Turkey Point Plant

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5.2 Water and Salt Balance Model

Tetra Tech, Inc., developed a model of the water and salt balance for the CCS. The purpose of this model was to quantify the volume of water and mass of salt entering and exiting the CCS over a 24-month period. Details of this Excel-based model, the underlying conceptualization of the relationship between the CCS and the surrounding environmental systems, key calculations, and results were provided in the Comprehensive Pre-Uprate Monitoring Report (FPL 2012a). That version of the model simulated water and salt flow to and from the CCS for the period between September 2010 and June 2012. In the Comprehensive Post-Uprate Monitoring Report, refinements to the model were made and water and salt flows to and from the CCS were simulated for the period between September 2010 and May 2015. In this report, the modeled period encompasses the reporting period (24-month period) from June 2015 through May 2017; while the reporting period is June 2016 through May 2017, the associated monitoring data were employed to append the reporting period to the existing balance model. This approach is followed because many of the parameters adjusted during calibration reflect changed CCS conditions that occurred during or just prior to the reporting period. The 24-month timeframe reflects influences associated with partial canal sediment removal, salinity reduction actions due to the addition of marine groundwater and L-31E canal water during the spring through late summer 2015, and decommissioning of Unit 1, the addition of low salinity UFA groundwater, and the extended extraction and disposal of hypersaline groundwater from beneath the CCS beginning in the fall of 2016.

The conceptual model and associated calculations were predominantly unchanged since the previous time they were presented (i.e., in the 2012 Comprehensive Pre-Uprate Monitoring Report) (FPL 2012a). As such, only a brief summary of the model is provided below. Model results and corresponding conclusions regarding the operation of the CCS are based on the current calibrated water and salt balance model and are provided herein. The Excel spreadsheet that comprises the model is provided in a separate data file.

5.2.1 Model Summary

As Figure 5.2-1 depicts, the water balance for the control volume (CCS) is comprised of groundwater seepage (lateral through the sides and vertical through the bottom), blowdown (additional water pumped from other units to the CCS), water added for CCS salinity management (pumped from L-31E and/or groundwater), precipitation (including runoff from earth berms between canals), and evaporation. Aside from evaporation and precipitation, these are the same mechanisms by which salt flows into and out of the CCS. The means by which water and/or salt is transferred (e.g., seepage, evaporation) are calculated using various equations provided in the 2012 Comprehensive Pre-Uprate Monitoring Report (FPL 2012a). For this report, calculations were performed for a 24-month period from June 2015 through May 2017. Average flows of water and salt into and out of the control volume were calculated for each day of this period using hydrologic, water quality, and meteorological data measured within, beneath, and adjacent to the CCS. The average daily flows were summed to estimate the amount of water and salt that enters or exits the control volume (i.e., the CCS) during each month and the entire

24-month period. These calculations demonstrate and validate the conceptual model of the CCS and, in so doing, illustrate the hydrologic mechanisms by which the CCS functions.

Calculated water flows are reported in 10^6 gallons per day (mgd). The mass flux into or out of the control volume is calculated by multiplying the volumetric flow by the salinity of the body of water from which the water is flowing. Salinity was monitored at all groundwater and surface water stations employed in the ensuing calculations and was reported in the PSS-78 scale, which is equivalent to grams per liter (g/L). Calculated mass fluxes are reported in thousands of pounds per day (lb x 1,000/day).

The gain/loss of water and salt mass within the control volume during some period of time results in a change in the control volume's water and salt mass storage. Increased water storage, for instance, occurs when more water enters the control volume than exits. Storage then can be estimated by summing all of the components of the water (and salt) balance. When the net flow is positive (into the control volume) during a specified period of time, the storage of the control volume increases. Conversely, a net negative (out of the control volume) flow implies a decrease in storage during a specified time period.

Another manner in which a change in storage can be estimated relies on direct measurements of water elevations and salinities within the control volume. A change in water elevation within the control volume can be calculated as a difference between water elevations at the beginning and end of a specified time period. The product of this change in water elevations and the surface area of the control volume provide an estimate of the change in the volume of water contained in the control volume during that period of time. Estimates of daily storage changes derived from this method are used to further calibrate the water and salt balance model to ensure an accurate simulation of temporal trends in CCS water elevation and salinity.

A significant change to the model since it was last calibrated is the representation of continued additions of UFA water. Since November 1, 2016, an average of 12.8 mgd of UFA water have been added to the CCS for salinity abatement purposes. Based on historical data from the operation of the 5 UFA wells, the salinity of the added water is assumed to be 2.63 (in PSS-78 scale) and is assumed to be temporally invariant.

5.2.2 Model Calibration, Results, and Discussion

The individual components of the water and salt balance were simulated daily and summed for each month from June 2015 through May 2017, as well as for the collective 24-month period. The individual components of flow are summed in order to calculate a simulated change in volume for each month and for the 24-month period. These simulated changes in storage were compared to observed changes in CCS water and salt storage for each month and the entire calibration period (June 2015 through May 2017). Errors between the simulated and observed storage changes were minimized by adjusting key variables associated with the flow balance model; this process is called calibration. The calibration process ensures that the model can accurately reflect the average changes in CCS storage over the 24-month timeframe, while also effectively capturing day-to-day changes in CCS water and mass storage. Calibration of the water and salt balance model was achieved by adjusting hydraulic conductivities of the aquifer

materials adjacent to and beneath the CCS that factor into the calculation of seepage to/from groundwater and Biscayne Bay. Additional adjustable parameters include the coefficients in the wind function (FPL 2012a), the amount of runoff that enters the control volume as percentage of precipitation, the amount of Unit 5 cooling tower water that is lost to evaporation before entering the CCS, and the salinity of the Unit 5 blowdown as a percentage of seawater. The calibrated model parameter values are provided in Table 5.2-1.

5.2.2.1 Parameter Adjustments

The horizontal hydraulic conductivities laterally adjacent to the control volume were calibrated to range between 500 ft/day (west and north CCS walls) and 1,600 ft/day (south CCS wall). The calibrated vertical conductivities beneath the control volume ranged from 0.1 ft/day to 2.2 ft/day. In order to achieve a better match to observed hydrologic and salt concentration conditions, the northern portion of the discharge canals into the CCS and return canals were calibrated to have higher vertical hydraulic conductivities (1.4 ft/day and 2.2 ft/day, respectively) than the middle/southern portions of the CCS discharge canals and southern portion of the return canals (0.1 ft/day). The variability in these vertical hydraulic conductivities is attributable to the non-uniform depth of a shallow high-flow zone that is variably intersected by deeper CCS canals. The magnitudes of and variability in vertical hydraulic conductivities are on the same order of magnitude as those in the prior model (which simulated through November 2016), where vertical hydraulic conductivity ranged from 0.1 to 1.6 ft/day. Horizontal hydraulic conductivities calibrated in this model are also on the same order of magnitude and range of values as those calibrated in the prior model (which simulated through November 2016), which ranged from 100 ft/day (east CCS wall) to 2,400 ft/day (south CCS wall).

In addition to changes in hydraulic conductivities, revisions were made to evaporation. The equation for evaporation (FPL 2012a) includes an empirical factor. This factor was reduced from 0.66 to 0.62 during the calibration of the 24-month balance model. As the modeled balance is very sensitive to evaporative losses, this was a significant change.

The percentage of additional precipitation-based inflow due to runoff from canal berms is an adjustable model parameter. This parameter is time-invariant and increases precipitation-based inflow for all precipitation events; as the precipitation increases, so too does the additional runoff inflow. Since the precipitation is a key inflow to the CCS for moderating salinity, the balance model is sensitive to this parameter. No change was necessary for this parameter, and it is defined to be 20% of direct precipitation inflow.

The impact of the parameters changes, particularly the adjustments made to the evaporation parameters, is a relatively accurate simulation of the monthly flow balance and simulated daily CCS conditions during the 24-month period between June 2015 and May 2017. The effect of these parameter adjustments on the earlier period of record (September 2010 through May 2015), which were previously simulated by prior versions of the water and salt balance model, were not evaluated as a part of this modeling effort.

