Chapter 2. History of Plan Formulation

This present study attempts to determine a reasonable alternative concept for restoring the Salton Sea and uses information from both recent (1998–2005) and past (1960s to 2003) studies. The specific concepts evaluated in this present study were screened and selected from hundreds of ideas and concepts that ranged from circulating ocean water from the Gulf of California or the Pacific Ocean to removing salts at the Sea through the use of enormous desalination plants, solar pond systems, and/or enhanced evaporation systems.

Rising salinity concentrations and the realization in the 1960s that increased salinity levels would eventually affect uses at the Sea led to various study efforts to determine methods to manage salinity. Early efforts and investigations to determine methods to reduce salinity in the Sea began in 1965 and resulted in the preparation of a 1969 Federal/State Reconnaissance Investigation Report and the 1974 Salton Sea Project Feasibility Report (Reclamation and State of California, 1974). Although numerous concepts for reducing salinity were studied and reported, rising water surface elevations at the Sea, due to increased agricultural development and subsequent drainage inflows into the Sea, muted the need for project implementation at that time.

In the mid-1980s, Federal and State agencies again began looking into ways of controlling salinity. P.L. 102-575, passed in 1992, gave Reclamation the authority to conduct salinity control studies. In response to that law, Reclamation and the Salton Sea Authority (SSA), which was established in 1993, published and provided a report to Congress in 1997 that contained an evaluation of a wide suite of proposed alternatives intended to address the salinity and elevation problems of the Sea.

In 1996, an initial screening study was conducted through an agreement with the SSA, the California Department of Water Resources (DWR), and Reclamation. In an effort to include a wide variety of potential solutions to the problems of the Sea, media announcements and public meetings were used to invite submittals of restoration alternatives. Through these efforts, 54 alternatives were identified and evaluated through a preliminary technical screening process. This preliminary screening effort provided the framework for developing alternatives in 1998 that would be analyzed and documented by various efforts, including a cooperative federal and state National Environmental Policy Act and California Environmental Quality Act (NEPA/CEQA) initiative.

Subsequent to the passage of the Salton Sea Reclamation Act of 1998, Reclamation and the SSA began the process of developing a Draft Environmental Impact Statement/Environmental Impact Report (DEIS/EIR). As part of this

NEPA/CEQA process, required public scoping meetings resulted in further alternative suggestions, as well as comments concerning the 54 alternatives that were derived from the previously mentioned screening process.

All 54 original alternatives were re-assessed, and new alternatives were considered, including those suggested by the public in 1998. The reassessment yielded 39 alternatives that were carried forward for additional screening analysis. A description of these alternatives is provided in the Salton Sea Alternatives Final Pre-Appraisal Report (November, 1998).

Subsequently, a January 2000 DEIS/EIR considered five project alternatives and compared each against three No Action/No-Project scenarios. Analysis of alternatives continued following publication of the DEIS/EIR and the receipt of public and agency comments. In addition, more information became available about the range of possible inflows to the Sea that could occur in the future. Restoration alternatives studies also continued following publication of the DEIS/EIR. In these studies, the strategy for salinity control presented in the DEIS/EIR was replaced by a strategy involving two basic types of modules for salinity control: salt removal modules and salt disposal modules. Using the modular strategy, eight salinity control alternatives, three salinity and elevation control alternatives, an alternative that would have involved construction on an impervious barrier across the middle of the Sea, and two specialized diking proposals were considered in a January 2003 status report (Reclamation, 2003).

After publication of the 2003 status report, the Quantification Settlement Agreement (QSA) was reached, and the associated Imperial Irrigation District (IID)-San Diego Transfer Agreement was approved. As a result of anticipated reduced inflows, alternatives involving salt removal and disposal were abandoned in favor of partial restoration solutions such as equal head barriers and impervious dam alternatives as well as habitat-pond-based alternative concepts. In 2005 Reclamation conducted appraisal level evaluations of eight different alternatives of these types. The alternatives evaluated in this present report are based on revisions to the alternatives studied in 2005.

Following are overviews of the January 2000 DEIS/EIR alternatives, the January 2003 status report alternatives, the year 2005 alternatives, and subsequent revisions made to these 2005 alternatives for this present study.

