

Delta Risk Management Strategy

Summary Status and Findings

Phase 1 Risk Analysis:

Determine Risks and Consequences of Delta Levee Failures

- **DRMS Scope of Work Developed May 2005 – 2 year Study**
- **Phase 1 Investigations began March 2006**
- **13 Technical Memorandums Completed (>2,000 pages)**
- **Phase 1 Draft Report Completed June 2007**
- **IRP Review Completed August 2007**

Phase 2 Risk Reduction Evaluations:

Initial Evaluation of Individual Risk Reduction Options (“building blocks”) and Combinations of Options (“Trial Scenarios”)

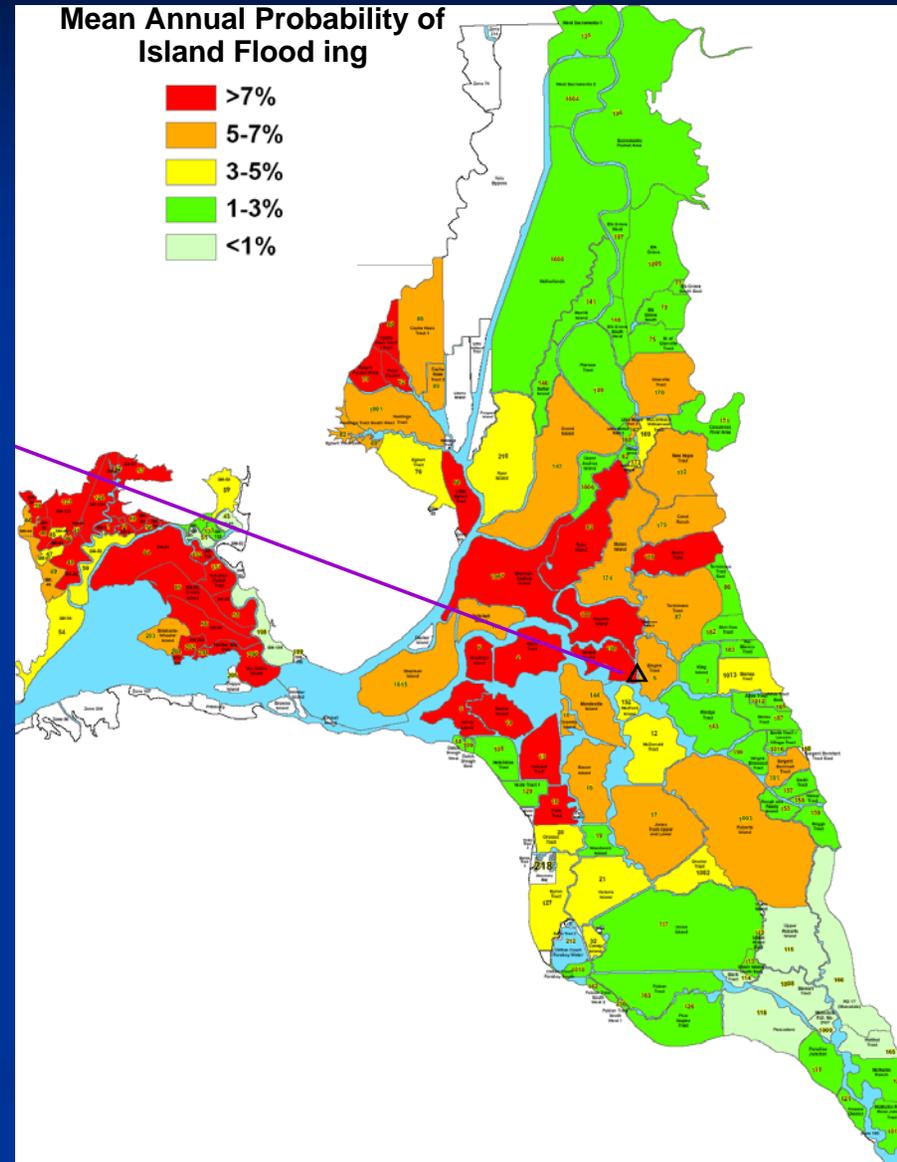
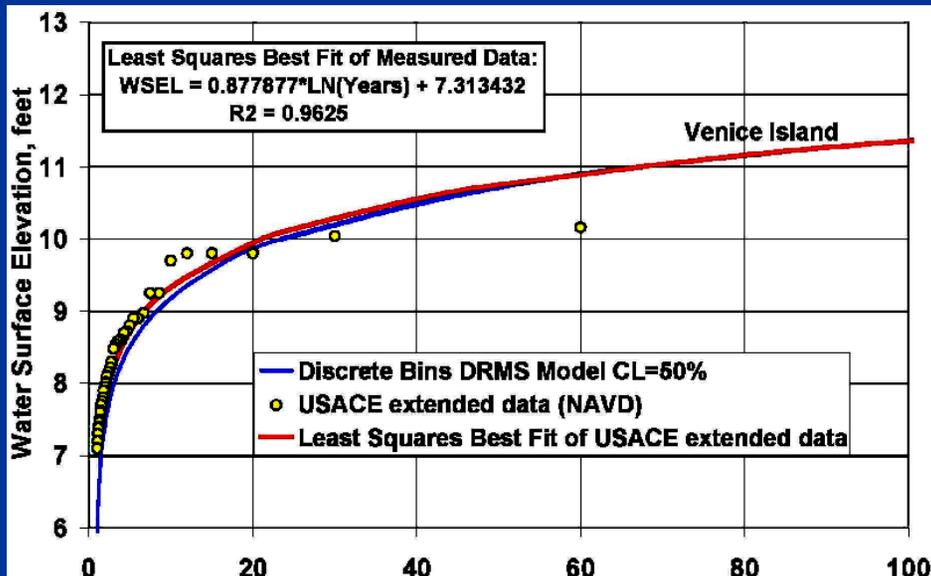
- **“Building Blocks” and 3 “Trial Scenarios” Developed June 2007**
- **Preliminary Results presented to Delta Vision Blue Ribbon Task Force in August 2007 BRTF Meeting**

