SALTON SEA WATER IMPORTATION
SUBMITTAL REVIEW

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Technical Memorandum (TM) #3.2

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Subject Area: Salton Sea Models

Topic: Salton Sea Accounting Model (SSAM)

This Technical Memorandum (TM) was prepared as part of the Salton Sea Water Importation Proposal Review to provide information to support and reflect the Independent Review Panel's evaluation of submitted ideas to restore the Salton Sea by water importation and provide the Salton Sea Management Program (SSMP) with approaches that are feasible. Parts of this TM may be used in the Panel's Screening Report, Fatal Flaw Report, Feasibility Report, and/or Summary Report (Reports). In the event that any discrepancies are found between the Reports and this TM, the Reports shall take precedence.

The purpose of this TM is to provide preliminary information on Salton Sea salinity, elevation, and surface area under various no action and water import scenarios. This information is provided to the Panel to assist in the feasibility evaluation and to demonstrate the capabilities of the SSAM for future modeling efforts.

1.0 Background

The Salton Sea Accounting Model (SSAM) is a spreadsheet model originally developed within the USBR in the 1990s. Starting in the mid-2010s, Tetra Tech updated this model with the latest available data for Sea inflows, elevations, and bathymetry data, added functionality for modeling various previously-identified mitigation measures, and used the model to assist various Salton Sea conservation studies. SSAM is a conceptual "bucket"-type model guided by water and salt mass balance on an annual timestep.

Model inputs include:

- Water flows through existing inflows

- Evaporation rates
- Precipitation rates
- Water import flows and salinity
- Water export flows and salinity

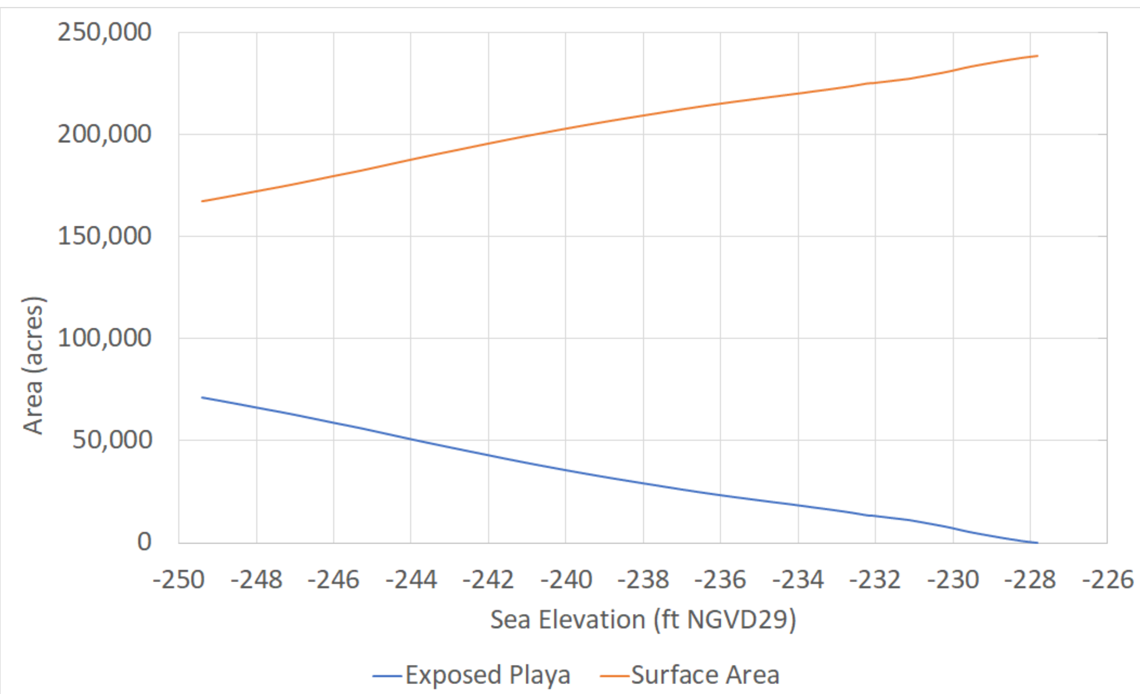
These parameters can be modified to model changes in conditions such as surface water elevation, salinity and lake surface area under different scenarios.

