GUIDE TO THE SALTON SEA RESTORATION PROJECT ALTERNATIVES

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SALTON SEA AUTHORITY

US DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION

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Guide to the
Salton Sea Restoration Project Alternatives

March 2002

Salton Sea Authority
and
Department of Interior, Bureau of Reclamation

The Salton Sea Restoration Project

A multiagency effort between the Salton Sea Authority and the Bureau of Reclamation
to address the environmental issues of the Salton Sea

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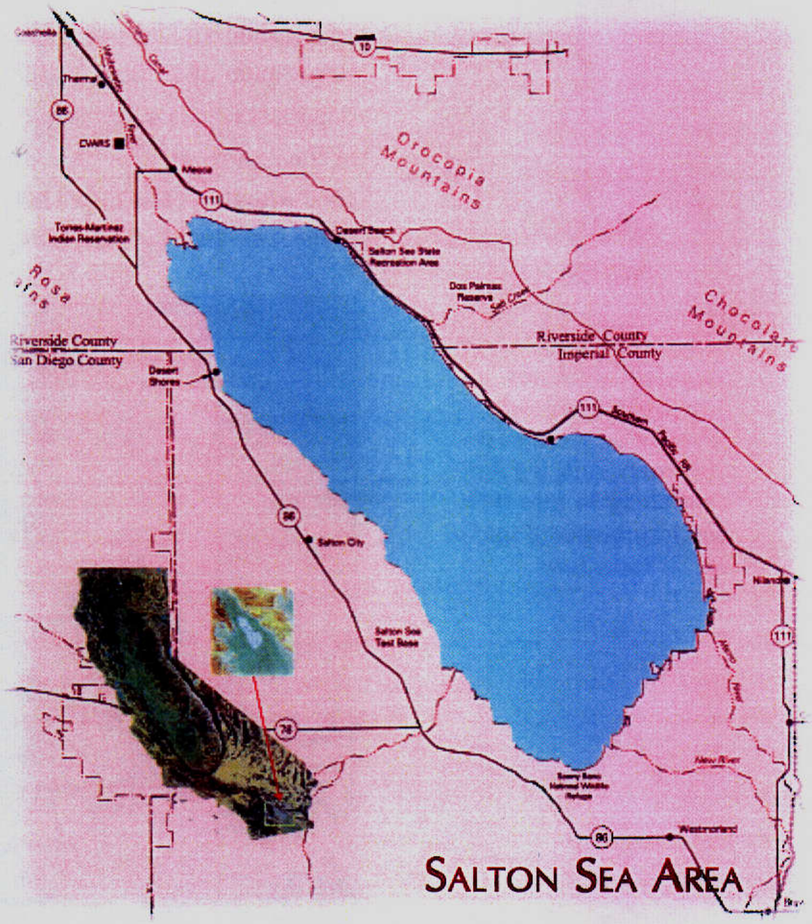
Perspective: Background of the Program

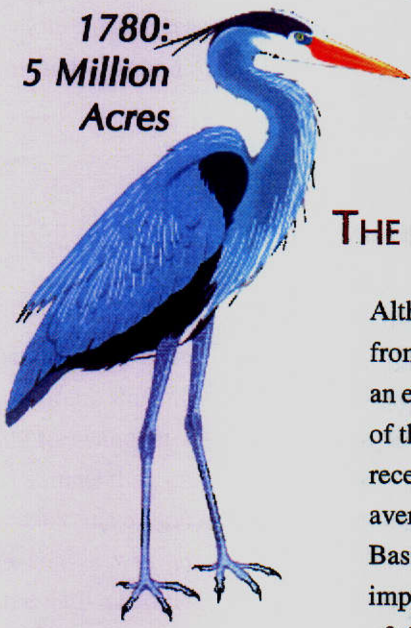
The Salton Sea is an excessively salty, nutrient-rich lake in a closed basin. Its sources of inflow are, primarily, agricultural drainage from the Imperial, Coachella, and Mexicali valleys and smaller contributions from municipal effluent and stormwater runoff. It has a productive sport fishery and provides important migratory and resident bird habitat within the Pacific Flyway. Millions of birds use the Sea every season, and approximately 400 bird species have been recorded within the Salton Sea ecosystem. Several endangered species, including the desert pupfish, brown pelican, and the Yuma clapper rail, inhabit the Salton Sea or adjacent habitats.

The Salton Sea is under stress, and habitats associated with it continue to deteriorate as the Sea's salinity increases, nutrients flow in, temperatures fluctuate, and oxygen in the water is depleted. Deteriorating conditions may be threatening the reproductive ability of some species, particularly sport fish, and may be causing additional ecosystem health problems. In addition to ecological problems, a rise in the Sea's level over time has flooded recreational facilities, including camping areas and boat launches.



California's Dwindling Wetlands

1780: 5 Million Acres



1999: 450,000 Acres

California's once abundant wetlands have been depleted severely over the past 200 years, and we are continuing to lose this precious resource into the 21st century.

Congress passed a law in 1992 to find ways to reduce and control the Sea's salinity, to provide habitat for its endangered species, and to enhance its fisheries and recreational opportunities. Then, in 1998, Congress passed the Salton Sea Reclamation Act to further the restoration process. This act calls for studies of the feasibility, benefits, and costs of using the Salton Sea as a reservoir for irrigation drainage and studies on how to reduce and stabilize the Sea's salinity and its surface elevation, to reclaim its healthy fish and wildlife resources and their habitats, and to enhance its recreational uses and economic development.

The Salton Sea: An Important Resource

Although the current Salton Sea was formed by an accidental release of water from the Colorado River nearly a century ago, the Salton Basin has long been an ecologically and culturally important area. Historically, the periodic shifting of the lower Colorado River caused Lake Cahuilla to repeatedly form and later recede in the area that the Salton Sea now occupies. Scientists estimate that, on average and over the past 2,000 years, the Colorado River flowed into the Salton Basin more often than it followed its current course. Lake Cahuilla was an important resource for birds and other wildlife, as well as for the native people of the region. But before California was settled, wildlife were better able to cope with the comings and goings of Lake Cahuilla because of other wetlands in the state that no longer exist.

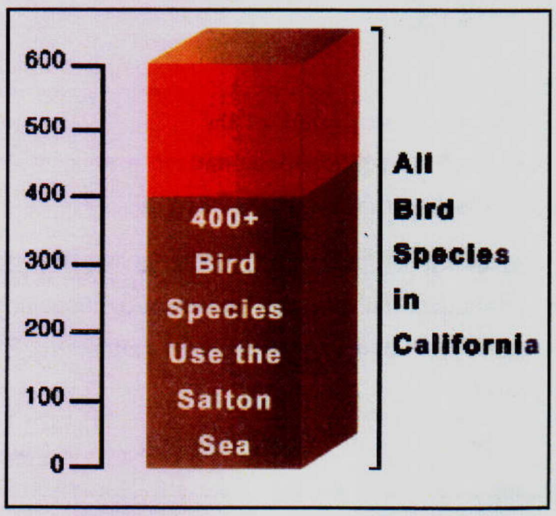
Waterbirds of the Salton Sea include (clockwise from upper right) great blue heron, black-necked stilt, snowy egret, and American avocet.

An Important Habitat for Migratory Birds

Migratory birds follow complex pathways that must be supported by the availability of appropriate habitat and adequate food. The Pacific Flyway is a migratory pathway for millions of birds traveling between the breeding grounds in Canada, Alaska, the Pacific Northwest, and the Northern Great Plains and wintering grounds along the Gulf of California, extending into Central and South America. The Salton Sea provides an important food source for fish-eating birds along that flyway.

At the time that the Salton Sea was formed, from 1905 to 1907, a substantial amount of wetland acreage within California was available for the millions of migrating birds that annually pass through the state. California now leads the nation in the percentage of historic wetland acreage lost. Scientists estimate that more than 95 percent of that acreage has been destroyed or adversely modified. Currently, less than 0.4 percent of the surface area of California is wetlands, compared to the nearly 5 percent at the time of settlement. Wetland losses have been a major factor in the population declines for some bird species; as a result, the Salton Sea has become a habitat of increasing importance.

The Salton Sea's importance extends beyond the Pacific Flyway. Records of the US Geological Survey's Bird Banding Laboratory disclose that birds banded at the Salton Sea have been reported from Russia and the North American Arctic to Latin America and from Hawaii to the Maritime Provinces of Eastern Canada. The considerable interchange evident with birds of the Pacific and Central flyways indicates that the importance of the Sea is far greater than transient local and regional bird use.



Of the 600 different bird species in the state, two-thirds of them spend at least part of the year at the Salton Sea.

The Salton Sea ecosystem supports some of the highest bird biological diversity in North America; more than 400 species have been reported within this ecosystem. To place this in perspective, the number of bird species within the ecosystem is approximately 70 percent of all the bird species recorded in California. In addition, approximately 100 species, or one-third of all species that are

A Timeline of the Salton Sea

Circa 12,000 years ago: Native Americans first occupy the Salton Basin.

1,300 years ago: Lake Cahuilla arises in the Salton Sink whenever the Colorado River's egress to the Gulf of California silts up. Riverine tribes, along present day eastern Imperial County border, practice farming.

Circa 1500: A large inflow of water from the gulf fills the lake to a body of water 26 times the size of the current Sea.

1540: Colorado River delta first explored by Spanish.

1604: Don Juan de Ornate, Spanish Governor of New Mexico, explores the river that he names the "Colorado."

1700-1750: Last large infilling of Lake Cahuilla occurs.

1774: Spanish make first contact with the Cahuilla people, ancestors of present day Torres Martinez Desert Cahuilla Indians.

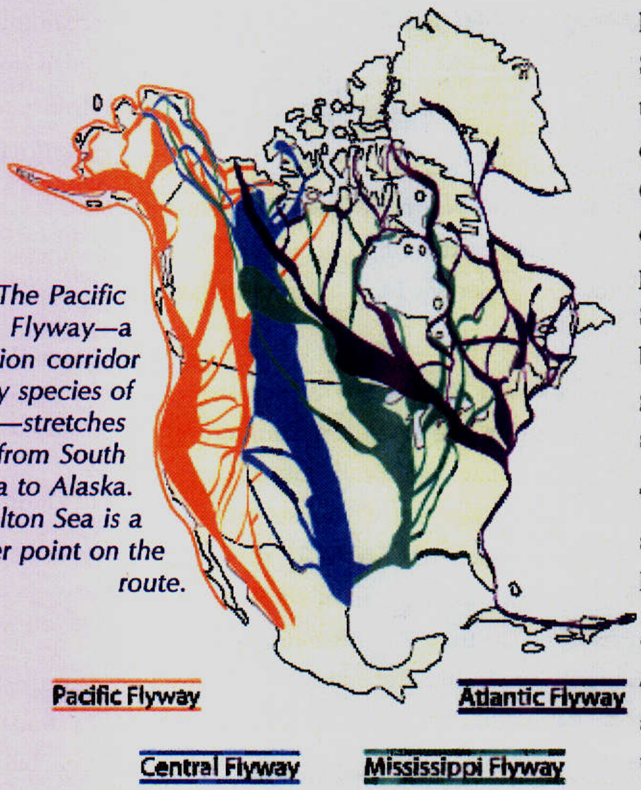
1840: Colorado River flooding to the Salton Sink recorded. New River possibly formed at this time.

1849: Forty-Niners begin crossing Imperial Valley on their way to California gold fields.

1853: Imperial Valley recognized as potential desert "garden spot," if it can be adequately irrigated.