October 25, 2007

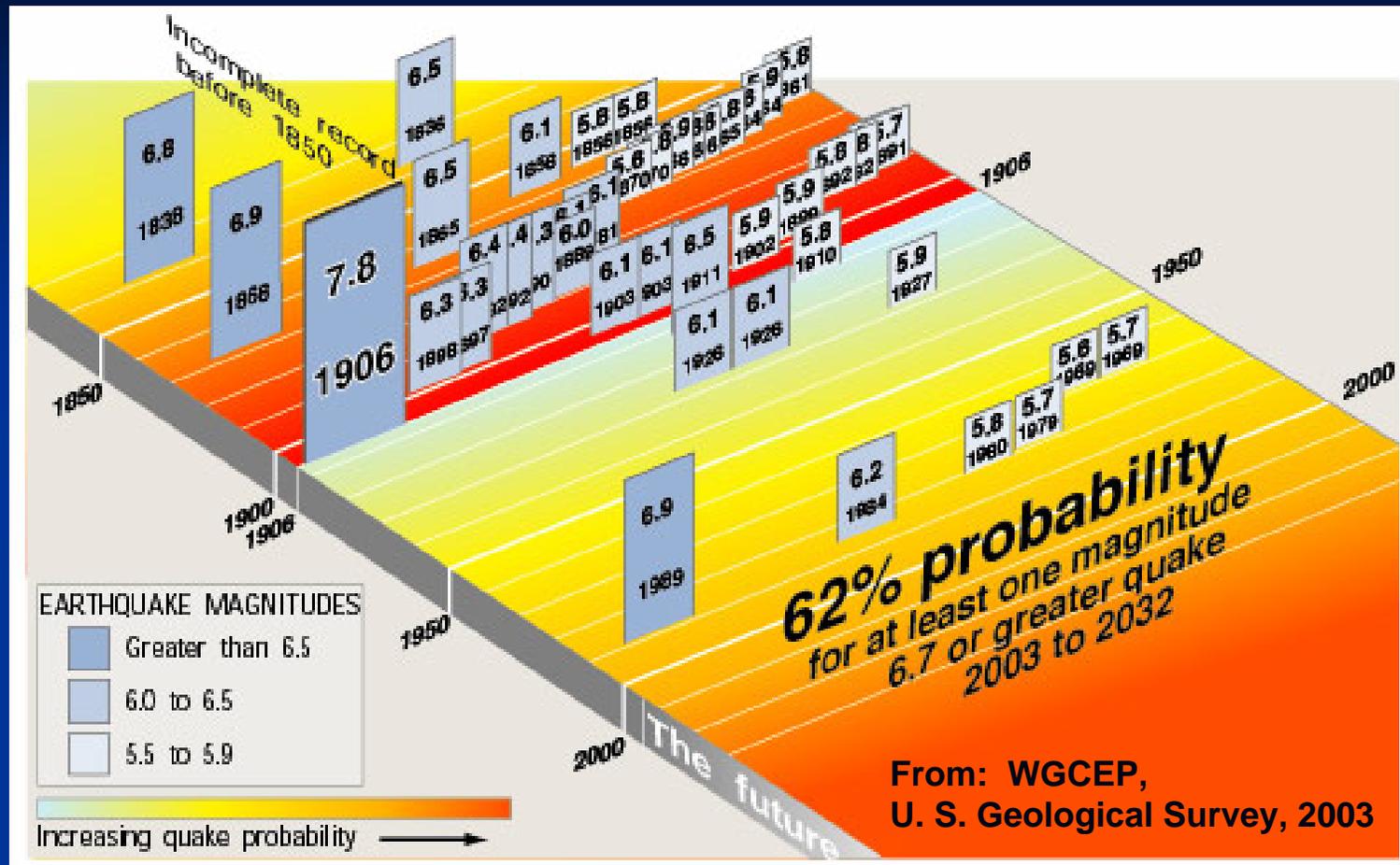
DRMS Phase 1 Preliminary Estimate of Annual Probability of Island Inundation from Flood Events

