THE SALTON SEA: PAST HISTORY, FUTURE PROSPECTS

John A. Johnson[1]

ACT: The topographic depression cradling the Salton Sea (Sea) has a long history lternating wet and dry conditions. Colorado River (River) delta mechanics ionally directed flows into the basin. This water quickly evaporated once the discharge returned to the Gulf of California. The current body of water was ed as a human accident when the River breached a temporary structure during high in 1905. The Sea would have again evaporated had it not been for agricultural age providing inflows that sustain the Sea to this day. The Sea has provided tunities for water-based recreation, fish and wildlife use, and speculative line development; however, as salinity has increased and nutrients provided by cultural runoff have caused eutrophic conditions, the original attraction faded and sea has become less desirable for both man and animal. Recent water supply demands promulgation of agricultural water quality objectives have created pressure to the amount and quality of water draining into the Sea. Changes made in response his pressure could accelerate the decline of the Sea. The U.S. Bureau of amation (Reclamation), other Federal agencies, and local entities recognize the urce potential provided by the Sea and are working together to address these dicting issues.

TERMS: Salton Sea; Colorado River; salinity

PURPOSE

The biologic, social, and economic environment of the Sea area has been nificantly influenced by human activity. This paper presents some of the issues and blems associated with artificial creation of the Sea by man on the one hand and, on other hand, the current desire to postpone or reverse the natural processes ociated with a terminal body of water that are viewed as detrimental to the values has come to expect as normal. The paper than focuses on methods of addressing se issues through a cooperative effort by local, state, and Federal entities.

THE DISTANT PAST

The Salton Basin (Basin), a below sea level topographic depression extending from Springs, California on the north to the Gulf of California on the south, has ergone historic cycles of filling with water and desiccation as the Colorado River radical course changes (Elders, 1979; Waters, 1981). Lake Cahuilla, the most nt predecessor to the Sea, at one time had a surface elevation slightly above sea (Sharp, 1982). The last filling of Lake Cahuilla has been dated at 300 (Norris ebb, 1979) to 500 years ago (Colorado River Board of California, 1992).

Between the time of the last filling of Lake Cahuilla and the recent formation ne Salton Sea, the area was similar to the searing, bare desert characteristic of basins to the east. Infrequent precipitation may have supported temporary pools standing water with associated ephemeral biota.

Since there is no outlet to the Basin, evaporation has provided the only escape water that enters it. High temperatures and low humidity contributed to rapid oration of the water that occasionally filled Lake Cahuilla, leaving a salty crust

gram Manager, U.S. Bureau of Reclamation, Lower Colorado Region, P.O. Box 61470, der City, NV 89005

on the Basin floor. Enough salt was deposited by 1900 to support a salt processing operation on the Basin floor near where the north end of the Salton Sea now exists (Dowd, 1960).

HUMAN INTRUSION ON NATURAL CONDITIONS

Without the influences of human activities in Imperial Valley (Valley) and along the Colorado River, the Sea would certainly not exist in its current form and probably would not exist at all. Not only did human activity cause the creation of the current Sea, but human activity now sustains it.

What was this human activity that culminated in the largest inland body of water in California? During the early westward population movement, settlers recognized the agricultural potential of the Imperial and Coachella Valleys. Unfortunately, there was no local water source for irrigation in the Imperial Valley, so farmers looked to the next closest water source--the untamed Colorado River 70 miles away. A diversion structure was built across the River and a canal was constructed to bring water to the Valley. Water deliveries began in June 1901.

The Salton Trough. Imperial Irrigation District is at the bottom. Coachella Valley Water District is at the upper left.

Irrigation itself would have altered the natural conditions of the Basin, for instead of creosote bush and cactus application of water allowed the sandy desert floor to sprout vegetables, cotton, and hay. Irrigation runoff and deep percolation began the process that would have eventually resulted in a body of water in the Salton sink. However, a structural failure on the Colorado River accelerated that process considerably.

