Technical Publication

ERA #434

Water Budget Analysis for Stormwater Treatment Area 1 West

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By

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EXECUTIVE SUMMARY

Stormwater Treatment Area 1 West (STA-1W) is a constructed wetland that is part of the Everglades Construction Project mandated by Florida's Everglades Forever Act (Section 373.4592, Florida Statutes [F.S.]). STA-1W was built as an expansion of the Everglades Nutrient Removal (ENR) Project, a constructed wetland to demonstrate the effectiveness of phosphorus (P) removal from agricultural runoff/drainage. The ENR Project was operated for five years (1994 to 1999), and STA-1W started operation on July 1, 1999. STA-1W currently covers 2,772 hectares (ha) (6,847 acres [ac]) and is located in South Florida (26° 38' N, 80° 25' W) at the eastern edge of the Everglades Agricultural Area (EAA). The EAA, with an approximate area of 223,855 ha (552,922 ac) under agriculture (Redfield et al., 1999), is a highly productive irrigation drainage basin with a major production of sugarcane. Ecological changes in the Everglades have been partially attributed to an increase in P concentrations in the inflow waters. Local, state and federal initiatives have been taken to reduce P loads from agricultural runoff/drainage. Water from the agricultural area flows to the south and southeast through four primary canals: Miami, North New River, Hillsboro, and West Palm Beach. The West Palm Beach canal, which carries runoff/drainage from the agricultural area and Lake Okeechobee releases, is the inflow source for STA-1W.

A minimum of 25 percent of the P load from the EAA is required to be removed at the basin level through the application of various agricultural Best Management Practices (BMPs) (Whalen and Whalen, 1994). Further removal of P is to be achieved through constructed wetland systems, known as Stormwater Treatment Areas (STAs), to an initial outflow total P concentration of 0.05 milligrams per liter (mg L^{-1}). STA-1W is one of the large-scale constructed wetlands that followed the successful operation of the ENR Project. This report presents the sixth annual water budget for STA-1W. Water budget analyses for five years of the ENR Project and five years of STA-1W were reported in the South Florida Water Management District's (SFWMD's) technical publications (Guardo et al., 1996; Abtew and Mullen, 1997; Abtew and Downey, 1998; Abtew et al., 2000; Abtew et al., 2001; Abtew et al., 2002; Abtew and Reardon, 2003 and Abtew, 2004).

The total inflow into STA-1W through the inflow spillway for the study period was 42,075 hectare-meters (ha-m) (341,094 acre-feet [ac-ft]), and the total outflow through the outflow pumps was 47,326 ha-m (383,663 ac-ft). Estimated seepage inflow from the L-7 levee through the roadside culverts was 305 ha-m (2,477 ac-ft). The seepage recirculation pump had a total flow of 1,863 ha-m (15,104 ac-ft). The areal average rainfall for the study period was 106.4 centimeters (cm), or 41.9 inches (in), and the total areal average evapotranspiration (ET) was 128.7 cm (50.7 in). A comparison with the previous six years of water budget shows that the surface water inflow for this period was the second largest, which indicates a second highest hydraulic loading during this period. The sum of the errors and unknowns (remainders) was 5,166 ha-m (41,880 ac-ft), which represents 10% percent of the total inflow into the system. Rainfall (6% percent) and ET (7% percent) comprise a small fraction of the current mass balance.

The mean hydraulic loading rate for the study period, based on the daily average inflow, was 4.2 centimeters per day (cm d^{-1}), (1.65 inches per day [in d^{-1}]). The mean hydraulic retention time was 10.1 days and was computed as the ratio of the mean estimated volume of STA-1W and the average of inflow and outflow. The mean estimated volume was computed using the area-weighted (by cell) mean depth of 45 cm (17.7 in) and total area of 2,772 ha (6,847 ac). Due to construction work, Cell 2, Cell 4 and Cell 5 were at times offline during the water year (Pietro et al., 2005). When a cell is offline, it results in reduction of effective treatment area and retention time.

