Chapter 8

Alternatives Considered for Elimination

Originally, four elimination criteria were developed to narrow the list of 54 alternatives to those alternatives that matched project requirements. These criteria were discussed and approved at an Authority workshop on October 19, 1995. Since that time, a decision was made not to use the $10 million OMR&E per year cost criteria for this analysis. The remaining three criteria were used to evaluate the original list of 54 alternatives plus any new alternatives received.

The proposal must meet the three criteria established:

- Achieve and maintain target salinity level of 40 ppt in the Salton Sea
- Achieve and maintain Salton Sea target water surface elevation to -232 m.s.l.
- Use proven technology and not involve research

Original 54 Alternatives

Some of the alternatives (cross-reference table on page 17) have partial solutions that may be used in conjunction with another alternative. Many of the alternatives have good ideas but lack a definitive plan or design, quantities, and costs. For reasons described earlier, Colorado River water is not available as a source to dilute Salton Sea water. The following alternatives could be considered for elimination because they were incomplete or did not meet one or more of the three criteria established. The number of the alternatives correspond to the number of the alternatives in the 1997 report.

Alternative 8 Onshore Evaporation Ponds

Included in the September 1997 report, this proposal was examined in the Reclamation and RAC report, Salton Sea Project, California, Federal-State

reconnaissance report (1969, and in the final report in 1974). It was also included in the Aerospace Corporation report, Salinity Control Study, Salton Sea Project, Report No. ATR-71 (S990)-5 (1971).

This alternative would involve pumping Sea water into evaporation ponds onshore where the water would be evaporated, leaving behind saline residue. Saline water would be removed from the Sea until the desired salinity was reached. At this point, pump-out would continue at a lower rate so that salts removed by pump-out each year would equal the annual inflow of salts. Eventually, the evaporation ponds would fill with salts, and disposal would be necessary. The southeastern shore of the Sea, between Bombay Beach and Red Hill, would be a potential location for onshore evaporation ponds.

In the initial stages of this proposal, a total of 400,000 acre-feet of water would be pumped each year. Evaporating this quantity of water would require nearly 70,200 acres.

The amount of land required for evaporation ponds is judged unacceptable, and the alternative would not maintain the water surface elevation of the Sea.

Alternative 9 Enhanced Evaporation/Solar Pond Power Generation

Included in the September 1997 report, this proposal uses technology first proposed by Ormat Turbines (Yavne, Israel) in 1980. It was updated numerous times from 1980 to 1989 by and for numerous agencies, including Ormat Technical Services, Inc. (Sparks, Nevada); Meyer Resources, Inc. (Davis, California); Imperial Irrigation District (Imperial, California); County of Imperial (El Centro, California); and the Coachella Valley Water District (Coachella, California).

The proposed project included a combination of a number of technologies: an EES and a crystallization pond to reduce the volume of the brine prior to pump-out and to provide concentrated brine for the solar pond; a lined solar salt gradient pond system; and a low temperature organic rankine electric powerplant. A deep injection well was also proposed or a pipeline for pump-out disposal along the railroad right-of-way to the Yuma Desalting Plant Main Outlet Drain Extension.

Based on a more recent report (Ormat, 1991), Ormat Turbines, Ltd., has since concluded that low efficiency electric powerplants, such as the organic rankine powerplant, cannot compete with conventional high temperature, high efficiency powerplants driven by fossil fuels unless fuel costs should increase. Therefore, the powerplant would not be cost effective when compared to grid power available locally at $0.0725 per kilowatthour, so is

not a proven technology for this application. However, in the same report, they conclude that a solar salt gradient pond with an EES may be cost effective for use with a multi-effect distillation (MED) desalting plant and have proposed a solar salt pond desalting plant to be built near Elait, Israel. This plant has yet to be built but is still being considered.

As a result of these more recent studies, this alternative uses proven technologies, but the power generation portion of the proposal would not be cost effective compared to purchasing local grid power at $0.0725 per kilowatthour. Deep well injection also would not be a reliable method for providing long-term disposal of large quantities of brine.

The use of a solar salt gradient pond desalting plant is a proven technology by Ormat Turbines, Inc., in Israel and at the Reclamation solar pond test facility in El Paso, Texas, on a small scale. However, a large pilot plant would have to be designed and built over a 2-year period of time, then tested for a 2-year period of time using Salton Sea water before it would be known whether a full-scale solar pond desalination plant would be cost effective compared to a conventional reverse osmosis desalting plant. As a result, this alternative, with an EES, is included as one of the subalternatives under the Water Treatment Alternative herein.

The Ormat EES is a proven technology which has been used in a commercial saltworks in Israel and can be used alone with other pump-out options to reduce the volume of brine before it is pumped, so the size and cost of the pipeline would be less, and the size and cost of evaporation ponds would be less at the final disposal site, because it is reported to reduce the size of the evaporation ponds by 5 to 10 times. In an earlier unpublished study by Reclamation, the cost was estimated to be $105 to $204 per acre-foot of pump-out water processed to dry salt in 1989 dollars.