1876: US Government establishes Torres Martinez Desert Cahuilla Indian Reservation, with a grant of 640 acres.

1891: Colorado River flooding to the Salton Sink recorded, forming 100,000-acre lake; 20,000 acres on the northern side of the Salton Sink are withdrawn from public use for the Torres Martinez Desert Cahuilla Indians.

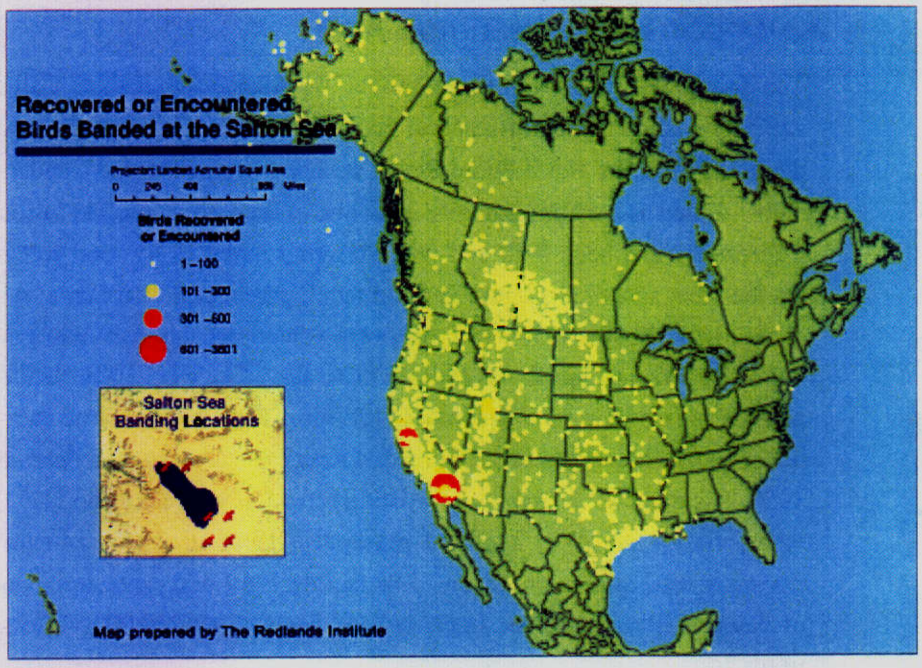


The Pacific Flyway—a migration corridor for many species of birds—stretches from South America to Alaska. The Salton Sea is a stopover point on the route.

known to breed in California, breed within the Salton Sea ecosystem. Among the birds using the Salton Sea are 19 species of water birds classified by the federal government, California, or both as species of high conservation concern because of their population status. The combination of the Sea's avian biodiversity and its importance as breeding habitat is unsurpassed by any limited geographic area within the contiguous 48 states and Latin America.

The following highlights reflect the variety of species and importance of the Sea as a bird habitat:

- During the summer at the Sea, up to 40 percent of all black skimmers in California and the larger of two breeding populations of the western subspecies of gull-billed tern breed there;
- Large numbers of California brown pelicans, American white pelicans, and a variety of other species, including substantial numbers of breeding black-necked stilt and American avocet, also use the Sea during summer;
- Winter use includes up to 30 percent of the entire North American breeding population of the white pelican and the primary wintering area in western North America for white-faced ibis;
- The Sea and surrounding agricultural lands support the largest wintering population of western snowy plover in the interior of the United States and an estimated 30 percent of the entire population of the mountain plover;
- The Sea is an important wintering area for the ruddy duck and one of the most important areas in the interior of western North America for wintering gulls;
- The Sea is one of only eight sites in the interior of western North America that holds over 10,000 shorebirds in fall and one of five such sites in the spring;



According to the US Geological Survey's Bird Banding Laboratory, the birds that stop over at the Salton Sea can be found throughout North America, as far south as Latin America and west to Russia. This shows that the Sea's importance extends throughout the hemisphere.

- In overall shorebird numbers, the Sea is the most important area in the intermountain and desert region of the West in spring and the second most important in fall, after Utah's Great Salt Lake;
- The Sea hosts one of the largest double-crested cormorant breeding populations in western North America and about 40 percent of the entire US breeding population of the Yuma clapper rail;
- The Sea is an important migratory stopover for eared grebe and black tern populations.

In summary, the Salton Sea ecosystem is a migratory bird habitat for all seasons that serves water birds and land birds alike. As a result, this ecosystem has become one of the crown jewels of avian biodiversity. If preserving the rich diversity of birds in this area is to be more than mere philosophy, then this ecosystem must be sustained in a way that preserves the current richness of species and provides for the numerous birds that use this area. Preserving this ecosystem must become a priority for the conservation community because it now serves as a critical link in the habitat chain needed to sustain migratory bird populations within western North America.

1901: Imperial Canal brings water from the Colorado River to the Imperial Valley.

1904: Silt blocks the Imperial Canal, preventing it from supplying water to the Imperial Valley.

1905: Temporary diversion of the Colorado River, constructed to replace water from the blocked canal, is breached by floodwaters. River changes course and flows into Salton Sink.

1906: Floodwaters continue to fill Salton Sea, threatening Imperial Valley's fledgling agriculture industry. Large concentrations of waterfowl, pelicans, and other birds reported in the Salton Sea area. Sea is at -195 feet below sea level.

1907: Southern Pacific Railroad closes the river breach. Sport fishing first promoted at Salton Sea.

1908: Breeding colonies of cormorants, white pelicans, and other birds found at the Sea.

1909: Thinking the Salton Sea would be gone by the 1920s, the US Government reserves in trust an additional 10,000 acres of land under the Sea for the benefit of the Torres Martinez Band.

1911: Imperial Irrigation District formed; discussions begin promoting a new canal to supply water to the valley.

Circa 1917-18: Netting mullet becomes profitable industry at Salton Sea during World War I.

1924: President Coolidge issues an executive order setting aside lands under the Salton Sea as a permanent drainage reservoir.

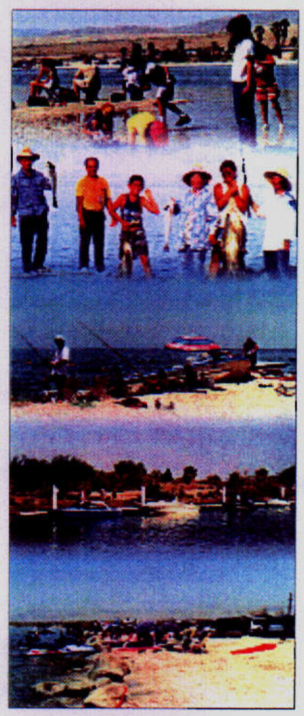
1928: Congress authorizes construction of Boulder Dam and the All American Canal, which will result in control of the Colorado and will eliminate flooding.

1930: Salton Sea Wildlife Refuge established.

1935: Salton Sea's level measured at -248 feet below sea level.

An Important Recreational Area

The Salton Sea is an area of recreational importance for southern California, and history shows that with restoration it could be a much greater resource. By the late 1950s, the North Shore Beach area had been developed, and a yacht club—touted as a marine paradise, with one of the largest marinas in southern California—had been built and was attracting many Hollywood celebrities. On the other side of the Salton Sea, the development of Salton City also began in earnest during the 1950s. Included were a championship golf course and the Salton Bay Yacht Club. It was claimed that Salton City would become the most popular sea resort in all of southern California. The Salton Sea State Park (later renamed the Salton Sea State Recreation Area) was dedicated on February 12, 1955. It served as an important inland recreation area until the late 1970s, when visitor numbers declined markedly because of the deteriorating environmental quality of the Sea. This facility has 1,400 campsites, hundreds of day-use sites, and other amenities and hosts about 250,000 visitors each year.

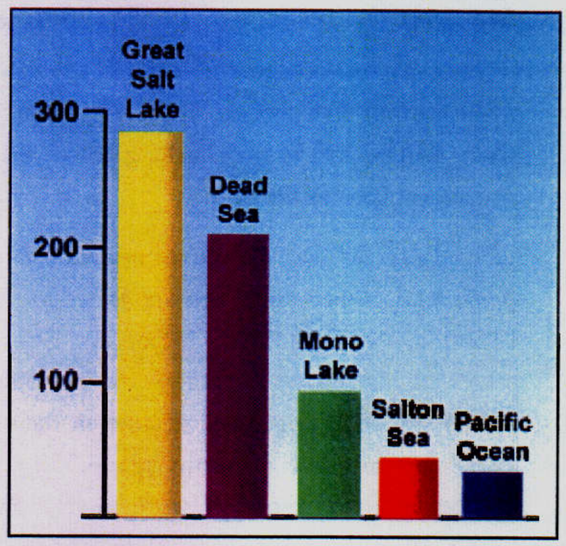


Once touted as a marine paradise, the Salton Sea offers visitors fishing, sunbathing, boating, swimming, and other outdoor activities.

Boat racing became a popular activity early in the history of the Salton Sea and persisted for many years. The Salton Sea 500 was a popular 500-mile boat race of the 1960s and was viewed by more than 5 million people when featured on CBS's "Sunday Sportstacular." The Salton Sea 300 replaced the boat races and is billed as the fastest, longest personal watercraft race in the world.

Sport fishing remains a popular activity at the Salton Sea, along with waterfowl hunting and bird watching. Sport fishing is the result of saltwater fish introduced from the Gulf of Mexico during the early 1950s and the introduction of tilapia, an exotic species from Africa, during the 1970s. Orange-mouth corvina is the most prized of the sport fish; corvina over 30 pounds are occasionally caught, and fish over 10 pounds are common. A report by the California Department of Fish and Game called the Salton Sea one of California's highest quality fisheries. The claim can still be made today, but it cannot be sustained unless the increasing salinity of the Salton Sea is arrested.

Bird watching and hunting have been popular activities since at least the 1920s and today provide substantial contributions to the economy of the local communities around the Salton Sea. The Salton Sea International Bird Festival, held annually since 1997, attests to the popularity of the Salton Sea ecosystem as a haven for bird watching. Hunting is supported by a substantial number of private duck clubs around the Sea, and waterfowl can be hunted on portions of the Sonny Bono Salton Sea National Wildlife Refuge and on the state's Imperial Wildlife Area Wister Unit.



In recent studies, the Sea's salinity was measured at 44,000 milligrams per liter. Unlike other saline lakes, the Sea supports a marine-like fishery.

A variety of other activities enhance the overall recreational value of the Salton Sea, including photography, camping, and kayaking. Because of its relative proximity to the large metropolitan areas of San Diego and Los Angeles, and with projected population growth within southern California, the large size of the Salton Sea makes it an even more valuable resource for the future. That value can only be realized through a Salton Sea that has acceptable water quality for people who are seeking water-related recreation.

1942: The All American Canal begins supplying water to the Imperial Valley.

1944-45: US Army B-29s, commanded by Lt. Col. Paul Tibbets, drop dummies of a new bomb into the Salton Sea. On August 6, 1945, Tibbets and his crew drop the first atomic bomb over Hiroshima, Japan.

1948: The Coachella branch of the canal begins carrying water to Coachella Valley.

1950: Orange-mouth corvina becomes the first saltwater game fish to be successfully established in the Salton Sea. Short-fin corvina and gulf croacker are also successfully transplanted.

1951: Sargo introduced to the Salton Sea.

1955: Salton Sea State Park dedicated, which at the time is the second largest state park in California.

1958: M. Penn Phillips Co. maps out Salton City.

1960: North Shore Beach and Yacht Club Estates opens on north side of Sea.

1961: The California Department of Fish and Game predicts the Salton Sea will die by 1980 or 1990 because of increasing salinity levels.

