MacVicar Consulting, Inc.
4524 West Gun Club Road, Suite 201, West Palm Beach FL 33415 Phone (561) 689-1708 Fax (561) 689-1026

BRIGHTON VALLEY PROJECT
WATER STORAGE AND TREATMENT ANALYSIS

Executive Summary

The proposed Brighton Valley Project is located in the Indian Prairie basin upstream of Lake Okeechobee and is bordered by the South Florida Water Management District (SFWMD) C41A and C-39A Canals and State Road 70 (Fig. 1). The project is a large-scale (8,200 acres) stormwater storage and treatment impoundment in a location that can receive local stormwater runoff as well as regulatory releases from Lake Istokpoga and Lake Okeechobee. Other potential inflow sources include local runoff from the C39A canal and stormwater from the Istokpoga Marsh Watershed Improvement District.

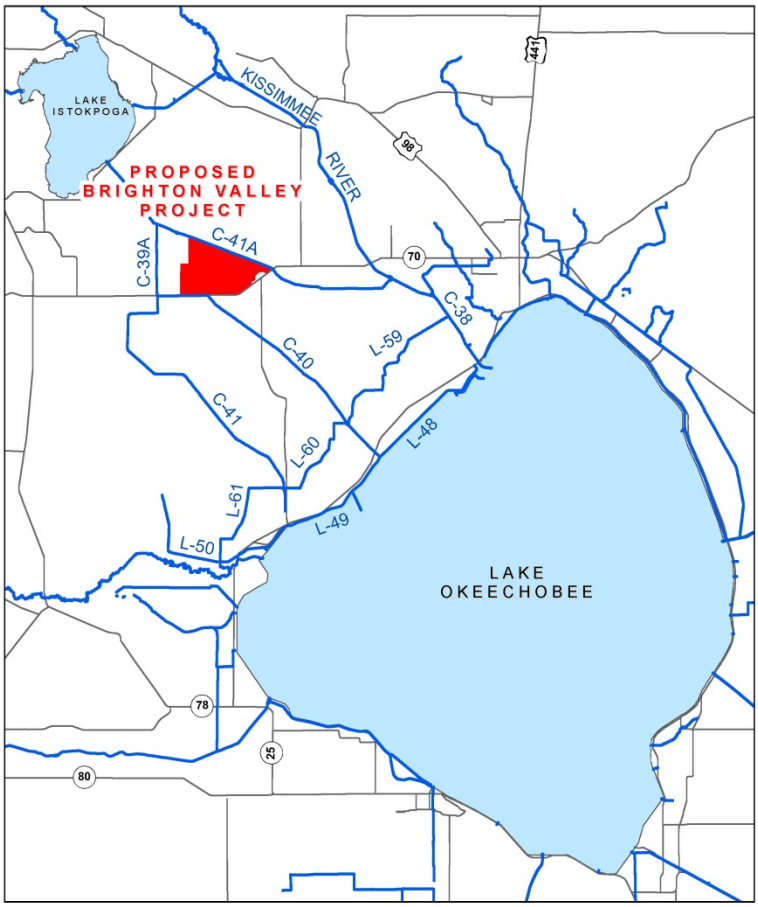


Figure 1. Location of the Brighton Valley Project.

The operational strategy evaluated in this analysis focuses on capturing runoff and filtering Lake Istokpoga releases from the C-41A Canal with an option of adding flow from the Kissimmee River and Lake Okeechobee when it is available. Similar to the operations of the West Water Hole, no water is diverted to the impoundment when the Lake Okeechobee stage is in, or below, the Base Flow Band. This avoids any reduction in water availability for users in the Lake Okeechobee Service Area during dry years and circulates water through the project only when Lake Okeechobee is discharging to tide.

This project is significantly different from the AquaFlorida Project proposed for the same location in 2001. That project was designed to optimize phosphorus removal from water already in Lake Okeechobee and required much higher capital and operating expenditures to achieve its objective. The current proposal is for a less intensive project that can be built for much less cost and can be enhanced later to meet changing objectives if desired.