Alternatives in the January 2000 Draft EIS/EIR

No Action/No-Project Scenarios

The January 2000 draft EIS/EIR considered five project alternatives that were each compared against three No Action/No-Project scenarios. The three future No Action/No-Project inflow scenarios were:

- Historical inflow conditions continue at average annual inflows of 1.36 million acre-feet per year (maf/yr).
- Average annual inflows were incrementally reduced to 1.06 maf/yr.
- Average annual inflows were incrementally reduced until they reached 0.8 maf/yr.

Project Alternatives

The five project alternatives considered were: Evaporation Ponds (Alternative 1), Enhanced Evaporation System at Bombay Beach (Alternative 2), EES at Salton Sea Test Base (Alternative 3), Evaporation Pond and EES (Alternative 4), and In-Sea EES in Evaporation Pond (Alternative 5).

Alternative 1 — two evaporation ponds would have been constructed within the southwest area of the Sea.

Alternative 2 — an Enhanced Evaporation System (EES) would have been constructed on a site north of Bombay Beach. With EES, Salton Sea water would have been sprayed from a height sufficient to allow the water to evaporate and the salts or brines to precipitate into a catchment basin, which would then be moved to precipitation ponds constructed nearby.

Alternative 3 — would have been similar to Alternative 2, except that the EES would have been constructed at the Salton Sea Test Base on the southwest side of the Sea.

Alternative 4 — would have combined the technology of Alternatives 1 and 3.

Alternative 5 — the same evaporation pond as under Alternative 1 would have been constructed, along with a 150,000 af/yr ground-based EES.

Additionally, several actions would have been common to all alternatives: (1) fish harvesting, (2) improved recreational facilities, (3) shoreline cleanup program, (4) Integrated Wildlife Disease Program, (5) long-term management strategy, and (6) Strategic Science Plan.

Finally, the following export options were considered as part of Alternatives 1 and 5:

- Export to expanded EES
- Export (by pipeline or canal) to the Gulf of California
- Export (by tunnel, pipeline, and canal) to the Pacific Ocean
- Export (by pipeline and canal) to Palen Dry Lake

Also considered was the import of water that originates as a brine stream from the proposed Central Arizona Salinity Interceptor (CASI), through Yuma, to the Salton Sea. In addition, the possibility of using periodic flood flows from the Colorado River as a source of water, as well as in-Sea displacement dikes constructed in the year 2015, were considered as part of some alternatives. Either of these actions would help maintain and stabilize Sea elevations under reduced inflow scenarios.

Alternatives Not Considered Further After the 2000 EIS/EIR

A number of the technologies considered in the draft EIS/EIR were not considered further because of technical and cost considerations, including large, deepwater, in-Sea ponds and import of water from other sources. In addition, although not part of the analyzed alternatives in the draft EIS/EIR, desalination of inflow water was considered but eliminated from further consideration because of the high costs.

Alternatives in the January 2003 Status Report

Analysis of alternatives continued following publication of the January 2000 draft EIS/EIR and the receipt of public and agency comments. In addition, more information became available about the range of possible inflows to the Sea that could occur in the future. The strategy for salinity control presented in the draft EIS/EIR was replaced by a modular strategy, which involved two basic types of modules for salinity control: salt removal modules and salt disposal modules.

Each salt removal module would remove about 1 million tons of salt per year from the Sea. For every salt removal module, one salt disposal module would also be required. The removal and disposal techniques were grouped into the following categories of alternatives:

- Salinity control alternatives
- Salinity and elevation control alternatives
- Specialized diking alternatives

Salinity Control Alternatives

Salinity control alternatives considered in the January 2003 status report are as follows:

- *SC 1: In-Sea Ponds* — In-Sea solar ponds with in-Sea terraced salt disposal would have been constructed using standard dike construction procedures.

- *SC 2: Ground-Based Enhanced Evaporation Systems* — EES, which involve spraying water in the air to accelerate the rate at which water evaporates, would have been used in conjunction with a series of evaporation ponds

- *SC 3: Tower EES* — A tower system that would spray water from nozzles along in-line showers would have been used to evaporate Sea water.

- *SC 4: In-Sea and On-Land Ponds* — A combination of (1) in-Sea solar ponds with in-Sea terraced salt disposal and (2) on-land solar ponds with on-land terraced salt disposal facility would have been constructed.

- *SC 5: On-Land Ponds* — On-land solar ponds would have been constructed along with on-land terraced salt disposal facilities.