1974: A plan is discussed to reduce salinity levels with a diking system.

1976: Tropical storm Kathleen floods farmland and increases level of Sea.

1977: Tropical storm Doreen sweeps through Imperial Valley.

1980: Conservation efforts by the Imperial Irrigation District begin to stabilize the Sea's level somewhat.

1988: Salton Sea Task Force formed.

1992: 150,000 eared grebes die on Salton Sea, capturing national attention.

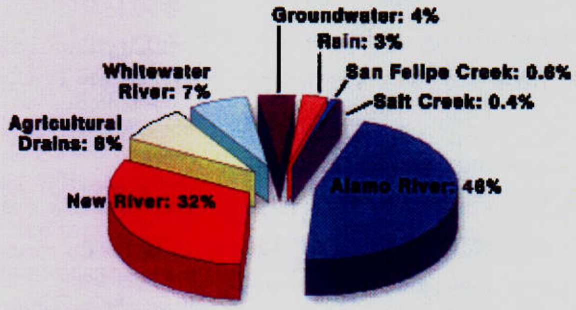
1993: Salton Sea Authority formed.

The Sea's Problems and Challenges

From an ecosystem health perspective, the Salton Sea can be compared to a patient with acute and chronic health problems. Salinity is like high blood pressure that will cause the patient to have a debilitating stroke or a fatal heart attack if not brought under control in the short term. Eutrophication and other aspects of water quality are chronic problems that can be equated to a slow-growing cancer. Those conditions will cause a variety of health problems and gradually will result in the Sea requiring extensive life support to prolong its existence as a viable entity, relative to the values human society seeks from the Sea. If not adequately dealt with, those problems also could result in the death of the patient.

Salinity is the more time-sensitive problem and must be dealt with immediately to stabilize the patient so it survives long enough for the other, more complex, problems to be addressed. This is not an either/or situation, as the investment in controlling salinity will be lost if the other problems are not also addressed. The salinity of the Sea has been measured recently at about 44,000 milligrams per liter (mg/L). Scientific investigations are being pursued to determine at what salinity the fishery would collapse. The fishery involves species that have

Sources of Inflow to the Salton Sea

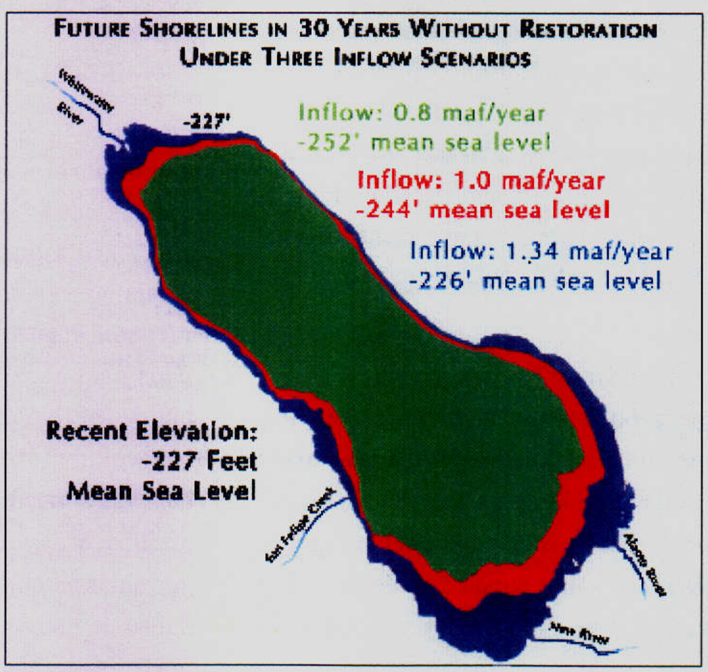


The bulk of the Sea's inflow comes from the Alamo and New rivers; the rest comes from various sources.

different levels of tolerance to salinity, as do the invertebrates that compose portions of the food base for the various fish species. Therefore, much of the fishery will be lost to salinity long before the most salt-tolerant species die out.

In the absence of more definitive current information, 60,000 mg/L is the salinity level projected for the loss of most of the sport fishery. Some age classes and species are likely to be lost at lower levels of salinity, thereby initiating a general decline in the fishery several years before a salinity of 60,000 mg/L is reached. If historic inflows were to continue, the fishery could last up to 60 years. However, using the baseline projected in the Imperial Irrigation District Water Conservation and Transfer EIR/EIS, within 25 years the Salton Sea would become too salty to sustain a viable sport fishery or a food base for fish-eating birds. If inflows to the Sea are reduced, those capabilities of the fishery could be lost within 10 years.

Rising salinity could also have significant biological ramifications on invertebrates. The pileworm is a major food source for some species of fish and birds. Pileworms will not tolerate increased salinity and will be eliminated from this ecosystem if the Sea becomes too salty. Other invertebrates, such as brine flies, will benefit from increased salinity. The shift in invertebrate populations will be beneficial for a few species of birds but not for many others.

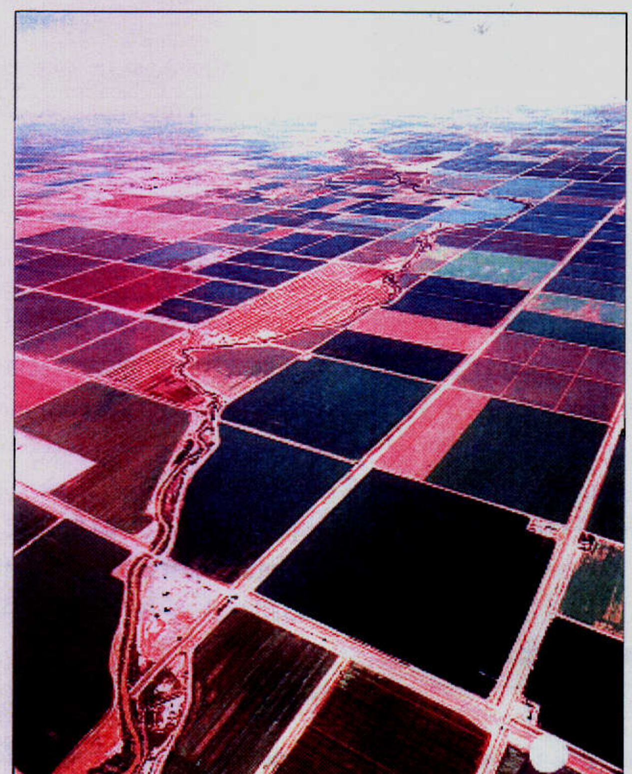


Restoration and the Critical Need for Water

The current slow rate of increase in the salinity of the Salton Sea is a result of the balance between inflows and evaporation. This balance makes it possible to reduce salinity at reasonable costs by exporting water (for example., through the use of on-land solar ponds). Reducing inflows to the Sea would upset the current balance between inflow and evaporation that establishes that rate at which salinity is increasing. If inflows are reduced, ultimately a new balance would be achieved, but during the transition, the rate at which salinity increases will accelerate. That increased rate of salinity cannot be overcome by most of the alternatives being considered to control salinity. Under most alternatives with reduced inflows, the salinity for a while would exceed safe levels for the fishery but eventually would be brought down to the levels where a fishery could be reestablished. For these alternatives to be successful without temporary loss of the fishery, it would be necessary to find a method to replace the water lost from reduced inflows; otherwise, large and costly in-Sea ponds would have to be constructed to reduce the evaporative surface area.

Effect of Inflow Reductions on Water Quality

Inflows could be reduced by 20 to 30 percent or more in the near future. As a result, the Sea could be 15 to 20 feet lower than its current elevation within the next 25 years. With evaporation outpacing inflow during the transition period, the salt currently in the Sea, plus new salts that enter, would concentrate in the water that remains. A drop of 15 to 20 feet and a more than doubling of salinity in a short period would hasten the collapse of the fishery and would dramatically change the invertebrate populations



The need for water in the West is increasing, and California is required to reduce its dependence on Colorado River water. Unfortunately, no new sources have been identified to replace water from the river.

1994: Die-off of eared grebes claims 20,000 birds.

1995: Salinity of the Sea approaches 45,000 mg/L.

1996: Type C avian botulism causes large-scale mortalities of white and brown pelicans.

1997: Congressman Bono forms the Congressional Salton Sea Task Force.

1997: Interior Secretary Babbitt launches multiagency effort to restore the sea.

1998: The Science Subcommittee is organized early in the year to research environmental issues affecting the Sea. Congressman Bono is killed in skiing accident. Mary Bono, his wife, is elected to Congress and picks up the banner for the Salton Sea. Congress passes Salton Sea Reclamation Act, directing the Secretary of Interior, acting through the Bureau of Reclamation, to prepare a feasibility study on restoring the Salton Sea and to submit it to Congress by January 1, 2000.

1999: In August, 7.6 million tilapia and croakers die from oxygen being depleted due to algae in Salton Sea. Yet scientific studies show the Salton Sea may have the most productive fishery in the world.

2000: Salton Sea Authority and Bureau of Reclamation release plans for Salton Sea restoration, and pilot projects are approved. Several systems, including enhanced evaporation and solar ponds, are tested to determine the best way to reduce salinity. A wildlife disease program is underway for early detection and response to disease outbreaks as a means for minimizing losses. The Salton Sea Authority enters into a partnership with the Salton Community Services District by funding a fish cleanup effort on the Sea's west shore.

2001-2002: Restoration planning continues, alternatives are revised, pilot projects are implemented.

of the Sea years sooner than inflow was not reduced. Both systems would negatively affect current bird populations of the Sea.

In-Sea ponds, constructed from dikes, could be used to counteract the loss of inflows. Their function would be similar to replacing lost inflows in that they would reduce the surface area and, thus, evaporative losses from the Sea. Inflow and evaporation could then be forced into a balance that would not result in the rapid increases in salinity and lower Sea elevations that would otherwise occur from reductions in inflow. However, because the Salton Sea is in a highly seismic area, the cost of dike construction could be higher than in other areas.

Possible sources for water have been sought to sustain the critical balance between inflow and evaporation without causing salinity to spike, while still accommodating water transfers. But this quest has been unsuccessful because of increasing demands on water in the West and the need for California to reduce its dependence on Colorado River water. Nevertheless, the costs of a smaller water body are also great. The resulting smaller body of water, with its high nutrient loadings, high temperatures, algal bloom, and dissolved oxygen problems, would likely produce more extensive odor problems. This condition, known as eutrophication, would continue unabated. These larger odor problems would be in addition to the temporary odor problems from massive and very sudden fish kills that could occur when salinity increases rapidly. The degraded environment would aggravate the socioeconomic conditions throughout the Salton Basin. Increased eutrophication, loss of the fish food base, and changes in the invertebrate populations are also likely to result in major changes in bird use patterns at the Salton Sea.

Effect of Inflow Reductions on Air Quality

The potential for reduced air quality from reduced inflows to the Sea is of growing concern, particularly in light of similar adverse impacts that have occurred at Owens Lake when its lake level decreased. Elevation drops of 15 feet or more at the Salton Sea can be expected as a result of reduced inflow and would expose more than 50,000 acres (80 square miles) of lake bottom. A recent dust storm on exposed sediments at the southern end of the Sea provided visible evidence that, under some conditions, fugitive dust from exposed areas of the Sea bottom can result in particles smaller than 10 microns (PM_{10}) becoming suspended in the air.