An analytical tool was developed to perform daily flow routing through the project utilizing hydrologic data for the period 1994-2013 collected by the SFWMD. Table 1 summarizes the results of the simulations of three scenarios: (1) Process up to 560 cfs available in C-41A only, (2) supplement flow from (1) with up to 200 cfs pumped to C-41A from the Kissimmee River and Lake Okeechobee, and (3) increase (1) to 980 cfs. The results indicate that scenario 1 has the potential to treat 95,000 acre-feet from C-41A, reducing the phosphorus load to Lake Okeechobee by 11 tons per year. In the most recent year, 2013, Scenario 1 would have reduced phosphorus flow to the Lake by 19.7 tons. These scenarios are viewed as reasonable initial project configurations that would keep initial costs low while providing significant benefits. Based on the cost and performance of the initial project the project can be modified to process more water and provide additional benefits in the future. Project and modeling details for the proposed options are provided at the end of this report.

Table 1: Brighton Valley Analysis Results

All flows are average annual for 1994 to 2013	Inflow TP Conc. (ppb)	Scenario 1	Scenario 2	Scenario 3
C-41A Inflow Pump		560	560	980
C-38/Lake O Inflow Pump		0	200	0
C41A West Inflow (ac-ft)	**198**	6,751	6,740	6,621
C41A East Inflow (ac-ft)	**198**	22,789	22,679	20,828
Lake Istokpoga (ac-ft)	**103**	65,425	65,325	85,037
C-38/Lake O. Inflow (ac-ft)	**150**	0	7,234	0
Total Project Inflow (ac-ft)		94,965	101,978	112,486
Rainfall (ac-ft)		31,315	31,315	31,315
Total Project Outflow (ac-ft)		92,025	98,541	109,639
Loss[1] (ac-ft)		34,255	34,752	34,162
Total Inflow Load (mtons)		15.5	16.8	17.5
TP Removal[2] (mtons)		11.0	12.0	12.1
Note[1]	Losses are made up of ET throughout the model simulation and some end of simulation storage.			
Note[2]	Assumes outflow concentration of 40 ppb			

Background

Phosphorus concentration within Lake Okeechobee has doubled since the 1970's and the total inflow phosphorus load to the Lake is presently about 4 times the target load set by Florida Department of Environmental Protection (FDEP) and Environmental Protection Agency (EPA). FDEP is currently developing a Basin Management Action Plan for Lake Okeechobee with the goal of meeting the Lake Okeechobee Annual TMDL of 105 metric tons of phosphorus in surface water inflow from a currently assumed average annual load of 420 metric tons. The Indian Prairie / Lake Istokpoga sub watershed was identified as the second largest contributor to lake loading with 23% of the 420 metric tons coming from this basin. The initial Brighton Valley project would make a significant start toward the BMAP target in this sub-watershed, with the potential for much larger reductions in the future.

Preliminary Brighton Valley Project Modeling Summary

A daily stormwater routing model was developed to determine the water storage and treatment potential of the Brighton Valley Project. The model development steps are described below followed by example input and output. The model allows for the quick evaluation of differently sized inflow facilities, and multiple combinations of water sources. The model was applied to the West Waterhole project, located just south of the Brighton location, and predicted results very close to those observed since that project was initiated.

