8.0 QUANTIFICATION OF NET WATER LOSSES TO SALTON SEA AND ADJACENT WETLANDS

8.0 QUANTIFICATION OF NET WATER LOSSES TO SALTON SEA AND ADJACENT WETLANDS

8.1 CONCEPTUAL MODEL WATER BALANCE ESTIMATES

8.1.1 Groundwater Discharge to Wetlands

Sections 3, 4, and 5 present a conceptual model of the groundwater consumption rates during the late 1980s for wetlands associated with the canals. Groundwater consumptive use rates from all canal wetlands complexes are summarized in Table 8-1. Groundwater consumptive use rates for the AAC wetlands are 7,429 acre-feet per year prior to lining and 7,159 acre-feet per year after lining and the implementation of mitigation measures. The net change is a decrease of 270 acre-feet per year due to the combination of lost canal bank vegetation and desert riparian wetlands (between Drops 2 and 3) and a gain in marsh/desert riparian wetlands due to mitigation measures applied at the Drop 3/Drop 4 complex. Although the mitigation measure results in a small net loss in seepage used by wetlands, there is no net loss in habitat value because the mitigation measure at the Drop 3/Drop4 complex replaces the poorer quality desert riparian wetland (50% salt cedar) between Drop 2 and 3 with higher quality marsh/desert riparian wetland.

Table 8-1

AAC and CB Wetland Groundwater Consumption
Conceptual Model of Pre- and Post-Lining Conditions

Wetland Complex	Wetland type	Current water use (af/yr)	Post-lining wetland water use (af/yr)	Change in water use (af/yr)	Percent Change
AAC-Drop 3/4	Marsh and desert riparian (9% marsh)	6,941	7,159	218	3.14
AAC-Drop 2/3 scattered	Desert riparian	488		-488	-100.00
AAC-canal bank	Marsh	240		-240	-100.00
Total AAC		**7,429**	**7,159**	**-270**	**-3.63**
CB- Unit A	Desert riparian (0.1% marsh)	3,510	1,930	-1,580	-45.01
CB- Unit B	Desert riparian (1.2% marsh)	2,675	82	-2,593	-96.93
CB- Unit C	Desert riparian (0.9% marsh)	11,100	0	-11,100	-100.00
CB- Unit D	Marsh and desert riparian (6% marsh)	20,340	14,181	-6,159	-30.28
CB- Unit E	Desert riparian (1.7% marsh)	385	57	-328	-85.19
Total CB		**38,010**	**16,250**	**-21,760**	**-57.25**
Total AAC and CB		**45,439**	**23,409**	**-22,030**	**-48.48**

Groundwater consumptive use rates for the CB wetlands are 38,010 acre-feet per year prior to lining and 16,250 acre-feet per year after lining and the implementation of mitigation measures. The net change is a decrease in seepage flux of 21,760 acre-feet per year due the loss of nearly all salt cedar, salt cedar/mixed vegetation, and other desert riparian in hydrologic units B, C, and E; the loss of 45 percent of vegetation in hydrologic unit A; and the loss of 30 percent of the marsh, salt cedar, salt cedar/mixed vegetation in hydrologic unit D (unit D includes the Salt Creek ACEC). The net loss of 30 percent of the marsh/desert riparian habitat in hydrologic unit D (6,159 acre-feet per year of seepage) reflects a loss of 13,284 acre-feet per year in seepage due to lining which is offset by an increase of 7,125 acre-feet per year for water supply for new wetlands created in Salt Creek. Although the mitigation measures still result in a 57 percent net loss in seepage used by wetlands, there is no net loss in habitat value because the mitigation measures replace the poorer quality desert riparian wetland (mostly salt cedar) with higher quality marsh/wetland (i.e., native cottonwood/willow, fan palms, honey mesquite, and screwbean mesquite).

8.1.2 Groundwater Discharge to Surface Waters

Sections 3, 4, and 5 present a conceptual model of groundwater discharge rates during the late 1980s to surface waters that drain into the Salton Sea. Some fraction of this groundwater discharge may be comprised of water derived from canal seepage. Groundwater discharge rates to major surface waters such as the East Highline Canal, the New and Alamo Rivers, the IID Drains, the Salton Sea, and Salt Creek are summarized in Table 8-2.