2.0 Model Outputs

2.1 Salton Sea Elevation and Surface Area

The SSAM model utilizes bathymetry data to calculate the impacts of changing water volume on the elevation of the lake surface and total surface area. Surface area data can then be utilized to calculate the area of exposed playa at various surface water elevations. Figure 1 shows the relationship between elevation and surface area.

Figure 1: Salton Sea Elevation and Surface Area



2.2 No Action Scenario

The no action scenario models no importation for the Salton Sea. The only water source to the sea is the local sources adding to 717,000 AFY based on the Quantification Settlement Agreement (QSA). The results of the no action scenario are an increase in salinity, a decrease in water surface elevation, and an increase in exposed playa. Figure 2 shows the increasing salinity, which is a result of continued salt inputs via the existing inflows and the concentrating of salts due to water loss through evaporation. Figure 3 shows how the declining sea elevation relates to an increase in exposed playa over time.

Figure 2: Sea Salinity in a No Action Scenario

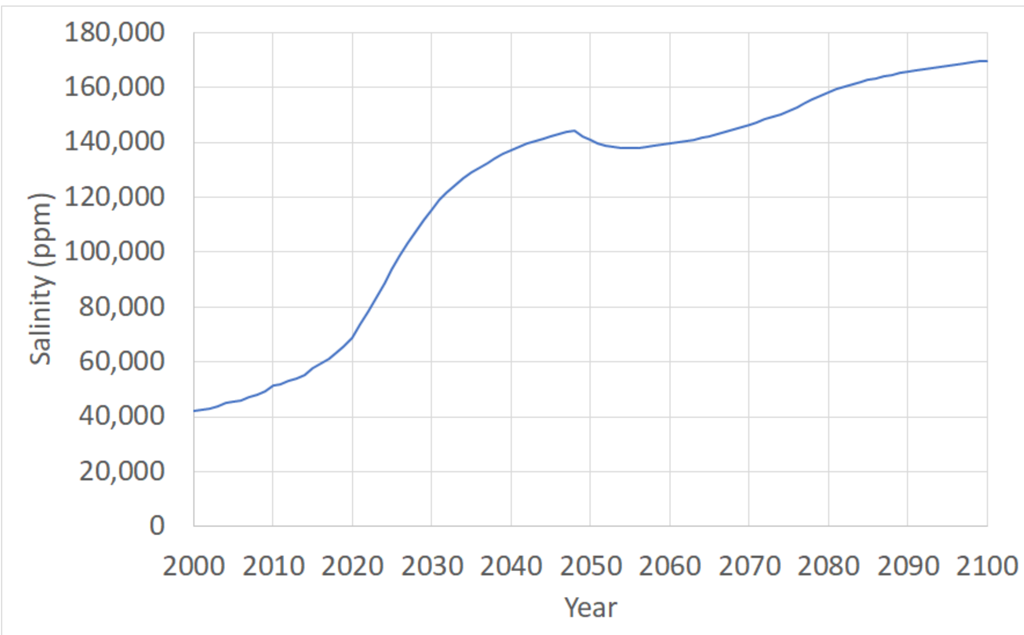
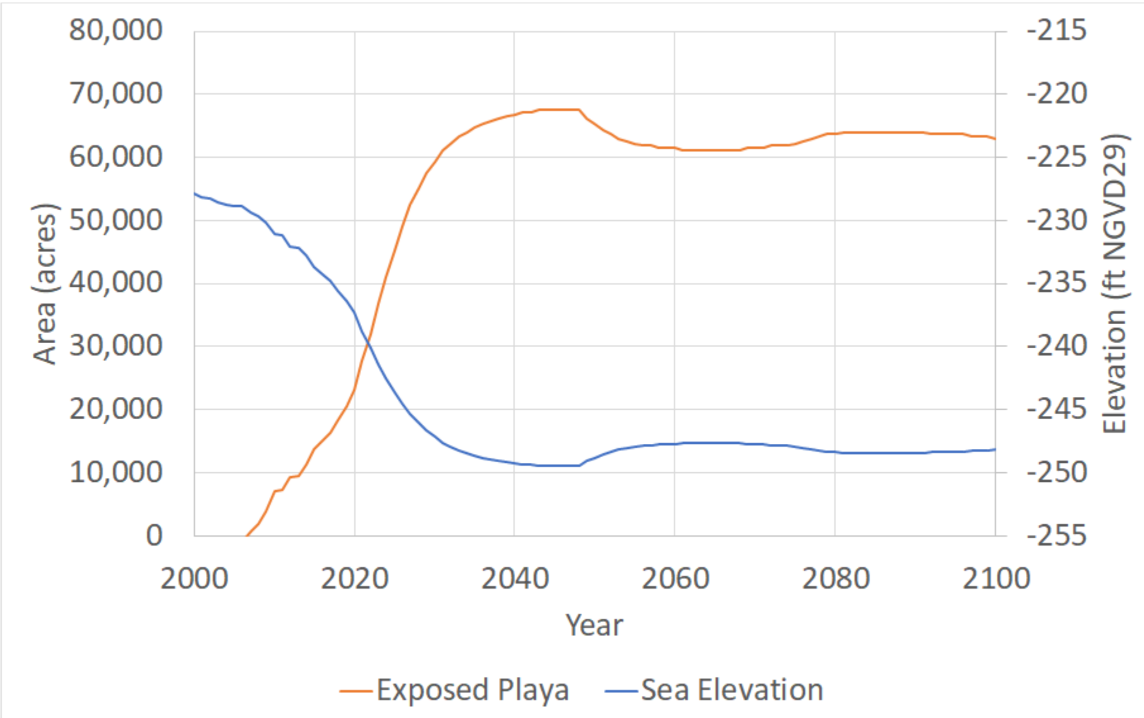