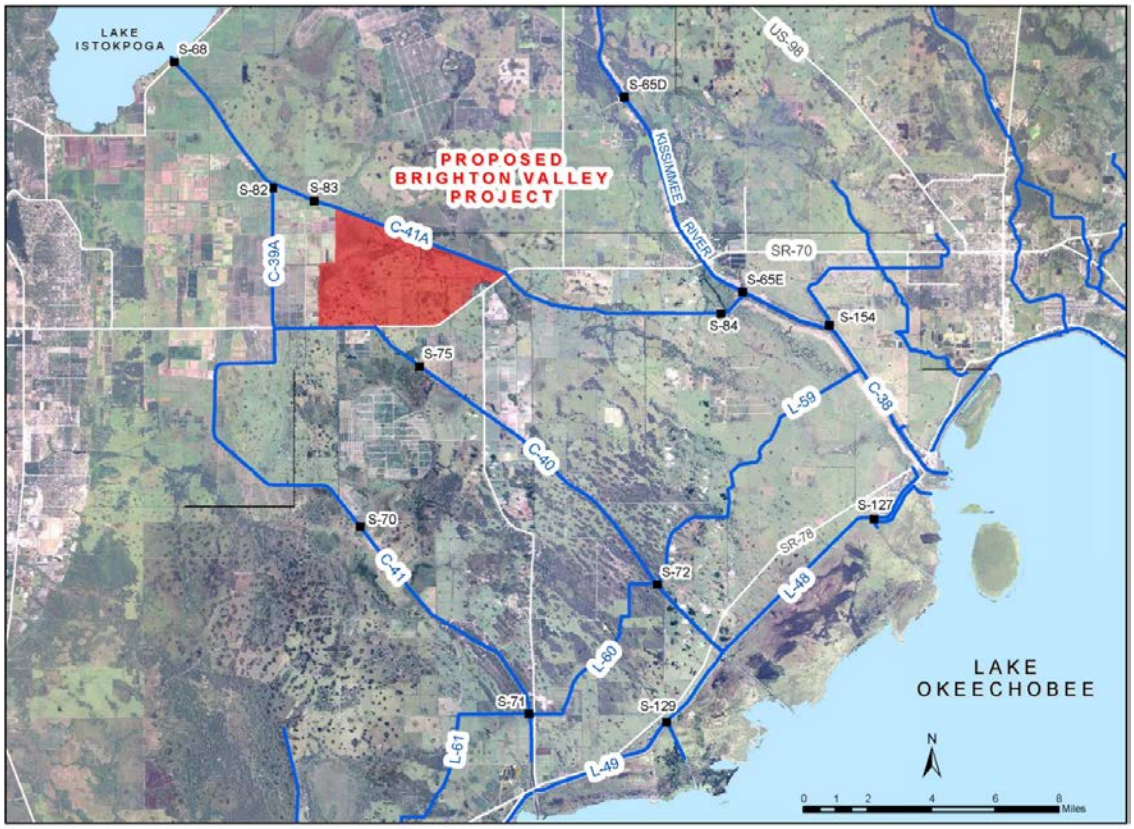


Figure 2. Project location and data sites used to develop routing model.

Figure 3 – Model results for Scenario 1

Brighton Valley Project

Model Input and Results

Inflow Capacities				
Brighton Valley North	8	36" Pump	560	cfs
Brighton Valley South	0	36" Pump	0	cfs
Supplemental KR/LO at S84	0	42" Pump	0	cfs
Outflow Weir Length	80	ft		

Average Annual

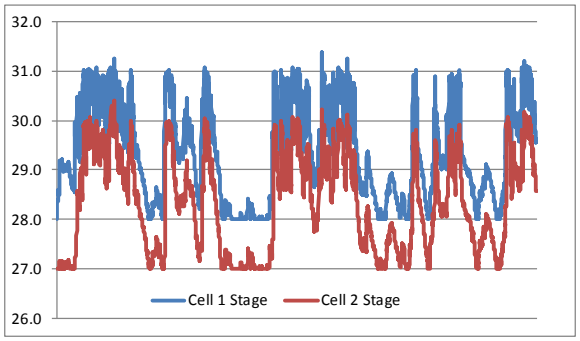
Sources	On/Off	Annual Inflow (acre*ft)	Long Term Concentration (ppb)	Annual Load (mtons)
C41A West Runoff	☑	6,751	198	1.6
C41A East Runoff	☑	22,789	198	5.6
L. Istok. Discharge	☑	65,425	103	8.3
KR/LO Supplemental	☐	-	150	-
Total North Inflow		94,965	133	15.5
C39A Supplemental	☐	-	571	-
Total		94,965	133	15.5
Total Outflow		92,025		