AAC canal seepage may contribute groundwater discharge into the East Highline Canal, the New and Alamo Rivers, the IID Drains, and the Salton Sea. It has been estimated that approximately 8,900 acre-feet per year of AAC seepage flows north towards Imperial Valley, and lining the canal to Drop 3 will decrease this seepage flow into Imperial Valley to the approximately 1,500 acre-feet per year of seepage between Drop 3 and the EHC. A large fraction (4,400 acre-feet per year) of groundwater discharge into the East Highline Canal is attributed to AAC seepage, therefore, there may be a significant reduction in groundwater discharge into the East Highline Canal after lining the AAC. But, because there is no direct or indirect pathway for the EHC water to the Salton Sea (see Section 4.4.4.1), lining the canal will not result in a net change in seepage water reaching the Salton Sea. The amount of groundwater that currently underflows the EHC is 4,900 acre-feet per year and after lining the canal this underflow rate is likely to drop to between 0 and 1,500 acre-feet per year, for a net reduction in seepage of 3,500 to 4,900 acre-feet per year. An unknown fraction of this canal seepage may reach the Salton Sea.

Table 8-2

Surface Water Groundwater Discharge for AAC and CB Conceptual Model of Pre- and Post-Lining Conditions

Surface Water Feature	Pathway to Salton Sea	Current Groundwater Discharge (af/yr)	Post-lining Groundwater Discharge (af/yr)
East Highline Canal	none	4,400	unknown
New River	direct discharge of fraction not consumed by ET	29,000	unknown
Alamo River	direct discharge of fraction not consumed by ET	60,400	unknown
IID Drains (south)	discharge via rivers of fraction not consumed by ET	NA - covered in New and Alamo River above	unknown
IID Drains (north of Vail Lateral)	direct discharge of fraction not consumed by ET	10,200	unknown
Salton Sea (SS)	direct discharge	2,000	unknown
Total surface water discharge to Salton Sea (AAC)	direct discharge of fraction not consumed by ET	104,200	unknown
Total groundwater discharge to Salton Sea (AAC)	direct discharge	2,000	unknown
Total water discharge to Salton Sea (AAC)		106,200	unknown
Salt Creek	direct discharge of fraction not consumed by ET	2,000	unknown
Salton Sea	direct discharge	8,000	unknown
Total surface water discharge to Salton Sea (CB)	direct discharge of fraction not consumed by ET	2,000	unknown
Total ground water discharge to Salton Sea (CB)	direct discharge	8,000	unknown
Total water discharge to Salton Sea (CB)		10,000	unknown
Total surface water discharge to Salton Sea (AAC+CB)	direct discharge of fraction not consumed by ET	106,200	unknown
Total groundwater discharge to Salton Sea (AAC+CB)	direct discharge	10,000	unknown
Total water discharge to Salton Sea (AAC+CB)		116,200	unknown

Total groundwater discharge rates into the New and Alamo Rivers, the IID Drains, and into Salton Sea are given in Table 8-2. However, it is difficult to estimate what fraction of these groundwater discharge rates represent groundwater derived from canal seepage due to the large distance and travel time between the canals and the discharge points, and a large number of assumptions would need to be made to make qualitative calculations (see discussion in Appendix D). For this reason, the values given by the groundwater model are thought to be much more accurate and no qualitative estimates were derived for the fraction of canal water in groundwater seepage into the New and Alamo Rivers, the IID Drains, and into Salton Sea.

CB canal seepage may contribute groundwater discharge into the Salton Sea and Salt Creek. It has been estimated that 8,000 acre-feet per year of groundwater discharges from the East Salton Sea area into the Salton Sea and 2,000 acre-feet per year of groundwater discharges from the East Salton Sea area into Salt Creek. Without mitigation measures, the Salt Creek baseflow would naturally cease after lining the canal since there was no baseflow prior to the CB. However, groundwater discharge into Salt Creek will remain the same after lining the CB based on a mitigation commitment to maintain 2,000 acre-feet per year of baseflow in Salt Creek. Currently, 29,810 acre-feet per year of the CB canal seepage is consumed as wetland evapotranspiration and 1,000 acre-feet per year of the CB canal seepage discharges into Salt Creek, allowing up to 1,540 acre-feet of canal seepage to potentially discharge into the Salton Sea. However, given that (1) canal seepage is not detected in the downgradient Andreas and Oasis Springs, (2) the San Andreas Fault may prevent a barrier to migration, and (3) the 1,540 acre-feet per year could be attributed to the range of uncertainty in the amount of canal water estimated to discharge into Salt Creek and the wetlands, it seems possible that canal seepage does not discharge into the Salton Sea. If this is the case, anywhere from 0 to 1,500 acre-feet per year of canal water may be lost as seepage into the Salton Sea.