5.2.2.2 Flow Balance Comparisons

Results of the calibrated 24-month water and salt balance model are provided in Tables 5.2-2 and 5.2-3, respectively. The modeled net flow of water, as calculated by summing the components of the water balance for the 24-month calibration period, is denoted as the "Modeled Change in CCS Storage" and was calculated to be an average inflow of 1.91 mgd over the 24-month calibration period. In other words, on average over the 24-month period, the volume of water in the CCS increased at a rate of 1.91 mgd. The observed change in storage, which is the difference in the volume of water in the CCS between the final and first days of the calibration period, divided by the number of days in the period, was observed to be an increase in storage at a rate of 0.39 mgd. Though the model overestimated the increase in storage, the residual error between the simulated and observed flow is only 1.52 mgd. This error is small (1.97%) relative to the variability in monthly net observed flows, which range from a net outflow of 34.4 mgd (February 2016) and a net inflow of 42.7 mgd (September 2015). These monthly net flows are provided in the calibrated water and salt balance model included as Appendix K. A summary of the water balance model results for the 2016-2017 reporting period is shown in Table 5.2-4. Note that, on average, the CCS storage increased at rate of approximately 4.27 mgd during the 2016-2017 reporting period, while a smaller amount of water was lost, on average, in the previous year.

The model simulated a net loss (outflow) of salt over the 24-month period at rate of 541 (lb x 1,000)/day. The corresponding observed rate of salt outflow was calculated by multiplying the average observed salinity in the CCS (based on salinities measured at monitoring stations TPSWCCS-1, -2, -4, -5, and -6) on the final and first days of the calibration period by the corresponding CCS volumes on those days. The difference between these two products, divided by the number of days in the calibration period, provides the observed net outflow of salt, 1,089 (lb x 1,000)/day. Thus, the model underestimates the salt outflow by approximately 548 (lb x 1000)/day. As in the case of water balance simulation, the magnitude of this overestimation is small (2.0%) relative to the range in monthly average flows; the observed monthly net mass fluxes range from an outflow of 16,994 (lb x 1,000)/day (November 2015) to an inflow of 10,593 (lb x 1,000)/day (July 2016). During the reporting period, the direction of net salt mass flow was into the CCS at a rate of 1,844 (lb x 1000)/day (Table 5.2-5). Analogous to water storage, this magnitude of flow is within the range of flows prior to June 2015. This stands in stark contrast to the 2015 to 2016 period, when net salt mass flow was out of the CCS at a rate of approximately 4,400 (lb x1000)/day.

Figures 5.2-2 and 5.2-3 illustrate the model's ability to match the magnitude and direction of net monthly flows of water and salt, respectively, over the 24-month period. With few exceptions, the model accurately simulated the direction of monthly averaged water and salt flows into and out of the CCS. Figure 5.2-2 compares observed and modeled net monthly flows of water into and out of the CCS. The wet season should be indicative of increased storage and inflow of water into the CCS and, accordingly, the 2015 and (beginning of the) 2017 wet seasons are periods of predominant inflow. However, due to relatively low precipitation, particularly in July 2016, the volume of water in the CCS generally decreased during the 2016 wet season. Dry seasons are marked by reductions in CCS water storage (general outflow). Net reductions in CCS storage are evident between January and March 2016. However, the addition of UFA water

starting in November 2016 is the likely cause of lower monthly outflows during the 2016/2017 dry season.

Figure 5.2-3 compares observed and modeled net monthly flows of salt into and out of the CCS. Unlike the flows of water in Figure 5.2-2, there is an apparent seasonal trend in salt mass flows (salt storage decrease during dry season, salt storage increase during wet season). Like the modeled water flows, modeled salt mass fluxes generally match observed fluxes well. Note that a significant loss of salt storage (salt outflow) was observed in November and December 2015. As previously documented, the salt outflows during these months are attributable to large volumetric seepage from the CCS to groundwater. By comparison, the 2016/2017 dry season salt outflows are relatively low. The addition of UFA water has aided in the moderation of dry season salinity without significantly increasing the stage of the CCS. As such, seepage to groundwater during the 2016/2017 dry season is low relative to seepage modeled during the prior dry season. This is discussed further in the conclusions.

5.2.2.3 Simulated CCS Water Levels and Salt

Implicit in the model's ability to simulate monthly net water and salt mass flows is the accurate simulation of daily flows to and from the CCS. Because the model is able to characterize the daily flows of water and salt, the model estimates the daily changes in CCS water and salt storage. As previously mentioned, these changes in storage are associated with daily changes in CCS water levels and salinity. Figure 5.2-4 shows the model-calculated water levels in the CCS, which varies over the period of record. These modeled water levels range between approximately -1.7 ft North American Vertical Datum of 1988 (NAVD 88) and 2.0 ft NAVD 88 and reflect an average water level throughout the entire CCS. Also shown in Figure 5.2-4 are the observed CCS water levels over time; the observed values reflect the mean of daily-averaged water elevations across the five sensors in the CCS (TPSWCCS-1, -2, -4, -5, -6). The model generally matches the seasonal trends in CCS water level changes (reductions during the dry season and increases during the wet season). However, between July 2016 and January 2017, the model under-simulates the CCS stage. Changes to the model intended to improve this match resulted in a degradation in the quality of the match to CCS salinity.

Changes in salt mass storage within the CCS can be used to calculate average CCS salinity changes over time. The simulated daily net flow of salt is divided by the simulated volume of water in the CCS, which results in a change in salinity. This change in salinity is added to the simulated salinity calculated for the previous day to produce a simulated salinity for the current day. Like the simulated CCS water level, the modeled salinity reflects a representative daily salinity throughout the CCS. Figure 5.2-5 compares the simulated salinities to those observed in the CCS over the period of record. Observed salinities are the mean of daily averaged salinities measured in the CCS monitoring stations (TPSWCCS-1, -2, -4, -5, and -6). The model matches the observed temporal trends in salinity reasonably well. However, the model over-simulates the magnitude of CCS salinity throughout much of the simulated timeframe. Interestingly, this bias is eliminated and the model match to CCS salinity improves in late 2016, when FPL began adding UFA water to the CCS.

5.2.2.4 Interim Activities Affecting Salt Removal

While not simulated in the water budget model, it is worth mentioning that FPL proactively initiated removal of hypersaline groundwater (up to 15 mgd) beneath the CCS as part of extended operational testing and monitoring of the UIC well beginning in late September 2016. Monthly Operating Reports have been submitted to FDEP and are available in the L-31E EDMS site.

Groundwater with a salinity ranging from 54 to 62 PSS-78 scale was pumped from four wells into the injection wells from September 28, 2016, through the end of the reporting period in May 2017. During this time, a total of 1,661 million pounds of salt had been removed from beneath the extraction wells and injected down the UIC. Table 5.2-6 provides a daily summary of the volume of hypersaline water pumped into the injection well and the mass of salt removed.

5.2.2.5 Conclusions

General Conclusions

The accurate simulation of changing CCS inflows, outflows, water elevations, and salinities is complex due to the different components of the balance model and their varying impacts on CCS water and salt storage. For instance, vertical flows into and out of the control volume are generally larger than horizontal flows and have a greater impact upon CCS water elevation. The salinity of inflowing water, however, can vary depending upon the source of the water. For example, water pumped from the UFA into the CCS is relatively low salinity and, as such, serves to reduce and/or moderate CCS salinity; vertical flow from groundwater beneath portions of the discharge canals to the CCS is saline to hypersaline and generally increases the salinity of the CCS. The correct balance of both water and salt mass flow is difficult to estimate in the model. In addition, observed CCS water temperatures varied by over 26°C (from approximately 18.3°C at TPSWCCS-6 in January 2016 to 44.4°C at TPSWCCS-1 in August 2016) during the simulated timeframe. The model addresses associated impacts to the CCS by explicitly simulating the effects of water/air temperature gradients on evaporation. Whereas myriad sources and sinks of water, varying salinities, and changes in water temperature do increase model complexity, the need to accurately simulate these different components of CCS operation constrains the number of possible solutions.