✓ Confirms High Probability of Failure for Western and Central Delta Islands

✓ DRMS Model closely matches USACE data and models



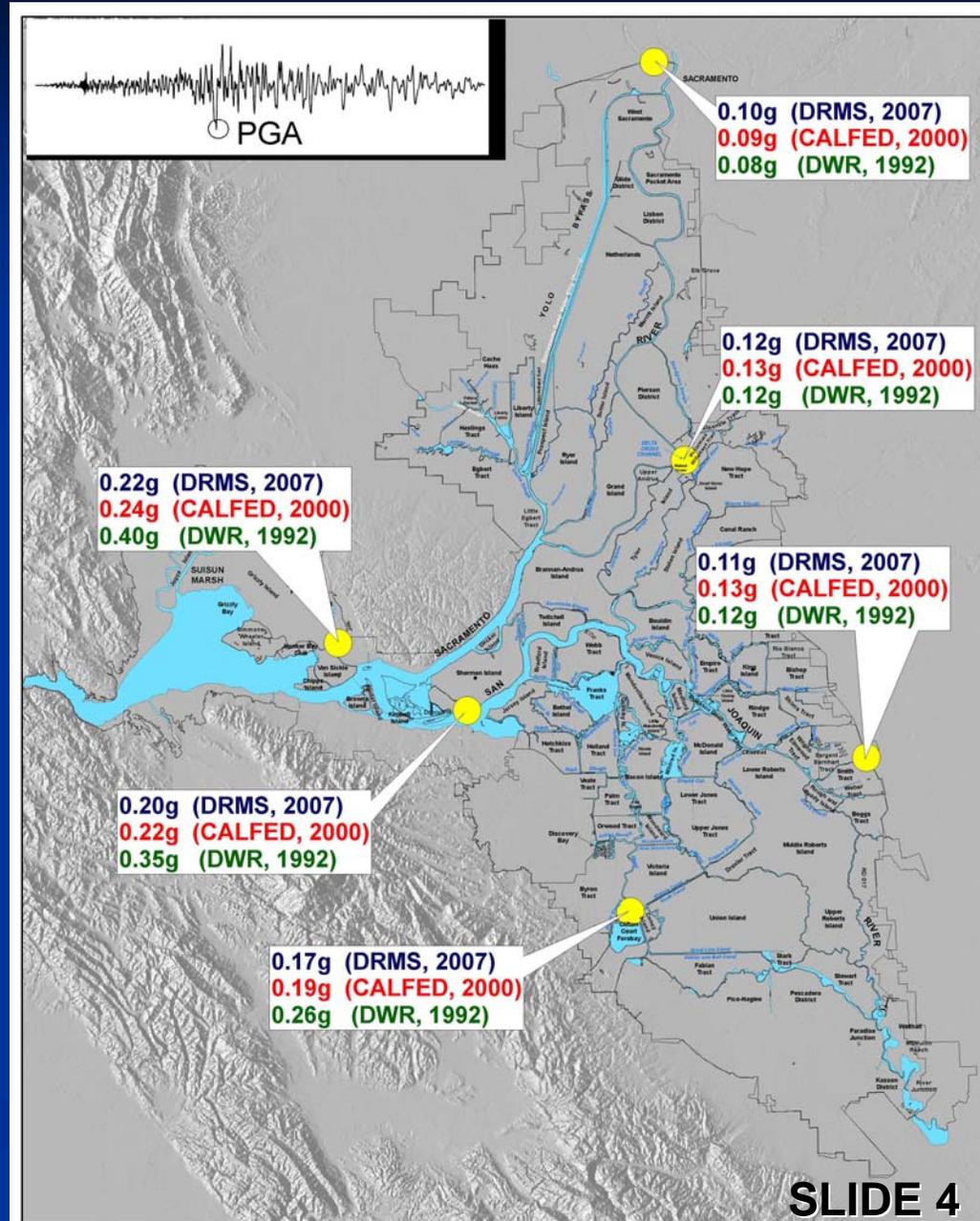
Past and Future Seismic Events in the Bay-Delta Region