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LIST OF ABBREVIATIONS AND ACRONYMS

ac	acre
ac-ft	acre-feet
BMP	Best Management Practice
cm	centimeter
cm d^{-1}	centimeter per day
cfs	cubic feet per second
EAA	Everglades Agricultural Area
ENR	Everglades Nutrient Removal
ET	Evapotranspiration
ft	feet
ha	hectare
ha-m	hectare-meter
HW	headwater
in	inch
in d^{-1}	inch per day
m^3S^{-1}	cubic meter per second
MAX	maximum
MIN	minimum
mm	millimeter
NGVD	National Geodetic Vertical Datum
P	phosphorus
Q	discharge
rpm	revolutions per minute
SFWMD	South Florida Water Management District
STA	Stormwater Treatment Area
TW	Tailwater
UVM	Ultrasonic Velocity Meter
WCA	Water Conservation Area

CONVERSION FACTORS

Metric	English
mm	0.03937 inch
cm	0.3937 inch
mm	3.2808 ft
ha	2.47 ac
ha-m	8.1068 ac-ft

ACKNOWLEDGEMENTS

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INTRODUCTION

Background

Stormwater Treatment Area 1 West (STA-1W) is a constructed wetland that is part of the Everglades Construction Project (ECP) mandated by Florida's Everglades Forever Act (EFA) (Section 373.4592, Florida Statutes [F.S.]). STA-1W was built as an expansion of the Everglades Nutrient Removal (ENR) Project, a constructed wetland to demonstrate the effectiveness of phosphorus (P) removal from agricultural runoff/drainage. The ENR operated for five years (1994 to 1999), and STA-1W started operation on July 1, 1999. STA-1W covers 2,772 hectares (ha) (6,847 acres [ac]) and is located in South Florida (26° 38' N, 80° 25' W) at the eastern edge of the Everglades Agricultural Area (EAA). The area of STA-1W after enhancement is 6,670 acres (2700 ha). The EAA is approximately a 223,855 ha (552,922 ac) (Redfield et al., 1999), highly productive irrigation drainage basin with a major production of sugarcane. Ecological changes in the Everglades have been partially attributed to an increase in P concentrations in the inflow waters. Local, state and federal initiatives have been taken to reduce P loads from agricultural runoff/drainage. Water from the agricultural area flows to the south and southeast through four primary canals: Miami, North New River, Hillsboro and West Palm Beach.

A minimum of 25 percent of the P load from the EAA is required to be removed at the basin level through the application of various agricultural Best Management Practices (BMPs) (Whalen and Whalen, 1994). Further removal of P is to be achieved through constructed wetland systems, known as Stormwater Treatment Areas (STAs), to an interim outflow total P concentration of 0.05 milligrams per liter (mg L^{-1}). STA-1W is one of six large-scale constructed wetlands that followed the successful operation of the ENR Project (Figure 1). This report presents the sixth annual water budget for STA-1W (May 1, 2004 to April 30, 2005). Water budget analyses for five years of the ENR Project and five years of STA-1W were reported in the South Florida Water Management District's (SFWMD's) technical publications (Guardo et al., 1996; Abtew and Mullen, 1997; Abtew and Downey, 1998; Abtew et al., 2000; Abtew et al., 2001; Abtew et al., 2002; Abtew and Reardon, 2003 and Abtew, 2004).

Site Description

A survey of the ENR Project indicated that the area is primarily covered by Okeechobee muck soils where one to two meters of peat overlies several meters of carbonate rock (Jammal and Associates, Inc., 1991). The topography of STA-1W is relatively flat, with an average elevation of 2.99 meters (m) (9.8 feet [ft]) National Geodetic Vertical Datum (NGVD). To the east, the L-7 levee separates STA-1W from the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Water Conservation Area 1 [WCA-1]). The seepage canal runs along the northern perimeter and the discharge canal on the west separates STA-1W from agricultural land. The narrow southern ENR levee separates STA-1W from the discharge area into WCA-1. STA-1W consists of five cells: cells 1, 2, 3, 4 and 5. Cells 1 and 3, and cells 2 and 4 (in series) comprise two parallel treatment trains of cells incorporated from the previous ENR. As shown in Figure 2a, the largest cell, Cell 5, has been added to the north and operates parallel to the other cells. The area and average ground elevation for each cell before the enhancement and reconfiguration of the cells are presented in Table 1a.

Enhancement of STA-1W and reconfiguration of the cells is underway. Changes in area are made to the initial configuration Cell 1, Cell 2, cell 4, Cell 5A and Cell 5B. The modification will result in eight cells (1A, 1B, 2A, 2B, 3, 4, 5A and 5B). By June 2005, Cell 2 was split into Cell 2A and 2B. Completion of the project is in November 2006, although the remaining cell division is expected to be completed by June 2006 (Kevin Snell, 2005, personal communication). Table 1b depicts cell by cell area and ground elevation after enhancement. Figure 2b depicts the new Cell configuration and major structures of STA-1W.

