2.0 Executive Summary

A planning level evaluation of various embankment configuration options has been performed to support the formulation and evaluation of alternatives for the restoration of the Sea. Detailed seepage, stability, deformation, risk, constructability, and cost evaluations have been completed to support the evaluation and selection of a preferred configuration option for the embankments and to develop optimized cross-sections.

Two embankment dam configurations have been developed that meet Reclamation's Public Protection Guidelines (Reclamation, 2003) and the established design criteria for planning level designs. The configuration options include:

- ✓ Sand Dam with Stone Columns
- ✓ Rockfill Dam with Jet Grouted Foundation

A modified "Rock Notches" dam with maximum seismic filters was also developed, meeting all Reclamation criteria except the provision of "full filters" between the embankment rockfill and the foundation. For this option, the filters made as extensive as possible while still meeting seismic stability and deformation requirements. However, because the filters did not provide full protection between the rockfill and foundation material under the downstream shell of the dam, it was eliminated it from further consideration.

An evaluation of these options determined that the sand dam with stone columns is Reclamation's preferred dam configuration option. "Optimized" configurations for the mid-Sea dam, south- and north-Sea dams, perimeter dikes, and concentric lakes dikes, and/or for the mid-Sea barrier (meeting static or combined static/seismic design criteria) were developed based on the sand dam with stone columns option.

A risk analysis of the "optimized" embankment designs for the Salton Sea restoration project was completed to evaluate potential failure modes, loss-of-life potential and estimates of the annual probability of failure and the annualized loss-of-life. After the risks for all of the failure modes for each structure were evaluated, results were compiled to develop a "composite" risk for each restoration alternative. It was determined that the risk of failure of an alternative could be described by the risk associated with failure of the "weakest link" in the system.

In general, the risk analysis confirmed that the "optimized" designs would comply with Reclamation's Public Protection Guidelines (Reclamation, 2003) with the

following exceptions. First, upon careful consideration of the available subsurface information and the morphology of the seafloor deposits, it was determined that there is some likelihood that liquefiable (and erodible) layers and lenses exist within the upper stiff lacustrine deposits. This possibility was considered in the risk analysis as Failure Mode 6 (FM No.6). The "optimized" cross-sections evaluated as part of the risk analysis were developed to meet static and seismic design criteria for the potential of liquefaction within the upper alluvial and soft lacustrine deposits and not within the upper stiff lacustrine. (Note: In this report and its appendices, the words "alluvial", as used above, and "alluvium", as used elsewhere, generally refer to the same deposit.) Further refinement of the cross-sections would be required to meet seismic design criteria should future site explorations identify/confirm potentially liquefiable materials within the upper stiff lacustrine deposits.

Second, the potential for fault offset that would translate through the seafloor deposits to the base of embankment structures crossing the Imperial / San Andreas Fault Transition Zone was identified in the risk analysis. This was considered as a potential failure mode (FM No.12) and the risk identified that further refinement of the cross-section of embankments crossing this zone would be required to meet seepage design criteria and to reduce the potential for failure following a seismic event that would cause surface rupture of the seafloor deposits. A modified cross-section has been developed that will reduce the risk of failure due to fault rupture to acceptable risk levels.

Using the "optimized" cross-sections, appraisal-level cost estimates were prepared for each of the five overall project alternatives and options under consideration by Reclamation. A summary of the estimated subtotal construction costs for the embankment portion of these alternatives is as follows:

	Alternative	**Estimated Subtotal Embankment Construction Costs**
1.	Mid-Sea Dam/North Marine Lake	$ 3,339,066,140
2.	Mid-Sea Barrier/South Marine Lake:	
	2A Static/Seismic design criteria	$ 898,087,677
	2B Static/Non-seismic design criteria	$ 707,092,179
3.	Concentric Lake Dikes:	
	3A Static/Seismic design criteria	$ 8,999,280,347
	3B Static/Non-seismic design criteria	$ 6,944,914,735
4.	North-Sea Dam/Marine Lake	$ 5,021,163,338
5.	Habitat Enhancement without Marine Lake	$ 568,560,600

It should be noted that this planning level study has developed embankment configurations and cost estimates beyond what was accomplished in the 2005 appraisal level studies. However, because of the very limited amount of information on the stratigraphy and engineering properties of the Sea foundation

deposits and potential construction material sources, the concepts and cost estimates are not yet at a funding level of detail. Funding level concept and cost estimate updates should be prepared when sufficient supplemental explorations have been completed for this purpose. The concepts and cost estimates could change dramatically if additional exploration information indicates significant differences from the baseline assumptions that have been made.