Mitigating dust problems can be costly. When Los Angeles diverted Owens Valley river water until Owens Lake was completely dry, unstable alkali soils were left, which are susceptible to becoming airborne during windstorms. A July 1998 memorandum of agreement between Los Angeles and the Great

Basin Unified Air Pollution Control District provides for a costly dust mitigation program that will involve wetting exposed sediment. The program will be long term and may cost $400 million to construct and $10 million per year to operate and may require 25,000 acre-feet of water each year.

Representative Mary Bono (left) and Senator Dianne Feinstein (right) along with Tom Veysey, former President of the Salton Sea Authority Board of Directors, present a commemorative plaque to Marta Brown, widow of the late Representative George Brown, in honor of Congressman Brown's work to save the Sea.

Evolution of Restoration Alternatives

Studies to manage the salinity of the Sea date back to the late 1960s, when the Bureau of Reclamation and the California Department of Water Resources evaluated possible alternatives. Positive results from that effort led to a joint feasibility study completed in 1974. After passage of Public Law 102-575 in 1992 and the formation of the Salton Sea Authority in 1993, Reclamation, the Authority, and the Department of Water Resources again began studying the Sea. In addition to some characterization studies, they completed a preliminary study of alternatives in 1997, and the next year, Reclamation published a report that evaluated 39 possible alternatives.

Congressional Support for Restoration

The latest effort to restore the Salton Sea was spearheaded by the late Congressmen Sonny Bono and George Brown. The current Congressional Task Force consists of Representatives Mary Bono, Duncan Hunter, Ken Calvert, and Jerry Lewis. Senators Dianne Feinstein and Barbara Boxer also have been supporters of the project.

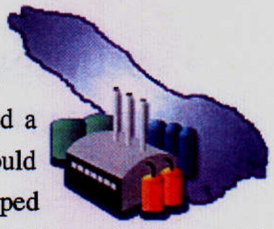
Congressional Task Force House Representatives Duncan Hunter and Ken Calvert participate in a panel discussion at the Salton Sea Symposium in January 2000.

Alternatives Considered in the Past

A large number of project alternatives have been considered over the years, many of which have been evaluated in some detail but ultimately were rejected for technical or performance reasons or because they were simply too expensive. Two classes of alternatives—desalination and pump in/pump out—appeared to hold promise for the Sea. They were evaluated in detail but were eliminated from further consideration.

Desalination. Desalination of both inflow and Salton Sea water has been considered.

Desalination of Inflow Water. Desalination of inflow water is impractical for several reasons. First, inflow waters have salt concentrations on the order of 1/20th that of the waters in the Salton Sea itself, so the amount of inflow water that would need to be treated would be 20 times the volume of highly saline Sea water that would need to be treated. Second, water flows into the Sea through three major tributaries, many agricultural drains, and a variety of lesser pathways. Multiple treatment plants would be needed, and all the salt still would need to be stopped from entering the Sea; therefore, some Sea water would also need to be treated. Finally, two product streams would be created: a brine stream would pose a disposal problem like other treatment methods, and a freshwater stream would be very expensive to produce. With a cost of 2 to 3 billion dollars just for desalination, this alternative was found to be impractical and cost prohibitive.



Desalination of Salton Sea Water. As with other methods of removing salt, Salton Sea water would have to be removed for desalination. This method also would create a brine stream, which would need to be disposed of, and a freshwater stream. Past work on this alternative has suggested that it would be at least ten times more expensive than constructing solar ponds to remove salt, and it would not offer any significant additional benefits, unless the freshwater stream were to be returned to the Sea. Although desalination has been eliminated in the past because of high costs, a technology that would take advantage of waste steam from geothermal activities at the south end of the Sea is now being considered. A pilot project is planned to determine if this desalination process could be cost effective.

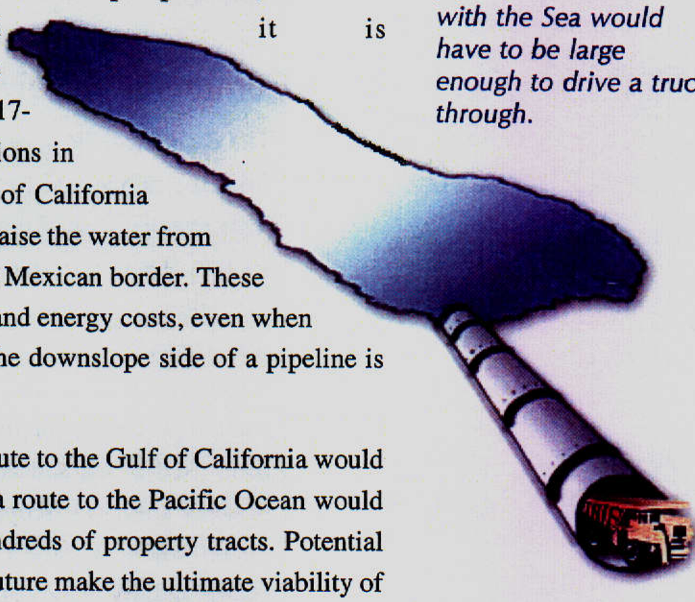
Ocean Water Pump In/Pump Out. An exchange of Salton Sea water via a pipeline or canal to either the Gulf of California or the Pacific Ocean would seem to be an obvious solution to the problems at the Sea. But for a number of reasons, this alternative also was found to be impractical.

Size. Because ocean water is only a little less salty than Salton Sea water, more than a million acre-feet—equal to the storage capacity of all reservoirs in southern California—would need to be pumped in and out of the Sea each year to reduce the current salinity and to create a new salt balance. To accommodate such large quantities, the pipeline itself would

have to be large enough to drive a truck through. The construction cost of this project would depend on future inflows but could be as much as $10 billion, with operating and energy costs approaching $250 million per year.

The diameter of any pipeline associated with the Sea would have to be large enough to drive a truck through.

Distance and Elevation. The Salton Sea is in a deep depression, below sea level and nearly as deep as Death Valley, and it is surrounded by mountains. A pipeline to the Pacific Ocean would involve constructing a 17-mile tunnel and pumping water to elevations in excess of 1,000 feet. A canal to the Gulf of California would involve constructing many locks to raise the water from below sea level and over the ridge near the Mexican border. These factors contribute to the high construction and energy costs, even when the revenue from cogenerating power on the downslope side of a pipeline is factored in.



Rights-of-Way and Permitting Issues. A route to the Gulf of California would involve construction through Mexico, and a route to the Pacific Ocean would require securing rights-of-way through hundreds of property tracts. Potential rights-of-way and permitting issues in the future make the ultimate viability of this alternative questionable. Millions of dollars could be spent over many years trying to resolve these issues, only to result in failure. At that time, it could be too late to find another solution to save the Sea.

Biological Resource Issues. The Salton Sea is teaming with fish and microscopic life that are unique. The introduction of these species to either the gulf or the ocean could create biological exotic species problems. This also could stall the permitting process.

Thus, the pump in/pump out alternatives are not considered reasonable or practical, and they were eliminated from further consideration.

Alternatives Considered in the Draft EIS/EIR

The National Environmental Policy Act requires the preparation of an environmental impact statement (EIS) for a major action that could have significant environmental impacts. The California Environmental Quality Act requires an environmental impact report (EIR). In January 2000, the joint lead agencies published a draft EIS/EIR that presented a two-phase strategy to address short-term and long-term needs at the Sea. Uncertainties about future inflows to the Sea, additional design studies, and public and agency comments led the project planners to reassess the alternatives presented in the draft EIS/EIR.

Deep water evaporation ponds and tower and ground-based enhanced evaporation systems alternatives were evaluated in the report. For Phase 2, export pipelines were evaluated, and two additional sources of water were considered: excess flood flows from the Colorado River and brine flows from the Central Arizona Salinity Interceptor Project.

Comments Received and Studies Undertaken

The draft EIS/EIR generated a lot of interest and a large number of comments from the public and agencies. Many people raised concerns about the long-term effectiveness of the alternatives, their cost, and the availability of the two sources of water considered for Phase 2. Partially because of comments received, the Salton Sea Authority commissioned an outside engineering evaluation of the alternatives. The engineers agreed that the alternatives would work but suggested a number of improvements. They also suggested evaluating smaller, shallow, solar evaporation pond systems, which are similar to those that have been used in the salt-making industry for hundreds of years. Shallow pond systems are less susceptible to earthquake damage than are large deep water ponds, which, as originally designed, would become less effective over time. Rising salinity in the ponds would cause their evaporative capacity to decrease, and ultimately they would fill up with salt.

Continuing Development of Alternatives

Pilot projects and other design work are continuing to refine and improve the alternatives discussed in this guide and to seek other alternatives. In addition to the desalination pilot project mentioned above, work on biological treatment methods is also planned, particularly focusing on reducing eutrophic conditions. Furthermore, the Salton Sea Science Office reviewed a partial-Sea solution proposed by the Pacific Institute, to be considered under water transfer scenarios that significantly reduce inflows. This proposal would involve constructing dikes at both ends of the Sea to capture relatively freshwater and allow the main Sea to shrink and become hypersaline. Wetlands would be constructed in the New and Alamo river channels to trap sediments and to provide some treatment for the water before it flowed into the impoundments. As new processes and technologies emerge, and as impacts of water transfers become known, other approaches may be considered in the future.

Restoration Framework

The Salton Sea Restoration Project is one of a number of actions that could affect conditions at the Sea. The restoration project has been planned within the framework of these other projects to ensure that the projects work together and to avoid duplicative efforts. Other projects that could have the greatest influence on the Sea are discussed below.

Imperial Irrigation District Water Transfer Program. The San Diego County Water Authority (SDCWA) and the Imperial Irrigation District (IID) have negotiated an agreement for the long-term transfer of water. Under the proposed contract, IID customers would conserve water to reduce the use of Colorado River water within the IID. Because the volume of conserved water would depend on the level of voluntary landowner participation, the agreement does not specify an amount to be transferred. The agreement instead sets the transfer quantity at a maximum of 200,000 acre-feet per year. An additional 100,000 acre-feet per year of conserved water would be made available in the future to Coachella Valley Water District or the Metropolitan Water District of Southern California. The water transfer program would likely reduce inflows to the Sea. The extent that inflows would be reduced would depend on the specific measures that would be adopted to support the transfer. Fallowing land would have much less effect on the Sea than other conservation measures, such as pump-back systems.

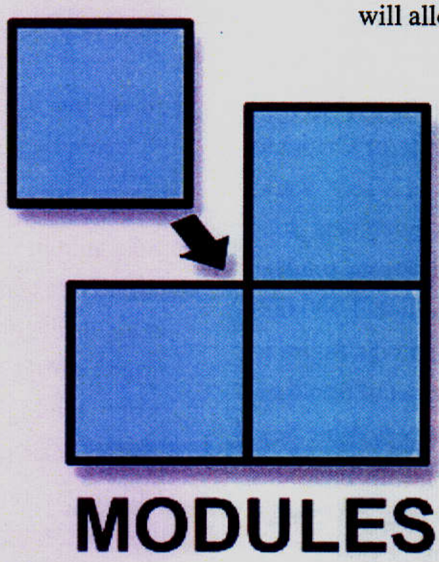
Total Maximum Daily Load Program. Congress, through the Clean Water Act, established the legal requirement that states list and rank impaired water bodies and that total maximum daily loads (TMDL) be established for constituents that are causing impairment. The Salton Sea watershed has been identified as a priority watershed for the TMDL program, and the Regional Water Quality Control Board is establishing TMDLs for these waters. A TMDL implementation plan that is economically reasonable and technically feasible will be developed as part of this process. The long-term goal of the TMDL process is to improve the quality of waters flowing into the Sea. This goal will at least partially address several project objectives. The TMDL program could also have an adverse effect on the salinity of the Sea, if it were to reduce inflows.