Alternative 12 Navigable Waterway / Mexicali Seaport

Included in the September 1997 report, this project was documented in the Meyer Resources, Inc. (Currie, et al., 1988) *Problems and Potential Solutions at Salton Sea* (December 1988) and *Summary Analysis of Authorities and Responsibilities Associated with the Salton Sea* (December 1988). The proposal was also mentioned in the Dangermond and Associates report, *Strategies for the Restoration and Enhancement of the Salton Sea* (July 1994), and it was also discussed in the Coachella Valley Water District report, *The Salton Sea* (undated).

This alternative failed to satisfy the target salinity requirement of achieving and maintaining 40 ppt. None of the references provided any detailed information on a seaport or navigable waterway between the Gulf of

California and the Sea. However, a new alternative was received after the scoping meetings which does have more detail. It is being reviewed and is part of chapter 7, New Combination Alternatives.

Alternative 13 190 mi^2 - Plastic Curtain

Included in the September 1997 report, this was proposed by Mr. Gerald Martin in a paper titled "Salton Sea Barrier Curtain Project," dated August 1995. This proposal would divide the Sea in half with a high-density polyethylene dam or curtain. The curtain separates the Sea into an evaporation section and a fresher water section.

This alternative did not use proven technology.

Alternative 14 Various Sized Impoundments - Plastic Curtain

Included in the September 1997 report, this was proposed by Mr. Gerald Martin in February 1992 and revised in April 1992 and August 1995. This proposal used a high-density polyethylene dam or curtain to create isolated areas within the Sea which would serve as evaporation ponds.

This alternative did not use proven technology.

Alternative 15 Canal / Dam to Base of Chocolate Mountains

Included in the September 1997 report, this proposal was received by the TAC from Mr. Seth Arnold, North Shore, California, in response to a public workshop held on August 31, 1995. The proposal used the concept of constructing a canal/dam system, with gates, to transport Sea water to the base of the Chocolate Mountains in order to provide an outlet for the Sea. Very little data was provided, making it difficult to understand how the proposal would work.

This proposal failed to satisfy the salinity target and elevation target criteria.

Alternative 16 Diked Impoundment to Gulf of California

Included in the September 1997 report, this proposal was proposed by Mr. Horace McCracken, Sunwater Solar, Inc., in February 1986, in January 1994, and in 1995. This proposal used a 40-mi^2 diked impoundment at the

south end of the Sea to concentrate Sea water by evaporation before it would be pumped by solar power to a height sufficient to allow it to flow by gravity in a canal to the Gulf of California.

The solar power is not reliable or cost effective. The use of discarded tires in the construction of the dike is unproven technology. There are some features in this proposal which are contained in other alternatives. (See chapter 5, Pump-Out/Pump-In Alternatives.)

Alternative 17 Frontier Aquadyne Enhanced Evaporation

Included in the 1997 report, this proposal was made by Frontier Aquadyne, Inc. It uses a low temperature brine concentrator to process the pump-out brine so that a cake salt is the output for disposal. This is not a proven technology for this application. In addition, Aquadyne is currently in default on a research contract to build and test a similar system for the Bureau of Reclamation. In an earlier unpublished study by Reclamation, the cost was estimated to be $3,910 per acre-foot of pump-out water processed to dry salt in 1989 dollars, if the tests of the technology proved successful. The system has been built and installed at Reclamation's El Paso solar pond test site, but is yet to be tested because of lack of funding. Thus, it is an unproven technology when compared to the Ormat Turbines, Inc., enhanced evaporation system.

Alternative 18 Solar Still Desalting / Colorado River Water Replenishment

Included in the 1997 report, this proposal was made by Environmental Enhancing Technologies (Daniels, 1990). It uses an enhanced solar still to produce and sell potable water and/or return it to the Sea, plus evaporation ponds to dispose of the concentrated flow and to reclaim and sell salt. Fresh water is also replenished from the Colorado River.

According to an unpublished study by the National Renewable Energy Laboratory (NREL), solar stills are not cost effective for large desalination plants when compared to conventional reverse osmosis desalination plants, so they are an unproven technology for large-scale plants (NREL, 1991).

Earlier information provided by the Western Salt Company concluded that the quality of the salt from the Salton Sea is so poor that it would have no market value. There also is no fresh water for replenishment available from the Colorado River, as proposed.

Alternative 19 SNAP Technology Enhanced Evaporation Tower

Included in the 1997 report, this proposal was submitted by Professor Dan Zaslavsky and the Technion, Israel, Institute of Technology. It uses a large, 3,300-foot tower structure to produce electricity and desalt water from the Sea. This alternative did not use a proven technology.

Alternative 20 Aquaculture / Evaporation Ponds

This alternative was proposed by Dov Grajcer, Ph.D., and Ms. Becky Broughton, Aquafarms International, in *Concept Strategy Commercializing Control of Salinity in the Salton Sea - Salton Sea Aquaculture Facilities* (1994).

This proposal used saltwater aquaculture facilities to raise fish in ponds created with water pumped from the Sea. Water from the fish rearing ponds would be disposed of by transferring it into evaporation ponds. Initially, a benchmark facility consisting of one 200-acre fish pond, one 400-acre evaporation pond, and 40 acres of support structure would be built to raise tilapia, a fish commonly produced in the area. The final stage of the plan called for 70 or more saltwater aquaculture facilities of similar composition and size, each using 2,000 to 4,000 acre-feet of Sea water per year.