8.2 NUMERICAL MODEL ESTIMATES

8.2.1 Groundwater Discharge to Wetlands

Sections 6 and 7 presents a numerical model that quantifies the groundwater budget including canal seepage and wetland groundwater consumption. The model calculates a quantitative water budget for the conditions with and without the canal-lining project as given in Figures 7-2 through 7-5. Water use rates from canal wetlands are summarized in Table 8-3. The water use rate for the AAC wetlands is

5,546 acre-feet per year after lining and the implementation of mitigation measures. The change is due to: (1) a combination of lost canal bank vegetation and desert riparian wetlands between Drops 2 and 3 (120 and 500 af/yr, respectively); (2) a gain in marsh/desert riparian wetlands due to mitigation measures applied at the Drop 3/Drop 4 complex (1,187 to 2,993, plus 220 af/yr, as described in Section 7.2.3.2); and (3) a decrease in groundwater evapotranspiration (ranging from 1,187 to 2,993 af/yr). Although the mitigation measure results in a small net loss in seepage used by wetlands, there is no net loss in habitat value because the mitigation measure replaces the poorer quality desert riparian wetlands (50% salt cedar) between Drops 2 and 3 with higher quality marsh/desert riparian wetland between Drops 3 and 4.

Table 8-3

AAC and CB Wetland Water Use, Numerical Model of Lined and Unlined Conditions in 2026 (with mitigation)

Wetland Complex	Wetland Type	Unlined Water Use* (af/yr)	Lined Water Use* (af/yr)		Change in Water Use* (af/yr)	
			High	Low	High	Low
AAC-Drop3/4	marsh and desert riparian (9% marsh)	5,326	5,546	5,546	+220	+220
AAC-Drop 2/3 scattered	desert riparian	500	0		-500	-500
AAC-canal bank	marsh	120	0		-120	-120
Total AAC		5,946	5,546	5,546	-400	-400
Total CB	marsh and desert riparian (3.8% marsh)	37,941	24,643	14,218	-13,298	-23,723
Total AAC and CB		43,887	30,189	19,764	-13,698	-24,123

Note: *Model output values are rounded only to the nearest af/yr for convenience in verifying against model output files. Rounding to the nearest 1,000 af/yr is appropriate to indicate the degree of predictive accuracy.

Uncertainty in the predictions of lined water use rates for 2026 is quantified in Table 8-3 by showing the high and low ends of the predicted range for each rate. These values are the same for the AAC, due to the effects of mitigation measures.

Groundwater consumptive use rates for the CB wetlands in 2026 are 37,941 acre-feet per year without lining and range between 14,218 to 24,643 acre-feet per year with lining and the implementation of mitigation measures. Again, there is no net loss in habitat value because the mitigation measure replaces the poorer quality desert riparian wetlands (70% salt cedar) with higher quality native marsh, honey mesquite, and screwbean mesquite.

8.2.2 Groundwater Discharge to Surface Waters

Sections 6 and 7 presents a numerical model which quantifies the groundwater budget, including the relation between canal seepage and groundwater discharge rates to surface waters that drain into the Salton Sea. Groundwater discharge rates to major surface water features which contribute flow to the Salton Sea, including the New and Alamo Rivers, the IID drains, the Salton Sea itself, and Salt Creek, are summarized in Table 8-4. Uncertainty in the predictions of lined discharge rates for 2026 is quantified in Table 8-4 by showing the high and low ends of the predicted range for each rate.

Table 8-4

**Groundwater Discharge to Surface Water Features,
Numerical Model of Lined and Unlined Conditions in 2026
(with mitigation)**

Surface Water Feature	Pathway to Salton Sea	Unlined Groundwater Discharge [1] (af/yr)	Lined Groundwater Discharge [1] (af/yr)		Change In Groundwater Discharge [1] (af/yr)	
			High	Low	High	Low
New River and Alamo River	Direct discharge of fraction not consumed by ET	63,324	63,315	63,210	-9	-114
IID Drains	Discharge via rivers of fraction not consumed by ET	21,769	20,798	9,227	-971	-12,542
Salton Sea (SS)	Direct discharge	24,320	22,605	14,112	-1,715	-10,208
Salt Creek	Direct discharge of fraction not consumed by ET	2,000	2,000	2,000	0	0
Total surface water discharge		87,093	86,113	74,437	-980	-12,656
Total groundwater discharge	Direct discharge	24,320	22,605	14,112	-1,715	-10,208
Total water discharge to SS	Direct discharge of fraction not consumed by ET	111,413	108,718	88,549	-2,695	-22,864

Note: [1] Model output values are rounded only to the nearest af/yr for convenience in verifying against model output files. Rounding to the nearest 1,000 af/yr is appropriate to indicate the degree of predictive accuracy.