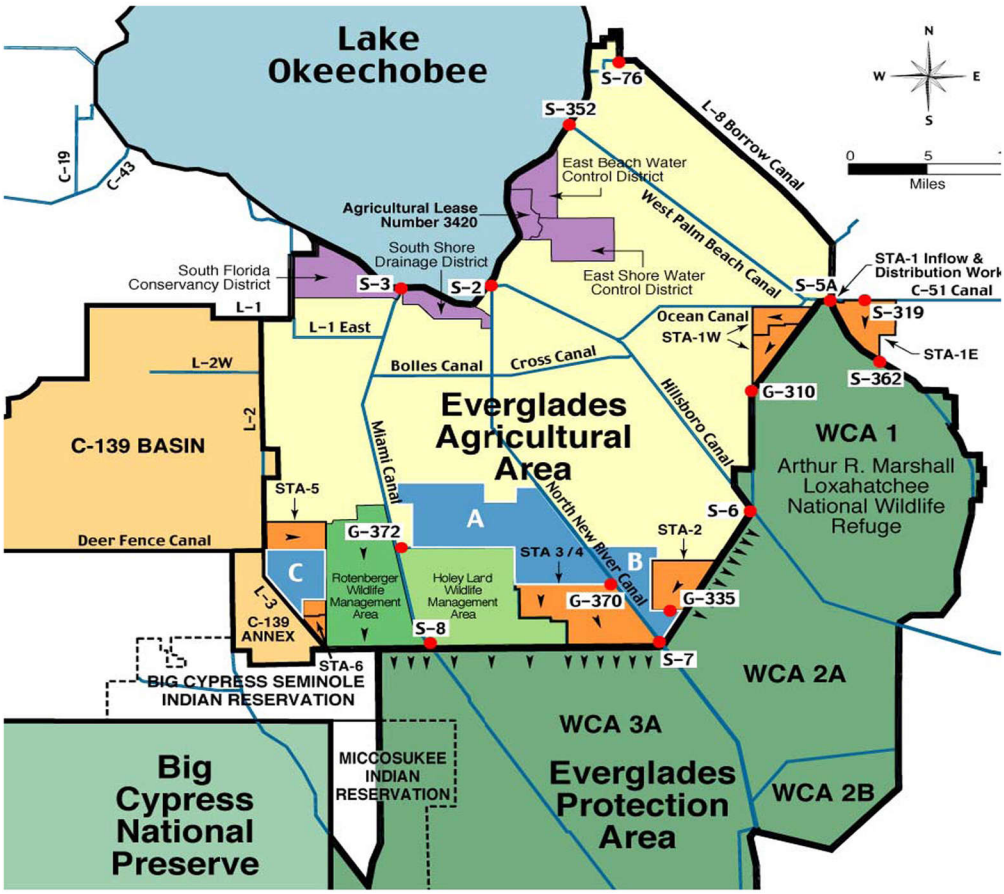

Figure 1. Location of Stormwater Treatment Area 1 West

Table 1a. Site characteristics of STA-1W

Cell	Area		Average gound elevation	
	ha	ac	m NGVD	ft NGVD
Cell 1	580	1,433	3.13	10.27
Cell 2	414	1,023	2.94	9.65
Cell 3	404	998	3.10	10.17
Cell 4	146	361	3.00	9.84
Cell 5	1,228	3,033	2.90	9.51
Total	**2,772**	**6,847**		
Average			**2.99**	**9.80**

Table 1b. Site characteristics of STA-1W after enhancement

Cell	Area		Average ground elevation	
	ha	ac	m NGVD	ft NGVD
Cell 1A	302	745	3.13	10.27
Cell 1B	302	745	3.13	10.27
Cell 2A	191	471	2.94	9.65
Cell 2B	190	470	2.94	9.65
Cell 3	415	1026	3.10	10.17
Cell 4	145	358	3.00	9.84
Cell 5A	228	562	2.90	9.51
Cell 5B	928	2293	2.90	9.51
Total	**2700**	**6670**		
Average			**3**	**10**