About 45,000 acres of land (70 by 640 acres) would be needed for the facilities and evaporation ponds. There was no mention of how the water would be transported to the fish farms. In addition, the proposal did not include evaporation from the fish ponds in calculating the overall water usage for the system, which would total nearly 240,000 acre-feet per year. Evaporation would eventually result in large quantities of salt accumulation, which was proposed to be trucked out and disposed of in the Pacific Ocean. If 80,000 pounds or 40 tons of salt, were to be removed via truck, 225,000 truck trips would be required every year, or 617 truck trips every day, 365 days a year.

Although this alternative would reduce the salinity concentration, it would do nothing to maintain the water surface elevation.

Alternative 23 Pumped Storage Canal to Gulf of California

Included in the September 1997 report, this proposal was developed by Dangermond and Associates, Inc., for Riverside County and the Coachella Valley Water District. It was documented in the report, *Strategies for the Restoration and Enhancement of the Salton Sea* (July 1994). This proposal

combined two main concepts—a pumped-storage power generation facility and a large canal/pipeline linking the Sea with the Gulf of California.

The pumped-storage power generation facility should be considered for elimination because the topography is very unfavorable for producing power. See "Power Recovery Potential" section in chapter 5. The canal/pipeline concept has some similarities to a new alternative, which is part of chapter 7, New Combination Alternatives.

Alternative 24 Solar Membrane Distillation

Included in the September 1997 report, this proposal was discussed in a letter from the National Water Research Institute to Ms. Roberta Burns. It uses a solar heated membrane distillation system to desalt the Sea water. It has been tested only on a small scale and has not been shown to be as cost effective for large-scale plants when compared to conventional reverse osmosis desalting plants, so it is an unproven technology.

Alternative 25 Disposal of Reject Stream to Yuma

Included in the September 1997 report, this proposal was presented in the Meyer Resources, Inc., report, *Summary Analysis of Authorities and Responsibilities Associated with the Salton Sea* (December 1988). The alternative included construction of a pipeline from the Salton Sea to Yuma to dispose of brine in the existing drain that empties into the Gulf of California. The existing drain was built to dispose of brine generated by operation of the Yuma Desalting Plant.

This proposal was a brine disposal option only. This proposal failed to satisfy both the salinity target and elevation target criteria but could be used with an alternative needing a disposal component. (See chapter 5, Pump-Out/Pump-In Alternatives.)

Alternative 26 Impoundment / Evaporation Pond / Pipeline to Gulf of California / Yuma Desalting Plant

Included in the September 1997 report, this alternative appeared in the Dangermond and Associates, Inc., report, *Strategies for the Restoration and Enhancement of the Salton Sea*, Sacramento, California (1994). It uses a combination of several alternatives discussed in the report, including a diked impoundment adjacent to the south shore, an onshore conventional lined

evaporation pond, and a pump-out pipeline to transport concentrated brine either to the Gulf of California or the Yuma Desalting Plant Main Outlet Drain Extension brine discharge canal.

This alternative uses proven technologies. However, use of conventional evaporation ponds requires large areas and large O&M costs. This proposal also was only a brine disposal option. It thus fails to satisfy both the salinity target and elevation target criteria but could possibly be used with an alternative needing a disposal component. (See chapter 5, Pump-Out/Pump-In Alternatives.)

Alternative 27 Impoundment / Wetlands / Enhanced Evaporation/ Solar Pond, Power Generation, and Desalting System

Included in the 1997 report, this proposal appeared in the Dangermond and Associates, Inc., report, *Strategies for the Restoration and Enhancement of the Salton Sea*. It uses a combination of several options discussed in the report, including a diked impoundment adjacent to the south shore; constructed wetlands near the mouths of Alamo, New, and Whitewater Rivers; and an Ormat EES, a solar salt gradient pond with a power system, and a desalting system. The method of pump-out or final disposal of the concentrated brine or raw salt is not discussed, so this alternative failed to satisfy the salinity target and elevation target criteria.

As discussed in the evaluation of alternative 9, a solar salt gradient pond powerplant would not be cost effective when compared to grid power available locally at $0.0725 per kilowatthour, so it is not a proven technology for this application.

The impoundment, enhanced evaporation systems, and solar pond desalting systems are proven technologies which could be used in combination with other alternatives. The solar salt gradient pond and desalting system would require a large pilot plant. Design and construction would require a 2-year period of time and testing for 2 years to verify that it would be cost effective using Salton Sea water compared to a conventional reverse osmosis desalting plant before constructing a full-scale solar pond desalting plant.

Alternative 28 Impoundment / Freshwater Shoreline / Solar Pond Power Generation and Desalting System / Pumped Storage / Wetlands

Included in the September 1997 report, this proposal appeared in the Dangermond and Associates, Inc., report, *Strategies for the Restoration and*

Enhancement of the Salton Sea. It uses a combination of several alternatives discussed in the report, including diked impoundments, constructed wetlands, or solar salt gradient pond with a power system and a desalting system.