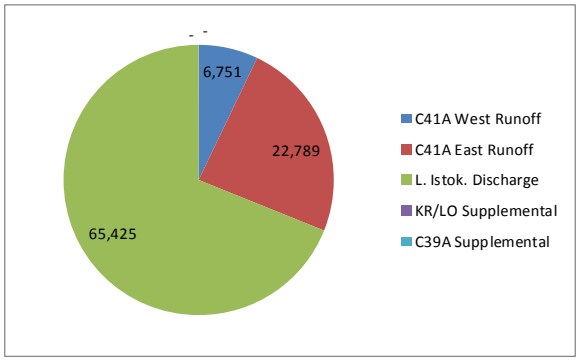
Treatment		
Hydraulic Loading Rate (m/year)	3.5	
Outflow Concentration	40	
Outflow Load (mtons)	4.5	
Removal (mtons)	11.0	
Average Annual Pumping		
Brighton Valley North	1,896	hours
Brighton Valley South	-	hours
Supplemental KR/LO at S84	-	hours
Hydraulic Residence Time	24	Days
Rainfall	31,315	acre*ft
ET	33,421	acre*ft

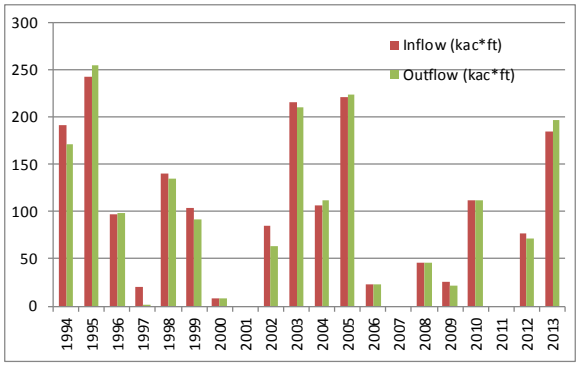
Calendar Year 2013

Sources	Inflow (acre*ft)	Long Term Concentration (ppb)	Annual Load (mtons)
C41A West Runoff	24,775	198	6.0
C41A East Runoff	46,845	198	11.4
L. Istok. Discharge	83,690	103	10.6
KR/LO Supplemental	-	150	-
Total North Inflow	155,311	147	28.1
C39A Supplemental	-	571	-
Total	155,311	147	28.1
Total Outflow	169,580		

Treatment		
Hydraulic Loading Rate (m/year)	5.8	
Outflow Concentration	40	
Outflow Load (mtons)	8.4	
Removal (mtons)	19.7	







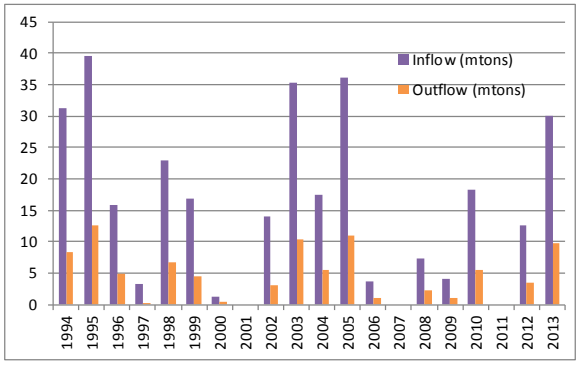


Figure 4 – Model results for Scenario 2

Brighton Valley Project

Model Input and Results

Inflow Capacities				
Brighton Valley North	8	36" Pump	560	cfs
Brighton Valley South	0	36" Pump	0	cfs
Supplemental KR/LO at S84	2	42" Pump	200	cfs
Outflow Weir Length	80	ft		