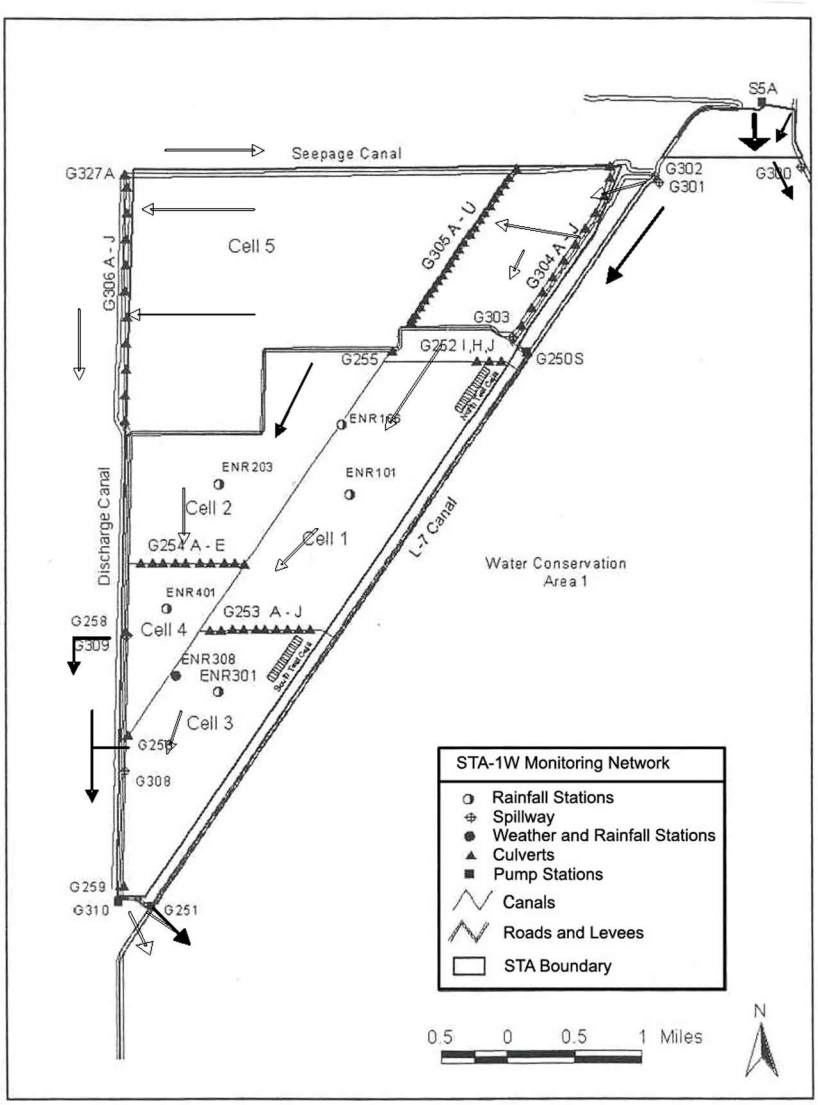

Figure 2a. STA-1W structures and monitoring network

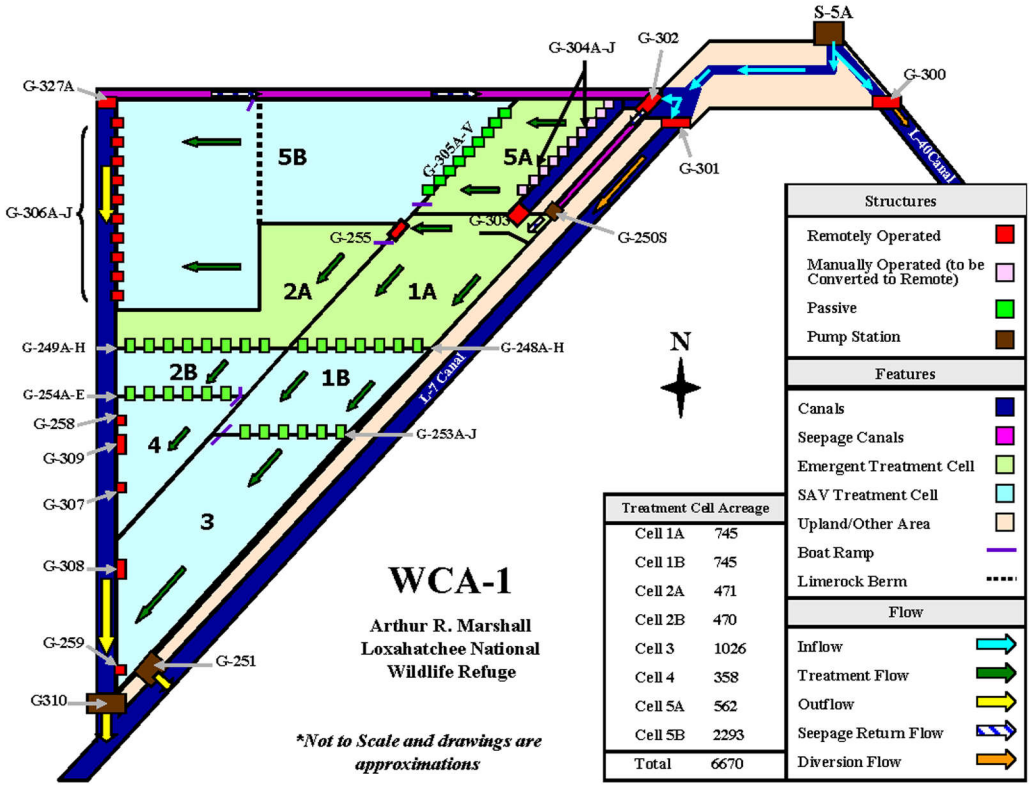

Figure 2b. STA-1W with new cell configuration and structures

Vegetation Cover

At STA-1W, vegetation cover generally varies from cell to cell and coverage changes with time. Cell 1 is covered mostly with emergent vegetation dominated by cattail (*Typha* spp.), but Cell 1 also contains significant coverage of submerged aquatic vegetation (SAV). A portion of Cell 1 contains the floating aquatics: water hyacinth (*Eichhorina crassipes*) and water lettuce (*Pistia stratiotes*) as well as leather fern (*Acrostichum* sp.), carolina willow (*Salix caroliniana*) and primrose willow (*Ludwigia* sp.). Cell 2 is mostly covered with floating islands that contain leather fern, carolina willow, primrose willow and cattail, but this cell also contains significant coverage of SAV and periphyton. Cell 2 contains the floating aquatics water hyacinth and water lettuce. Cell 3 is mostly covered with emergent vegetation dominated by cattail, but also contains significant coverage of pickerelweed (*Pontederia cordata*), arrowhead (*Sagittaria latifolia*), duck potato (*Sagittaria lancifolia*), spikerush (*Eleocharis* sp.) and carolina willow. Cell 4 is covered with SAV dominated by southern naiad (*Najas guadalupensis*), coontail (*Ceratophyllum