As discussed in alternative 9, a solar salt gradient pond powerplant would not be cost effective when compared to grid power available locally at $0.0725 per kilowatthour, so is not a proven technology for this application. An EES is not included in this alternative, so it would require a large area of conventional evaporation ponds to concentrate the brine for the solar salt gradient pond desalting system, which is not likely to be cost effective.

The remaining portions of the proposal cannot meet the salinity target and elevation target alone, but could possibly be used with another alternative.

Alternative 29 Impoundment / Solar Pond Powerplants / Pumped Storage / Wetlands / Pump-Out to Laguna Salada

Included in the September 1997 report, this proposal appeared in the Dangermond and Associates, Inc., report, *Strategies for the Restoration and Enhancement of the Salton Sea.* It uses a combination of several alternatives discussed in the report, including diked impoundment, solar salt gradient pond powerplants in the United States and Mexico, and constructed wetlands.

As discussed in alternative 9, a solar salt gradient pond powerplant would not be cost effective when compared to grid power available locally at $0.0725 per kilowatthour, so is not a proven technology for this application. An EES is not included in this alternative, so a large area of conventional evaporation ponds would be required to concentrate the brine for the solar salt gradient pond desalting system, which is not likely to be cost effective.

The remaining portions of the proposal could possibly be used with another alternative.

Alternative 30 Move Yuma Desalting Plant to the Sea

Included in the 1997 report, this alternative was proposed by Mrs. Iver Watkins, Salton Sea Beach, and Mr. Alex Michaels of Alex Michaels Company during the public workshops held in September and October 1995. It proposed moving the Yuma Desalting Plant to desalt the Salton Sea water. The Yuma Desalting Plant must be maintained in a ready reserve mode so that it can be used when required to meet the agreement signed with Mexico. All of the desalting plant, including all of the conventional pretreatment

system, high pressure pumps, and the membrane desalting system, are built to remove the salt from relatively low salinity brackish water with a TDS of 3 ppt, so the systems are completely different from what would be required to desalt the Salton Sea, which is a highly concentrated Sea water with a TDS of 44 ppt. It would thus cost more to move and modify the system than it would cost to build an entirely new plant designed specifically for the Salton Sea salinity.

Thus, the Yuma Desalting Plant is not available, and its pretreatment and desalting systems are not a proven technology applicable to the Salton Sea salinity. It cannot meet the Salton Sea salinity target and the elevation target criteria as currently built.

Alternative 31 Poplar Tree Constructed Wetlands

Included in the September 1997 report, this idea was proposed by Mr. Neil J. Maxwell, Salton Sea Beach, in the August 1995 public workshop by letter dated August 11, 1995. This proposal used a stand of poplar trees planted in such a way that nitrates contained in the inflow to the Sea would be removed by flowing water through the trees.

This proposal primarily addressed concentrations of nitrates. It did not address salinity of the Sea. This proposal failed to satisfy the target salinity requirement of achieving and maintaining 40 ppt.

Alternative 32 Special Pretreatment Reservoirs

Included in the September 1997 report, this alternative was proposed by Mr. Tim Bloom, Diversified Scientific Technologies, Rancho Mirage, California, in a workshop on August 15, 1995. It uses percolation pretreatment reservoirs to capture water before it enters the Sea in order to remediate inflow pollution. No information is provided on what the pretreatment is or how it would work.

It does not meet the Salton Sea salinity target criteria or the elevation target criteria and does not use a proven technology.

Alternative 33 U.S. Filter Corporation—New River Desalting

Included in the 1997 report, this alternative was proposed by Mr. Eldon Gill of Lobland-Waring, Palm Desert, California, in a commentary solicited for the Salton Sea Symposium (undated). It uses a nanofiltration system to treat the inflow to the Sea. Nanofiltration would improve the inflow water

quality but would remove very little salt from the inflow. Treating just the inflow also would not reduce the salinity to targeted levels, and it would not control the surface elevation.

Therefore, this alternative does not meet the salinity target or the elevation target criteria.

Alternative 34 Groundwater Pump for Selenium Management

Included in the September 1997 report, this concept was proposed by Hydrologic Consultants, Inc., Davis, California, in *Proposal to Plan and Operate a Pilot Program for the Management of Selenium by Groundwater Pumping*, dated December 8, 1995. In this proposal, selenium would be managed by pumping groundwater from a deep aquifer that underlies those areas that presently produce high selenium concentrations in drainage water flows.

This alternative did not achieve and maintain the target salinity of 40 ppt or provide any elevation control. Also, it is uncertain whether this pumping proposal would work because of clay layers that are dispersed throughout the Valley.

Alternative 35 Freshwater Blending

Included in the 1997 report, this alternative was proposed by Mr. J. Wendell Graves of Brawley, California, at one of the public workshops in 1995. It proposed pumping New River water to a storage reservoir at 30 feet above sea level. Salton Sea water and fresh water from an unnamed source would be blended with the New River water, and the blended water would flow back to the Sea. As proposed, this alternative would not remove salt from the Sea. This alternative, therefore, does not meet the salinity target or the elevation target criteria.