Siltation problems at the permanent diversion structure on the Colorado River required the construction of a temporary facility. The fall of 1905 saw unusually high flood flows on the Gila River, a tributary just upstream. The combination of flows and a temporary structure was an equation for disaster, and in the fall of failure of the temporary structure caused the entire flow of the Colorado River to down the delivery canal toward the Basin. When the water reached the end of the it overflowed into the lowest part of the Basin, creating the Salton Sea. Attempts the irrigators to repair the breach were both technically unsuccessful and financially catastrophic. Under bankruptcy proceedings, assets of the irrigation facilities were to the Southern Pacific Company who finally closed the breached diversion in February 1907.

By that time the Sea surface had reached an elevation of -197 feet, about 2 higher than the current elevation and 80 feet above the low point in the Basin. the breach closed, the major inflow to the Sea stopped and evaporation caused a decline in surface elevation. By 1920 the elevation was down to -248 feet. At elevation inflow from irrigation activities balanced evaporation and the water elevation stabilized. Since that time Sea levels have steadily increased, respond to expansion in irrigated agriculture acreage and resultant increases in inflow.

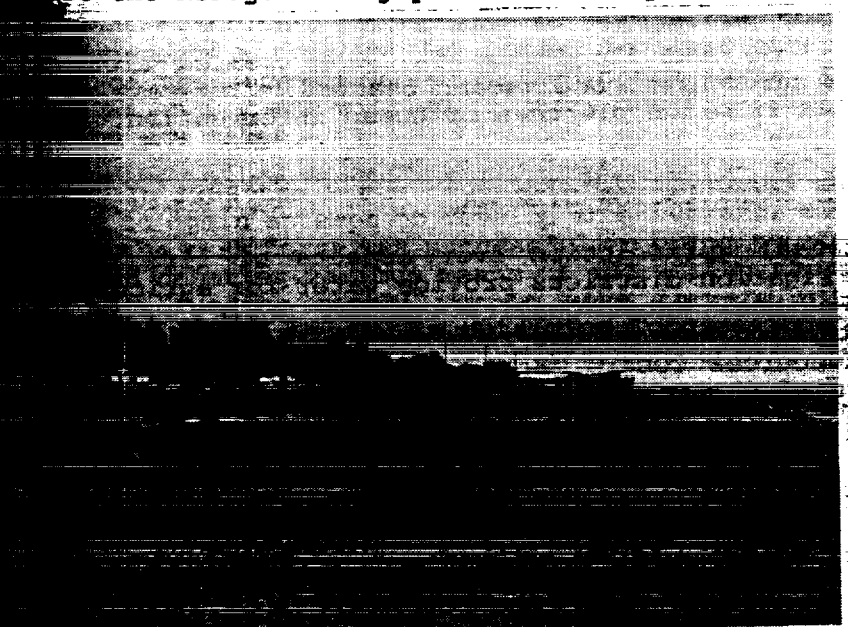
Human-induced changes in the Basin became irreversible in the 1930's. irrigation deliveries to Imperial Valley gained stability by the construction facilities authorized by the Boulder Canyon Project Act and by the establishment institutional provisions for the distribution of Colorado River water. Hoover Dam the All-American Canal system assured a permanent, secure supply of irrigation for agriculture in the Imperial and Coachella valleys. Today, agriculture constitutes a major economic base in Imperial County and provides an important source of vegetables and other produce to the entire nation, particularly in the winter.

ADAPTION TO THE CHANGES

As irrigated agriculture became more established through improved facilities and tutional arrangements, the importance of the Salton Sea as a repository for cultural drainage was recognized. In 1924 and again in 1928, President Coolidge d Executive Orders setting aside federal land under the Sea as a public water ve for irrigation drainage. And in 1968 the State of California declared by nte that the primary use of the Sea is for the collection of agricultural drainage seepage, leaching, and control waters. Agriculture in the Imperial and ella Valleys simply would be possible without the age repository afforded by sea.

Beaches once heavily used...