Constructed Wetlands Projects. Several wetlands projects have been planned around the Salton Sea, and two pilot projects have already been implemented. Congress funded two wetland pilot projects that have been constructed on the New River, one near Brawley and the other near Imperial. Other projects include one proposed by the California Department of Fish and Game and one proposed by the Torres Martinez band of the Desert Cahuilla Indian Tribe at the north end of the Sea. These projects are designed to provide additional wildlife habitat in the area and to improve the quality of the inflows to the Sea.

These other projects make it increasingly difficult for project planners to forecast both near-term and future inflows to the Sea, so a modular strategy was developed to provide project flexibility to respond to variations in future inflows.

Modular Strategy

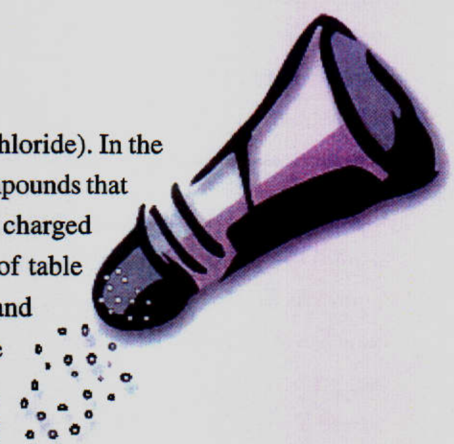
The modular strategy enables the project planners to develop restoration alternatives that can be increased in capacity by adding modules. This strategy will allow the project to respond to needs at the Sea and will gradually change over time, rather than be segmented into two distinct phases. The modular strategy has helped Reclamation and the Salton Sea Authority develop alternatives and to continue evaluating possible future inflows to the Sea.



Using a modular approach allows for planning and designing a base system that works if recent inflow conditions continue and that can be expanded if inflows decrease in the future. If, during the planning process, decisions are made on the Imperial Irrigation District Transfer Project or any other projects that could affect future inflows, then the most likely future inflow scenario could be better defined. In such a case, project alternatives could be sized to respond to these inflows by selecting the appropriate number of modules that would be needed.

The modular strategy involves two basic types of modules for salinity control—Salt removal modules and salt disposal modules—and several technologies and configurations are being considered. Each salt removal module would remove about a million tons of salt per year from the Sea. That quantity would increase if the salinity in the Sea were to increase. The salt products extracted from the Salton Sea would be stored in a salt disposal module, one for each salt removal module.

All Salt is Not "Salt"

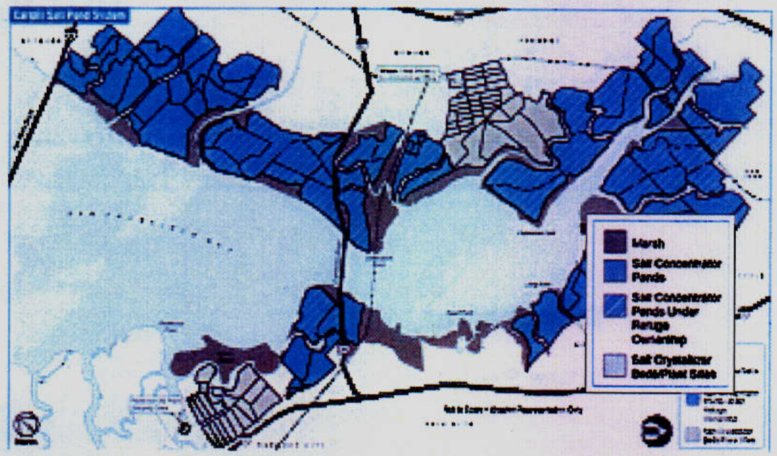


All salt is not table salt (sodium chloride). In the world of science, salt refers to compounds that readily dissolve in water to form charged particles called ions. In the case of table salt, separate particles of sodium and chloride ions are formed in the water. In addition to these ions, Salton Sea water contains ions of calcium, magnesium, and other materials, so the salt extracted would not be pure table salt but a mixture of different salts. As such, it would have little commercial value, unless the salts were separated and purified. Transportation costs from the Salton Basin make the sale of this salt even less attractive. Thus, most, if not all, salt products removed from the Sea presumably would have to be stored or disposed of locally.

Salt Removal

Two basic strategies are being considered for salt extraction: enhanced evaporation systems (EES) and solar evaporation ponds.

The EES process involves spraying water into the air to accelerate evaporation. Two EES technologies are being considered: A tower system, which would spray water from in-line showers, and ground-based blower units, which operate similar to snow-making equipment. The EES units would convert Salton Sea water to a concentrated brine that would be pumped to a disposal module.



The solar evaporation pond process would require constructing a series of shallow ponds. Salton Sea water would be pumped to the first pond and would flow by gravity to the other ponds. In the last pond, brine saturated with salts would be pumped to a disposal module. To form the solar evaporation ponds, dikes would be constructed within the Salton Sea, or berms would be built on land. (References to solar ponds elsewhere in this guide should be understood to mean solar *evaporation* ponds.)

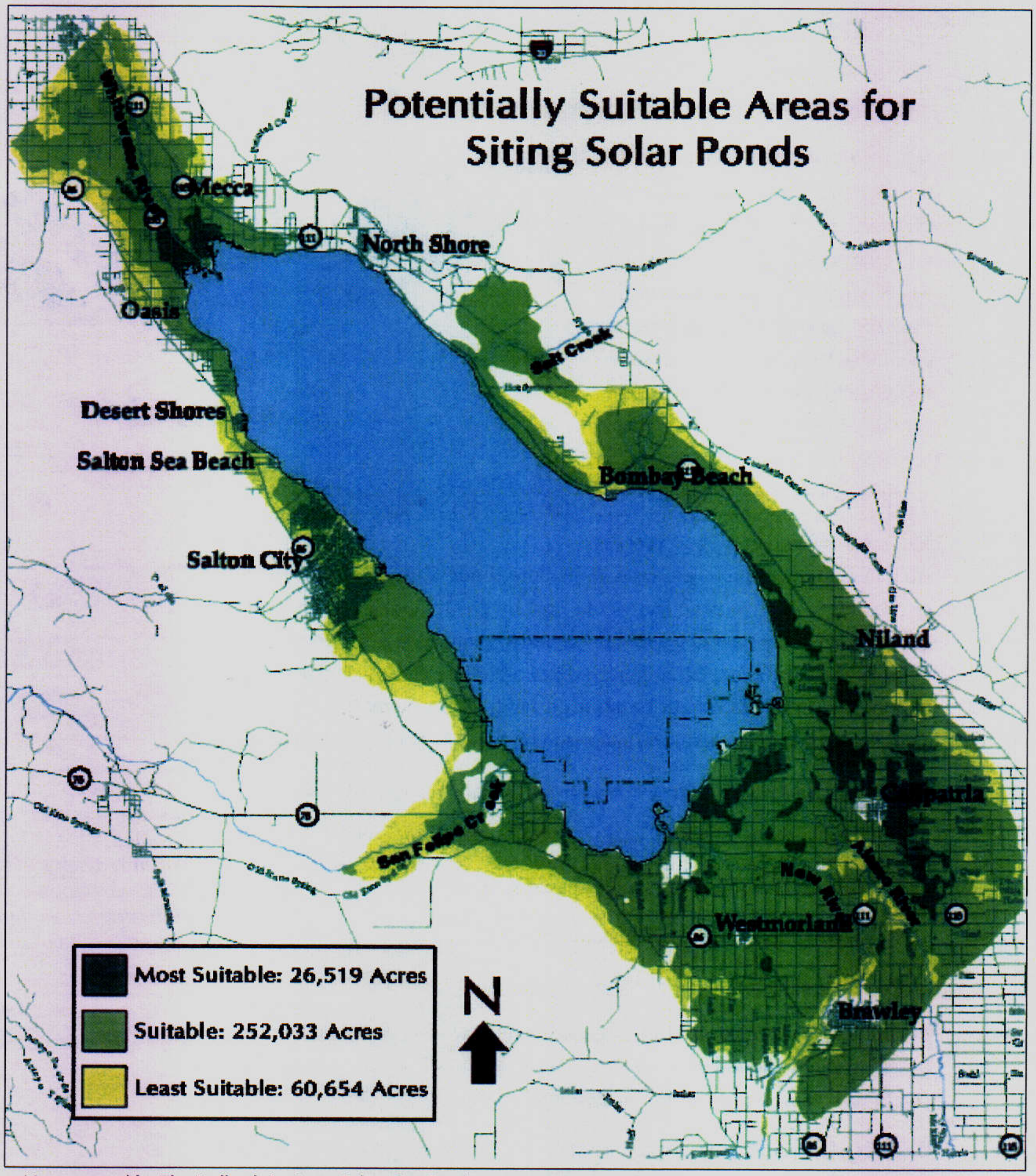
Desalination ponds are used in a number of locales in the West, notably Utah's Great Salt Lake (above) and the southern end of San Francisco Bay.

In summary, the following types of modules are being evaluated for salt removal:

- EES, using towers with in-line shower technology;
- EES technology, using ground-based spray units;
- Solar evaporation ponds constructed on land; and
- Solar evaporation ponds constructed in the Salton Sea.

In addition to these basic technologies, flat and steeper terrain factors were considered for on-land solar pond systems, and shallow and deeper water conditions were considered for in-Sea pond systems.

Solar ponds could create diverse habitats around the Sea. Large solar pond systems are in operation at the Great Salt Lake in Utah and at the south end of San Francisco Bay, both of which are of comparable scale to what would be constructed at the Sea. Brine shrimp and brine flies would provide a food base for birds and other wildlife, and islands could be constructed to provide nesting habitat.



Map prepared by The Redlands Institute, Salton Sea Database Program

Salt Disposal

Restoration of the Sea would require disposing of waste salt products, and it is likely that disposal ponds would be used for this material. Conceptual designs have been prepared for both on-land and in-Sea salt disposal. The disposal options involve terracing the salts in what eventually would be comparable to a sanitary landfill. Initially, earthen berms would be built to contain shallow ponds, where the solid salts would crystallize. As the salt deposits formed, the berms would be built up higher, on top of the existing salt deposits.

In addition to disposing of salt products, Reclamation and the Salton Sea Authority are investigating selling or recycling some of the salt products. If commercially viable options are identified, then disposal requirements would be reduced.

Above is a photo simulation of a typical salt disposal facility after 30 years.

Project Siting: Where?

At the current stage of alternative development, specific locations where facilities could be sited have not been identified. Instead, the staff of the University of Redlands Salton Sea Database Program identified areas that would be generally suitable for salt removal and disposal modules, based on criteria supplied by the lead agencies. Separate analyses identified areas suitable for each method of salinity control and for disposing of waste salts.

The University of Redlands staff analyzed suitable areas for both on-land and in-Sea facilities, and in each case, they considered different criteria. For example, for on-land ponds criteria were assessed in order of most to least importance: Slope of land, soil characteristics, elevation above the Sea, and distance from developed areas and the Sea.

Data layers were created for each criterion, using computer mapping software. Suitable areas then were modeled by assigning different weights to each layer and creating a composite suitable areas layer. The amount of suitable land area identified through this process for different facilities is identified in the accompanying bar chart. A sample map showing suitable areas for on-land ponds is shown on page 18.

How Many Modules Are Needed? How Big?