Though the model is able to simulate the complex dynamics associated with the CCS over a 24-month timeframe with reasonable accuracy, there are periods of time where the simulated flows of water and salt do not accurately reflect observed conditions. Consequently, the simulated water levels and salinities in the CCS deviate from those that have been observed at various times in the simulation period. However, the overall performance of the model reinforces its utility as a tool for understanding how the CCS has and will operate under varying meteorological, hydrological, and operational conditions. This is best demonstrated by the fact that the same conceptual model employed to characterize changes in CCS storage of water and salt during this 24-month timeframe (June 2015 through May 2017) was used to explain changes in storage during the prior approximately 4.5-year Uprate monitoring period.

The robustness and accuracy in the model underpins FPL's informed understanding of processes that control the CCS and the manner in which the CCS interacts with the adjacent aquifer and water bodies. This accuracy in simulating the historical changes within the CCS bolsters confidence in the model's utility as a tool to evaluate the sensitivity of CCS operations to certain factors such as changes in operation, drought conditions, storm events, salinity abatement activities, and other potential environmental stresses. Additionally, the model quality validates the fact that the most appropriate data are being collected to effectively capture CCS operations, identify interactions between the CCS and the surrounding environment, and support FPL's comprehension of historical and future operations of the CCS. Continued application and updating of this model is recommended to improve the quality with which it simulates historical conditions in order to bolster the confidence with which futures decisions regarding CCS operations can be made.

Impacts of UFA Water Additions

Perhaps the most important element of the simulated CCS balance during the 24-month timeframe is the continuous addition of UFA water between November 2016 and May 2017. Earlier predictive modeling concluded that, under normal conditions, the addition of 14 mgd of UFA water would eventually reduce CCS salinity to 34 PSS-78. Because this has not yet occurred, it is important to analyze model results in order to better understand what is driving the changes in salinity.

Two key elements of the CCS water and salt balance model that influence the temporal change in CCS salinity are precipitation inflows (the addition of freshwater to the CCS) and evaporative outflows (the removal of freshwater from the CCS). Precipitation-based inflows help to reduce and/or moderate CCS salinity; evaporative losses cause increases in salinity. Monthly evaporative flow rates are generally greater than precipitation flow rates. As such, the difference between monthly precipitation and evaporation (precipitation minus evaporation) is usually negative. During months when this difference is near-zero or positive, CCS salinity will generally decrease. This is evident from September 2015 through January 2016, when positive and near-zero differences between precipitation and evaporation (Figure 5.2-6) helped to produce a reduction in salinity from 79 PSS-78 to 35 PSS-78. Note, FPL also added L-31E canal water through November 2015, which also helped to reduce CCS salinity.

In the months that followed (February through July 2016), monthly evaporation was consistently and significantly greater than monthly precipitation (Figure 5.2-6). Accordingly, the average CCS salinity increased from 35 PSS-78 to 70 PSS-78. Much of this increase occurred by the end of May 2016. During the same 4-month period (February through May) in 2017, the monthly differences between evaporation and precipitation were even more negative than in 2016 (except in March). Whereas salinity increased by 20 PSS-78 between February and May 2016, salinity during the same four months in 2017 has remained relatively stable (increase from 65 PSS-78 to 67 PSS-78). The reason for the stability in salinity in spite of the adverse imbalance between evaporation and precipitation is the addition of UFA water. These additions of low salinity water help to offset the disparity between evaporation and precipitation and, in so doing, help moderate salinity. The continued addition of UFA water, combined with less significant disparities between evaporation and precipitation, should help reduce CCS salinity to 34 PSS-78.

When the UFA water-based approach to CCS salinity abatement was proposed, there were concerns that the associated increase in CCS stage would induce significant seepage of hypersaline water into Biscayne aquifer. Figure 5.2-7 plots the monthly average rates of vertical seepage of salt into the Biscayne aquifer through the base of the CCS (negative values represent outflow from the CCS; positive values represent inflow into the CCS). Inspection of this plot reveals that, relative to other months during the simulated 24-month timeframe, vertical seepage of salt since the full commencement of UFA water additions (November 2016) has been relatively moderate. It is anticipated that the long-term reduction in CCS salinity to 34 PSS-78 will help to moderate the flow of salt from the CCS into the Biscayne aquifer.

TABLES

Table 5.2-1. Calibration Parameters.

Parameter Name	Calibrated Value	Units
Vertical Hydraulic Conductivity (Zone A)	1.4	ft/day
Vertical Hydraulic Conductivity (Zone B)	0.1	ft/day
Vertical Hydraulic Conductivity (Zone C)	0.1	ft/day
Vertical Hydraulic Conductivity (Zone D)	2.2	ft/day
West Face Hydraulic Conductivity	500	ft/day
East Face Hydraulic Conductivity	25	ft/day
North Face Hydraulic Conductivity	500	ft/day
South Face Hydraulic Conductivity	1600	ft/day
Evaporation Modifier (Factor Multiplier)	0.62	
Runoff Modifier (as % of Precipitation)	20%	
Blowdown Evaporation Factor	30%	
Blowdown Concentration (as % of Seawater)	0.50	

Table 5.2-2. Calculated Fluid Flows from Water Budget Components from June 2015 through May 2017.

June 2015 to May 2017			
Water Budget Component		Flow (MGD)	Volume (gal x 10^6)
Into CCS	W. Seepage	0.44	318.79
	E. Seepage	0.26	186.70
	N. Seepage	0.02	13.54
	S. Seepage	6.80	4971.32
	Bottom Seepage	2.20	1606.72
	Precipitation and Runoff	21.78	15920.48
	Evaporation	0.00	0.00
	Unit 3, 4 Added Water	0.59	428.76
	Unit 5 Blowdown	0.18	131.98
	ID Pumping	3.90	2852.92
	Added Water (e.g. L-31E)	18.12	13247.06
	Plant Outflow	Equal to Intake	
	Plant Intake	Equal to Outflow	
	Total In:	**54.28**	**39678.27**
Out of CCS	W. Seepage	0.00	-0.37
	E. Seepage	-0.26	-190.50
	N. Seepage	-0.01	-5.99
	S. Seepage	-1.22	-891.14
	Bottom Seepage	-13.41	-9801.13
	Precipitation and Runoff	0.00	0.00
	Evaporation	-37.47	-27393.69
	Unit 3, 4 Added Water	0.00	0.00
	Unit 5 Blowdown	0.00	0.00
	ID Pumping	0.00	0.00
	Plant Outflow	Equal to Intake	
	Plant Intake	Equal to Outflow	
	Total Out:	**-52.37**	**-38282.82**
Modeled Change in CCS Storage:		**1.91**	**1395.46**
	Observed Change	**0.39**	**288.23**

Key:
CCS = Cooling Canal System.
gal = Gallon.
ID = Interceptor Ditch.
MGD = Million gallons per day.

Table 5.2-3. Calculated Mass Flows from Salt Budget Components from June 2015 through May 2017.

June 2015 to May 2017			
Mass Budget Component		lb/day (x1000)	Mass (lb x 1000)
Into CCS	W. Seepage	3.80	2777.73
	E. Seepage	68.81	50298.89
	N. Seepage	4.09	2993.06
	S. Seepage	1348.98	986102.07
	Bottom Seepage	670.41	490068.71
	Precipitation and Runoff	0.00	0.00
	Evaporation	0.00	0.00
	Unit 3, 4 Added Water	0.00	0.00
	Unit 5 Blowdown	26.37	19274.82
	ID Pumped Water	320.25	234102.33
	Added Water (e.g. L-31E)	3796.45	2775204.60
	Plant Outflow	Equal to Intake	
	Plant Intake	Equal to Outflow	
	Total In:	**6239.15**	**4560822.20**
Out of CCS	W. Seepage	-40.50	-29603.04
	E. Seepage	-101.95	-74522.64
	N. Seepage	-3.46	-2526.71
	S. Seepage	-447.89	-327409.72
	Bottom Seepage	-6186.75	-4522513.47
	Precipitation and Runoff	0.00	0.00
	Evaporation	0.00	0.00
	Unit 3, 4 Added Water	0.00	0.00
	Unit 5 Blowdown	0.00	0.00
	ID Pumping	0.00	0.00
	Plant Outflow	Equal to Intake	
	Plant Intake	Equal to Outflow	
	Total Out:	**-6780.54**	**-4956575.58**
Modeled Change in CCS Storage:		**-541.39**	**-395753.38**
	Observed Change	**-1089.17**	**-796183.62**

Key:
CCS = Cooling Canal System.
ID = Interceptor Ditch.
lb = Pound(s).