The existence of the Sea midst of a former desert ly attracted wildlife, ationists, and speculators ng for a fast profit. It take migratory birds to discover the new body ater and large flocks of geese, and shore birds took advantage of the fits it provided by ering there. The open provided by the Sea was the only attraction for ds. Winter crops grown in Valley provided abundant ter fodder and the birds did hesitate to take advantage the fare unintentionally ered up by the farmers. In der to alleviate crop redation and heal the versarial relationship that developed between the birds the farmers, a federal wildlife refuge was established in 1930 at the southern tip the Sea. The Salton Sea National Wildlife Refuge, maintained by the Fish and dlife Service, grows crops for winter feed and is now host to the second most versified population of birds in the country. Bird watchers from all over the world it the Refuge to enjoy the diversity and large numbers of birds.



now often abandoned.

By the mid-1950's the salinity concentration of the Sea has risen to approximately the salinity of the ocean and the California Department of Fish and Game transplanted a number of marine species from the Gulf of California to the Sea. Orangemouth corvina, sargo and gulf croaker have flourished and, until recently, have provided an excellent sport fishery. Tilapia apparently escaped into the Sea from a nearby tropical fish farm in the mid-1960's and have thrived to become a popular gamefish. Proximity to major population centers of southern California and fishing success experienced at the Sea contributed to high fisherman use and associated economic productivity.

Other water based recreation was also popular through the 1970's. Sunbathing, water skiing, boating, swimming, camping, and picnicking were enjoyed by locals and visitors alike. In order to serve recreational visitors, the California Department of Parks and Recreation developed the Salton Sea State Recreation Area along 20 miles of the northeastern shoreline. Primitive and improved campsites, recreation vehicle sites, picnic, and restroom facilities are available.

The emerging local robust economy of the late 1950's and early 1960's, opportunity to market the area as a thriving resort, and availability of cheap land were not lost on real estate speculators. Large parcels of desert land surrounding the Sea were purchased, "streets" were bladed in, and residential lots were marketed to potential buyers in the midwest and east who were ripe for a sales pitch based on images of easy California living, rapid and perpetual property appreciation, and eternal availability of water-based recreation. Nearly 30,000 lots were reported "developed" (USDI and The Resource Agency of California, 1974).

While the area had great promise and expectations were high, the realities of a closed basin and terminal sea eventually conspired to dampen many dreams. As the Sea has aged, its attractiveness has waned. Publicity about the New River, a highly polluted river originating in Mexico and terminating in the Sea; occasional fish kills, repugnant odors, and blighted aesthetics; and increasing salinity concentrations have all contributed to the decline in the popularity of the area.

Natural fish recruitment has apparently been negatively impacted by the increasing salinity, resulting in a declining fishery. This, in turn, has had repercussions on fish-eating bird populations and on visits by fishermen. Visitation by other recreational segments have also declined as the Sea became less attractive. While visitation to the Salton Sea National Wildlife Refuge has remained steady at 40,000 over the last four or five years, visitation to the Salton Sea State Recreation Area and Imperial County Red Hill Marina have declined precipitously. Visitation to the recreation area has gone from 261,889 in 1985 to an estimated 130,000 in 1991; visitors to the Red Hill Marina declined from 40,149 in 1987 to 8,216 in 1991 (unpublished data). In spite of the enthusiasm displayed by housing development salesmen, housing construction did not track projections displayed in the sales brochures. Even today houses occupy only a fraction of the total lots available; most lots simply sit vacant.

Rising water levels since the mid-1980's have encroached upon improvements built at prime shoreline locations. Dikes built to protect these facilities were marginally successful and many structures are now deteriorating from water intrusion. Owners of shoreline property have successfully sued the irrigation districts who serve farmers in the Coachella and Imperial Valleys, claiming that irresponsible irrigation practices caused the flooding. The irrigation districts are still paying damages.

Unfulfilled economic expectations and flood damages have created areas of abandoned businesses, deteriorating structures, and vacant beaches. It seems as if nature is attempting to wrest the Sea from the clutches of human intervention.

THE HUMAN INTERVENTION DILEMMA

Many entities have institutional jurisdiction over aspects of life in the Imperial and Coachella Valleys. Irrigation districts provide water for agriculture and municipal uses. The local Regional Water Quality Control Board, under the oversight of the Environmental Protection Agency, has regulatory responsibility over water quality. The State Water Resources Control Board has the responsibility to assure the beneficial use of waters of the State. The counties have certain zoning authority. Often the interests conflict.

