EVALUATION OF OPTIONS FOR RECLAMATION OF THE SALTON SEA

Testimony before the
Subcommittee on Water and Power
U.S. House of Representatives Committee on Resources

March 12, 1998

SUPPLEMENTAL SHEET

SUMMARY AND CONCLUSIONS

Los Alamos National Laboratory has been providing technical support for the remediation of the ecological problems in the Salton Sea. This testimony will report on how the results of our work in evaluating various concepts for addressing high salinity and variable water levels of the Sea relate to H.R. 3267.

Based on our analysis, we conclude that:

- Desalination is not a viable concept for salinity and elevation control of the Salton Sea.
- "Pump-out" is a feasible method for salinity control, but the size of the Salton Sea could decrease by approximately 35%. Furthermore, the Sea would continue to increase in salinity for about 25 years.
- "Diked impoundment" could control salinity and elevation if the dike is reinforced to serve as a dam. If the dike is earthen, the size of the Sea could decrease by about 20%. In either case, the impoundment area would have high salinity water.

The ecological and institutional consequences of the various concepts need to be better analyzed before a final selection is made. Furthermore, the impact of anticipated water diversion from the Salton Sea and the possible use of excess Colorado River water need to be factored into the decision.

In summary, the options identified for consideration in H.R. 3267 appear to be the most feasible for reclaiming the Salton Sea. However, the elevation requirements in the proposed legislation could restrict the options. This is because the existing shoreline is the result of an equilibrium condition between historical inflows of about 1.3 MAF/year and evaporation, and meeting the elevation requirements with a substantially reduced inflow could be a considerable challenge.

Finally, while Los Alamos appreciates the proposal to jointly appoint a member of the Research Management Committee, a better role for the Laboratory might be to assist in the feasibility study.

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INTRODUCTION

Los Alamos National Laboratory, which is operated by the University of California for the Department of Energy, was asked last May by the Congressional Salton Sea Task Force to provide technical support for the remediation of the ecological problems in the Salton Sea. Today I am going to report on how the results of our work in evaluating various concepts for addressing high salinity and variable water levels of the Sea relate to H.R. 3267. Our results are preliminary and in some cases qualitative, but they can be used to help guide decision-makers in their deliberations. Ultimately, selecting the "best" solution for reclaiming the Salton Sea will have to integrate performance, economic, ecological, and institutional factors into the decision.

SALINITY AND WATER LEVEL CONTROL

Los Alamos has examined the cost, salinity, and Sea level changes resulting from three remediation concepts:

- desalination;
- pump-in; pump-out; and
- diked impoundment

and compared these results with "no action." We have concentrated on performance and economic issues and have not evaluated ecological or institutional factors in this analysis.

The purpose of this work is to determine the primary advantages and disadvantages of each concept. For each concept, there are numerous variations, so detailed engineering designs must be completed once a concept is selected.

Due to anticipated water conservation, for our analysis we assumed the inflow into the Salton Sea will linearly decrease from the present flow of 1.3 million acre-feet per year (MAF/year) to 1.0 MAF/year over a twenty year period. It is important to note that the results are strongly influenced by this assumed inflow reduction. Similarly, using excess Colorado River water could also have a major impact on the results.

The "water and salt balance" model that we used is a fairly simple computer simulation that calculates elevation, surface area, volume, and salinity. The model also takes into account changes in evaporation rate due to changes in salinity and surface area.

No Action

If no action is taken the Salton Sea will, of course, continue to increase in salinity from today's level of 44 ppt. Figure 1. The Sea would reach a salinity level of about 60 ppt in about 15 years. This is important because some believe that most fish can no longer live in water at this salinity level. The salinity level would reach almost 100 ppt in 30 years, and after 50 years would approach 120 ppt.

Regarding water level, the elevation of the Sea would be lowered from today's -227 feet to -242 feet after 30 years. This 15 foot drop in elevation would result in a reduction in the Sea's surface area by approximately 20%--from about 380 sq. miles to 304 sq. miles.

Desalination
If there were an inexpensive filtering or distillation method to remove salt from high-salinity water, desalination would be an obvious solution to the problems of the Salton Sea. The process could be used to reduce the salinity of the water already in the Salton Sea, or to desalinate ocean water being pumped from the Gulf of California as part of a "pump-in, pump-out" scheme.

If desalination is used to freshen the water in the New, Alamo, and Whitewater Rivers and the water allowed to flow into the Salton Sea, this reduces the quantity of salt going into the Sea but does not solve the problem because salt is not being removed from the Sea. Furthermore, if the desalinated water is diverted instead of flowing into the Salton Sea, this will lower the Sea's elevation and increase its salinity thereby making the problem worse.

One desalination proposal was developed last year by U.S. Filter. They proposed treating New and Alamo River water prior to entering the Salton Sea and diverting about 160 TAF/year for recycle. The saline water, 45 TAF/year, would be disposed of, in addition to 22 TAF/year of water which would be pumped out of the Salton Sea for a total water loss to the Sea of 227 TAF/year (160 + 45 + 22). U.S. Filter estimates that the total project capital cost would be between $750 million and $1.0 billion.