Table 5.2-4. Calculated Fluid Flows from Water Budget Components for the Period of Record (June 2016 through May 2017).

June 2016 through May 2017			
Water Budget Component		Flow (MGD)	Volume (gal x 10^6)
Into CCS	W. Seepage	0.43	155.87
	E. Seepage	0.34	123.65
	N. Seepage	0.03	10.23
	S. Seepage	9.13	3332.78
	Bottom Seepage	3.21	1172.49
	Precipitation and Runoff	16.64	6072.22
	Evaporation	0.00	0.00
	Unit 3, 4 Added Water	0.62	225.86
	Unit 5 Blowdown	0.00	0.66
	ID Pumping	1.37	499.65
	Added Water	14.67	5353.54
	Plant Outflow	Equal to Intake	
	Plant Intake	Equal to Outflow	
	Total In:	**46.43**	**16946.96**
Out of CCS	W. Seepage	0.00	0.00
	E. Seepage	-0.05	-16.58
	N. Seepage	0.00	-0.06
	S. Seepage	0.00	0.00
	Bottom Seepage	-6.28	-2293.51
	Precipitation and Runoff	0.00	0.00
	Evaporation	-35.83	-13078.48
	Unit 3, 4 Added Water	0.00	0.00
	Unit 5 Blowdown	0.00	0.00
	ID Pumping	0.00	0.00
	Plant Outflow	Equal to Intake	
	Plant Intake	Equal to Outflow	
	Total Out:	**-42.16**	**-15388.63**
Modeled Change in CCS Storage:		**4.27**	**1553.58**
	Observed Change	**-0.30**	**-110.29**

Key:
CCS = Cooling Canal System.
gal = Gallon.
ID = Interceptor Ditch.
MGD = Million gallons per day.

Table 5.2-5. Calculated Mass Flows from Mass Budget Components for the Period of Record (June 2016 through May 2017).

June 2016 through May 2017			
Mass Budget Component		lb/day (x1000)	Mass (lb x 10^6)
Into CCS	W. Seepage	5.05	1843.29
	E. Seepage	88.42	32271.84
	N. Seepage	6.32	2305.82
	S. Seepage	1626.51	593674.81
	Bottom Seepage	983.54	358990.31
	Precipitation and Runoff	0.00	0.00
	Evaporation	0.00	0.00
	Unit 3, 4 Added Water	0.00	0.00
	Unit 5 Blowdown	0.27	96.93
	ID Pumping	76.05	27756.70
	Added Water	2411.92	880352.15
	Plant Outflow	Equal to Intake	
	Plant Intake	Equal to Outflow	
	Total In:	**5198.06**	**1897291.84**
Out of CCS	W. Seepage	0.00	0.00
	E. Seepage	-23.45	-8559.83
	N. Seepage	-0.09	-31.72
	S. Seepage	0.00	0.00
	Bottom Seepage	-3331.30	-1215925.70
	Precipitation and Runoff	0.00	0.00
	Evaporation	0.00	0.00
	Unit 3, 4 Added Water	0.00	0.00
	Unit 5 Blowdown	0.00	0.00
	ID Pumping	0.00	0.00
	Plant Outflow	Equal to Intake	
	Plant Intake	Equal to Outflow	
	Total Out:	**-3354.84**	**-1224517.26**
Modeled Change in CCS Storage:		**1843.22**	**672774.59**
	Observed Change	**786.86**	**287202.42**

Key:
CCS = Cooling Canal System.
lb = Pound(s).
ID = Interceptor Ditch.

5.2-6. Interim Salt Mass Removed.

Day	Millions of Gallons of Water	Daily Salt Removal (millions of lbs.)	Total Cumulative Salt Removed (millions of lbs.)
09/28/16	6.3	3.0	3
09/29/16	15.3	7.4	10
09/30/16	14.9	7.2	18
10/01/16	14.9	7.2	25
10/02/16	14.9	7.1	32
10/03/16	14.9	6.9	39
10/04/16	14.8	6.9	46
10/05/16	14.9	8.8	54
10/06/16	7.7	12.7	67
10/07/16	0.0	0.0	67
10/08/16	7.7	20.2	87
10/09/16	14.9	6.8	94
10/10/16	14.9	6.8	101
10/11/16	14.9	6.7	108
10/12/16	14.9	6.8	114
10/13/16	14.9	6.8	121
10/14/16	14.9	6.7	128
10/15/16	14.9	6.7	135
10/16/16	14.9	6.7	141
10/17/16	14.9	6.7	148
10/18/16	14.8	6.7	155
10/19/16	14.8	6.7	162
10/20/16	14.8	6.6	168
10/21/16	14.8	6.6	175
10/22/16	14.8	6.6	181
10/23/16	14.8	6.7	188
10/24/16	14.8	6.6	195
10/25/16	14.8	6.6	201
10/26/16	14.8	6.6	208
10/27/16	14.8	6.6	215
10/28/16	14.8	6.6	221
10/29/16	14.8	6.6	228
10/30/16	14.8	6.6	234
10/31/16	14.8	6.6	241
11/01/16	14.8	6.6	248
11/02/16	14.8	6.7	254
11/03/16	14.8	6.7	261
11/04/16	14.4	6.5	268
11/05/16	14.8	6.7	274
11/06/16	14.8	6.6	281
11/07/16	14.8	6.6	288
11/01/16	14.8	6.6	294
11/02/16	14.8	6.7	301
11/03/16	14.8	6.7	307
11/04/16	14.4	6.5	314
11/05/16	14.8	6.7	321
11/06/16	14.8	6.6	327
11/07/16	14.8	6.6	334
11/08/16	14.8	6.6	341
11/09/16	14.8	6.6	347
11/10/16	14.8	6.6	354
11/11/16	14.8	6.6	360
11/12/16	14.8	6.6	367
11/13/16	14.8	6.6	374
11/14/16	14.8	6.6	380
11/15/16	14.8	6.6	387
11/16/16	14.8	6.6	394
11/17/16	14.8	6.6	400
11/18/16	14.8	6.6	407
11/19/16	14.8	6.6	413
11/20/16	14.8	6.6	420
11/21/16	14.8	6.6	427
11/22/16	14.8	6.7	433
11/23/16	14.8	6.7	440
11/24/16	14.8	6.7	447
11/25/16	14.8	6.6	453
11/26/16	14.8	6.6	460
11/27/16	14.8	6.6	467
11/28/16	14.8	6.6	473
11/29/16	14.2	6.4	480
11/30/16	14.8	6.6	486
12/01/16	14.8	6.6	493
12/02/16	14.8	6.6	500
12/03/16	14.8	6.6	506
12/04/16	14.8	6.6	513
12/05/16	14.8	6.6	519

5.2-6. Interim Salt Mass Removed.