- *SC 6: Vertical Tube Evaporation (VTE) Desalination* — One or two desalination plants would have been constructed at the south end of the Salton Sea using VTE.

- *SC 7: Mid-Sea Causeway* — A causeway or barrier across the central narrower area of the Sea would have been used to divide the Sea into two separate water bodies, essentially creating a two-celled solar pond system out of the Salton Sea itself.

- *SC 8: North-Sea Causeway* — This alternative was similar to SC 7, except that the dike would have been located farther north, which would have allowed for maintenance of a marine environment in the south basin.

Salinity and Elevation Control Alternatives

Three alternatives that not only would have controlled salinity but also would have controlled elevation (SEC) were formulated from the previously mentioned components:

- *SEC 1: In-Sea Ponds with Displacement Dikes* — In-Sea pond/dike systems that would have reduced surface area and could also be used to create solar ponds that remove salt from the Sea.

- *SEC 2: VTE Desalination with In-Sea Displacement Dikes* — Construction of a VTE desalination plant to remove salts coupled with in-Sea dike systems that would have reduced surface area and could be used for disposal of brines from the desalting operation.

- *SEC 3: Import/Export* — Import/export pipelines to convey water from the Salton Sea to the Gulf of California and return water from the Gulf to the Sea. SEC 3 had two parts—SEC 3a and 3b. SEC 3a was a pipelines alternative, and SEC 3b was a pipelines and unlined canals alternative.

A fourth alternative would have involved construction of an impervious barrier across the middle of the Sea. The barrier would have acted as a dam to hold back water and control salinity in the north portion of the Sea and would have allowed the south end of the Sea to become hypersaline with reduced elevations.

Specialized Diking Proposals

Two proposals would have used dikes to create impoundments around the Sea to provide benefits that may not have been provided under the other alternatives. Under the *Pacific Institute Proposal for Diked Impoundments*, dikes would have been constructed within the Sea near the north and south shores to capture inflows and to stabilize the water surface elevation at -230 feet. The impounded north and south shore areas would have transitioned to brackish, estuarine conditions.

Under the *U.S. Filter Proposal for Shallow Water Shoreline Dike Integrated with Desalination, Water Transfer, Seabed Reclamation, and Salt Storage*, a dike would have ringed the Sea, separating better quality water along the shoreline from hypersaline water in the center. A desalinization plant at the north end of the Sea would have produced approximately 500,000 acre-feet per year of water with low salinity, which would have been transferred to urban water users via the Coachella Canal and the Colorado River Aqueduct. The concentrate from the plant would have been returned to the central Sea.

Several other elements were expected to have been included with all alternatives: wildlife disease control, created wetlands, recreation and public information, continuing work on eutrophication assessment and control measures, shoreline cleanup, and fishery management.

Alternatives in the November 2005 Appraisal Studies

The following alternatives were studied in the November 2005 appraisal level study:

- Mid-Sea Dam with North Marine Lake (Alternative 1)
- Mid-Sea Dam with South Marine Lake (Alternative 2)
- Concentric Ring Dikes with Cascading Reservoirs (Alternative 3)
- Combined Alternative (similar to the Salton Sea Authority concept) (Alternative 4)

- Mid-Sea Barrier with North Marine Lake (Alternative 5)
- Mid-Sea Barrier with South Marine Lake (Alternative 6)
- Mid-Sea Barrier with South Marine Lake with Habitat Ponds (Alternative 7)
- Revised Evolving Salton Sea with Habitat Ponds (Alternative 8)

Following is a description of each of these alternatives.

Alternative 1: Mid-Sea Dam with North Marine Lake — Under this alternative, an impervious dam embankment would have been constructed to maintain the water on the north side of the embankment at a higher elevation than the brine pool on the south side. The area south of the embankment would have served as an outlet for water and salt from the north; it would have rapidly shrunk in size and increased in salinity to form a brine pool.

Alternative 2: Mid-Sea Dam with South Marine Lake — Under this alternative, an impervious dam embankment would have been constructed to maintain the water on the south side of the embankment at a higher elevation than the brine pool on the north side. The dam embankment would have been designed and constructed the same as for Alternative 1, except the upstream and downstream sides would have been reversed, it would have been longer, and the crest of the dam would have been 5 feet higher.

Alternative 3: Concentric Ring Dikes with Cascading Reservoirs — Under this alternative, two concentric annular 15-foot-deep pools (outer and inner lakes) would have been formed within the Sea. A brine pool would have developed insides these pools.