Salinity concentration in the Sea is inversely related to surface elevation and Sea volume. Rising elevations are associated with stable or declining salinity concentration; lower elevations are associated with increasing salinity concentrations. This happens because the salt quantity remains relatively constant while the water volume changes.

As the availability of water supplies in California has become more critical in recent years, attention was directed toward more efficient use of existing supplies. The irrigation districts have participated in this effort. Canal lining to reduce

epage, automated controls to limit spills, pumpback systems to eliminate field ilwater runoff, pricing structure and other measures have been implemented. While ch had been done, the State Water Resources Control Board in 1988 directed the perial Irrigation District to initiate measures that will conserve at least an ditional 100,000 acre-feet of water a year. Pressure for further conservation ntinues. Unfortunately, implementation of conservation measures has the indirect fect of increasing the salinity of the Sea. Lower inflow translates to lower Sea lume and higher salt concentration.

Conservation measures also tend to create conflicts with numeric objectives for ter quality parameters in surface waters of the Valley. Such water quality jectives are being established under The California Inland Surface Waters Plan as quired by the federal Clean Water Act. The Environmental Protection Agency is shing to upgrade the numeric objectives to standards. Canal spills and tailwater noff dilute subsurface drain discharges, currently keeping many of the surface waters thin the objectives. Removal of canal spills or tailwater runoff through nservation measures will remove the dilution effect and result in exceeding the jectives. Direct methods of treating surface waters may improve the quality of those ters, but will exacerbate the salinity problem in the Sea.

By irrigating lands in the Valley a body of water with important values was eated and sustained. Those values were not viewed as temporary and natural processes e now diminishing them. Improving irrigation efficiency and water quality in surface ters that support the Sea will accelerate that degradation. Ceasing irrigation together will quicken the degradation process even more. Even ending irrigation and ing Colorado River water to maintain the Sea will not stop the natural process, but ll only prolong it. However, the quest to overcome this cycle and defeat the gradation process is not to be denied by the complexity or expense of the job.

HUMAN EFFORTS TO SUPPRESS NATURAL "DEGRADATION"

Many local people are now looking back at the bustling economy and recreational tivities of the 1950's and 1960's with fond memories and yearn to return to those good old days". Fish and wildlife interests want to assure the continuation of ecies that were introduced into the Sea. There is an unwillingness to sit back and atch the Sea succumb to natural processes without putting up a good fight. "Save the ea" has become the rallying cry of those who want to maintain the benefits they have me to value.

Beginning in the mid-1960's, federal and state governments joined forces to rmulate and evaluate methods of controlling the Sea's salinity. That early effort ielded a lot of ideas, but did not culminate in implementation of a project. roposals included variations of a pipeline to the Gulf of California, evaporation mpoundments within the Sea, desalting, and other expensive and complex schemes. The ost of the recommended project did not exceed the perceived benefits to the extent hat an entity was willing to carry the financial burden, thus no further development ction was taken.

In 1988 the State of California promoted the formation of a state-federal task rce to again attempt to develop an acceptable way of controlling Salton Sea salinity. ile the task force was successful in bringing attention to the issues surrounding the and debating various means of addressing those issues, it had neither the charter the funding capability to move forward with a project. The task force was strumental, however, in obtaining Congressional authorization (Public Law 102-575) a $10 million planning and research effort by the Bureau of Reclamation.

In June 1993 the Imperial Irrigation District, Coachella Valley Water District, perial County, and Riverside County formed the Salton Sea Authority, a state-rtered joint powers authority. Its purpose is to direct and coordinate "actions lating to improvement of water quality and stabilization of water elevation and to hance recreational and economic development potential of the Salton Sea and other neficial uses, recognizing the importance of the Salton Sea for the continuation of dynamic agricultural economy in Imperial and Riverside Counties." Funding for thority activities has so far been through services of staff from Authority members other interested agencies. Application has been made for a water quality grant m the State Water Resources Control Board to fund environmental scoping activities d update economic assessments. Indications for receiving the grant are favorable.