If the amount of water that evaporates in a given year exceeds the amount of inflow, the elevation of the Sea's water surface will start to decline. This could occur because of water withdrawals for restoration, water transfers from the basin, a combination of these factors, or other reasons. The Sea's elevation would continue to decline until the water surface became smaller and the amount of evaporation and inflow became balanced. Evaporation does not remove salt, so the Sea's salt concentration would increase as elevation declined. If the Sea's surface elevation began to decline, more salt than just the inflow amount would need to be removed to maintain the current salt concentration.

The inflow of water to the Sea in the recent past has been about 1.34 million acre-feet per year, containing about five million tons of total dissolved solids. Water enters the Sea from the New, Alamo, and Whitewater rivers, from numerous agricultural drains, and from other sources. It appears that between 0.7 and 1.2 million tons of that inflowing salt precipitates each year. Therefore, to stop the increase in salinity in the Sea, if there are no elevation changes, 4 million tons of salt would need to be removed each year to eliminate inflowing salt. Removing an additional 2 million tons per year, for a total of 6 million tons, would gradually reduce the salinity.

To compensate for the incoming salt load and to gradually reduce salinity, the minimum number of modules for restoration is four to six. More modules would be needed under reduced inflow scenarios; as many as 15 modules could be needed, depending on the type of module and the amount of inflow reduction. That many modules would be costly to construct, would consume large blocks of land, and would generally be impractical. A single solar pond module with disposal area would occupy about six square miles, either on land or in the Sea. An EES module with disposal area would occupy about two square miles.

For comparison, disposing of six million tons of salt per year would be comparable to the disposal capacity of the Mesquite Mine and Landfill near Glamis, about 35 miles southeast of the Salton Sea. The landfill can accommodate 600 million tons of solid waste and has a design life of 100 years (six million tons a year). The footprint of the landfill is 2,290 acres, within a project area of 4,245 acres.

Not Just Salinity Control: Other Restoration Elements

In addition to salinity control measures, other restoration elements would be included with all alternatives. These elements are designed to address the project's multiple goals and objectives, when combined with salt removal and disposal actions. They are designed to help stem further degradation of the Sea and may be supplemented with later actions developed under the adaptive management efforts of the Salton Sea Restoration Project. The other restoration elements consist of the following possible actions:

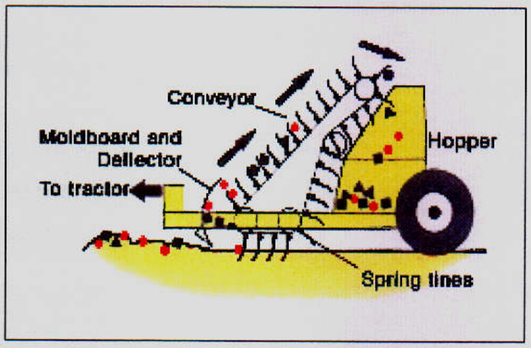
Wildlife Disease Control. An integrated approach would be implemented to reduce the incidences of wildlife disease at the Sea. The program would include environmental monitoring, disease surveillance and response, and scientific investigations of disease ecology. Wildlife rehabilitation also would be provided because of the avian botulism problem affecting pelicans at the Salton Sea.

Created Wetlands. A wetland habitat would be created to preserve snag habitat used by aquatic wildlife in the northern portion of the Sea.

Recreation and Public Information. The recreational enhancements program would fund improvements to recreational facilities around the Sea. Specific improvements would be designed to meet future needs but may include a visitor center or interpretive boards at restoration facilities, improved access areas or new access points for restoration facilities, upgrades to public use areas (such as piers or other waterfront areas, particularly in areas near restoration facilities), and public outreach material (such as literature or videos to promote recreational opportunities at the Sea.

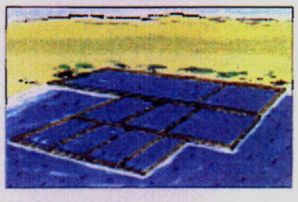
Eutrophication Assessment. Eutrophication from the abundance of organic material in the Salton Sea has been recognized as one of the major factors affecting recreation and fish and wildlife resources. A number of possible treatments have been identified that could help reduce eutrophication. These include treating the Sea with alum, adding polymers to increase the settling rate of fine particles in the tributaries, reducing loading to tributaries, limiting total maximum daily loads, treating wetlands, and managing the fisheries. An ongoing assessment would determine the extent to which these programs would be practical and beneficial for the Sea.

Shoreline Cleanup. This program would be designed to improve aesthetics and to reduce odors around the Salton Sea. The program would include a fish recovery system and cleanup program to remove dead fish along the shoreline, particularly in areas of likely public exposure. This would reduce noxious odors and nutrient loading in the Sea, creating a healthier environment for the public and the fishery.



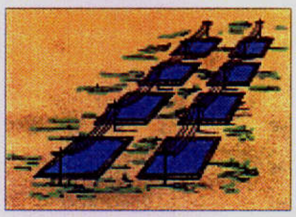
One way to rid the Sea's beaches of dead fish is to use machinery, such as that shown above, which would be towed along the beach behind a tractor. Tines on the bottom of the unit would scoop up the fish and deposit them in a hopper for disposal.

Fishery Management. This would be a collaborative effort among the lead agencies, other agencies charged with resource management (such as the California Department of Fish and Game and the US Fish and Wildlife Service), and possibly private or commercial interests. Two elements of fishery management are being investigated at the Salton Sea: A fish hatchery and fish



In-Sea Solar Evaporation Ponds

Ground-Based Enhanced Evaporation System Blowers



Tower Enhanced Evaporation System

population control. The fish hatchery would be an interim measure to ensure the continuance of a sport fishery and a food base for fish-eating birds. The hatchery would be designed to preserve the genetic stock of key sport fish in the Sea that can tolerate high levels of salinity. The hatchery would operate if salinity were to continue to increase, until salinity levels returned to safe levels as part of the restoration effort. Fish population control could include harvesting certain species at key times during the year to avoid overcrowding.

Summary of Salton Sea Restoration Alternatives

The salt removal and disposal modules and other restoration elements have been grouped into six alternatives, which vary by the method of salt removal (solar ponds or EES) and the location (in the Sea or on land). The number of salt removal modules required for each alternative would depend on the assumptions used for both baseline and future inflows.

The six alternatives are described below.

Alternative 1: In-Sea Ponds. In-Sea solar ponds with in-Sea terraced salt disposal would be constructed using standard dike construction procedures. As shown in Table 2-5, if the average inflow is 1.34 million acre-feet a year (maf/yr) (similar to the recent past), the number of modules required would be four. Depending on inflow conditions, 6 to 12 modules would be needed for reduced inflow scenarios.

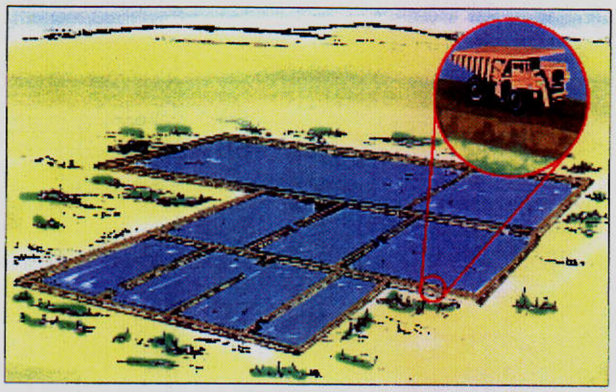
Alternative 2: Ground-Based EES. Ground-based, EES turbo-enhanced blower units would be constructed on land, and concentrated brine products would be pumped to an on-land, terraced, salt disposal facility or facilities. If the average inflow is 1.34 maf/yr (similar to the recent past), the number of modules required would be six. Depending on inflow conditions, 9 to 15 modules would be needed for reduced inflow scenarios.

Alternative 3: Tower EES. An on-land EES tower configuration would be constructed with in-line showers and an on-land, terraced, salt disposal facility. The number of modules required would be the same as those required for Alternative 2 for all inflow scenarios.

Alternative 4: In-Sea and On-Land Ponds. This alternative would involve the construction of a combination of in-Sea solar ponds, with an in-Sea, terraced, salt disposal facility, and solar ponds, with an on-land, terraced, salt disposal facility. If the average inflow is 1.34 maf/yr, similar to the recent past, this alternative would require two in-Sea modules and two on-land modules.

Depending on inflow conditions, three in-Sea modules and three on-land modules, increasing to seven in-Sea modules and seven on-land modules, would be needed for reduced inflow scenarios.

Alternative 5: On-Land Ponds. On-land solar ponds would be constructed, along with on-land terraced salt disposal facilities. The number of modules required would be the same as the number required for Alternative 2 for all inflow scenarios.



On-land solar ponds would be contained by earthen berms, which would be wide enough to accommodate a dump truck.

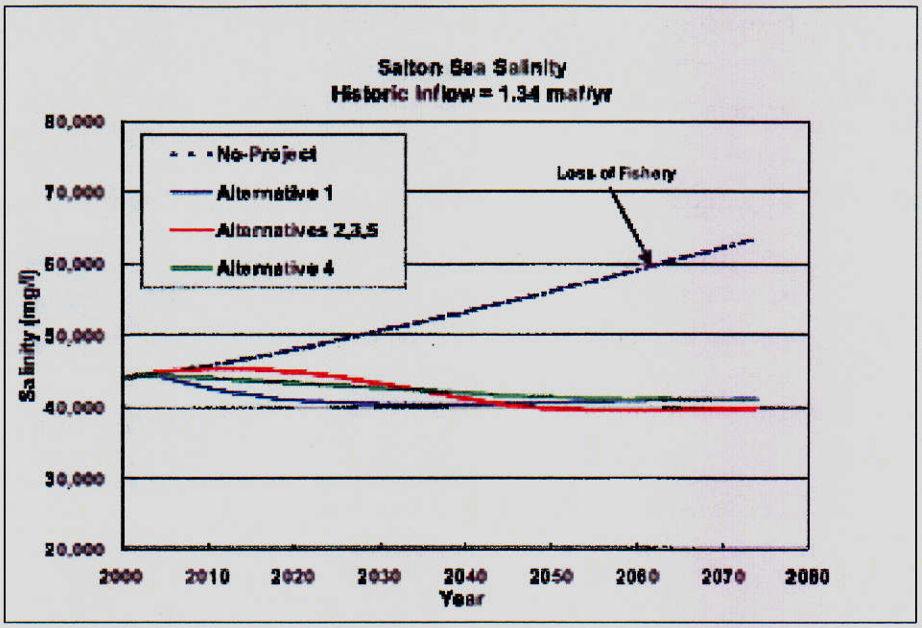
Performance and Cost of Restoration Alternatives

The five restoration alternatives were evaluated using the Salton Sea Accounting Model, which evaluates the balance between inflow and evaporation and calculates the resulting change in elevation of the Sea and salinity from year to year. Simulations were performed for several future inflow scenario graphs (see pages 24 and 25). For each future inflow condition a large number of hypothetical sequences of future inflows were modeled for the no project case and for each alternative. The model results for two future inflow conditions have been selected for presentation on the following pages—future inflows similar to the recent past (about 1.34 maf/year) and future inflows reduced to 1.0 maf/yr. These combinations were selected to illustrate how changes in future inflows affect the Sea and the performance of the project alternatives. For each inflow condition, predicted future values of salinity and water surface elevation are shown. The goal in the model was set to reduce the salinity in the Sea from about 44,000 m/L to 40,000 m/L.