Alternative 36 Replenishment by Colorado River Surplus

Included in the 1997 report, this alternative appeared in the Meyer Resources, Inc., *Problems and Potential Solutions at the Salton Sea* for the RAC (December 1988). It proposed diverting the excess water during wet years from the Colorado River directly to the Sea to reduce the salinity level. Availability of water is unreliable. (See section on "Excess Flows" in chapter 5.) This proposal would improve salinity only temporarily and could not permanently satisfy the salinity target. Elevation control also would not be possible.

This alternative, therefore, does not meet the salinity target and the elevation target criteria.

Alternative 37 Venturi Air Pump

Included in the September 1997 report, this proposal was submitted in a letter, dated January 1990, written by Burke Hensley and Son, Banning, California. This alternative proposed the use of venturi action to pull air into tributary inflow and oxygenate the water to stimulate the natural purification process.

This proposal failed to satisfy the salinity target and elevation target criteria.

Alternative 38 Foraminifera Studies (Research)

Included in the September 1997 report, this alternative was proposed by Dr. Richard Casey, representing Ocean Research International of San Diego at the August 1995 workshop. This proposal suggested acquiring sediment samples from the Sea to evaluate the microscopic forms of life with shells (foraminifera) which have been preserved in this sediment.

This alternative was a research proposal. It failed to achieve and maintain the target salinity of 40 ppt and would not address elevation.

Alternative 39 Potential Use of Study Ponds

Included in the 1997 report, this alternative was submitted by Dr. Richard Casey, Float, Inc., and Ocean Research International, San Diego, California, in a letter dated June 10, 1995. It proposed installing floating platforms and plastic floating liners to create several ponds and plastic floating canals to dilute the Sea water in the ponds to run experiments of fisheries, aquaculture, recreation, and wildlife. It was a proposal for conducting research and does nothing to control salinity or water surface elevation of the Sea.

Therefore, this alternative does not meet the salinity target and elevation target criteria.

Alternative 40 Injection Well Salt Disposal

Included in the September 1997 report, this proposal was first made by Aerospace Corporation in *Salinity Control Study Salton Sea Project* (Goldsmith, 1971) and resubmitted by Mr. Michael Duffey of Holtcille, California, in 1995. This proposal would inject Sea water into high-salinity geothermal resource areas.

Requirements for pretreatment prior to injection were unknown. No attempt was made to predict geologic formations or difficulties in drilling wells. Injecting a high solids brine would be extremely expensive because of the resultant injection well plugging. This alternative had too many unknowns to determine if it would work.

Alternative 41 Air Diffusion / Ultraviolet Ozone System

Included in the September 1997 report, this alternative was proposed in a letter by Mr. Bill Ryan Free of Winterhaven, California (June 19, 1991) and by Ms. Elaine Thompson and Mr. John N. Hinde representing Air Diffusion Systems of St. George, Utah, in a letter dated September 28, 1995. This proposal would use a diffused air and ultraviolet ozone system installed on the Sea's floor to oxygenate and recirculate water, eliminating toxic substances and restoring its natural balance.

This proposal failed to satisfy the target salinity requirement of achieving and maintaining 40 ppt.

Alternative 42 Surface Aeration

Included in the September 1997 report, this letter dated June 19, 1991, to the Department of the Interior from Mr. Bill Ryan Free of Winterhaven, California, provided hand-drawn sketches of concepts for improving conditions of the Sea but did not contain a narrative description. The sketch implied that aeration fountains would be built into the Sea, and the quality of the water would be improved through oxygenation.

Very little information was provided. This proposal failed to satisfy the salinity target and elevation target criteria.

Alternative 43 Gravel Berms

Included in the September 1997 report, this proposal was given in an oral presentation by Mr. Sergio Garcia in the August 1995 public workshop. This

alternative proposed building gravel berms at several points along tributaries to the Sea to serve as coarse filters to remove large solid matter.

This proposal failed to achieve and maintain the target salinity of 40 ppt and did not address elevation.

Alternative 44 Sea Water Filtration

Included in the September 1997 report, this proposal was made by Mr. Richard Goralczyk of the Zitelli Trust, Palm Springs, California, in a report to Mr. Phillip Meyer, dated January 18, 1990. The technology in this proposal used a free energy source which would cause chemicals to separate from one another and from the Sea water.

This alternative did not use proven technology.

Alternative 45 Enzyme-Activated Removal

Included in the 1997 report, this alternative was proposed by Mr. Clay Thorne, Thorneco Environmental Technologies, Payson, Arizona, in the "Treatability Study Report for Thorneco, Inc., Enzyme-Activated Cellulose Technology," dated February 1992 by PRC Environmental Management, Inc., for the U.S. Environmental Protection Agency. It proposed to use an enzyme-activated cellulose treatment technology to remove specific metals and inorganic and organic compounds. Very little information is provided on tests reported to have been made on small systems. The removal of these metals and inorganic and organic compounds also would not control the salinity or elevation of the Sea.

Therefore, this alternative does not meet the salinity target and the elevation target criteria and does not use a proven technology.