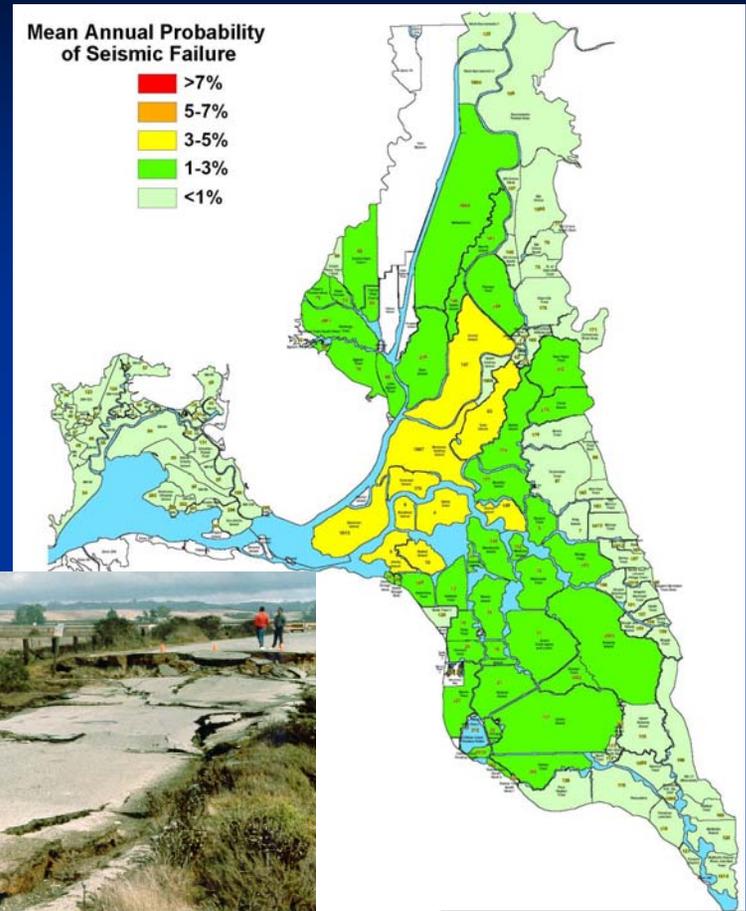
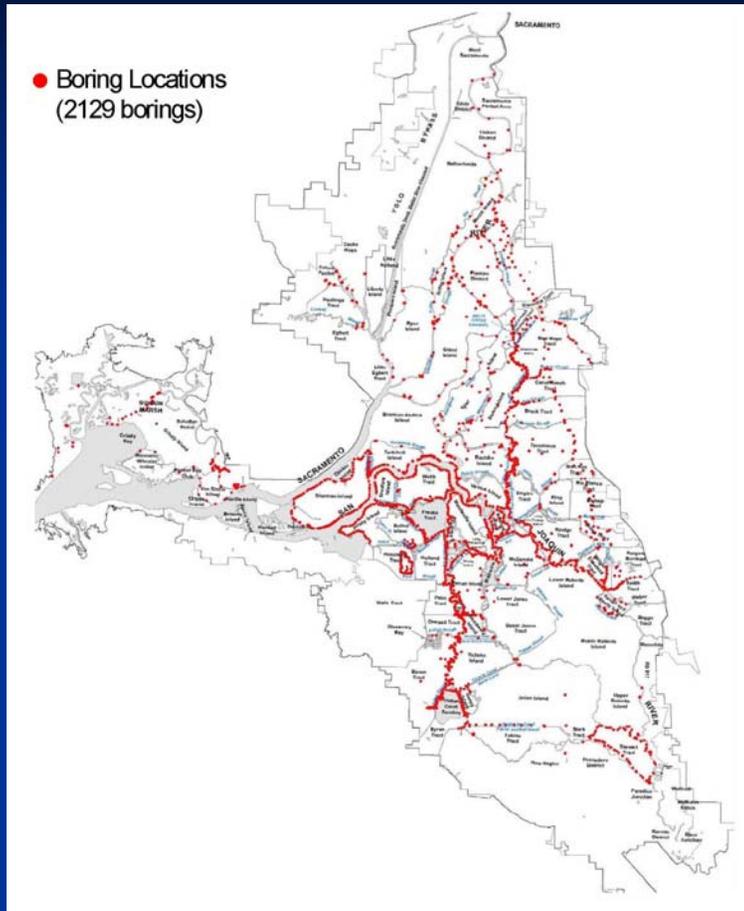
- Reclaimed Delta has generally been in a relatively low seismic period
- Increased probability for future large earthquakes

Potential Stiff Soil/Rock Earthquake Motions for a 100-year Earthquake

- ✓ Potential earthquake motions fairly well understood and agreed upon
- ✓ DRMS potential earthquake motions in agreement with previous evaluations
- ✓ Potential earthquake motions larger in western and central delta; relatively low in the eastern Delta