Figure 3: Sea Elevation and Exposed Playa in a No Action Scenario



2.3 WATER IMPORT

A water importation scenario was also modeled using SSAM, shown in Figures 4 and 5. In this scenario, the existing inflow is the QSA-defined 717,000 AFY and an additional 1,000,000 AFY of water imported into the Salton Sea beginning in the year 2030 to “fill” the lake. After achieving the target surface water elevation (-229 ft in this scenario), the additional import is reduced (to an average of 433,000 AFY) to match the net evaporative loss and maintain a constant lake level (Figure 4). The results of the water importation are an increase in elevation, a decrease in exposed playa, and an increase in salinity. While there is an initial drop in salinity as the Sea water mixes with the ocean water, salinity continues to increase without a mechanism to remove salt from the basin (Figure 5).

Figure 4: Sea Elevation with 1 MAFY Water Import to fill, then 0.43 MAFY to maintain

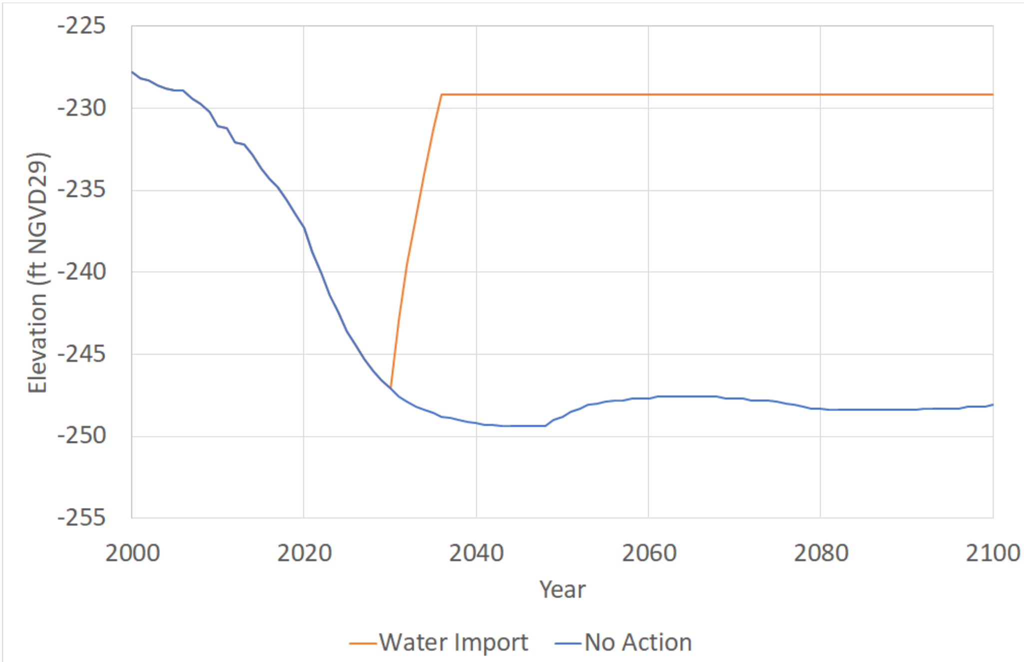