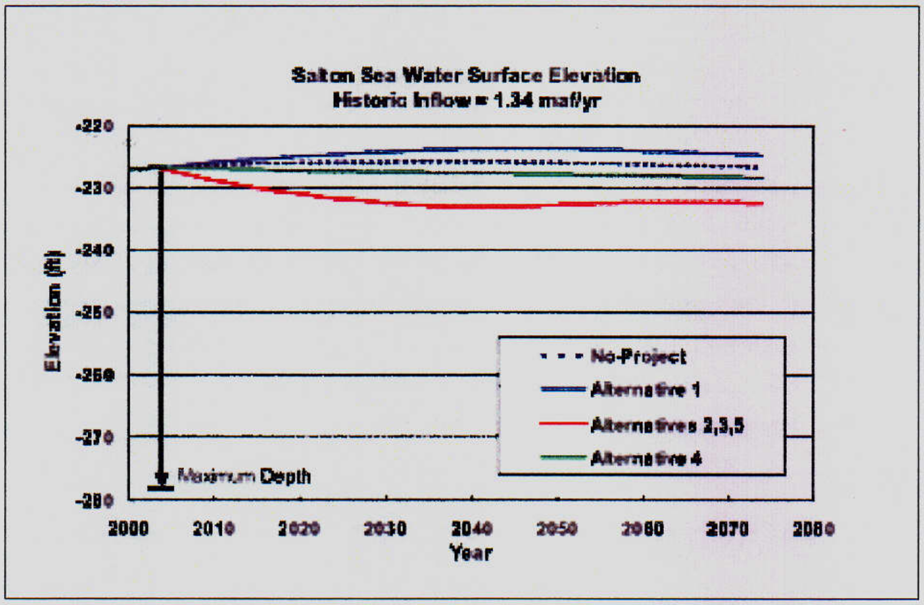
Note: For Alternatives 4 and 6, land use conversion would not be required if inflows were to remain similar to the recent past.

Discussion of Model Results

If average inflow to the Sea is reduced to 1 maf/yr, salinity could quickly exceed 60,000 mg/L, even with alternatives 2, 3 or 5 in place. A resulting impact would be the loss of most of the fishery; however, through time, the salinity could be brought down to target levels. In the interim, if the fishing is to be restored within the Salton Sea at the target level of about 40,000 mg/L, it would be necessary to preserve the current genetic stock of fish that have adapted to higher than ocean water salinity levels, as proposed under the fishery management element. The processes of maintaining brood stock followed by hatchery operations would be expensive. Also, the near-term loss of the fishery and the associated loss of sport fishing revenues would further stress local economies.

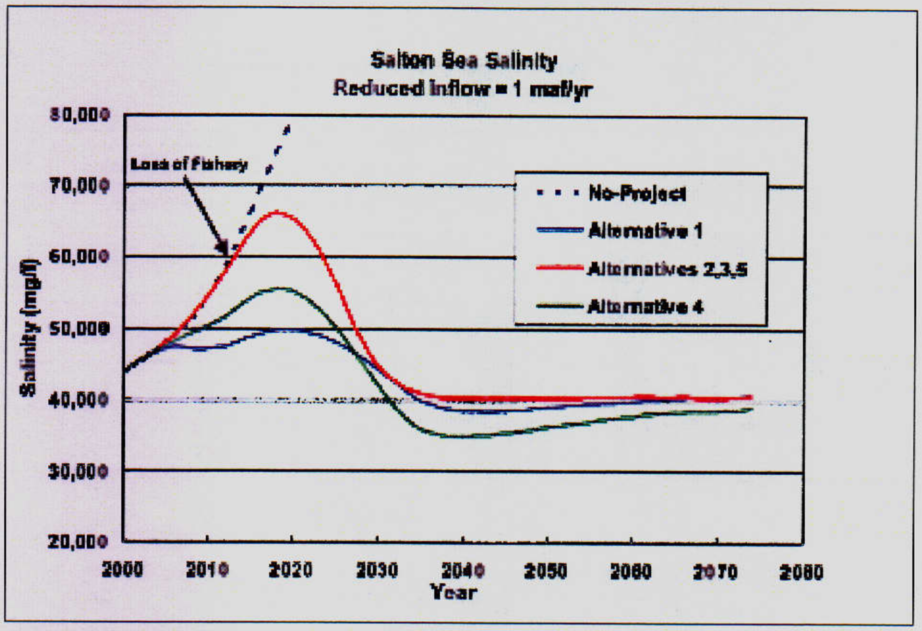


Salinity if future inflow is 1.34 million acre-feet per year

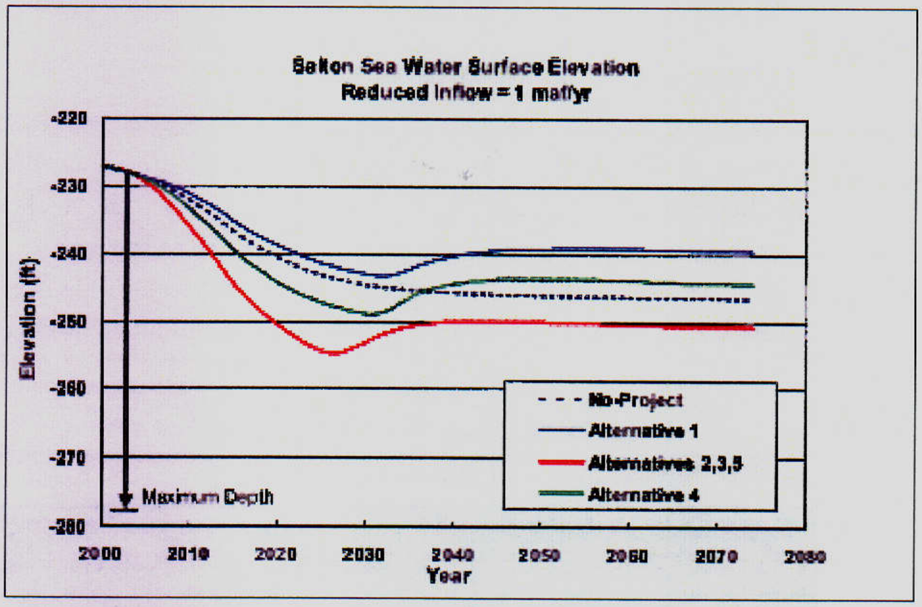


Water surface if future inflow is 1.34 million acre feet per year

If transfers or mitigation for conservation measures are accomplished by fallowing agricultural land, then the effect on inflow to the Sea could be minimal. By implementing conservation methods (such as fallowing) that may not affect the Sea, finding replacement water, constructing in-Sea ponds, or some combination of these factors, salinity could be controlled and the Sea's

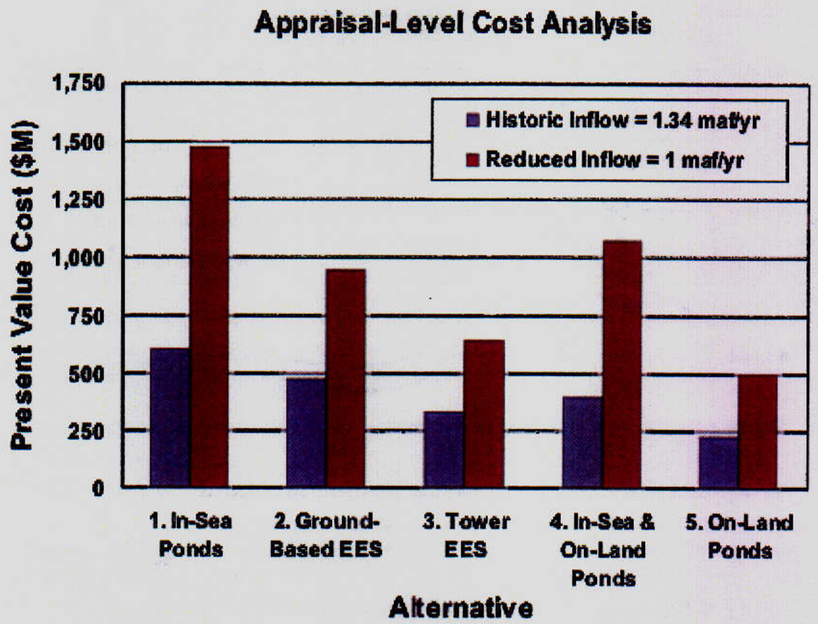


Salinity if future inflow is 1.0 million acre-feet per year



Water surface elevation if future inflow is 1.0 million acre-feet per year

elevation would remain near its current level. Salinity control measures without these considerations are shown to perform poorly under reduced inflow conditions.



Appraisal-Level Cost Analysis

An appraisal-level cost analysis provides project planners with a preliminary estimate of the costs of a project, based on conceptual designs rather than detailed engineering analyses. The chart on the top of page 26 shows the appraisal-level cost estimates for the Salton Sea Restoration Project Alternatives. The total estimated present value of each alternative is shown for two inflow scenarios: Continuation of historic inflows and reduced future inflows at one

General Scoring Values Used in Alternatives Evaluation

	Score	Performance	Environmental Factors	Cost
Best	5	Fully meets or exceeds performance objective	No adverse effects/may be beneficial	Lowest cost alternative
	4	Has strong contribution to objective	No adverse effects	20% to 50% more than lowest cost alternative
	3	Contributes to objective	Minimal adverse effects or some adverse effects offset by beneficial effects	50% to 100% more than lowest cost alternative
	2	Contributes to objective, but with substantial restrictions	Adverse effects/can be mitigated	Two to three times the cost of lowest cost alternative
	1	Likely to provide slight contribution to objective, but difficult to subtantiate	Significant but mitigable effects	Three to five times the cost of lowest cost alternative
Poorest	0	May have adverse effect on objective	Significant effects cannot be mitigated	Greater than five times the cost of lowest cost alternative

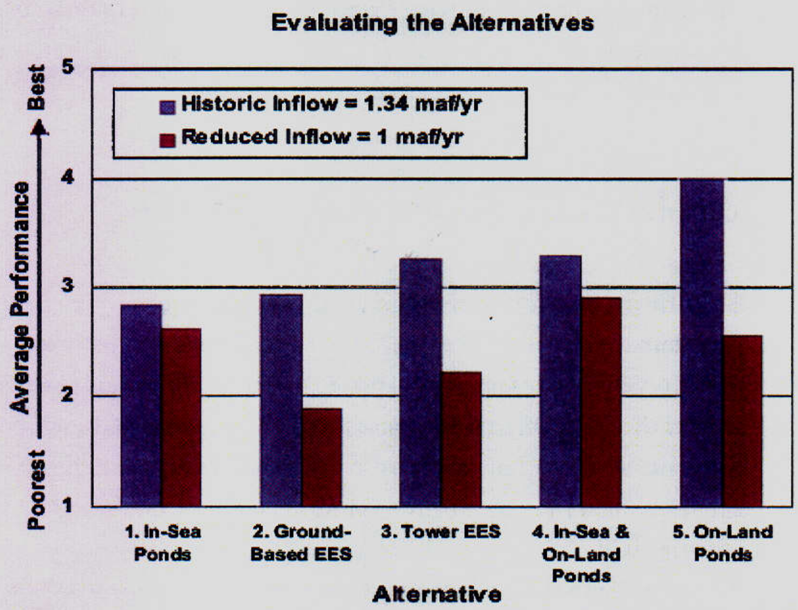
All the proposed alternatives for reducing the Sea's salinity were subjected to a matrix of scoring values to analyze them from best to poorest, using three criteria (above). The six alternatives were evaluated further on how they would perform in terms of inflow criteria (below).

million acre-feet per year. Present value is a measure of the total cost of a project, including capital costs for land and construction, as well as an amount that would be needed today to fund future operation, maintenance, repairs, and energy.