DRMS Phase 1 Preliminary Estimate of Annual Probability of Island Inundation from Seismic Events



- ✓ Levee Seismic Fragility estimated using data from available borings – currently under review in response to IRB comments
- ✓ Estimated Probability of Failure from Seismic Events less than half of that for Flood Events (more infrequent)
- ✓ Economic Losses could exceed \$60 Billion for Catastrophic Seismic Event

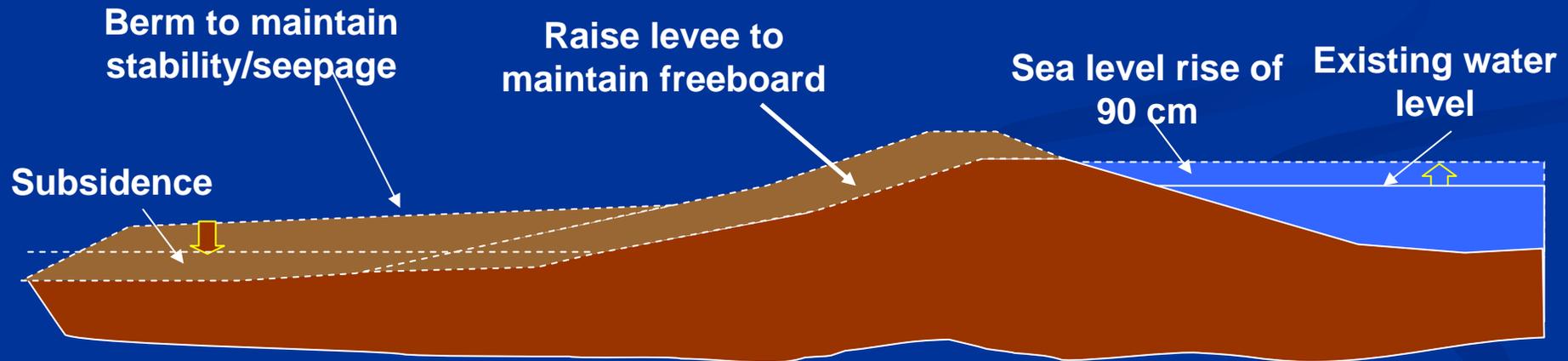
Phase 2 – Evaluating Alternatives to Mitigate Current and Future Risks

- Initial Trial building blocks and scenarios identified and evaluated
- Evaluations are based on preliminary concepts and cost assessments
- Further/improved evaluations will proceed as:
 - Preferences/priorities are identified
 - Options are optimized (e.g., levee optimization work group)
 - Costs are refined
 - More detailed assessments are conducted

DRMS Phase 2 Preliminary Estimate of Risk Mitigation Measures to Address Future Sea Level Rise and Island Subsidence

April 2007 DRMS and September 2007 CALFED ISB Recommendations for Sea Level Rise:

- Assume ~90 cm by 2100
- Consider at least up to ~140 cm by 2100



Costs to Maintain Current Level of Performance for 90 cm SLR over the next 100 years (to ~2100)

	Per mile cost	Total Cost for 500 miles upgrade
On Island fill	~ \$ 9 million	~\$ 4.4 Billion
Imported fill	~ \$ 24 million	~\$ 11.8 Billion

DRMS Phase 2: Risk Reduction Options under Consideration

Levee Options

- Mitigation for Sea Level Rise, Island Subsidence: ~\$ 9 to \$ 24 million per mile (simply maintaining current levee performance over the next 100 years)
- Levee Improvements
 - PL84-99 Standard: ~\$ 2 - 22 million per mile
 - Urban Levee Standards: ~\$ 13 - 36 million per mile
 - Seismically repairable levees: ~\$ 25 - 52 million per mile
- Increased funding for levee maintenance: ~\$12 to 25 million per year
- Improved emergency preparedness/response: ~\$100 million

} Incremental costs in addition to sea level rise/subsidence mitigation

Note: 1. Levee cost estimates depend upon availability of levee material on each island
2. Estimated costs are preliminary and developed for use in risk reduction evaluations

Water Export Conveyance Options

- Status Quo with Improved levees
- Armored Pathway along Middle River
- Isolated Conveyance Facility

DRMS Phase 2: Risk Reduction Options under Consideration (continued)

Infrastructure Options

- Elevate State Highways (Highways, 4, 12, and 160) ~ \$ 6 billion
- Armored Infrastructure Corridors (e.g. incorporate Highway 4, Mokelumne Aqueduct, and BNSF Railroad across Central Delta ~ \$ 3 billion

Ecosystem Restoration Options

- Land Use Changes to Reduce/Reverse Island Subsidence
- San Joaquin Bypass ~ \$2 billion
- Restoration of portions of Suisun Marsh to Tidal Wetlands ~ \$ 170 million
- Cache Slough Restoration ~ \$ 400 million
- Fish Screens on River/Island Diversions ~ \$ 165 million
- Setback Levees used to provide Shaded Riverine Habitat ~ \$35 million/mi.