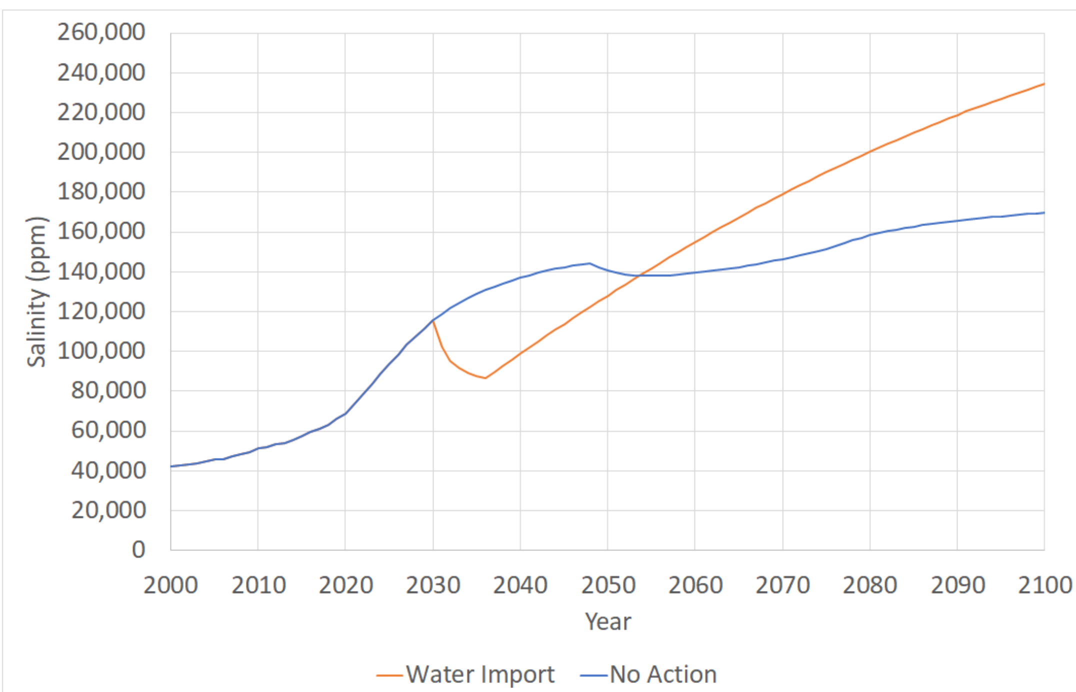


Figure 5: Sea Salinity with Water Import (1 MAFY to fill, 0.43 MAFY to maintain) vs No Action



2.4 WATER IMPORT WITH DESALINATION

To model desalination of imported ocean water, the salinity of the imported water was reduced based on the size of the theoretical desalination facility. The same inflow and imported water flows were used as the previous scenario. Desalination facilities were sized at 50 and 370 MGD, representative of the Carlsbad Desalination Facility, the largest in the US, and the Ras Al Khair facility in Saudia Arabia, the largest desalination plant in the world, respectively. Similar to the no desalination scenario, an initial decrease in salinity is achieved due to mixing, followed by an increase in salinity over time. The size of the desalination plant dictates the initial decrease in salinity and slope of the long-term salinity increase. The results of these scenarios are shown in Figure 6 below.