The impact of the above proposal on the salinity of the Salton Sea is an increase to about 120 ppt at 30 years, which is 20 ppt higher than doing nothing. Furthermore, the elevation of the Sea under this scenario would decrease to -250 feet with a corresponding reduction in surface area of over 30%, to about 260 square miles.

Another proposal, by the Metropolitan Water District (MWD), would divert approximately 450 TAF/year of Alamo (390) and Whitewater (60) River water. After desalination, the water would be delivered to the Colorado River Aqueduct. MWD estimates the capital cost would be $1.1 billion with operation costs of $58 million/year. Once again, from the point of view of remediating the Salton Sea, this makes the Sea smaller and saltier.

In summary, while desalination can be used to produce fresh water for urban household use, in our opinion desalination approaches to reduce the salinity of the Salton Sea would be prohibitively expensive.

Pump-In, Pump-Out
Another concept that has received attention consists of pumping water from an external source to the Salton Sea and pumping water from the Sea to an external location. The advantage of such a concept is that it has the potential to allow simultaneous control of salinity, elevation, and surface area.

The obvious source for pump-in water is the Gulf of California which, of course, is at ocean water salinity. However, for this concept to be practical for salinity control without a reduction in the level of the sea, the salinity of the pump-in water needs to be considerably less than that of ocean water. If the pump-in water is at ocean water salinity, very large quantities of water must be pumped, both in and out. For example, pumping in 400 TAF/year of ocean water and pumping out 500 TAF/year of Salton Sea water is required for the Salton Sea to approach ocean water salinity. Figure 2. Even with this large amount of water exchange, the elevation would decrease by about 23 feet. Figure 3. Our estimate is that the capital cost for such a system would be about $1.7 billion, with another $30 million per year in operating costs (assuming electricity costs of 3.5 ¢/kWh).

Since it is unlikely there will be a source of low-salinity pump-in water, a variation of this concept is "pump-out" only. Pumping out a relatively small 150 TAF/year of Salton Sea water will allow the Salton Sea to reach ocean salinity. Figure 4. This would create a smaller Salton Sea by about 35% (to 245 square miles) with an elevation only about 3 feet lower than pumping in 400 TAF/year and pumping out 500 TAF/year. Our estimate of the capital cost for this system is about $300 million, with operating costs being approximately $5 million per year.

Therefore, "pump-out" achieves nearly the same result as "pump-in, pump-out," and at a much lower cost. Providing that a smaller Salton Sea by approximately 35% is acceptable, "pump-out" should be considered as a viable option for the Salton Sea.

One important issue that needs to be resolved with this concept is the destination of the pumped water. One frequently mentioned area is the Laguna Salada in Mexico. Technically this is feasible, but would entail reaching an agreement with Mexico. Another important issue with "pump-out" is that the salinity level would increase for about 25 years, hitting a peak of about 65 ppt before decreasing. Figure 5.

Diked Impoundment

Another concept that has the potential for controlling salinity and elevation is the creation of in-Sea impoundment areas by diking. This could result in a Salton Sea with the same elevation as now and a salinity level comparable to that in the ocean. The primary disadvantage of "diked impoundment" is that part of the surface area in the Sea would be in an impoundment area which would contain very saline water. Fish would not be able to survive in the impoundment, and in time this brine would precipitate salt.

Eventually, this salt would have to be removed from the impoundment area--the cheapest way probably being to pump out the brine. When this has to be done is uncertain and will depend on the criteria for pumping out the brine. A lower bound would be when the brine first reaches saturation while the upper bound would be when the impoundment area fills up with salt.

Using our assumptions on inflow volumes, an impoundment area of about 10% of the area of the Salton Sea (approximately 35 square miles) would allow the Salton Sea to reach ocean salinity. Figure 6. An estimate of the cost of an earthen dike is about $300 million--however, such a dike would only provide salinity control and the Sea could ultimately be reduced in area by about 20%. A larger, reinforced dike with an impoundment area of almost 30% of the present Sea would be required to maintain the existing shoreline. Figure 7. A reinforced dike providing both salinity and elevation control would probably raise the capital cost by more than a factor of two. Operation costs would be approximately $2 million/year.

If having part of the Salton Sea at a high salinity level is acceptable, we feel that "diked impoundment" is also a viable option for the Salton Sea.

CONCLUSIONS

Based on our analysis, we conclude that:

- Desalination is not a viable concept for salinity and elevation control of the Salton Sea.
- "Pump-out" is a feasible method for salinity control, but the size of the Salton Sea could decrease by approximately 35%. Furthermore, the Sea would continue to increase in salinity for about 25 years.
- "Diked impoundment" could control salinity and elevation if the dike is reinforced to serve as a dam. If the dike is earthen, the size of the Sea could decrease by about 20%. In either case, the impoundment area would have high salinity water.