Average Annual

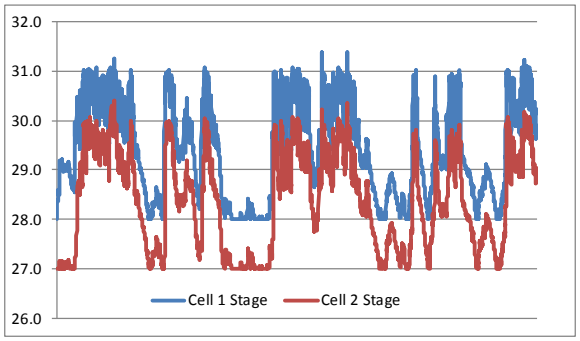
Sources	On/Off	Annual Inflow (acre*ft)	Long Term Concentration (ppb)	Annual Load (mtons)
C41A West Runoff	☑	6,740	198	1.6
C41A East Runoff	☑	22,679	198	5.5
L. Istok. Discharge	☑	65,325	103	8.3
KR/LO Supplemental	☑	7,234	150	1.3
Total North Inflow		101,976	134	16.8
C39A Supplemental	☐	-	571	-
Total		101,976	134	16.8
Total Outflow		98,541		

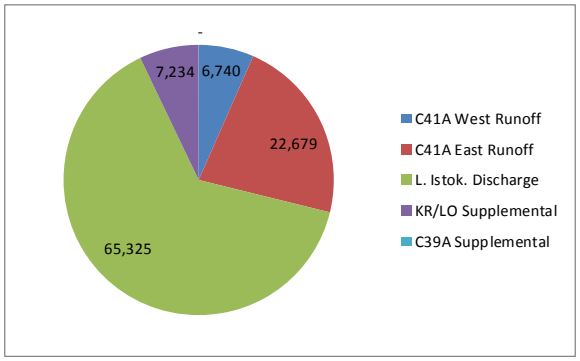
Treatment		
Hydraulic Loading Rate (m/year)	3.8	
Outflow Concentration	40	
Outflow Load (mtons)	4.9	
Removal (mtons)	12.0	
Average Annual Pumping		
Brighton Valley North	2,038	hours
Brighton Valley South	-	hours
Supplemental KR/LO at S84	413	hours
Hydraulic Residence Time	24	Days
Rainfall	31,315	acre*ft
ET	33,745	acre*ft

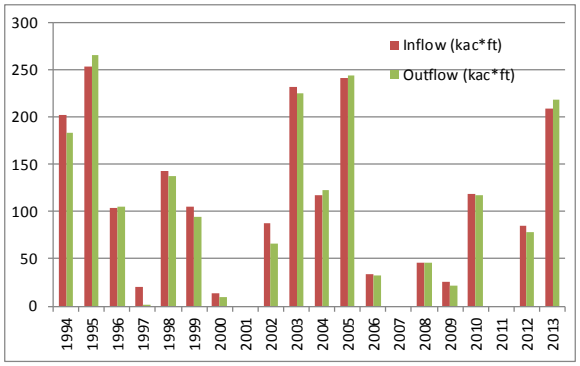
Calendar Year 2013

Sources	Inflow (acre*ft)	Long Term Concentration (ppb)	Annual Load (mtons)
C41A West Runoff	24,775	198	6.0
C41A East Runoff	46,845	198	11.4
L. Istok. Discharge	83,690	103	10.6
KR/LO Supplemental	10,312	150	1.9
Total North Inflow	165,622	147	30.0
C39A Supplemental	-	571	-
Total	165,622	147	30.0
Total Outflow	177,788		

Treatment		
Hydraulic Loading Rate (m/year)	6.2	
Outflow Concentration	40	
Outflow Load (mtons)	8.8	
Removal (mtons)	21.3	







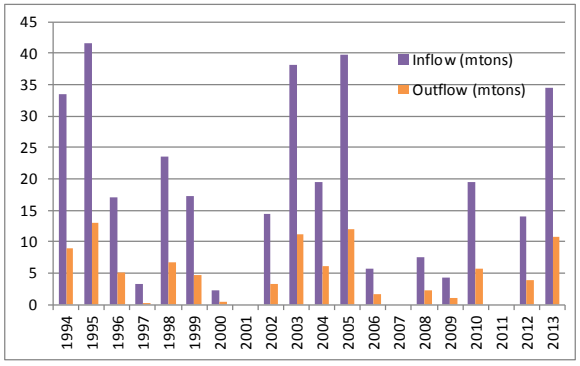


Figure 5 – Model results for Scenario 3

Brighton Valley Project

Model Input and Results

Inflow Capacities				
Brighton Valley North	14	36" Pump	980	cfs
Brighton Valley South	0	36" Pump	0	cfs
Supplemental KR/LO at S84	0	42" Pump	0	cfs
Outflow Weir Length	100	ft		