8.3 QUANTIFIED NET WATER LOSSES TO SALTON SEA AND ADJACENT WETLANDS

8.3.1 Comparison of Numerical and Conceptual Model Predictions

The change in seepage rates at the wetlands and Salton Sea due to the AAC and CB canal lining projects is estimated using both the conceptual and numerical models in Table 8-5. The estimated change in seepage rates at the AAC and CB wetlands are quite similar for both calculation methods. This is attributed to greater certainty in the fate of the wetland seepage since the travel times and distances are smaller. In contrast, the estimated change in seepage rates at the Salton Sea covers a much wider range. This is attributed to greater uncertainty in the seepage fate at the Salton Sea since the travel times and distances are so great, especially for the AAC seepage. The conceptual model approach also does not have the ability to track seepage once it enters the complex discharge conditions in central Imperial Valley, while the numerical model can estimate whether seepage discharges into the Salton Sea or into a river or drain feeding the sea.

Table 8-5

Summary of Water Loss Estimates for Conceptual and Numerical Model in 2026

	Loss to the Salton Sea acre-feet per year			Loss to the wetlands acre-feet per year		
	Conceptual Model	Numerical Model		Conceptual Model	Numerical Model	
Project		High	Low		High	Low
Total AAC Lining and CB Lining	NA	-3,000	-23,000	-22,000	-14,000	-24,000

Note: Figures have been rounded to the nearest 1,000 acre-feet to reflect the uncertainty in the model predictions.

The numerical and conceptual models estimate that the largest change in AAC seepage discharge is for seepage into the East Highline Canal. The numerical model estimates that the second largest change in AAC seepage discharge is for seepage into the IID drains. Thus, a key factor in determining the net seepage loss to the Salton Sea is the fraction of discharge into the IID drains consumed during transport through the drain system; yet, this value is unknown. For this report, none of the surface water discharge was assumed to be consumed during transport to the Salton Sea; thus, these estimates present a worst-case scenario.

The conceptual model estimates a higher loss to wetland but this assumes steady-state conditions. Thus, the numerical model results are more reliable since steady-state conditions may not occur by 2026.

8.4 CONCLUSIONS

8.4.1 Most Likely Estimates

Reviewing the model results, the most likely estimate for the amount of water that may be lost to the Salton Sea and to the adjacent wetlands due to the proposed canal lining projects is 10,000 acre-feet per year and 19,000 acre-feet per year, respectively, for a total of 29,000 acre-feet per year. These estimates account for the mitigation commitments already identified for each project. Specifically, the mitigation commitments take into account current wetlands that are dominated by an invasive exotic phreatophyte--salt cedar. Salt cedar has taken over approximately 50 percent of total wetland acreage in the AAC and 70 percent for the CB. Mitigation measures include the replacement of the poorer quality desert riparian wetlands with higher quality native marsh, honey mesquite, and screwbean mesquite.

8.4.2 Uncertainty in Estimates

There is a much wider range in the predicted seepage losses to the Salton Sea, as compared to the wetlands, due to the greater uncertainty in this estimate as discussed below.

The unlined rates in Tables 8-3 and 8-4 (2026) are subtracted from the high and low lined rates to compute changes in rates (losses) due to lining the canals. "High" unlined rates are used for both calculations, thus the "low" rate changes are probably exaggerated. For example, the "low" value of -23,000 for the loss the Salton Sea may be beyond the actual lower limit. For this reason, we estimated the most likely value (10,000 af/yr) to be near the high end of the computed range (-3,000 to -23,000 af/yr).

The predictions of groundwater loss to the Salton Sea are most sensitive to this, because the Salton Sea may be farther from steady-state in 2026 as compared to the wetlands. The stated range of uncertainty for the wetlands of -14,000 to -24,000 af/yr does not require adjustment.