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Finally, while Los Alamos appreciates the proposal to jointly appoint a member of the Research Management Committee, a better role for the Laboratory might be to assist in the feasibility study.

Thank you.

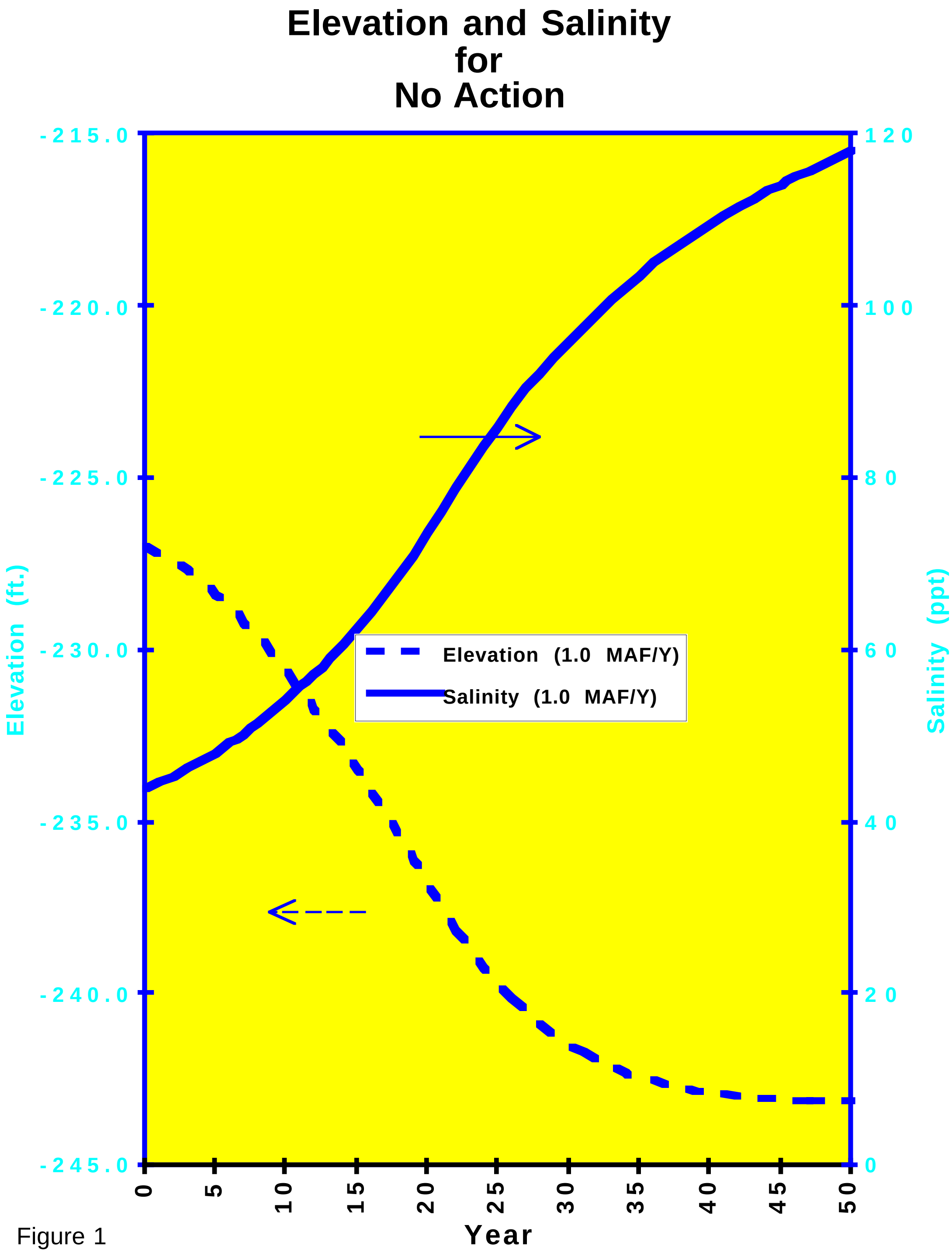
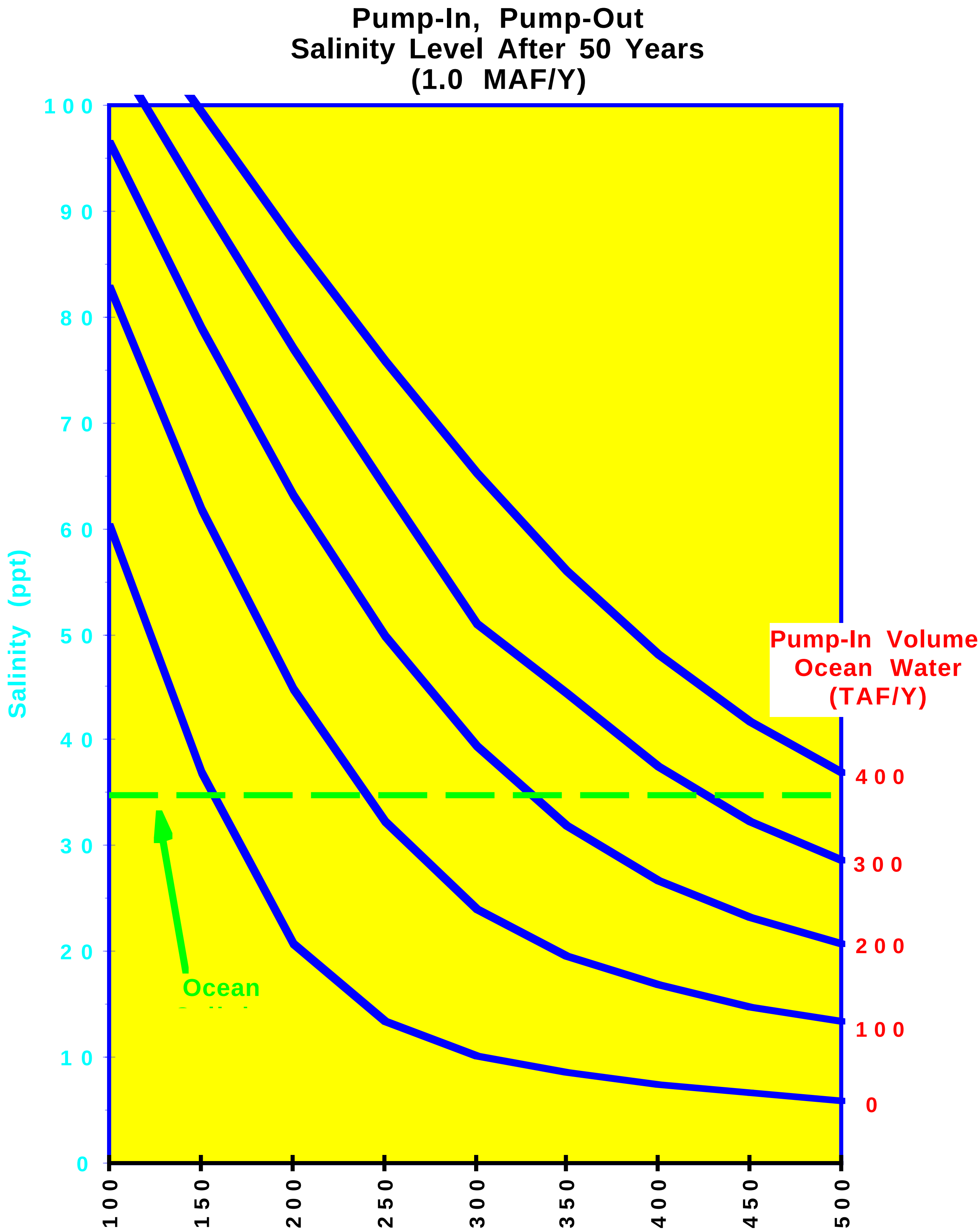