Average Annual

Sources	**On/Off**	**Annual Inflow (acre*ft)**	**Long Term Concentration (ppb)**	**Annual Load (mtons)**
C41A West Runoff	☑	6,621	198	1.6
C41A East Runoff	☑	20,828	198	5.1
L. Istok. Discharge	☑	85,037	103	10.8
KR/LO Supplemental	☐	-	150	-
Total North Inflow		112,487	126	17.5
C39A Supplemental	☐	-	571	-
Total		112,487	126	17.5
Total Outflow		109,639		

Treatment		
Hydraulic Loading Rate (m/year)	4.2	
Outflow Concentration	40	
Outflow Load (mtons)	5.4	
Removal (mtons)	12.1	

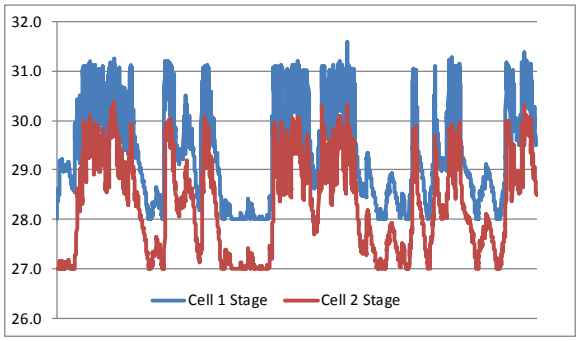
Average Annual Pumping		
Brighton Valley North	1,277	hours
Brighton Valley South	-	hours
Supplemental KR/LO at S84	-	hours
Hydraulic Residence Time	19	Days

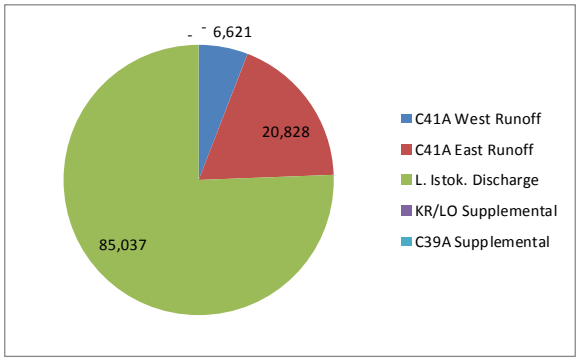
Rainfall	31,315	acre*ft
ET	33,344	acre*ft