Day	Millions of Gallons of Water	Daily Salt Removal (millions of lbs.)	Total Cumulative Salt Removed (millions of lbs.)
12/06/16	14.8	6.6	526
12/07/16	14.8	6.6	533
12/08/16	14.8	6.6	539
12/09/16	14.8	6.6	546
12/10/16	14.8	6.6	553
12/11/16	14.8	6.6	559
12/12/16	14.8	6.6	566
12/13/16	14.8	6.3	572
12/14/16	14.8	6.5	579
12/15/16	13.2	5.8	584
12/16/16	13.7	6.0	591
12/17/16	14.8	6.5	597
12/18/16	14.8	6.5	604
12/19/16	14.8	6.6	610
12/20/16	14.8	6.6	617
12/21/16	14.8	6.6	623
12/22/16	14.8	6.6	630
12/23/16	14.8	6.6	636
12/24/16	14.8	6.6	643
12/25/16	14.8	6.6	650
12/26/16	14.8	6.6	656
12/27/16	14.8	6.6	663
12/28/16	14.8	6.6	670
12/29/16	14.8	6.6	676
12/30/16	14.8	6.6	683
12/31/16	14.8	6.6	689
01/01/17	14.8	6.6	696
01/02/17	14.8	6.6	703
01/03/17	14.8	6.6	709
01/04/17	14.8	6.5	716
01/05/17	14.8	6.5	722
01/06/17	14.8	6.6	729
01/07/17	14.8	6.6	736
01/08/17	14.8	6.6	742
01/09/17	14.8	6.6	749
01/10/17	11.2	5.0	754
01/11/17	14.7	6.7	761
01/12/17	14.5	6.6	767

Day	Millions of Gallons of Water	Daily Salt Removal (millions of lbs.)	Total Cumulative Salt Removed (millions of lbs.)
01/13/17	14.8	6.7	774
01/14/17	14.8	6.7	781
01/15/17	14.8	6.8	787
01/16/17	14.8	6.8	794
01/17/17	14.8	6.8	801
01/18/17	14.8	6.8	808
01/19/17	15.0	6.8	814
01/20/17	14.8	6.6	821
01/21/17	14.8	6.7	828
01/22/17	14.8	6.7	834
01/23/17	7.8	3.5	838
01/24/17	14.8	6.7	845
01/25/17	14.8	6.7	851
01/26/17	14.7	6.6	858
01/27/17	14.7	6.7	865
01/28/17	14.8	6.7	871
01/29/17	14.8	6.7	878
01/30/17	13.0	5.9	884
01/31/17	14.8	6.7	891
02/01/17	14.7	6.7	897
02/02/17	14.8	6.6	904
02/03/17	14.7	6.6	910
02/04/17	14.8	6.6	917
02/05/17	14.8	6.6	924
02/06/17	14.7	6.6	930
02/07/17	14.7	6.6	937
02/08/17	14.8	6.7	944
02/09/17	14.7	6.6	950
02/10/17	14.8	6.7	957
02/11/17	14.7	6.6	964
02/12/17	14.7	6.6	970
02/13/17	14.7	6.6	977
02/14/17	14.7	6.5	983
02/15/17	14.7	6.6	990
02/16/17	14.7	6.6	997
02/17/17	14.7	6.7	1,003
02/18/17	14.7	6.7	1,010
02/19/17	14.7	6.7	1,017

5.2-6. Interim Salt Mass Removed.

Day	Millions of Gallons of Water	Daily Salt Removal (millions of lbs.)	Total Cumulative Salt Removed (millions of lbs.)
02/20/17	14.7	6.7	1,023
02/21/17	14.7	6.7	1,030
02/22/17	14.7	6.7	1,037
02/23/17	14.7	6.6	1,043
02/24/17	14.7	6.7	1,050
02/25/17	14.7	6.7	1,057
02/26/17	14.7	6.7	1,063
02/27/17	14.7	6.7	1,070
02/28/17	14.7	6.7	1,077
03/01/17	14.7	6.7	1,083
03/02/17	14.7	6.7	1,090
03/03/17	14.7	6.7	1,097
03/04/17	14.7	6.7	1,104
03/05/17	14.7	6.7	1,110
03/06/17	14.7	6.7	1,117
03/07/17	14.7	6.7	1,124
03/08/17	14.7	6.7	1,130
03/09/17	14.7	6.7	1,137
03/10/17	14.7	6.7	1,144
03/11/17	14.7	6.6	1,150
03/12/17	14.1	6.4	1,157
03/13/17	14.7	6.7	1,163
03/14/17	14.7	6.6	1,170
03/15/17	14.7	6.7	1,177
03/16/17	14.7	6.7	1,183
03/17/17	14.7	6.7	1,190
03/18/17	14.7	6.7	1,197
03/19/17	14.7	6.6	1,203
03/20/17	14.7	6.7	1,210
03/21/17	14.7	6.7	1,217
03/22/17	14.7	6.6	1,223
03/23/17	14.7	6.7	1,230
03/24/17	14.7	6.7	1,237
03/25/17	14.7	6.7	1,243
03/26/17	14.7	6.7	1,250
03/27/17	14.7	6.6	1,256
03/28/17	14.7	6.6	1,263
03/29/17	14.7	6.6	1,270

Day	Millions of Gallons of Water	Daily Salt Removal (millions of lbs.)	Total Cumulative Salt Removed (millions of lbs.)
03/30/17	14.6	6.6	1,276
03/31/17	14.6	6.6	1,283
04/01/17	14.6	6.6	1,290
04/02/17	14.6	6.6	1,296
04/03/17	14.8	6.6	1,303
04/04/17	14.2	6.4	1,309
04/05/17	14.7	6.6	1,316
04/06/17	14.2	6.0	1,322
04/07/17	14.8	6.6	1,329
04/08/17	14.8	6.7	1,335
04/09/17	14.3	6.5	1,342
04/10/17	14.8	6.7	1,348
04/11/17	14.8	6.6	1,355
04/12/17	14.8	6.6	1,362
04/13/17	14.8	6.6	1,368
04/14/17	14.8	6.6	1,375
04/15/17	14.8	6.6	1,382
04/16/17	14.8	6.7	1,388
04/17/17	14.8	6.7	1,395
04/18/17	14.8	6.7	1,402
04/19/17	14.8	6.7	1,408
04/20/17	14.8	6.7	1,415
04/21/17	14.8	6.7	1,422
04/22/17	14.8	6.6	1,428
04/23/17	12.9	5.8	1,434
04/24/17	12.9	6.6	1,441
04/25/17	14.8	6.6	1,447
04/26/17	14.8	6.6	1,454
04/27/17	14.8	6.6	1,461
04/28/17	14.8	6.6	1,467
04/29/17	14.8	6.6	1,474
04/30/17	14.8	6.6	1,480
05/01/17	14.8	6.6	1,487
05/02/17	14.8	6.6	1,494
05/03/17	14.8	6.6	1,500
05/04/17	14.8	3.9	1,504
05/05/17	14.8	6.6	1,511
05/06/17	14.8	6.6	1,517

5.2-6. Interim Salt Mass Removed.

Day	Millions of Gallons of Water	Daily Salt Removal (millions of lbs.)	Total Cumulative Salt Removed (millions of lbs.)
05/07/17	14.8	6.6	1,524
05/08/17	14.8	6.6	1,530
05/09/17	14.8	6.5	1,537
05/10/17	14.8	6.6	1,543
05/11/17	14.8	6.6	1,550
05/12/17	14.8	6.6	1,557
05/13/17	14.8	6.6	1,563
05/14/17	14.8	6.6	1,570
05/15/17	14.8	6.6	1,576
05/16/17	14.8	6.6	1,583
05/17/17	14.8	6.5	1,589
05/18/17	14.8	6.6	1,596
05/19/17	14.8	6.5	1,602
05/20/17	14.8	6.5	1,609
05/21/17	14.8	6.5	1,616
05/22/17	14.8	2.1	1,618
05/23/17	6.1	0.0	1,618
05/24/17	7.3	0.0	1,618
05/25/17	0.1	4.2	1,622
05/26/17	9.6	6.5	1,628
05/27/17	14.7	6.5	1,635
05/28/17	14.8	6.5	1,641
05/29/17	14.7	6.5	1,648
05/30/17	14.7	6.5	1,655
05/31/17	14.7	6.5	1,661