Elevation and Salinity
for
No Action
-215.0
-220.0
-225.0
-230.0
-235.0
-240.0
-245.0
120
100
80
60
40
20
0
Elevation (ft.)
Salinity (ppt)
Elevation (1.0 MAF/Y)
Salinity (1.0 MAF/Y)
0
5
10
15
20
25
30
35
40
45
50
Year

Figure 1



Pump-In, Pump-Out
Salinity Level After 50 Years
(1.0 MAF/Y)
Salinity (ppt)
100
90
80
70
60
50
40
30
20
10
0
Ocean
Pump-In Volume
Ocean Water
(TAF/Y)
400
300
200
100
0
100
150
200
250
300
350
400
450
500
Pump-Out Volume (TAF/Y)

Figure 2

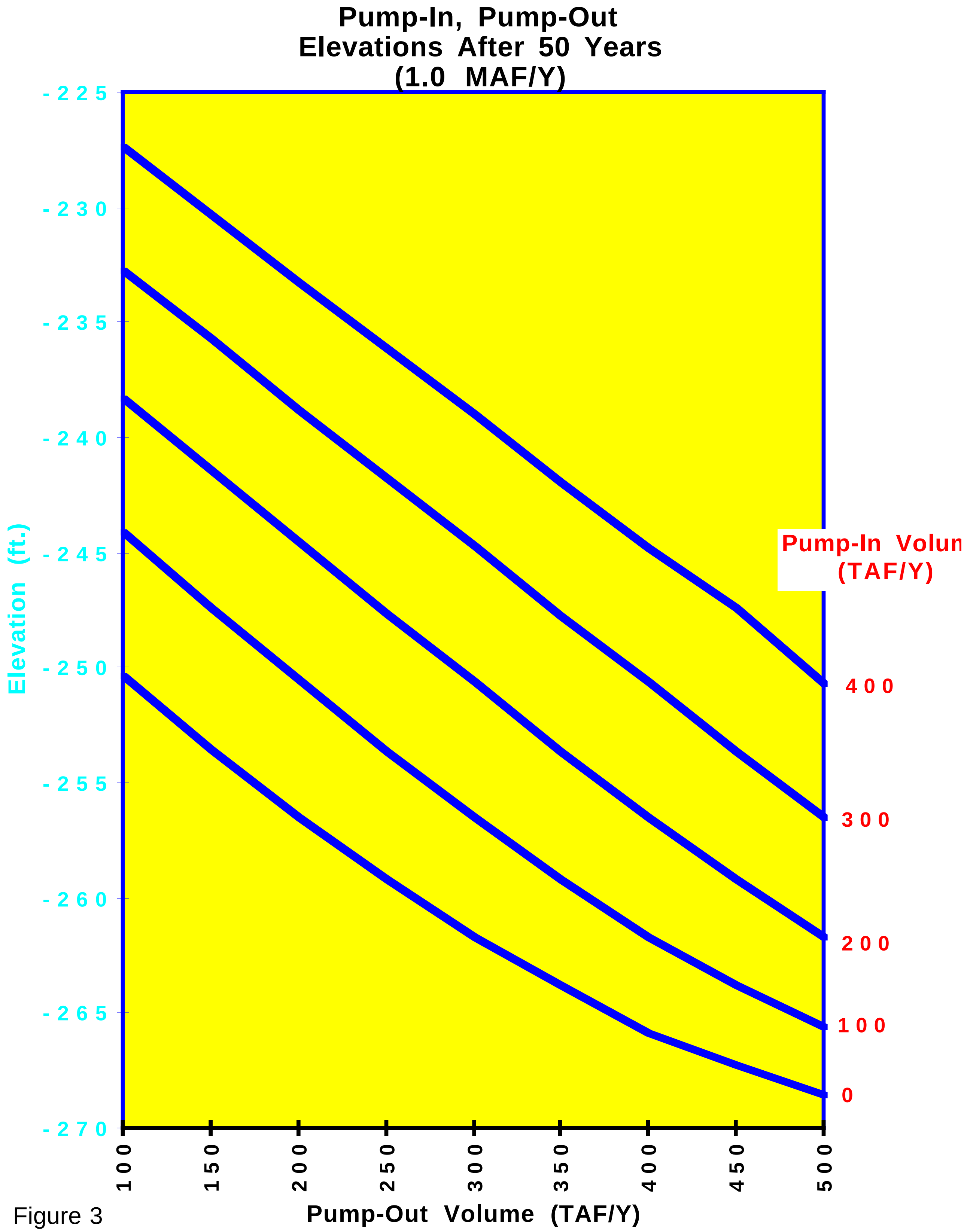
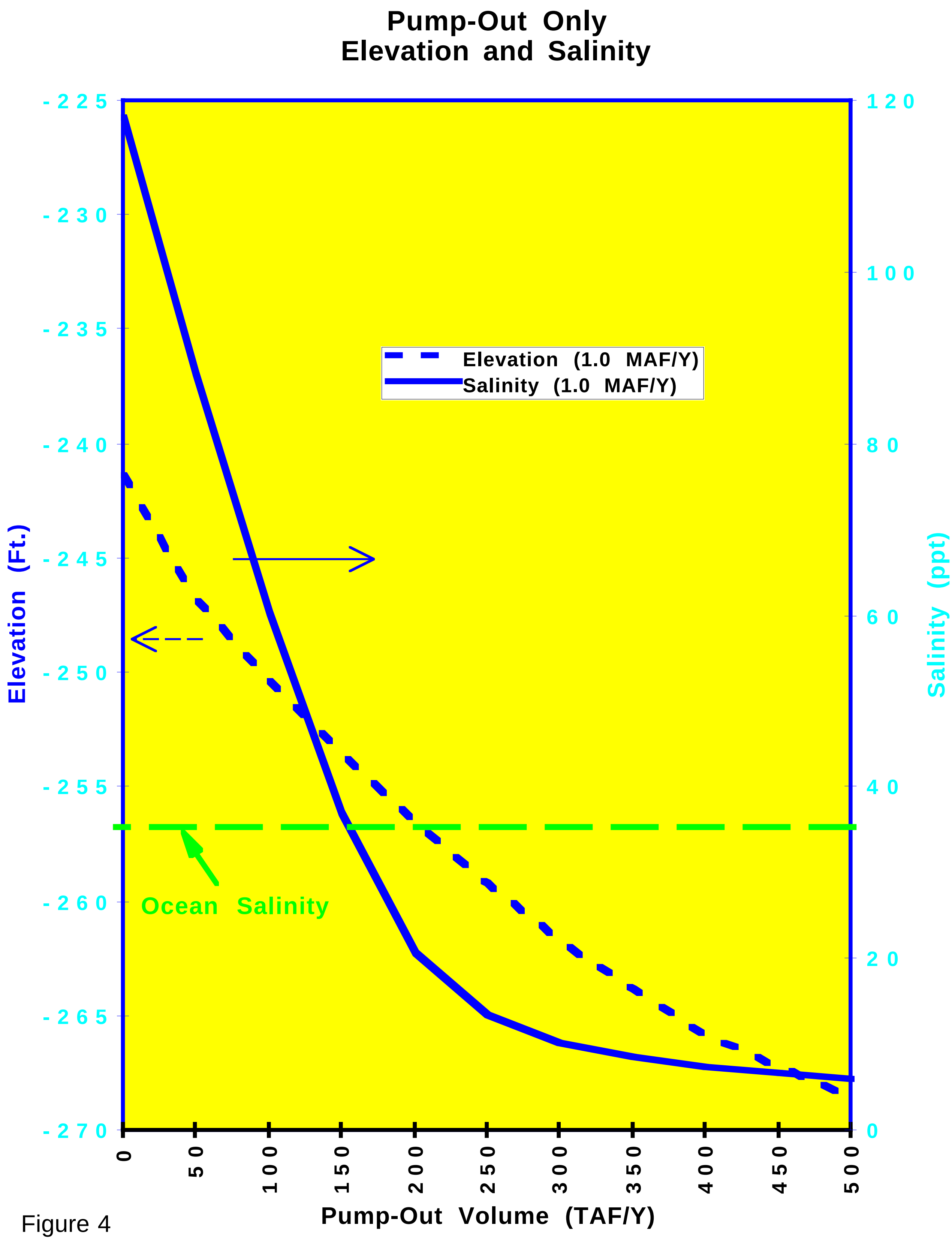