Alternative 4: Combined Alternative (Similar to the Salton Sea Authority concept) — This alternative would have included a north lake similar to that in Alternative 1, but with the addition of an outer pool impounded behind a 31-mile-long perimeter (concentric ring) dike along the south and southwest sides of the Salton Sea. The alternative also would have included a 6-mile ring dike along the east side and a 6-mile-long canal along the southeast side of the exposed sea bed/brine pool.

Alternative 5: Mid-Sea Barrier with North Marine Lake — This alternative would have created a smaller, shallower Salton Sea by constructing an in-Sea semi-pervious barrier to separate the northern and southern portions. Water on the north side of the barrier would have supported marine habitat; the brine pool on the south side would have served as an outlet for water and salt from the northern side.

Alternative 6: Mid-Sea Barrier with South Marine Lake — This alternative was conceptually similar to Alternative 5, except the water south of the barrier would have supported marine habitat.

Alternative 7: Mid-Sea Barrier with South Marine Lake and Habitat Ponds — This alternative was the same as Alternative 6 with the addition of habitat ponds.

Alternative 8: Evolving Sea with Habitat Ponds — Under this alternative, the main body of the Sea would have continued to serve as a repository for agricultural runoff, but it would not have been subject to salinity or elevation control. As a result, the Sea would have evolved into a hyper saline lake and, eventually, a brine pool as inflows decreased over time.

Revision of 2005 Alternatives for Present Study

The alternatives studied in 2005 were refined for this current stage of Reclamation's study after coordination with the Salton Sea Authority and the California Department of Water Resources. The objectives behind further developing the alternatives were to:

- Make sure that the alternatives that were carried forward were consistent with the directions being taken by the SSA and DWR
- Incorporate DWR's Saline Habitat Complex concepts
- Refine the alternatives to reflect the latest engineering and environmental viability knowledge

Year 2005 alternatives were either eliminated or refined for this current study in the following way:

Mid-Sea Dam with North Lake: This alternative was considered redundant to the North Sea Marine Lake included in the Salton Sea Authority Alternative. The alternative was modified to involve a dam on the north end that would only impound Whitewater River flows. The dam design would provide for water depths below the 10-meter threshold hydrodynamic modeling studies identified as the limit needed to reduce likelihood of prolonged thermal stratification (Chapter 6). This alternative was modified to include Saline Habitat Complex.

Mid-Sea Dam with South Marine Lake: This alternative was eliminated as it was considered too costly, given the depth of water and length of dam that would have to be constructed. The concept was also identified as having serious prolonged stratification issues.

Concentric Ring Dikes and Cascading Reservoirs: This alternative was modified to be consistent with the Imperial Group's new proposed concentric lakes

alternative. In the concentric lakes concept, each lake would receive river water directly through channels and diversions constructed at the south end of the Salton Sea. This concept is substantially different than the cascading ring concept studied in 2005. In the new Concentric Lakes Dikes Alternative, river water would be impounded in each lake and held in storage for a minimum of 3 years to achieve specified salinity targets.

Combined Alternative (Similar to Salton Sea Authority Concept): This alternative was modified to reflect the current Salton Sea Authority Alternative.

Mid-Sea Barrier with North Marine Lake: This alternative was dropped from further consideration because it was hydraulically more complex than the Mid-Sea Barrier with South Marine Lake Alternative. In addition, the fish and wildlife related resource benefits of a south lake were considered more important than those of a north marine lake. The delta and shoreline habitat areas on the south end are considered higher priority than on the north end.

Mid-Sea Barrier with South Marine Lake: This alternative was modified to include Saline Habitat Complex.

Mid-Sea Barrier with South Marine Lake and Habitat Ponds: This alternative was eliminated from further consideration because of questions related to constructing and operating very large selenium treatment plants.

Evolving Sea with Habitat Ponds: This alternative was replaced with a habitat enhancement only alternative that includes substantial acreages of Saline Habitat Complex.

The current alternatives presented in this summary report are as follows:

- Mid-Sea Dam with North Marine Lake
- Mid-Sea Barrier with South Marine Lake
- Concentric Lakes
- North-Sea Dam with Marine Lake
- Habitat Enhancement without Marine Lake
- No-Project

These alternatives are described in detail in the next chapter.