demersum*), and pondweed (*Potamogeton illinoensis*) with naturally occurring periphyton. Cell 5A (eastern) is covered with mixed vegetation containing cattail, southern naiad, the floating aquatics water hyacinth and water lettuce. Cell 5B (western) is covered with submerged aquatic vegetation dominated by southern naiad, coontail and hydrilla (*Hydrilla verticillata*) with naturally occurring periphyton. Also, small amounts of cattail and water hyacinth are present in this cell (Neil Larson, SFWMD, personal communication, 2003).

SYSTEM HYDRAULICS AND OPERATION

System Hydraulics

STA-1W Inflow and Distribution

Water from West Palm Beach Canal (C-51) that previously was pumped into the Refuge (WCA-1) via the S5A pump station and flowed through the Refuge is presently diverted to STA-1W. A small portion of the area of WCA-1 near the S5A pump station is levied and forms the STA-1W inflow and distribution (STA-1 Inflow Basin) that serves as a storage area to divert water into STA-1W and into STA-1E (upon completion). There are two former and four new water control structures in the STA-1 I&D. The S5A pump station delivers water from C-51 (West Palm Beach Canal); the S5AS spillway controls WCA-1 inflow and outflow at the junction of L-8 and C-51. The junction has culvert structures S5AW and S5AE. The four spillway structures are G300, G301, G302 and G311.