Pump-In, Pump-Out
Elevations After 50 Years
(1.0 MAF/Y)
Elevation (ft.)
-225
-230
-235
-240
-245
-250
-255
-260
-265
-270
Pump-In Volum
(TAF/Y)
400
300
200
100
0
100
150
200
250
300
350
400
450
500
Pump-Out Volume (TAF/Y)

Figure 3



Pump-Out Only
Elevation and Salinity
Elevation (1.0 MAF/Y)
Salinity (1.0 MAF/Y)
Ocean Salinity
Elevation (Ft.)
Salinity (ppt)
Pump-Out Volume (TAF/Y)
-225
-230
-235
-240
-245
-250
-255
-260
-265
-270
120
100
80
60
40
20
0
0
50
100
150
200
250
300
350
400
450
500

Figure 4

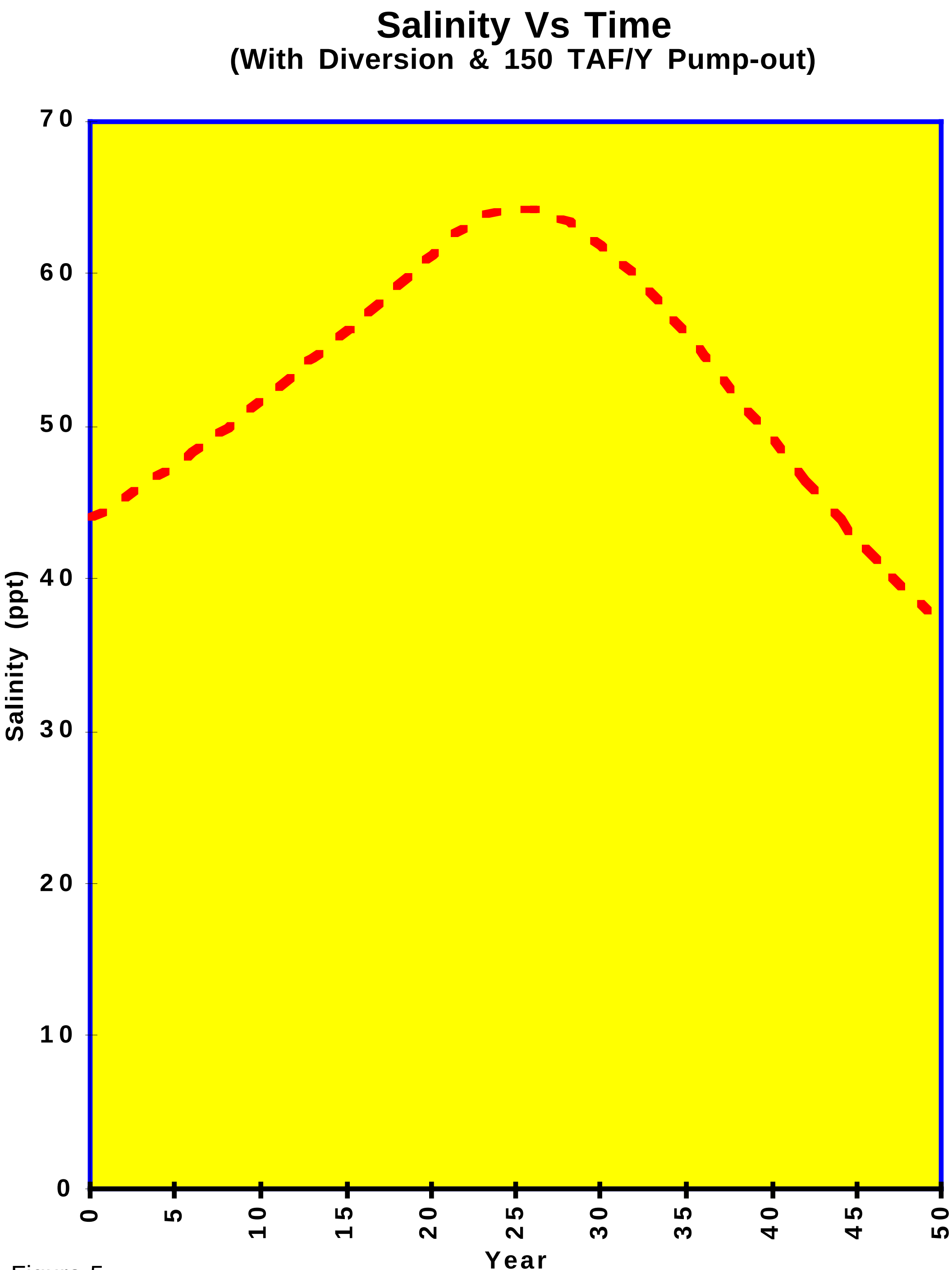
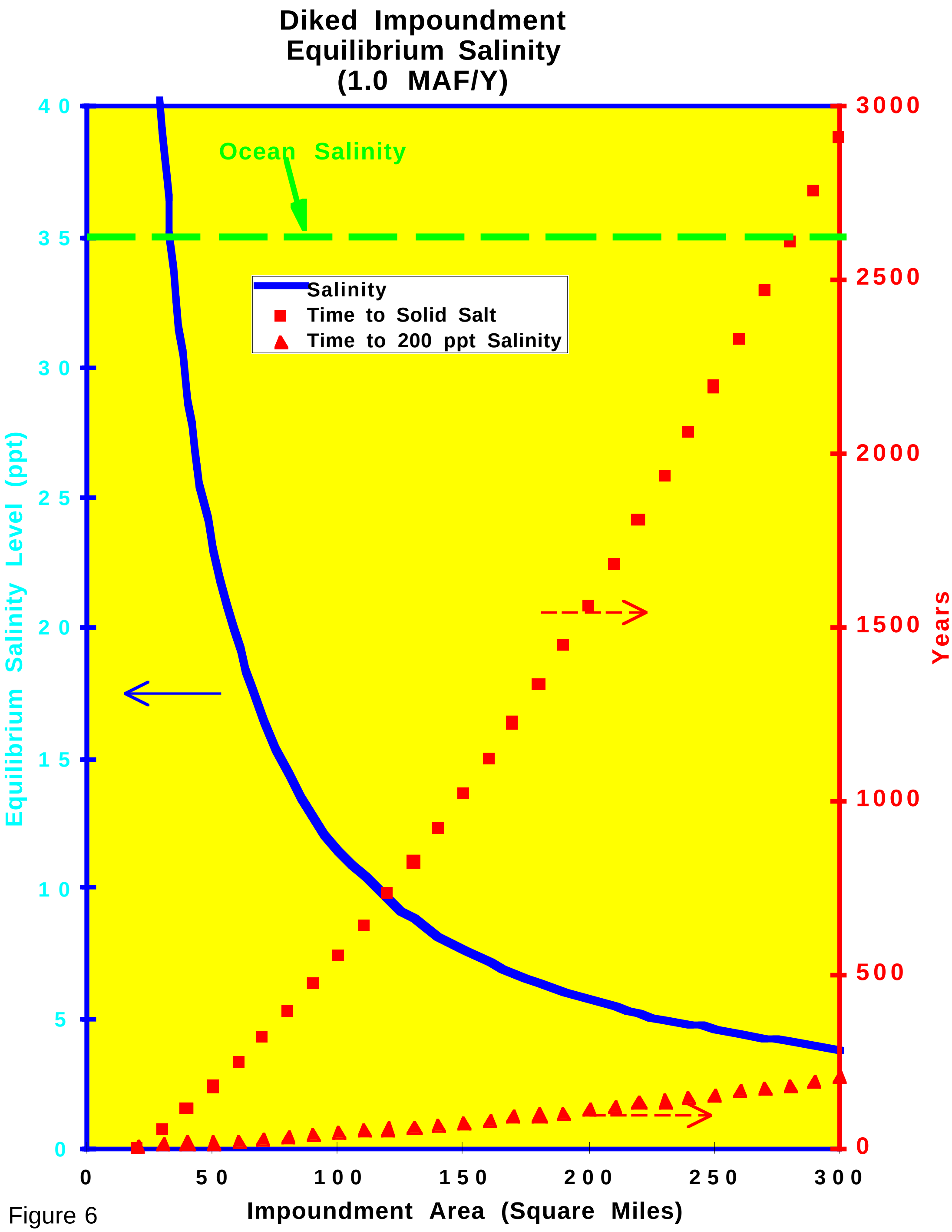
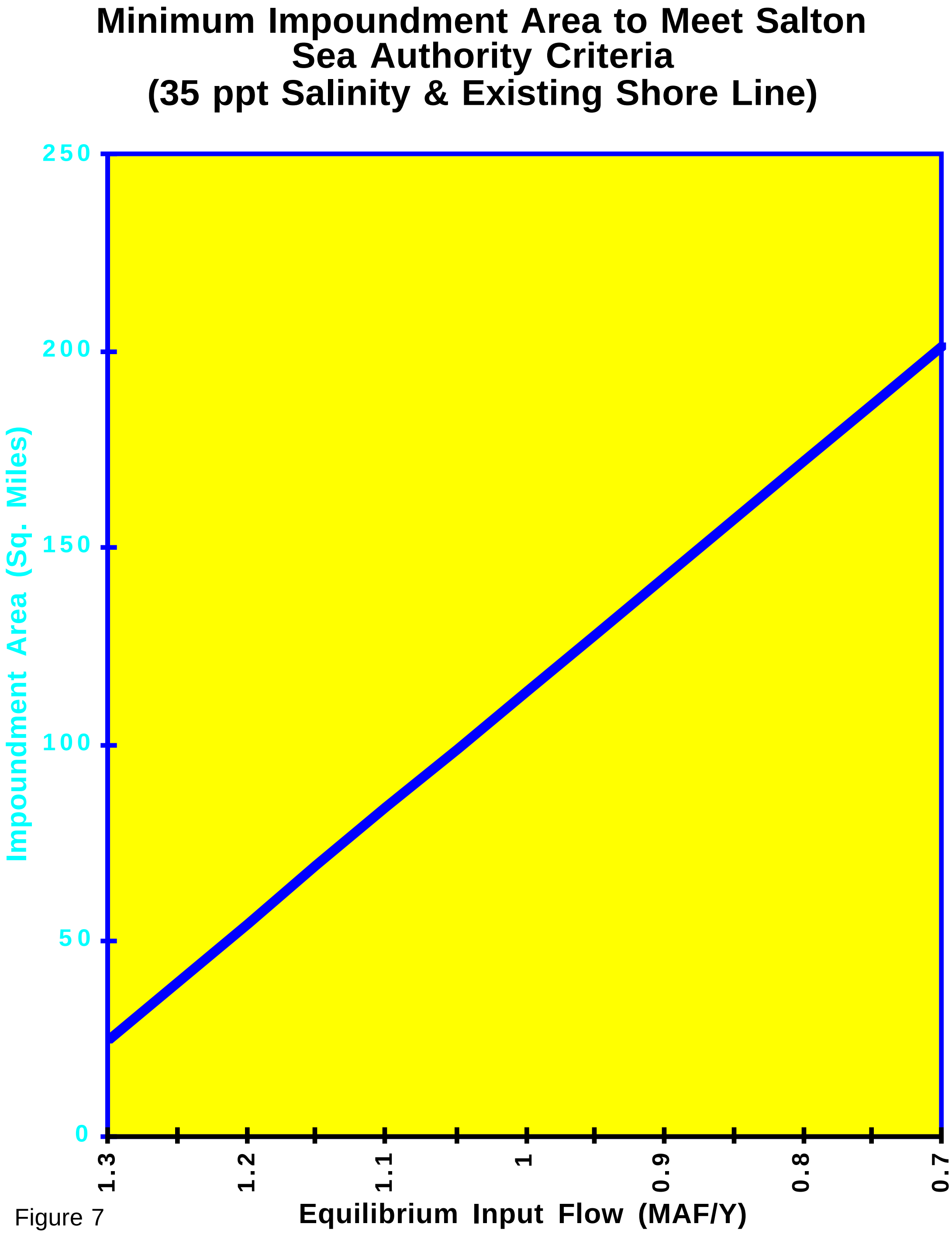

Salinity Vs Time
(With Diversion & 150 TAF/Y Pump-out)
70
60
50
40
30
20
10
0
Salinity (ppt)
0
5
10
15
20
25
30
35
40
45
50
Year

Figure 5



Diked Impoundment
Equilibrium Salinity
(1.0 MAF/Y)
Ocean Salinity
Salinity
Time to Solid Salt
Time to 200 ppt Salinity
Equilibrium Salinity Level (ppt)
Years
Impoundment Area (Square Miles)
0
5
10
15
20
25
30
35
40
0
500
1000
1500
2000
2500
3000
0
50
100
150
200
250
300

Figure 6



Minimum Impoundment Area to Meet Salton Sea Authority Criteria
(35 ppt Salinity & Existing Shore Line)
250
200
150
100
50
0
Impoundment Area (Sq. Miles)
1.3
1.2
1.1
1
0.9
0.8
0.7
Equilibrium Input Flow (MAF/Y)

Figure 7