The Water and Science appropriation act for fiscal year 1994 included $100,000 for use by the Bureau of Reclamation to initiate Salton Sea planning and research under authority of Public Law 102-575. Fifty percent local cost sharing is required and efforts are underway to identify cost sharing participants. Reclamation and Salton Sea Authority members are formulating a program for the expenditure of the combined $200,000. It is anticipated that the program will include data collection that is basic to any salinity control project that may be pursued in the future--verifying Sea bottom topography, measuring Sea currents and water quality variation, and evaluating new twists to old proposals.

After selenium was implicated in reproductive failures, deformities, and mortalities of waterfowl at Kesterson Reservoir in California the Department of the Interior initiated an effort to determine the possibility of similar contamination in other areas receiving irrigation water from federal projects. During that effort the Sea was identified as an area of potential contamination. Detailed studies by the U.S. Geological Survey and the Fish and Wildlife Service were inconclusive with regard to impacts of elevated levels of selenium and boron on wildlife. While elevated levels of some contaminants were found, no direct impacts to wildlife were documented. Consequently, Reclamation is funding additional studies by the Fish and Wildlife Service to collect more specific data on any wildlife impacts. Results from this effort are expected by the end of 1994.

While many massive projects for managing the salinity and elevation of the Sea have been proposed, little attention has been directed toward more modest endeavors that could extend the enjoyment of many values the Sea offers without trying to reverse the "degrading" progress of nature. Reclamation has proposed a new General Investigations planning study starting in October 1994 that would address these more modest possibilities in the context of the interrelationships between water quality, water conservation, Sea salinity, endangered species, and enhancement of the Salton Sea National Wildlife Refuge. Local cost sharing of at least 50 percent of the estimated $1,000,000 will be required. The fate of this proposal will not be known until after the Congress passes an appropriations bill for fiscal year 1995.

Consideration is being made within Reclamation and the Department of the Interior to unilaterally fund an effort separate from the General Investigations study, but necessary for its successful accomplishment. This effort would involve attempting to identify surface drains in the Valley that have the potential for impacting wildlife. If that effort is successful, then one of the General Investigation study tasks will focus on possibilities for mitigating those impacts.

In addition to the activities presented above, the Imperial Irrigation District, the Coachella Valley Water District, and others are actively engaged in studies and research of issues that affect the Sea.

CONCLUSION

The existence of the Salton Sea is an artifact of human-induced changes in natural processes that produced values humans are now finding hard to relinquish. Additional human intervention is now required to maintain those values against the unrelenting progress of those same natural processes. Successful intervention may become cheaply in financial, social, institutional, or environmental terms. But many are determined to explore the limits of that intervention.

REFERENCES

Colorado River Board of California, Report to the California Legislature on the Current Condition of the Salton Sea and the Potential Effects of Water Conservation, April 1992.

Dowd, Munson J., Historic Salton Sea, 1960.

Elders, W.A., "The Geological Background of the Geothermal Fields of the Salton Trough", published in Guidebook: Field Trip No. 7--Geology and Geothermics of the Salton Trough, prepared for the Geologic Society of America, 92nd Annual Meeting, San Diego, November 1979.

rris, Robert M. and Robert W. Webb, Geology of California, University of alifornia, Santa Barbara, John Wiley & Sons, 1979.

rp, Robert V., "Tectonic Setting of the Imperial Valley Region", published in The mperial Valley, California, Earthquake of October 15, 1979, Geological Survey rofessional Paper 1254, 1982.

ted States Department of the Interior and The Resources Agency of California, alton Sea Project, California, Federal-State Feasibility Report, April 1974.

ublished data provided informally by Mr. William R. Radke, Salton Sea National ildlife Refuge; Mr. Steve Horvitz, Salton Sea State Recreation Area; and f. Randy Rister, Imperial County Fish and Game Commission.

rs, Michael R., "Late Holocene Lacustrine Chronology and Archaeology of Ancient ke Cahuilla, California", Quaternary Research 19, 373-387, 1983.