G300 is a two-bay, reinforced concrete, U-shaped spillway with vertical lift gates installed on the crest of ogee-shaped weirs. The purpose of this structure is to bypass flows from the STA-1 Inflow Basin area into the L-40 borrow canal that runs along the eastern edges of WCA-1. G301 is a three-bay, reinforced concrete, U-shaped spillway with vertical lift gates on weirs. The purpose of this structure is to bypass flow from the STA-1 Inflow Basin area into WCA-1 along the L-7 borrow canal on the western edge of WCA-1. G302 is a fixed-crest, concrete ogee spillway equipped with two vertical lift gates each of which are 6 m (20 ft) wide. The purpose of this structure is to supply inflow to the five cells of STA-1W from the STA-1 Inflow Basin area. G302 has a capacity of 92 cubic meters per second ($m^3 s^{-1}$) (3,250 cubic feet per second [cfs]). G311 is designed as a three-bay, reinforced concrete spillway with lift gates on weirs. The purpose of this structure is to supply water from the STA-1 Inflow Basin area to STA-1E, which is currently under construction. It can also transfer water from STA 1-E to STA 1-W via the inflow basin when needed. Current structure information for the STA-1W stations is provided in Table 2. Structure locations are shown in Figure 2a. After completion of the modification, an updated structure table will be provided in the coming year water budget publication.

STA-1W Inflow, Internal, and Discharge Structures

The supply canal to STA-1W is about 2.72 kilometers (km) (1.7 miles [mi]) long, extending between the inflow structure G302 and the flow-control structures into cells 1, 3, 2 and 4 (G303). The canal has a side slope of 2.5:1, with a bottom width of 18.3 m (60 ft) at elevation -1.52 m (-5 ft) NGVD. Expected velocities in the inflow canal vary between 0.232 m s^{-1} (0.76 ft s^{-1}) and 0.418 m s^{-1} (1.37 ft s^{-1}) (Hutcheon Engineers, 1996). G303 is a two-bay ogee spillway equipped with two lift gates with each 4.9 m (16 ft) wide and with a discharge capacity of 50.4 $m^3 s^{-1}$ (1780 cfs).

The perimeter and inter-cell levees facilitate vehicle transportation within the wetland. There are culverts situated below the levees for inflows, outflows, and inter-cell water delivery. Under each levee, the culverts are spread along the levee to facilitate distribution of flow over the downstream cell area. The uniformity of flow distribution depends on the ground surface elevations and vegetation cover of the receiving cell.

Upstream of cells 1 and 2, there was initially a buffer cell that received flow from G250S (seepage return pumps) and the inflow spillway G303. Also, there was a levee with 10 culverts (G252A-J) between the Buffer Cell and Cell 1. However, the transition to STA-1W involved degrading about 70 percent of the levee and

removing all but three of the culverts (G252H, I, and J). The number of culverts between the buffer cell and Cell 2 originally was five (G255A through E), but the number was increased to seven (G255A-G) during the transition from ENR to STA-1W, which made a direct connection between Cell 1 and 2. Similarly, there were initially five G254 culverts between cells 2 and 4 under the ENR Project, but they were increased to nine as part of STA-1W (G254A, A1, B, B1, C, C1, D, D1 and E). The levee between cells 1 and 3 has 10 culverts G253 (A through J), which did not change during the transition from ENR to STA-1W. Between cells 3 and 4 there are five culverts (G256A through E), which were not affected by the transition from ENR to STA-1W.

The inflow to Cell 5 occurs through ten corrugated metal pipe culverts, which are 29.3 m (96 ft) long (G304A through J). The combined capacity of the inflow culverts (G304A through J) is 41.6 $m^3 s^{-1}$ (1,470 cfs). The Florida Power and Light (FPL) levee runs across Cell 5 dividing the cell into two parts. Twenty-two culverts (G305A through V) were constructed to deliver water from the eastern part to the western part of the cell. Each of the G305 culverts is 213 cm (84 inches) in diameter and 27.4 m (90 ft) long, with an invert elevation of 1.07 m (3.5 ft) NGVD. Seepage and recirculated water from the discharge canal is pumped through G250S to Cell 1 through the former ENR Buffer Cell, which is now part of Cell 1. G250S has three main pumps with a combined capacity of 5.66 $m^3 s^{-1}$ (200 cfs), and three supplemental pumps from the old ENR inflow pump station G250 with a combined capacity of 8.49 $m^3 s^{-1}$ (300 cfs).

At the west side of Cell 3 there are two outflow structures (G308 and G259) releasing to the discharge canal. Similarly, G258 and G309 are the two outflow structures releasing to the discharge canal from Cell 4, located at the west side. Hydraulic information for internal structures is shown in Table 3.