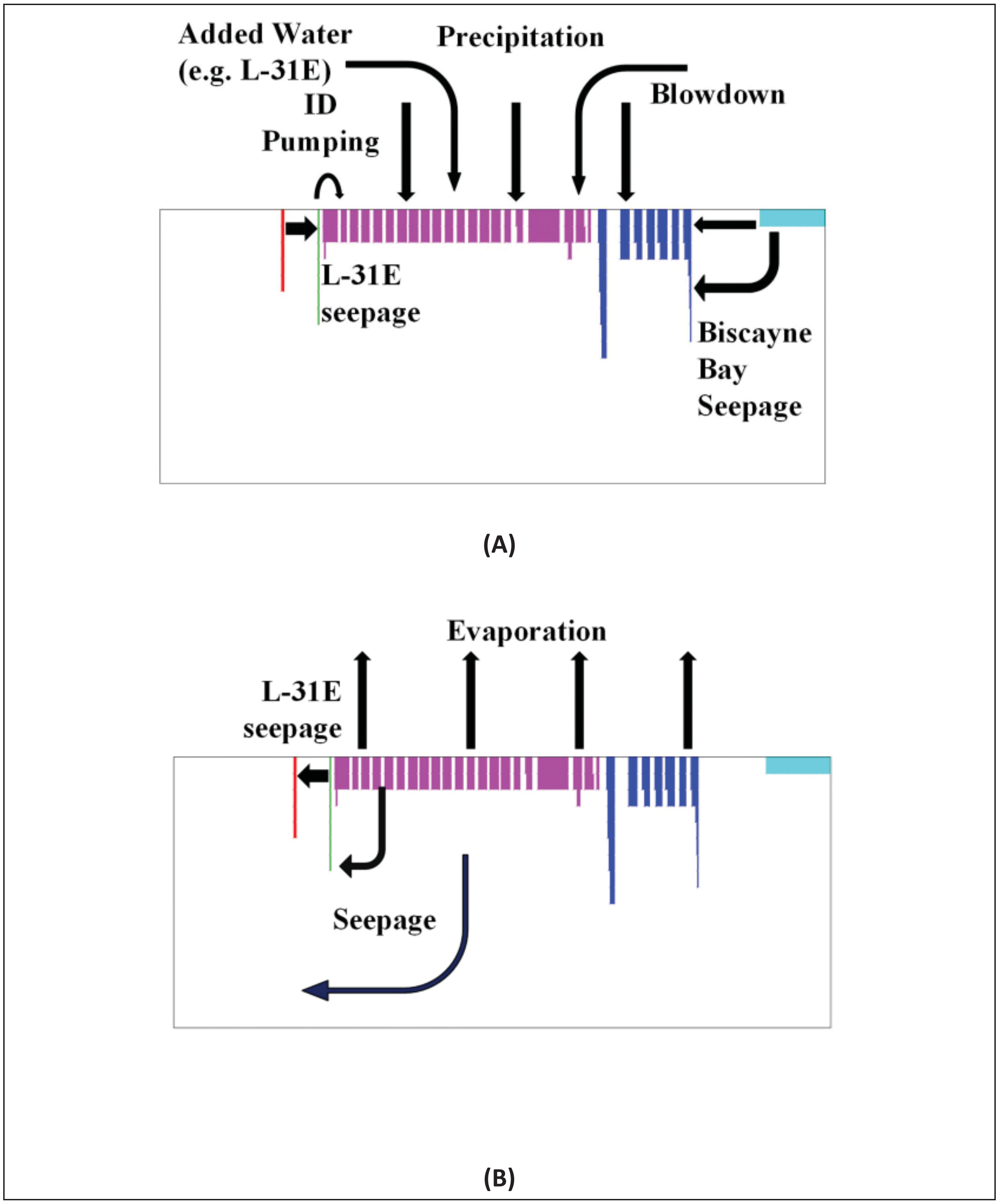

Figure 5.2-1. Flow into (A) and out of (B) the CCS, Shown in Cross-Section.

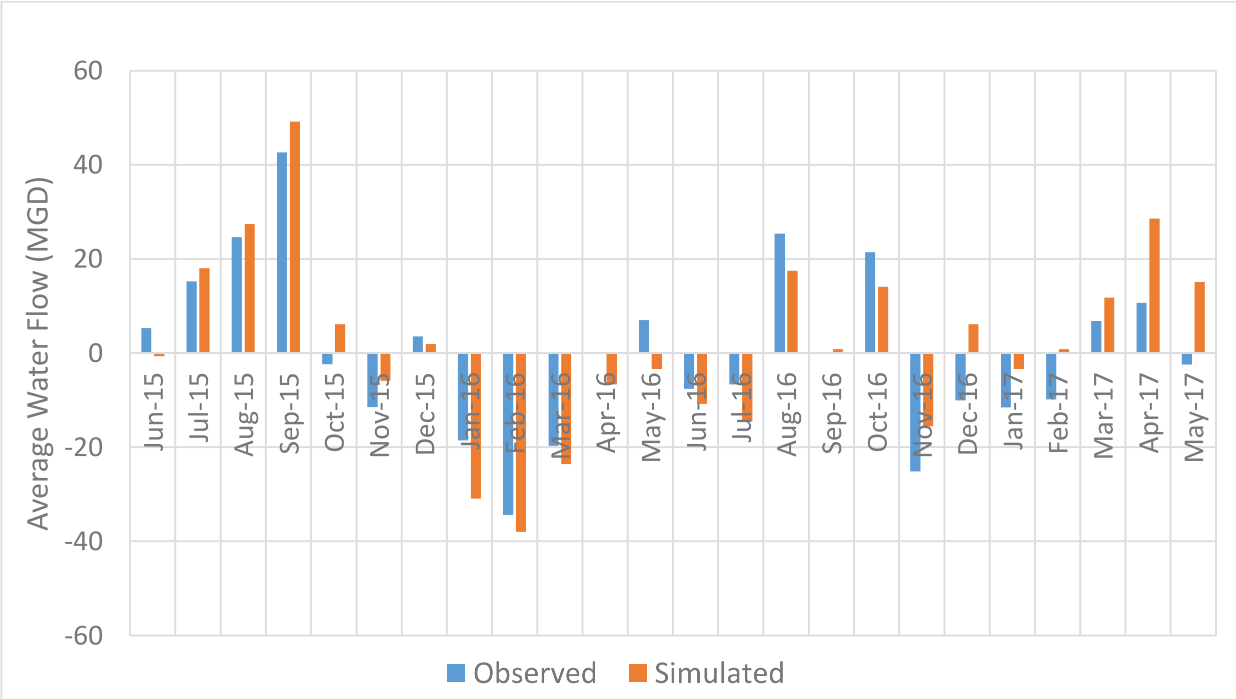

Figure 5.2-2. Modeled versus Measured Net Monthly Flows of Water for the CCS during the Period from June 2015 - May 2017.

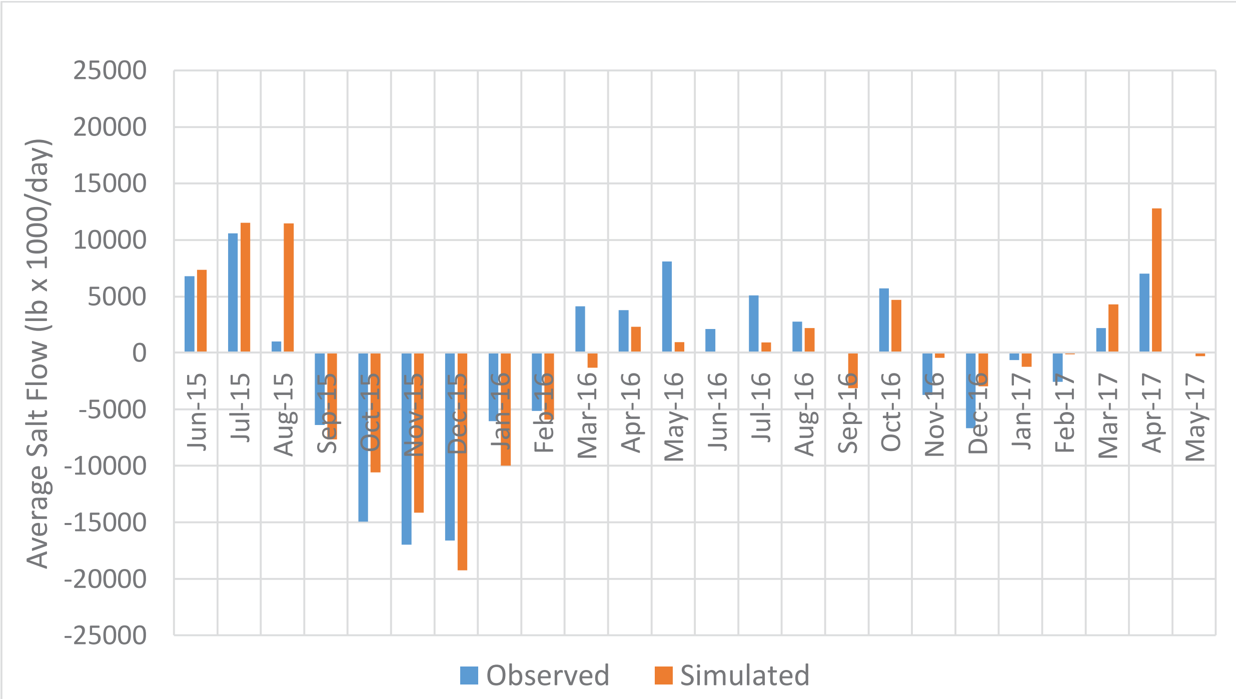

Figure 5.2-3. Modeled versus Measured Net Monthly Flows of Salt Mass for the CCS during the Period from June 2015 - May 2017.