Figure 6: Impacts of desalinating imported water on Sea salinity

To achieve a long-term reduction in salinity in the Salton Sea, desalination of the Sea water would be required in addition to any desalination performed on imported water.

2.5 SALT MANAGEMENT

Inflow to the Salton Sea is primarily through agricultural runoff. Water that is applied to agricultural land dissolves salts that are present in the soil, and transport these salts into the Sea. The SSAM estimates the salinity of the inflow water based on the total flow, with the assumption that the salt export from the soils is constant. Therefore, as flows decrease, the salinity of the inflow increases. At the modeled

QSA inflow of 717,000 AFY, the salinity is estimated at 3,550 mg/L, corresponding to an input of 3.46 million tons of salt per year. Even if imported water was desalinated prior to discharge into the Sea, salinity would continue to increase without removal of this salt.

A high-level evaluation was conducted to estimate the size of a reverse osmosis (RO) desalination facility required to remove the salt added via the existing inflows. The following assumptions were made:

- Sea salinity of 50,000 mg/L
- 50% recovery (standard for seawater desalination via RO)
- 99.2% salt rejection (standard for RO)

Under these conditions, a 45.5 MGD RO plant would be required to remove the salt carried into the sea from the QSA inflow.

3.0 Water Import Flow Requirements

This section evaluates the amount of water required to restore the Sea to various elevations as well as to maintain those elevations after the desired surface water level has been reached.

3.1 Restoring Lake Levels

The following exercise evaluates the import flow that would be necessary to restore the Salton Sea to various surface water levels. This theoretical scenario involves short-term purchase of Colorado River water to fill the Sea while infrastructure for a long-term import solution is being constructed. Here, a 5-year fill period was assumed. The evaluation begins with the 2024 elevation and salinity and assumes imported water from the Colorado River containing 700 mg/L TDS. The final lake levels are presented at 2-foot intervals between –240 and –230 feet. The importation flows needed to fill the lake within 5 years are shown in Table 1.

Table 1: Flows required to restore Salton Sea water levels

Final Sea Elevation	Flow of Import Water Needed (AFY)	Final Salinity (mg/L)
-230	825,000	57,000
-232	740,000	60,000
-234	635,000	64,000
-236	530,000	69,000
-238	425,000	75,000
-240	325,000	82,000

3.2 Maintaining Lake Levels

This exercise evaluates the import flow that would be necessary to maintain the Salton Sea levels at the 2-foot increments utilized above. Inflows were adjusted beginning in 2030. As evaporative loss is dependent on salinity, the flow required to maintain surface levels changes over time. The average annual flows beyond QSA flows required from 2030 through the project duration (2078) for each sea elevation are shown in Table 2 below.

Table 2: Flow requirements to maintain Salton Sea water levels

Final Sea Elevation	Average Flow of Import Water Needed (AFY)
-230	528,000
-232	487,000
-234	447,000
-236	408,000
-238	364,000
-240	319,000

4.0 Summary and Next Steps

Using the Salton Sea Accounting Model, the impacts on sea salinity, elevation, and inflow can be evaluated and visualized under different scenarios. The Support Team can utilize the SSAM to evaluate the feasibility of components of RFI responses as needed. The Panel can also request model runs for additional scenarios to assist in the feasibility evaluation.

5.0 References

United States Bureau of Reclamation (USBR). (2000). *Salton Sea Accounting Model (Draft).* https://www.usbr.gov/lc/region/saltnsea/pdf_files/daar/daar_att-b.pdf

Colorado River Basin Salinity Control Forum. (2020). *Water Quality Standards for Salinity Colorado Rivery System (Draft)*. https://coloradoriversalinity.org/docs/2020%20REVIEW%20-%20June%20Draft%20Complete.pdf