Alternative 46 Power / Freshwater Cogeneration

Included in the 1997 report, this alternative was proposed by Mr. Frank DiCola, Cogeneration Partners of America, Cheery Hill, New Jersey, in a letter dated January 28, 1992. It proposed to use a gas-fired turbine cogeneration system in combination with a thermal distillation desalting system to produce power and fresh water. Previous studies have shown that when using high cost fossil fuels in the United States, thermal distillation desalting systems are not cost effective when compared to sea water reverse osmosis desalting systems, so it is not a proven technology for this application.

Alternative 47 Water Conservation

Included in the September 1997 report, this proposal was contained in Imperial Irrigation District's *IID/MWD Water Conservation Program Impacts to Salton Sea* (May 1989) and in a Colorado River Board of California publication, *Report to the California Legislature on the Current Condition of the Salton Sea and the Potential Effects of Water Conservation* (April 1992). This proposal would use water conservation programs to help reduce the amount of water used for irrigation, thereby reducing inflows to the Sea.

This would decrease the water surface elevation and increase the salinity level. This proposal failed to satisfy the salinity target and elevation target criteria.

Alternative 48 Drainage Water Reuse or Blending

Included in the September 1997 report, this proposal was made by Mr. J.D. Rhoades, U.S. Department of Agriculture, in at least 10 publications dating from 1977 to 1996. This proposal suggested collecting agricultural drainage water for reuse on salt-resistant crops.

This proposal failed to achieve and maintain the target salinity of 40 ppt.

Alternative 49 Pulsed Plasma

Included in the 1997 report, this alternative was proposed by AURIX, Inc., of El Cajon, California, in the article "Pulsed Power Discharge Wastewater Treatment Technology" (undated). It proposed to use a pulsed plasma discharge wastewater treatment technology, which would reportedly remove metals and toxic substances and cause most dissolved and suspended solids in the water to settle. Additional research would be required to verify these claims, and a water treatment system by itself without pump-out would not control the salinity and elevation of the Sea.

Therefore, this alternative does not meet the salinity target and the elevation target criteria and does not use a proven technology for this application.

Alternative 50 Hydropower / Filtration System / Resort

Included in the 1997 report, this alternative was submitted by Mr. Steven Queen of Rancho Cucamonga, California, in a letter dated March 7, 1994. It

proposed to use a combination of solar cells and fuel cells to pump water up through a vapor desalting chamber into storage tanks where it flows down through a hydroturbine and static pressure reverse osmosis desalting system. The entire system is enclosed within a large 150-foot tower.

Because this alternative is based only on a conceptual sketch with no analyses or test data, this alternative is not a proven technology.

Alternative 51 Slow Sand Reverse Osmosis Filtration

Included in the 1997 report, this alternative was proposed by Mr. C. Brent Cluff in a number of technical papers from 1990 through 1992. It proposes the use of slow sand filtration and/or nanofiltration as a pretreatment system for a reverse osmosis desalting system to remove salt from the Salton Sea. This method of pretreatment will be considered along with other methods of pretreatment under the Water Treatment Alternative, Reverse Osmosis Desalting Plant with Pump-In/Pump-Out. It will also require pilot plant testing along with the other methods of pretreatment. It is a proven technology, at least in some applications.

This is only a pretreatment alternative, which by itself does not meet the salinity target and the elevation target criteria, but could possibly be used with the Water Treatment, Reverse Osmosis Desalting Plant with Pump-In/Pump-Out alternative.

Alternative 52 Electrochemical Extraction

Included in the 1997 report, this alternative was proposed by Mr. Ernie Brown, North Shore, California, in a letter dated August 8, 1995, in response to public workshops held in August and September 1995. It proposes to apply a low voltage direct current to metal plates suspended in the Sea to remove salt and precious metals. No analysis or detailed test data or cost and performance analysis were provided, and only a very small scale test was reported to have been made. Removal of salt and precious metals alone also does not control the elevation.

Therefore, this alternative does not meet the salinity target and the elevation target criteria and does not use a proven technology for this application.

Alternative 53 Mexican Cleanup of New River

Included in the September 1997 report, this alternative was presented by Mr. Narenda N. Gunaji, Commissioner, International Boundary and Water Commission, United States and Mexico, in a letter dated July 31, 1991. This alternative basically addressed the water quality problem in the New River at the Mexican border.

This proposal failed to satisfy the target salinity requirement of achieving and maintaining 40 ppt.

Alternative 54 Land Speed Racetrack

Included in the September 1997 report, this concept was presented in a letter dated April 4, 1994, to the Salton Sea Authority by Mr. Ken Mack, representing California Timing Association (1995). This alternative suggested the use of salt to build a racecourse for setting land speed records.

This proposal was a brine disposal option only. The proposal failed to achieve and maintain the target salinity of 40 ppt and would not address elevation, but could be used with an alternative needing a disposal component.

New Alternatives

Other alternatives were presented to Reclamation in 1998 to consider in solving the salinity and water surface elevation problems in Salton Sea. The alternatives that could be considered for elimination from this group follow.

New Alternative Recovering Salts from the Salton Sea

This proposal was presented in a letter dated June 10, 1998, to the Imperial Irrigation District by Mr. Gerald Grott of Superior Salt, Inc., Twentynine Palms, California. This alternative is for a saltworks to be built adjacent to evaporation ponds to reclaim and market the salt.