DRMS Phase 2 Water Export Conveyance Element: Improved Levees

Preliminary Design/Construction Costs

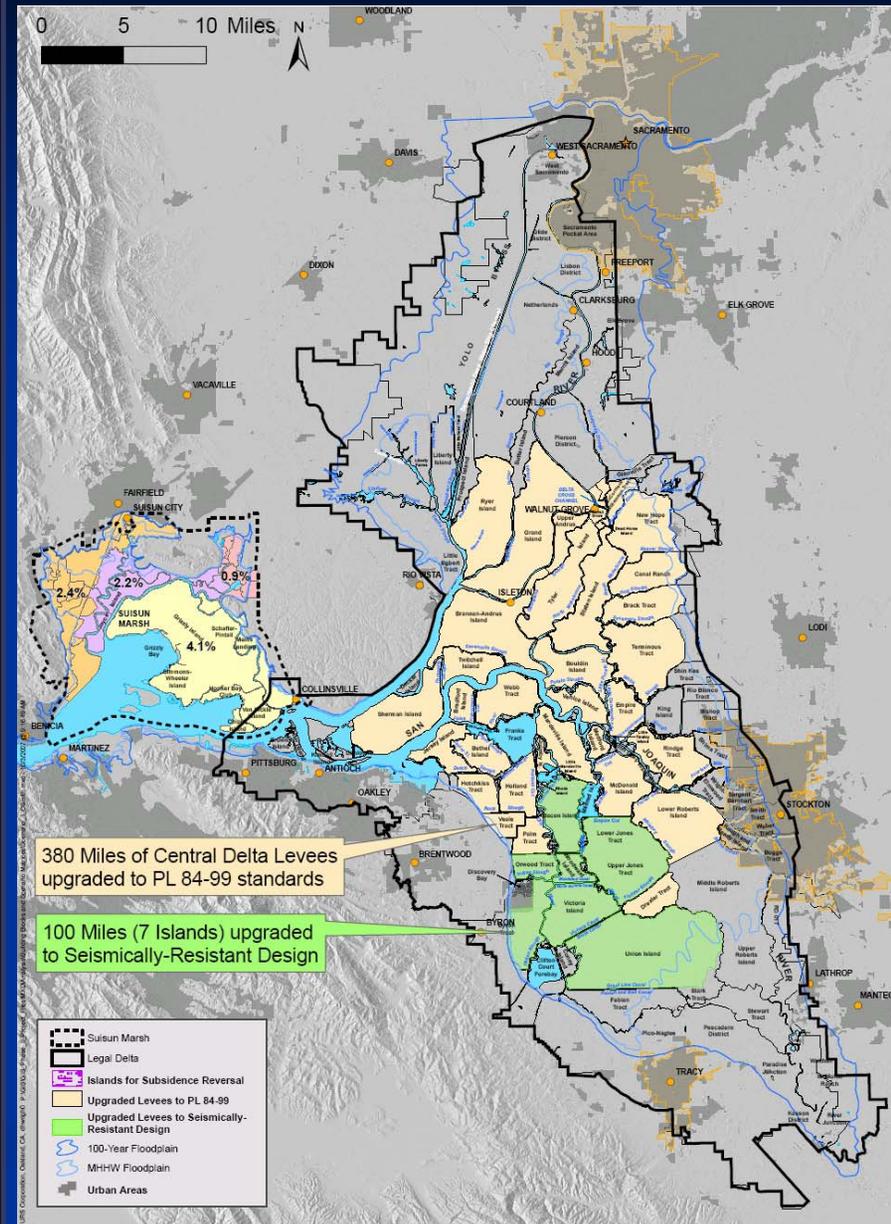
- 380 levee miles to PL84-99 ~ \$ 1.7 Billion
- 100 miles to Seismic Resistant Setback Levee ~ \$ 3.8 Billion
- Total Cost ~ \$ 5 ½ Billion

Potential Benefits Include:

- Reduced Risk of Salt Water Intrusion/Water Export Interruption
- Reduced Impact to Ecosystems
- Reduced Flood Risk Due to Overtopping and Seepage – helps protect agriculture, on-island ecosystem/habitat, and legacy towns
- Improved Protection for Some Infrastructure (Highway 4, Mokelumne Aqueduct, BNSF RR)
- Creates 100 Miles of Riparian Corridor

Limitations Include:

- Lower Reliability (compared to ICF & AP) of Water Export due to Physical and Environmental Risks
- Continues Current Impacts to Fisheries
- Costs do not include mitigation for sea level rise or continued island subsidence