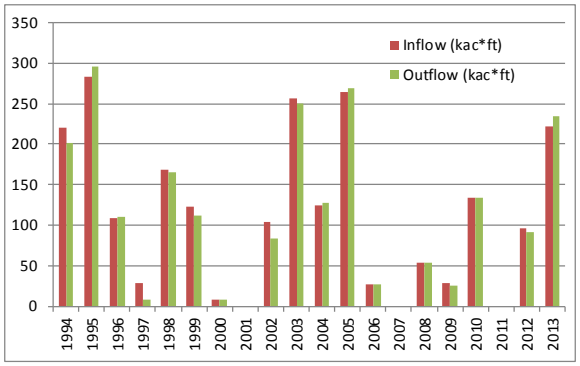
Calendar Year 2013

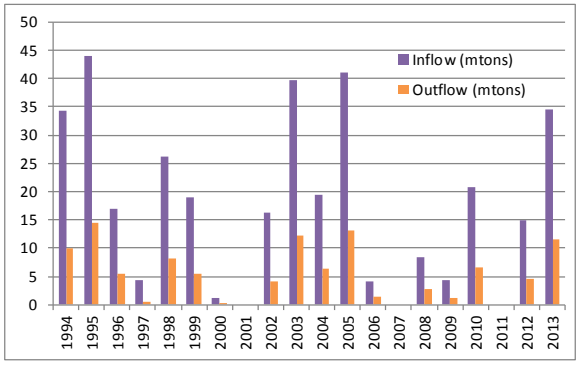
Sources	**Inflow (acre*ft)**	**Long Term Concentration (ppb)**	**Annual Load (mtons)**
C41A West Runoff	24,636	198	6.0
C41A East Runoff	47,216	198	11.5
L. Istok. Discharge	120,739	103	15.3
KR/LO Supplemental	-	150	-
Total North Inflow	192,591	138	32.9
C39A Supplemental	-	571	-
Total	192,591	138	32.9
Total Outflow	206,834		

Treatment		
Hydraulic Loading Rate (m/year)	7.2	
Outflow Concentration	40	
Outflow Load (mtons)	10.2	
Removal (mtons)	22.7	









Model Development

Data Set for Evaluation: Data was compiled from the following sources:

DBHYDRO:

Daily Flow at S68, S82, S83, S84, S75, S70, S71 & S72.
Daily Lake Okeechobee Stage.
Daily Rainfall and ET at S75.

South Florida Water Management Model (SFWMM):

Rainfall and ET at the approximate center of Brighton Valley.

Lake Okeechobee Operations Screening Model (LOOPS):

LORS08 bands and simulated lake stage from 1993-2005.

2014 Draft SFER Table 8-8:

Ten year average TP concentration data by basin.

Model Setup. The analysis period of 1994 through 2013 was selected based on the availability of a complete record of measured flow at the District structures.

Data was combined as follows for model input:

Flow: Observed DBHYDRO 1994 to 2013

Rain and ET: South Florida Water Management Model input file for 1994 to 2002, and measured data from the S75 weather station for 2002 to 2013

Lake Stage: Lake Okeechobee Operations Screening Model (LOOPS) was used for 1994 to 2006, Actual data from DBHYDRO was used for 2006 to 2013. The actual Lake stage for years prior to 2007 was not used since a different Lake Schedule was in operation. Since the current Lake schedule was adopted in 2008 the LOOPS model simulation of the current schedule was used to simulate the Lake stage had the current schedule been in effect for WY 1993 through 2006.

LORS08 Bands: LOOPS 1994 to 2013 for the current schedule were used to identify periods when project operations would be restricted.

Project Inflow: Potential inflow sources were compiled on a daily basis based on the following logic (all constrained to greater than or equal to zero):

C41A West Runoff = $Q_{S82} + Q_{S83} - Q_{S68}$

C41A East Runoff = $Q_{S84} - Q_{S83}$

Lake Istokpoga Discharge = When flow at S68 > 0 then the minimum of (Q_{S68}, $Q_{S82} + Q_{S83}$, $Q_{S84} + Q_{S71} + Q_{S72}$) to exclude irrigation releases

Kissimmee River and Lake Okeechobee. When flow at S84 has been zero for a specified number of days then flow to the Brighton Project = the westward pump capacity at S84

C39A (South inflow). When local runoff is available then the flow to Brighton from C39A = Q_{S75} – West Waterhole Capacity (ultimately determined to be a less efficient option)

The Brighton Valley project was modeled with the following assumptions:

Maintain depth below 3'

No project inflow from any source when Lake Okeechobee is in, or below, the base flow sub band

Prioritize north inflow as follows up to the specified inflow capacity when storage capacity in the project is available:

C41East Runoff ➔C41A West Runoff ➔Lake Istokpoga ➔Kissimmee River/Lake Okeechobee

South inflows up to specified capacity (not used in Scenarios 1 to 3)

Model input and output is shown in the following figures for Scenarios 1 to 3.

Through the evaluation of the many possible scenarios available, it was determined that adding pumps to the north inflow was more efficient and eliminated some engineering challenges of bringing water into the project from the C39A canal. Also, increasing potential inflows by adding Lake Okeechobee as a source can supplement treatment volume when local flows are not available without adding burdensome logistics. Details for the three scenarios presented in the introductory table are shown in Figures 3 to 5.