The outflow from Cell 5 to the discharge canal flows through ten corrugated metal pipe culverts, which are 183 cm (72 in) in diameter and 39.6 m (130 ft) long and have a combined discharge capacity of 41.6 $m^3 s^{-1}$ (1,470 cfs). G327A is a gated culvert, which is 213 cm (84 in) in diameter, and 39.6 m (130 ft) long with 2.83 $m^3 s^{-1}$ (100 cfs) discharge capacity. G327C is a culvert 39.3 m (129 ft) long and has a discharge capacity of 2.83 $m^3 s^{-1}$ (100 cfs).

The discharge from Cell 1 into Cell 3 flows through ten culverts, which are 183 cm (72 in) diameter and 17.7 m (58 ft) long (G253A through J). Discharge from Cell 2 into Cell 4 flows through nine culverts (G252A, A1, B, B1, C, C1, D, D1, and E), which are 183 cm (72 in) diameter and 16.5 m (54 ft) long. Discharge from Cell 3 is to the discharge canal through G308 and G259 and to WCA-1 through the G251 pump station. G308 is a gated weir with a discharge capacity of 15.85 $m^3 s^{-1}$ (560 cfs). G259 is a gated culvert which is 183 cm (72 in) in diameter and 23.9 m (78.5 ft) long. Discharge from Cell 4 is into the discharge canal through G309, G258 and into Cell 3 through G256A through E. G309 is a gated weir with a discharge capacity of 15.85 $m^3 s^{-1}$ (560 cfs). G258 is a gated culvert which is 183 cm (72 in) in diameter and 23.5 m (77 ft) long. G256A-E consists of five culverts which are 183 cm (72 in) in diameter and 16.6 m (54.5 ft) long. The STA-1W outflow structures are composed of the G251 and G310 pump stations. G251 has six identical pumps with a combined capacity of 12.74 $m^3 s^{-1}$ (450 cfs). G310 is equipped with six pumps of three different capacities, with a total capacity of 86 $m^3 s^{-1}$ (3,040 cfs). G310 has two electric pumps with a combined discharge capacity of 5.66 $m^3 s^{-1}$ (200 cfs), two diesel pumps, with a combined discharge capacity of 26.6 $m^3 s^{-1}$ (940 cfs), and two diesel pumps with a combined discharge capacity of 53.8 $m^3 s^{-1}$ (1,900 cfs).

Reconfiguration of STA -1W cells is underway. Changes are being made to the initial configuration of Cell 1, Cell 2, Cell 4, Cell 5A and Cell 5B. The modification will result in eight cells (1A, 1B, 2A, 2B, 3, 4, 5A and 5B). By June 2005, Cell 2 was split into Cell 2A and 2B. Completion of the project is scheduled for November 2006 although the remaining Cell division is expected to be completed by June 2006 (Kevin Snell, 2005, personal communication). Flow path with the new configuration of cells is from Cell 1A to Cell 2A and to Cell

3; from Cell 2A to Cell 2B and to Cell 4; from Cell 5A to 5B. New structures are designed to pass flow from Cell 1A to Cell 2B (G248A-H) and from Cell 2a to Cell 2B (G249A-E). Also an additional discharge structure from Cell 4 into the discharge canal is planned (G309).

Table 2. Structure information for STA 1-W

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Table 3. Hydraulic information for STA-1W internal structures and seepage pump station

Station	G250S	G252	G253	G254	G255	G256	G258	G259	G305
Type	pump	culvert	culvert	culvert	culvert	culvert	culvert	culvert	culvert
Units	6	3	10	9	7	5	1	1	22
DBKEY	JK278	16207, 16235, 16236	16237, 16238, 16208 to 16211, 16247 to 16450	16212 to 16215, 16251	16731 to 16735	16736 to 16740	15940	15939	stations not active
Bypass stage		15.5 ft.	15.5 ft.	15.5 ft.	15.5 ft.	15.5 ft.	15.5 ft.	15 ft.	18.3 ft.
Flow line Elevation		5 ft.	5 ft.	5 ft.	5 ft.	5 ft.	2.5 ft.	1.5 ft.	3.5 ft.
Flow line Length		54.5 ft. barrel	54.5 ft. barrel	54.5 ft. barrel	54.5 ft. barrel	54.5 ft. barrel	78 ft. barrel	78.5 ft.	90 ft.
Cross Section Diameter	3@42 in. 3@36 in. propeller	72 inches	72 inches	72 inches	72 inches	72 inches	60 inches	72 inches	84 inches

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The discharge canal extends between G327A at the northwest corner and the G310 pump station at the southwestern corner. The discharge canal is about 9.12 km (5.7 mi) long with bottom width varying from 15.2 m (50 ft) at G327A to 24.4 m (80 ft) at G308 and to 30.5 m (100 ft) at G259, to account for changes in flow magnitude and ground elevation.

