of pre-existing agreements, policies, funded projects, and practices, is referred to as the "business-as-usual" (BAU) scenario. Defining a BAU Delta is necessary because one of the objectives of this project is to estimate whether the current practices of managing the Delta (i.e., BAU) are sustainable for the foreseeable future. The results of the Phase 1 Risk Analysis based on the BAU assumption not only maintained continuity with the existing Delta, but also served as the baseline for evaluating the risk reduction measures considered in Phase 2.

The existing procedures and policies developed to address "standard" emergencies in the Delta, as covered in the BAU scenario, do not cover some of the major (unprecedented) events in the Delta that are evaluated in the Risk Analysis. In these instances, prioritization of actions is based on (1) existing and expected future response resources and (2) the highest value of recovery/restoration given available resources.

This study relied solely on available data. In other words, the effects of stressing events (changing future earthquake frequencies, future rates of subsidence given continued farming

practices, the change in the magnitude and frequency of storm events, and the potential effects of global warming) on the Delta and Suisun Marsh levees were estimated using readily available engineering and scientific tools or based on a broad and current consensus among practitioners. Using the current state of knowledge, the DRMS project team made estimates of the future magnitude and frequency of occurrence of the stressing events 50, 100, and 200 years from now to evaluate the change in Delta risks into the future.

Because of the limited time available to complete this work, no investigation or research was conducted to supplement the current state of knowledge.

Perspective

The analysis results presented in the individual TMs do not represent the full estimate of risk for the Delta and Suisun Marsh. The full estimate of risk is the probable outcome of the hazards (earthquake, floods, climate change, subsidence, wind waves, and sunny day failures) combined with the conditional probability of the subject outcomes (levee failures, emergency response, water management, hydrodynamic response of the Delta and Suisun Marsh, ecosystem response, and economic consequences) given the stressing events. The attached Risk Analysis Report presents a full characterization of risk for the Delta and Suisun Marsh. The Risk Analysis Report integrates the initiating (stressing) events, the conditional probable response of the Delta levee system, and the expected probable consequences to develop a complete assessment of risk to the Delta and Suisun Marsh.

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List of Acronyms and Abbreviations

AB	Assembly Bill
ARS	acceleration response spectrum
BAU	business as usual
Bay Modeling	Bay Modeling-Hydrodynamics
BDCP	Bay-Delta Conservation Plan
BNSF	Burlington Northern Santa Fe Railroad
BPT	Brownian Passage Time
CALFED	California Bay-Delta Authority Program
CCWD	Contra Costa Water District
CDEC	California Data Exchange Center
CDFG	California Department of Fish and Game
CEM	Coastal Engineering Manual
cfs	cubic feet per second
CIMIS	California Irrigation Management Information System
cm	centimeter(s)
cm/s	centimeter(s) per second
CPT	cone penetrometer test
CSR	cyclic stress ratio
CVP	Central Valley Project
CVPM	Central Valley Production Model
Delta	Sacramento–San Joaquin River Delta
DRMS	Delta Risk Management Strategy
DSM2	Delta Simulation Model 2
DWR	California Department of Water Resources
EBMUD	East Bay Municipal Utility District
EC	electrical conductivity
EI	Economic Insights
ENSO	El Nino Southern Oscillation
ER&R	Emergency Response and Repair
FC	fines content
feet/sec	feet per second

FEMA	Federal Emergency Management Agency
Geomatrix	Geomatrix Consultants, Inc.
GIS	geographic information system
HD	Hydrodynamics submodel
HEI	Hanson Environmental, Inc.
HTE	Hultgren & Tillis Engineers
IFB	initial freeboard
I-O	input-output
IPCC	(United Nations) Intergovernmental Panel on Climate Change
IRP	Independent Review Panel
JBA	Jack R. Benjamin & Associates, Inc.
km	kilometer
KMEP	Kinder Morgan Energy Partners
kV	kilovolt(s)
LPIII	Log Pearson Type III
M	magnitude
mg/l	milligrams per liter
MHHW	mean high higher water
MNE	Moffatt & Nichol Engineers
m/s	meter(s) per second
m^2/s	square meters per second
MSL	mean sea level
NAVD88	North American Vertical Datum of 1988
NDAL	Net Delta Area Losses
NGA	Next Generation of Attenuation
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
OD	outside diameter
PE&A	Pacific Engineering & Analysis
PGA	peak ground acceleration
PG&E	Pacific Gas and Electric Company
PL	Public Law
PMF	probability mass function

POD	pelagic organism decline
psf	pounds per square foot
PSHA	probabilistic seismic hazard analysis
PSHRP	Probabilistic Seismic Hazard Review Panel
PWA	Phillip Williams Associates
RG	Redars Group
RMA	Resource Management Associates
RMSE	root mean square error
ROD	Record of Decision
RPC	regional purchase coefficient
SA	spectral acceleration
SAIC	Science Applications International Corporation
SF	scaling factor
SFBR	San Francisco Bay Region
SPT	standard penetration test
SRP	Levee Seismic Vulnerability Review Panel
SRRQ	San Rafael Rock Quarry
SWP	State Water Project
TAC	Technical Advisory Committee
TDI	Total Delta Inflow
TM	technical memorandum
TOC	total organic carbon
URS	URS Corporation
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
UWMP	Urban Water Management Plan
VC	Vulnerability Class
V_S	shear-wave velocity
WAM	Water Analysis Module
WE	Watercourse Engineering, Inc.
WGCEP	Working Group on California Earthquake Probabilities
WGNCEP	Working Group on Northern California Earthquake Potential
WOCSS	Winds on Critical Streamline Surfaces (model)

WR Economics	Western Resource Economics
WSE	water surface elevation
WY	Water Year