Process for Evaluating Restoration Alternatives

The alternatives were evaluated using a numerical scoring process that took into account performance, environmental issues, and cost. Performance was evaluated with respect to the program goals and objectives within the context of the restoration project framework. Environmental factors were evaluated on the potential of an alternative to affect conditions at or near the Sea within

Evaluating the Alternatives



seven environmental resource categories. Cost was rated on the estimated net present value of the alternatives, where net present value is a factor that combines capital construction costs with the amount of money that would be needed in the present to pay for operation, maintenance, energy, and repairs over 30 years. The salinity control alternatives were evaluated under the following inflow conditions: Future inflows are the same as those in the recent past and they are substantially reduced. The scoring results are shown in the table on page 26 and in the histogram below.

KEY MILESTONES

2002

- **Publish revised draft EIS/EIR**
- **Encourage public involvement and comment**
- **Publish final EIS/EIR**
- **Issue Record of Decision**

2002-2003

- **Complete pilot studies**
- **Prepare detailed designs**

2003 Onward

- **Begin construction of salt removal modules**
- **Implement restoration solutions**

Highest Rated Alternatives

When the performance, environmental, and cost factors are weighted equally, Alternative 5 scores highest overall for the higher inflow conditions, and Alternative 4 scores highest for the lower inflow conditions. The scoring suggests that on-land solar ponds would be an effective solution if inflows remain similar to historic conditions. A combination of on-land and in-Sea ponds could be effective under reduced inflow conditions. A summary comparison of restoration alternatives is provided on page 29.

THE NEXT STEPS

Next steps in the Salton Sea Restoration Project are completing the environmental process, moving from conceptual designs to final detailed design, and implementing the project if decisions are made to go forward with the project and if funding is secured.

Completing the Environmental Process

The alternatives outlined in this document will be evaluated in a revised draft EIS/EIR, in which the environmental consequences of constructing each of the alternatives will be considered. The document will be made available for public review and comment, and public hearings will be held at several locations around the Sea. Official responses will be prepared and included in a final EIS/EIR, at which time a record of decision will outline the actions that the agencies intend to take for the future of the project. At this point, the lead agencies will notify the public as to whether or not they plan to continue with the project, and if so, which alternative will be implemented.

If a decision is made to proceed with the project, additional environmental analyses may need to be conducted for individual project components, as detailed designs and siting are completed.

Moving from Conceptual Design to Final Design

At this point, only conceptual designs of the alternatives and cost estimates have been prepared. From a design perspective, the next step involves preparing detailed engineering designs that include specific siting. Part of this process involves completing two pilot projects that will add important information into the design of salinity control measures. One pilot project near the southeast

Summary Comparison of Salton Sea Restoration Alternatives

Alt.	Salt Removal	Salt Disposal	If Inflows Decrease	Advantages	Disadvantages
1	In-Sea solar evaporation pond systems	Brine pumped to in-Sea disposal ponds, with sides built up over time to accommodate salt deposition	Expand from four in-Sea modules to 10 if inflows are reduced to 1 maf/yr	In-Sea construction reduces evaporative surface of Sea; has least effect on elevation	In-Sea construction is at least five times more expensive than on land
2	Ground-based EES blower units	Brine pumped to on-land disposal ponds, with sides built up over time to accommodate salt deposition	Expand from six EES modules to 13 if inflows are reduced to 1 maf/yr	Minimum land area requirement	High maintenance and energy costs; without replacement water, system performs poorly during transition to lower inflow even with many more modules
3	Tower EES with line showers	Same as Alternative 2	Expand from six EES modules to 13 if inflows are reduced to 1 maf/yr	Less land area than ponds; slightly more land required than ground-based EES, but lower energy requirements.	Spray drift of salt mist from high towers identified as a concern by some agencies; same performance problems as Alternative 2 for reduced inflows
4	In-Sea and on-land solar evaporation pond systems	Brine pumped to in-Sea and on-land disposal ponds, with sides built up over time to accommodate salt deposition	Expand from two on-land and two in-Sea modules to six in-Sea and six on-land modules if inflow is reduced to 1 maf/yr	In-Sea modules provide surface area reduction to help maintain elevation, but less costly than full in-Sea system; performs reasonably well over wide range of inflows	High cost of in-Sea ponds; institutional hurdles and potential economic effects of land use conversion
5	On-land solar evaporation pond systems	Same as Alternative 2	Expand from six solar pond modules to 13 if inflows are reduced to 1 maf/yr	Most cost effective if inflows are similar to historic conditions	Same performance problems as Alternative 2 for reduced inflows, plus land area for ponds and disposal areas increases substantially

Aerial view of east side solar evaporation pond pilot project prior to filling.

shore of the Sea is being used to evaluate various design components of solar evaporation ponds. A second pilot project, at the former Salton Sea Test Base, is being used to design disposal methods and to test ground-based EES units. Other pilot projects are evaluating the other restoration elements, including removing dead fish from the shoreline and the water surface and monitoring and controlling wildlife disease. The shoreline cleanup and wildlife disease monitoring and control pilot projects have been in place and have been operating successfully for over a year, and a fish cleanup project is scheduled to begin in early 2002.

Implementation

Following completion of the environmental process and detailed engineering designs, the project would be implemented. This would involve constructing salt removal and disposal modules and implementing the other restoration elements. Implementation would have a local economic benefit by creating short-term construction jobs and long-term job opportunities for operating and maintaining the facilities.

How to Obtain Information

Information about the Salton Sea Restoration Project can be obtained by contacting one of the agencies or Web sites listed below.

Salton Sea Authority
78-401 Highway 111, Suite T
La Quinta, California 92253-2066

Phone: (760) 564-4888
Fax: (760) 564-5288

Salton Sea Science Office
78-401 Highway 111, Suite R
La Quinta, California 92253-2066

Phone: (760) 777-1564
Fax: (760) 564-5288

US Department of the Interior
Bureau of Reclamation
Lower Colorado Regional Office
Post Office Box 61470
Boulder City, Nevada 89006-1470

Phone: (702) 293-8129
Fax: (702) 293-8023

Internet Web Site Addresses

Salton Sea Restoration Project Web Site. The Salton Sea Authority project Web page can be accessed from http://saltonsea.ca.gov/.

US Bureau of Reclamation Salton Sea Project Web Site. This project Web page can be accessed from the US Bureau of Reclamation Lower Colorado Region Web site at http://www.lc.usbr.gov. Starting from the Lower Colorado Region home page, click on the Salton Sea icon to access the Salton Sea Restoration Project Web page. It contains useful information, plus e-mail links to the project leads.

University of California Redlands Salton Sea Database Program Web Page. This Web page contains useful information on the UC Redlands database program. The Web page can be accessed through Reclamation's Web site, http://www.lc.usbr.gov.

Glossary

California Environmental Quality Act (CEQA)
Establishes California policy to consider the influence of human activities on the natural environment. Requires preparation of an environmental impact report (EIR).

Clean Water Act of 1972, 1987 (CWA)
Federal legislation for improving the nation's water resources. Requirements include identifying waters that do not comply with water quality standards, ranking impaired waterbodies, and establishing total maximum daily loads (TMDLs) for those pollutants causing impairments.

Disposal Facility
Ponds that could be created by constructing either dikes within the Salton Sea or berms on land. Brines from either EES or solar ponds would be pumped to the disposal ponds, and salts would crystallize. The sides of the ponds would be raised over time as salt beds built up in the bottoms of the ponds.

EIS/EIR
Environmental impact statement/environmental impact report; a document prepared in compliance with NEPA and CEQA to assess effects of a project.

Endangered Species Act (ESA)
An act of Congress of 1972 (16 USC 1531-1543). The act requires federal agencies to ensure that their actions do not jeopardize the existence of endangered or threatened plant or animal species.

Enhanced Evaporation System (EES)
Spray technologies that could be used to evaporate Salton Sea water and to create a concentrated salty brine that would be captured in a catchment basin and pumped to a disposal facility.

National Environmental Policy Act (NEPA)
Public Law 91-190, passed by Congress in 1969, established a national policy to consider the influence of human activities on the natural environment. Requires that an EIS be prepared and made available to the public before decisions are made on major federal programs that have significant environmental impacts.

Salinity
The concentration of salts in a liquid commonly measured in milligrams per liter (mg/l) or parts per million (ppm).

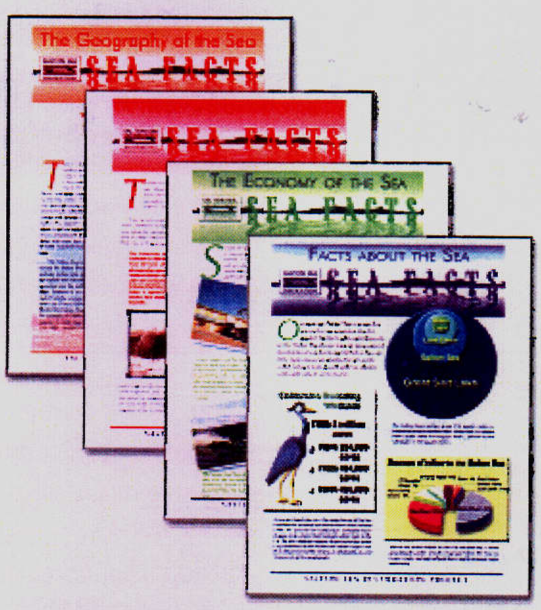
Solar evaporation ponds
A sequence of ponds that could be created by constructing either dikes within the Salton Sea or berms on land. Salton Sea water would be pumped to the first pond where it would flow by gravity to the other ponds. Heat from the sun would evaporate water and concentrate salts, with salinity increasing from pond to pond. Concentrated brine from the final pond would be pumped to a disposal facility.

Special-status species
A plant or animal species recognized by federal or state law as protected because it is endangered or threatened with extinction throughout all or a significant portion of its range.

US Environmental Protection Agency (EPA)
The independent federal agency established in 1970 to regulate federal environmental matters and to oversee the implementation of federal environmental laws.

Salton Sea Authority and Bureau of Reclamation

The Salton Sea Authority and the US Department of the Interior, Bureau of Reclamation participated as equal partners in completing the environmental compliance process and in other activities required for implementing the Salton Sea Restoration Project. The Secretary of the Interior designated the Bureau of Reclamation as the lead agency for all of the federal agencies involved in the Salton Sea Restoration Project because of its mission in water resource protection and development, its responsibilities for managing the Colorado River, its capabilities in the areas of planning, design, and construction, and its ongoing successful relationship with the Salton Sea Authority. The Salton Sea Authority is the local lead agency. Its formal members include Imperial County, Riverside County, the Imperial Irrigation District, and the Coachella Valley Water District. Each has a direct stake in restoring the Sea. The Salton Sea Authority also includes ex-officio representatives from several state and federal agencies and the Torres-Martinez Desert Cahuilla Indians.



Satisfy Your Sea of Curiosity with SEA FACTS

Did you know that the Salton Sea area is home to 40 percent of the entire US population of the threatened Yuma clapper rail; that at one time, more people visited the Salton Sea than Yosemite National Park; that in 1774 there were 6,000 Cahuilla Indians living around the Sea; and that the Salton Basin has been a lake bed many times in the past? These and other interesting bits of information are presented in SEA FACTS. The Salton Sea Authority developed these colorful fact sheets to inform the public about the sometimes complex issues involved in restoring the ecological health of the Sea and the economic viability of the area. SEA FACTS are available from the Salton Sea Authority by calling (760) 564-4888 or by faxing your request to (760) 564-5288.

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