This proposal failed to satisfy both the salinity target and elevation target criteria but could be used with an alternative that produced salt. This could eliminate the very high cost of trucking large quantities of salt to the Pacific Ocean that is present in some of the alternatives.

New Alternative $10 Million Award to Working Facility

This proposal was presented in a letter dated June 5, 1998, to the Salton Sea Authority by Mr. Robert D. Adams, Desert Hot Springs, California. Mr. Adams also read his proposal on July 15, 1998, at a public scoping meeting in La Quinta, California. This proposal is an idea to set up a $10 million fund to be awarded to whomever can demonstrate, with a working facility, the means of producing potable water from the ocean in large quantities deliverable to consumers at marketable prices.

This proposal failed to satisfy both the salinity target, elevation target, and proven technology criteria.

New Alternative Mining Minerals for Profit

This proposal was presented in a letter dated June 22, 1998, to Congresswoman Mary Bono by Mr. Mark Russell, Indian Wells, California. This proposal includes a number of ideas, including mining salt, precious metals, and nitrogen; producing electricity; and setting up fish farms.

This proposal failed to satisfy both the salinity target and elevation target criteria. This could eliminate the very high cost of trucking large quantities of salt to the Pacific Ocean that is present in some of the alternatives.

New Alternative Recreation Facilities / Impoundment / Injection Wells

Carl B. Johnston of Johnston and Associates presented this proposal to the Salton Sea Authority by letter dated February 25, 1998. This alternative uses water pumped out of the Salton Sea for various recreational activities and uses earth injection procedures for brine disposal.

The flow rates discussed in the proposal would fail to satisfy both water surface elevations and salinity requirements. Additionally, trial of earth injection procedures is not a proven technology for the site. Using evaporation ponds may be useful as discussed elsewhere.

New Alternative Solar Still / Solar Works Disposal

This proposal was presented in a letter dated February 4, 1998, to the Salton Sea Authority by Mr. Victor M. Ponce of San Diego State University. It uses a solar still desalting plant with pump-in of the desalted water to the Sea

and a pump-out system to dispose of the concentrate reject flow to evaporation ponds in a saltworks for ultimate disposal of the raw salt by railroad.

According to an unpublished study by NREL (1991), solar stills are not cost effective for large desalination plants when compared to conventional reverse osmosis desalination plants. This, then, is an unproven technology for large-scale plants needed for the Salton Sea.

New Alternative Gas Turbine / Hydro / Desalinization

This proposal was delivered to Ms. Valarie Richards of Coachella Valley Association of Governments on October 31, 1997, by Arthur Lowe of Eagle Crest Energy Company. It uses a combination of technologies, including a gas-fired combined cycle turbine that generates electrical power and steam for a MED desalting plant that is enclosed in a 50-story-tall concrete tower. The electrical power that is generated is used in combination with a pumped storage hydroelectric powerplant.

The proposed desalting plant is not a proven technology as Metropolitan Water District stated in a presentation at the American Desalting Association Conference on August 4, 1998, that only a small 2,000-gallon-per-day seawater test unit has been tested to date, but funding is currently being pursued to build and test a larger demonstration plant. The cost and performance of a demonstration plant need to be published before it can be determined whether this technology is cost effective when compared to a conventional seawater reverse osmosis plant and before it can be considered as a proven technology for use at the Salton Sea.

New Alternative Floating Solar Still Modules

This proposal was received in July 1998, by an undated letter, at the Salton Sea Authority from Mr. Mike Brady of Palm Springs, California. This alternative uses floating in-sea solar desalination modules (SDMs) to enhance evaporation rates and collect salt, and it uses solar batteries to supply electrical power for operation.

According to an unpublished study by NREL, solar stills are not cost effective for large desalination plants when compared to conventional reverse osmosis desalination plants. It is, then, an unproven technology for large-scale plants needed for the Salton Sea (NREL, 1991). The proposal also failed to meet the water surface elevation criteria. It uses an unproven technology to

increase the evaporation rate to a required 4,380 inches per year. Using more SDMs to lower the required evaporation rate would not solve the failure to meet the unproven technology criteria.

New Alternative Geothermal Power Revitalization

This proposal was presented in a letter dated July 17, 1998, to the California Energy Commission by Mr. Walter Studhalter of Douglas Energy, Placentia, California. This alternative provides a list of ways that funding under the Salton Sea Project might be used to revitalize the geothermal industry in California. No analysis or data was provided to determine whether geothermal power would be a cost-effective way to provide heat for a thermal desalting plant or compete with grid power that is currently available at $0.0725 per kilowatthour. Grid power would be used for pumping in a reverse osmosis desalting plant or for pumping water in the pump-in/pump-out alternative. It also proposes using heat engines to operate on the temperature differences in the Salton Sea water. This operation would be less efficient than conventional geothermal power systems because the temperature difference would be much less. Without a detailed analysis, the methods proposed would have to be considered as unproven technologies for solving the problems at the Salton Sea.