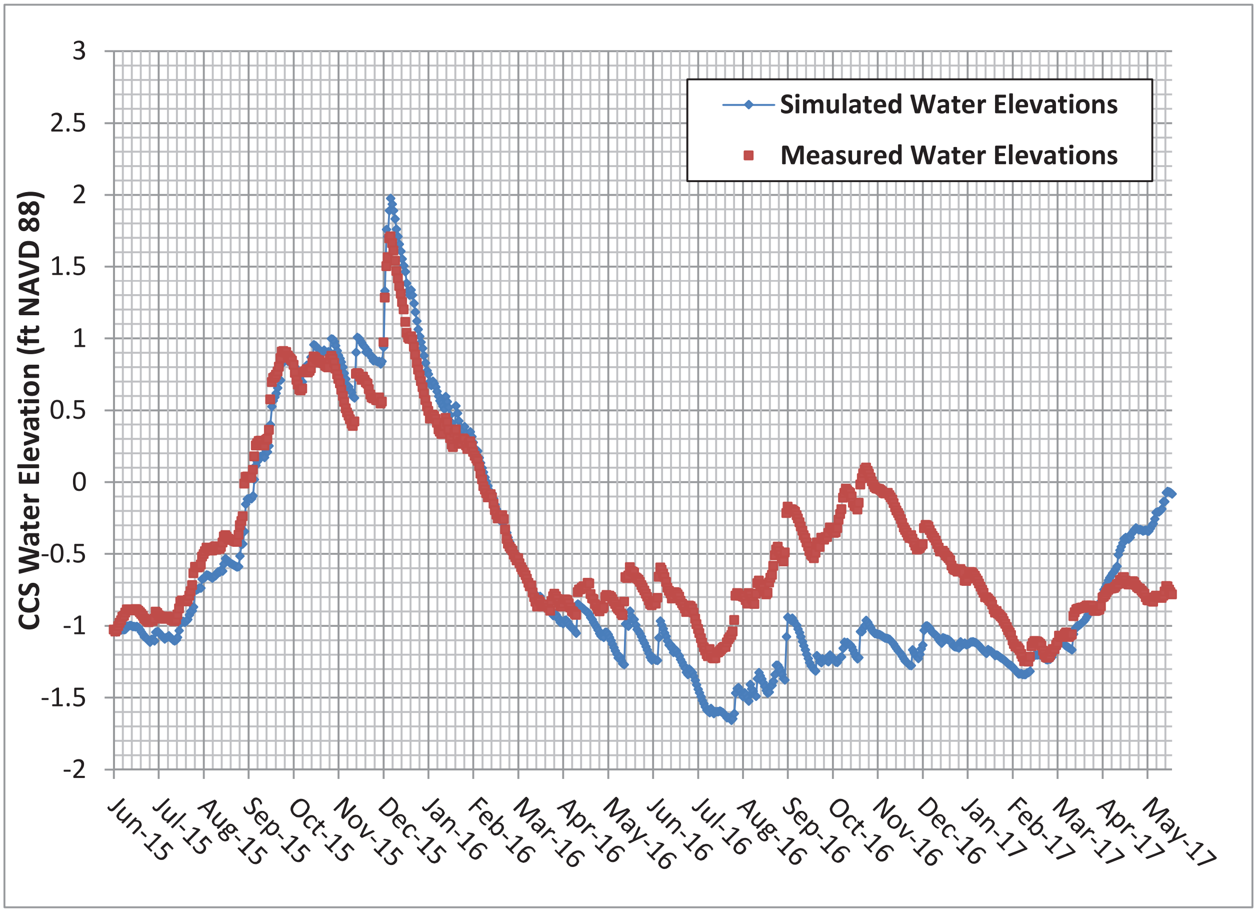

Figure 5.2-4. Modeled versus Measured Water Elevations (NAVD 88) in the CCS during the Reporting Period; Used to Validate the Conceptual Model and Calibrate the Water Balance Model to Temporal Trends in Water Elevation.

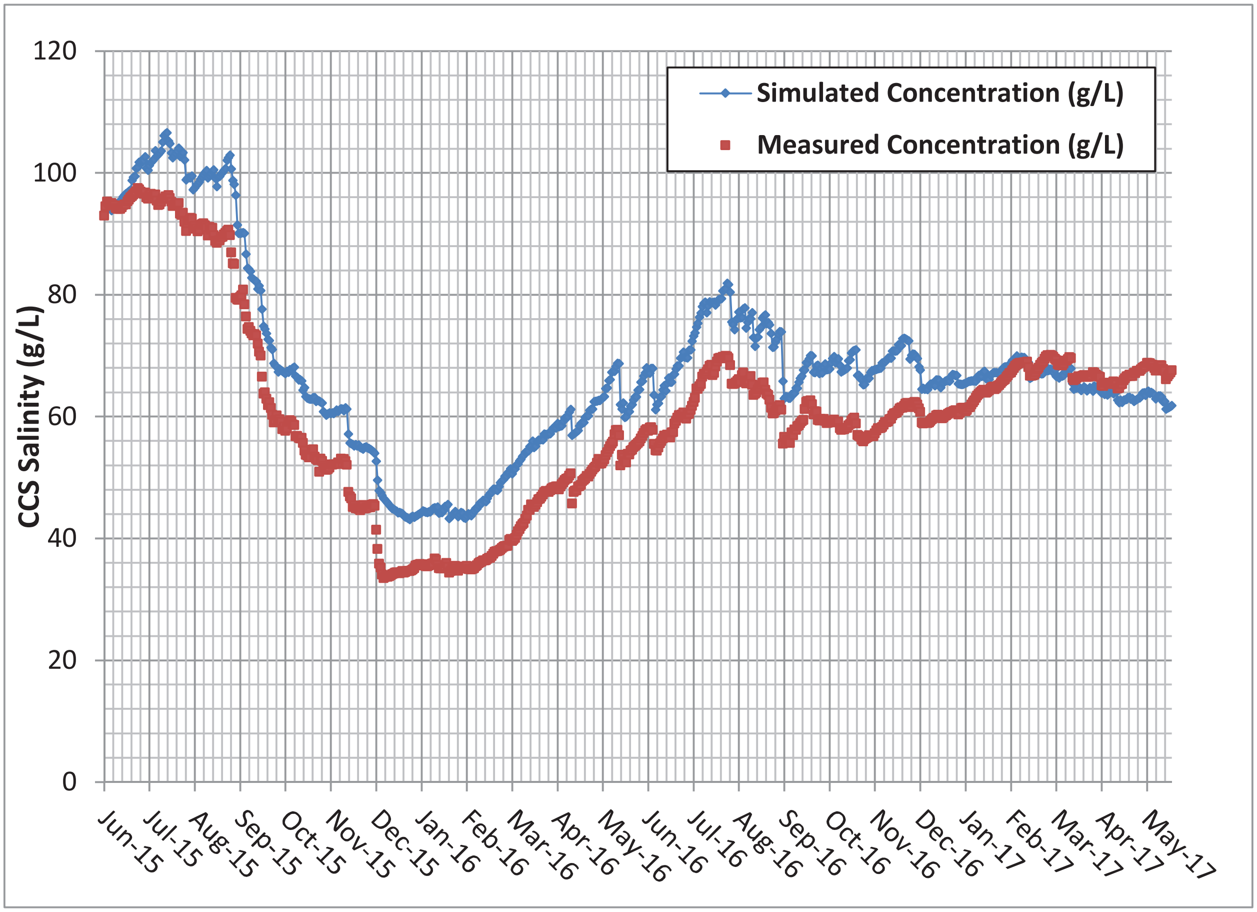

Figure 5.2-5. Modeled versus Measured Salinity in the CCS during the Reporting Period; Used to Validate the Conceptual Model and Calibrate the Water Balance Model to Temporal Trends in Salinity.