DRMS Phase 2 Water Export Conveyance Element: Armored Pathway

Preliminary Design/Construction Costs

- 15,000 cfs Facility ~ \$ 5 ½ - 9 Billion
- 10,000 cfs Facility ~ \$ 4 ½ - 8 Billion
- 5,000 cfs Facility ~ \$ 3 ½ - 6 Billion

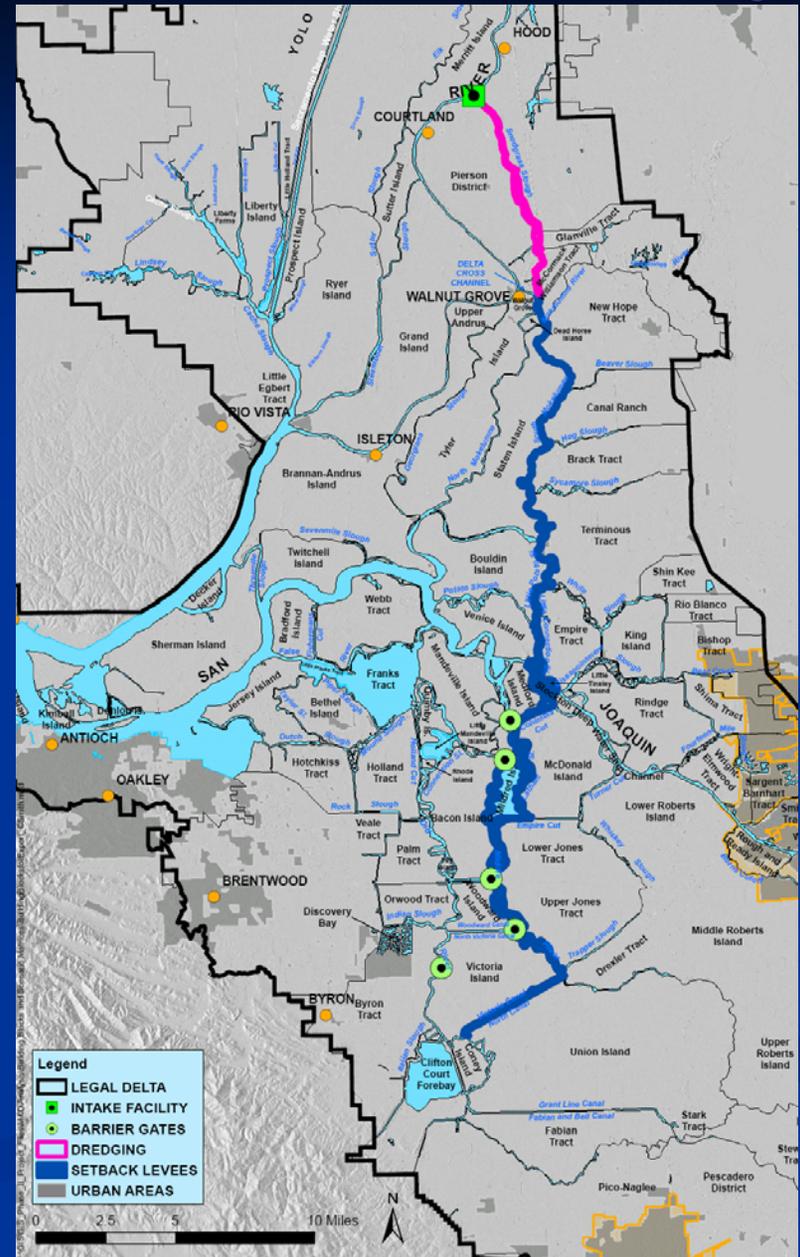
(Costs depend upon level of Middle River levee improvements)

Potential Benefits Include:

- Significant Reduction in Risk of Water Export Interruption
- Significant Benefits to Fish by Isolating Old River from Middle River/Setback Levees
- Operational Flexibility Using Barrier Gates

Limitations Include:

- Operational Limitations to be Determined
- Lower Reliability compared to ICF for Water Export due to Physical and Environmental Risks
- Costs do not include mitigation for sea level rise or continued island subsidence