New Alternative Solar Still / Hydro-Physical Technologies / Desalting Plant

This proposal was presented in a letter dated July 16, 1998, to the Salton Sea Authority by Mr. Michael H. Teeter of Hydro-Physical Technologies Inc., Las Vegas, Nevada. This alternative is a combination solar still desalting system and a proprietary OSU unit.

According to an unpublished study by NREL (1991), solar stills are not cost effective for large desalination plants when compared to conventional reverse osmosis desalination plants, so this is an unproven technology for large-scale plants needed for the Salton Sea.

New Alternative Create Salt Marsh

This proposal was presented in a letter dated July 18, 1998, to the Salton Sea Authority by Mr. Pierre F. Savineau, Cathedral City, California. This idea was to create a salt marsh to remove the salt from the Sea. No other information on the marsh was provided.

This proposal failed to satisfy both the salinity target and elevation target criteria.

New Alternative Use Stabilized Dredged Sediment Material

This proposal was presented in a letter dated July 28, 1998, to the Salton Sea Authority by Mr. Derron L. LaBrake of Consolidated Technologies, Inc. (CTI), Blue Bell, Pennsylvania. Their process combines dredged material with either municipal solid waste ash or coal fly ash and lime kiln dust to make a grout material that binds the contaminants in the sediment for structural fill. The letter from CTI mentions "sediments with elevated concentrations of contaminants (selenium) that would be removed from the Sea and rendered inert." At present, contaminated sea-bottom sediment is not considered to be a problem to be addressed by any of the Salton Sea alternatives.

The potential use for this concept of stabilized dredged sediment appears to relate to the diked impoundment alternatives for the Salton Sea. The dredged sediment from the bottom of the Sea would be used to construct the dike embankment(s) creating the in-Sea impoundment(s). The use of dredged Sea-bottom sediment to construct the impoundment dikes has been judged technically infeasible due to seismic (earthquake) dike instability concerns. The information provided by CTI does not include any data related to placing their stabilized dredged sediment material into an ocean (Sea) water environment. Their stabilized dredged sediment product is placed into an upland containment facility, not the ocean. Thus, the potential use of stabilized dredged sediment to construct impoundment dikes in the Salton Sea, even though this process might improve on the strength of the dredged sediment, is an unproven technology. There are additional salinity and elevation problems with all of the diked impoundment alternatives.

This proposal failed to satisfy both the salinity target and elevation target criteria. Also, this appears to be an unproven technology for constructing impoundment dikes. There is a possibility of using this technology, and the designers could consider using it in higher level designs, if appropriate.

New Alternatives Floating Plastic Curtains / In-Sea Dikes

This proposal was submitted at a public scoping meeting held on July 16, 1998, at La Quinta, California, by Mr. Shelton L. Stringer of Southland Geotechnical, Inc. This proposal is similar to alternatives 13 and 14 in the

September 1997 report. It included the use of a double membrane of high-density polyethylene to create a curtain or dam which isolates areas within the Sea into evaporation ponds.

This alternative did not use proven technology.

New Alternative — Colorado River Water Conservation and Flood Prevention Project

Mr. Wieslaw Czajkowski of the Association of the Colorado River Waterway Recreation Project presented a copy of the title report by cover letter, dated July 18, 1998, to the Salton Sea Authority and Bureau of Reclamation. This alternative increases the salinity of the Salton Sea to salinity levels of the Dead Sea and then revitalizes it with ocean water and water from various other sources of water.

This proposal fails to satisfy the requirement to keep salinity below a reasonable level. It does, however, contain several features that are discussed above in this report. Most of the discussions can be found in chapters 3 and 5.

New Alternative — Heat-Pump Evaporation / Condensation System

This proposal was E-mailed on August 13, 1998, to the Bureau of Reclamation by Mr. Scott A. Stormo of Earth Systems Consultants. His idea was to evaporate water in a heat pump and recapture the energy in a condenser system to heat the next batch of water. This proposal is similar to alternative 9 in the September 1997 report. Production costs are higher than alternative energy production methods.

This is unproven technology. Also, this proposal failed to satisfy both the salinity target and elevation target criteria.

Additional Ideas

Several ideas were mentioned by persons at the public scoping meetings held on July 15, 16, and 17 in the Salton Sea basin. The ideas are summarized below, followed by an evaluation.

Collect Irrigation Flows and Treat Before it Hits the Sea. This idea is not new. Alternative 33 in the September 1997 report addresses removing the salts before the water enters the Sea. Whether it is removal of salt or

treating contaminants, the criteria for reducing the salinity of the Sea is not reached. The salinity of the irrigation flows is about 3 ppt, which is considered low compared to the 44 ppt of the Sea. A further reduction of the salinity of the flows would have little effect on the salinity of the Sea.

Construct Wetlands to Act as a Filter for Contaminants and Nutrients. The Bureau of Reclamation, Imperial Irrigation District, and Desert Wildlife Unlimited are working together on building a wetland pilot project on the New River. Again, this may help clean up some of the pollutants, but it will not reduce the salinity of the Sea.

Public / Private Partnership. A public/private partnership is currently being undertaken with the wetland pilot project mentioned above. This type of partnership is a possible option to be used on any selected alternative.