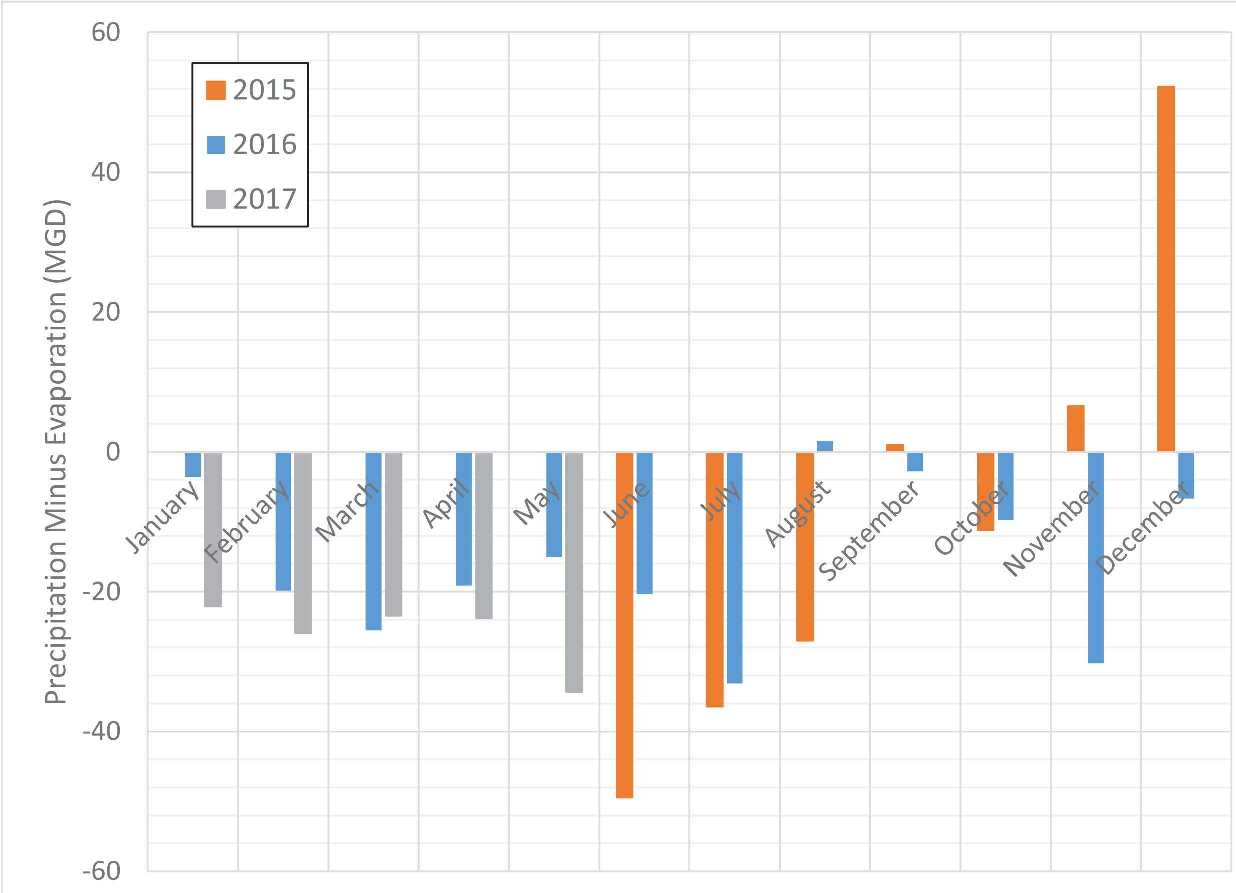

Figure 5.2-6. Modeled Monthly Differences between Precipitation and Evaporation (precipitation minus evaporation) for the 24-month Simulation.

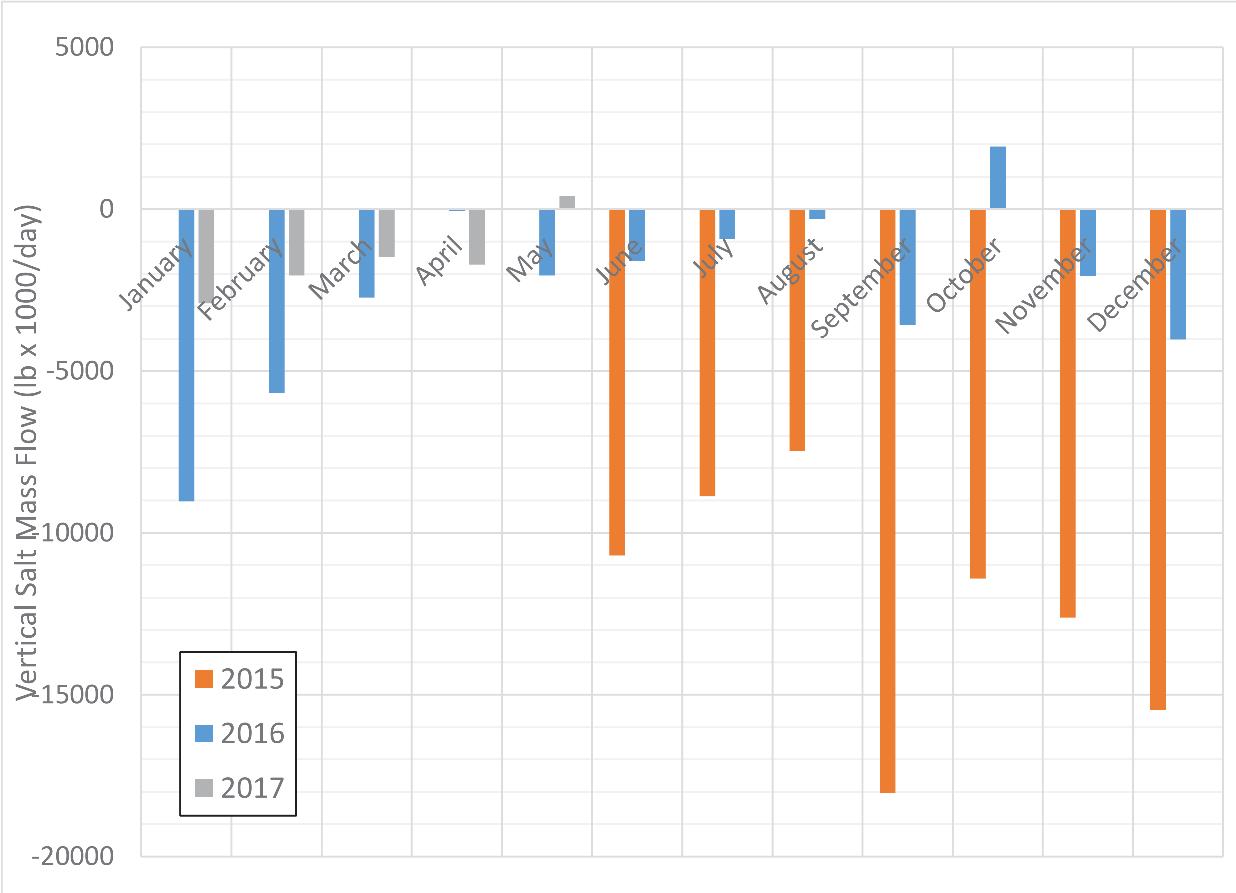

Figure 5.2-7. Modeled Monthly Vertical Salt Mass Seepage between the CCS and Biscayne Aquifer; Negative Values Indicate Seepage of Salt Mass out of the CCS.