DRMS Phase 2 Water Export Conveyance Element: Isolated Conveyance Facility

Preliminary Costs

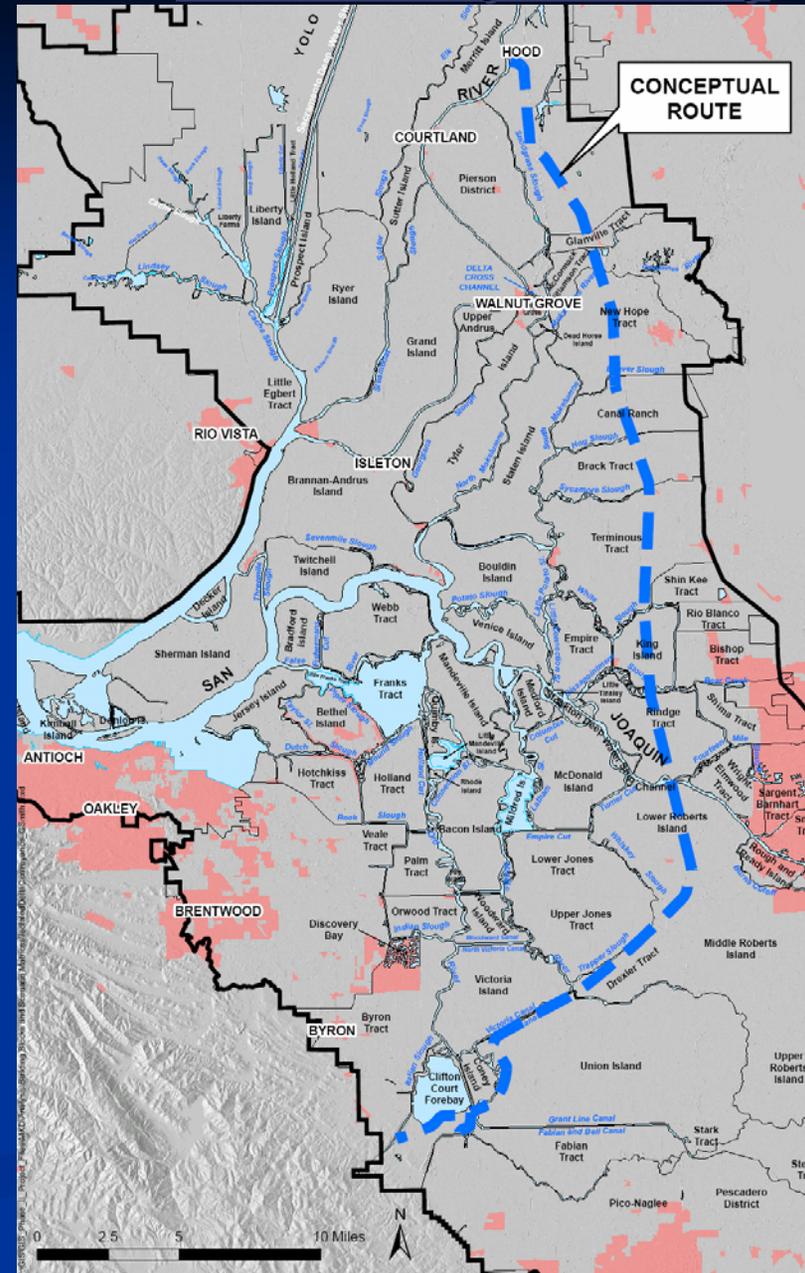
- 15,000 cfs Facility ~ \$ 4.9 Billion
- 10,000 cfs Facility ~ \$ 4.2 Billion
- 5,000 cfs Facility ~ \$ 3.3 Billion

Potential Benefits Include:

- Most Reliable Water Conveyance Approach - Major Reduction in Risk of Water Export Interruption
- Offers Most Flexibility for Water Quality in the Delta by Isolating Water Export from Delta Water
- Reduces Water Treatment Costs and Salt Accumulation in Agricultural Fields
- Decreases Impacts to Fisheries

Limitations Include:

- By itself, ICF Provides the Least Protection to Delta Islands
- Will require additional Env. Mitigation costs
- ICF only obtains water from Sacramento River; not able to use high winter flows in San Joaquin River
- Costs do not include mitigation for sea level rise or continued island subsidence



Limitations to All Water Export Conveyance Elements:

- **Significant Risk of Levee Failure Remains in Most of the Delta/Potential Fish Entrainment**
- **Requires Additional Maintenance Costs to Keep up with Sea Level Rise/Subsidence**
- **Governance of Water Export/Quality to be Determined**
- **Long-Term Management Plan to be Determined for Maintaining/Abandoning Delta Islands**

DRMS Phase 2: Developing a Risk Reduction Trial Scenario

Elements of Risk Reduction Scenario

- ✓ Selection of Islands/Levees to mitigate for sea level rise/subsidence
- ✓ Optimize Levee Improvements for different Islands/Levees (e.g. HMP, PL84-99, Urban, Seismically Repairable)
- ✓ Level of increased levee maintenance and to which levees to be applied
- ✓ Improved level of Emergency Response preparation/ response
- ✓ Selection of Land Use changes for different islands
- ✓ Selection of infrastructure improvements
- ✓ Selection of Water Export Conveyance, or dual conveyance
- ✓ Selection of Ecosystem Restoration Components
- + Long-term Governance Plan for Water Quality/Export and Maintenance/Recovery of Islands

Delta Risk Management Strategy

Next Steps