Current Operation

S5A diverts water from the West Palm Beach canal into the STA-1 Inflow Basin area. From the STA-1 I&D area, water flows to STA-1W through spillway G302 or is bypassed to WCA-1 through G300 and G301 when the need arises. Water flows into Cell 5 via inflow canal and through culverts G304 A through J, and into Cells 1, 2, 3 and 4 through the gated weir structure G303. The old ENR seepage pumps (G250S) control stages in the seepage canal north of treatment Cell 5 and redirect flow to the former ENR (Cells 1, 2, 3 and 4). Culverts, installed beneath G302, deliver seepage return flow to the G250S pumps. The G250S pumps convey the seepage return flow into Cell 1 that also receives inflow from G303. Thus, inflow to Cell 1 is primarily direct flow from G303 and partly through the remaining culverts G252 (H, I, and J) from the old Buffer Cell of the ENR. Cell 2 receives flow from Cell 1 through culverts G255 (A through G). Water flows from Cell 1 to Cell 3 through culverts G253 (A through J). Water delivery between cells 2 and 4 occurs through nine culverts G254 (A, A1, B, B1, C, C1, D, D1, and E). At the west end of Cell 3 there are two outflow structures releasing to the discharge canal, G309 spillway and G258 culvert. Similarly, G308 spillway and G259 culvert are the two outflow structures releasing to the discharge canal from Cell 4, located at the west end. Water delivery from Cell 4 to 3 is through culverts G256A through E as was during the former ENR project. Outflow from STA-1W is through pump stations G251 lifting water from Cell 3 to WCA 1 and G310 lifting water from the discharge canal to WCA 1.

With the reconfiguration of the Cells as described earlier, the operation will change. When the new configuration is operational, changes in operation will be included in future reports. Operational decision making for STA-1W for water year 2005 is presented in Chapter 4, SFER 2006 (Pietro et al., 2005). In January 2005, Cell 2 and Cell 4 were taken offline to begin a divide levee in Cell 2 and an outflow structure in Cell 4. In February 2005, outflows from Cell 5 were recirculated through the seepage canal due to high outflow TP concentrations. Cell 5 was offline during lime rock berm improvement work (Pietro et al., 2005).

HYDROLOGY AND HYDROLOGIC MONITORING

Rainfall

STA-1W has a six-gage rainfall monitoring network. The rainfall gauging stations along with their corresponding database keys and Theissen weights are presented in Table 4. The gage locations are depicted in Figure 2a. The areal average rainfall on the project site was computed using a Theissen-weighted average of the six-gage network. Minimal data gaps at a station are estimated, while extended gaps result in areal rainfall computation using remaining stations with a new set of Theissen weights. The daily distribution of areal average rainfall for the study period is depicted in Figure 3. The monthly summary of areal average rainfall for STA-1W is shown in Table 5. The 12-month total areal average rainfall for STA-1W was 106.4 cm (41.9 in). The eleven year (May 1, 1994 to April 30, 2005) average areal rainfall for the previous ENR constructed wetland and the current STA-1W was 127.3 cm (50.1 inches).

Table 4. rainfall stations in STA-1W, database retrieval keys and Theissen weights

Stations	DBKEY	Theissen Weights
ENR101	15851	0.087
ENR106	DU515	0.441
ENR203	15874	0.222
ENR301	15877	0.126
ENR308	15888	0.049
ENR401	15862	0.075

Evapotranspiration

The daily evapotranspiration (ET) was computed from high-resolution weather data using a radiation-based ET estimation model that was developed based on lysimeter studies in the ENR (Abtew, 1996a; 1996b). A complete weather station is located in Cell 3 (ENR 308). The daily distribution of ET for STA-1W for the study period is depicted in Figure 3. Monthly summary of ET for STA-1W is shown in Table 5. The 12-month total areal ET for STA-1W was 128.7 cm (50.7 in). The ten year (May 1, 1995 to April 30, 2005) average areal ET for the previous ENR and current STA-1W was 132.2 cm (52.1 in).

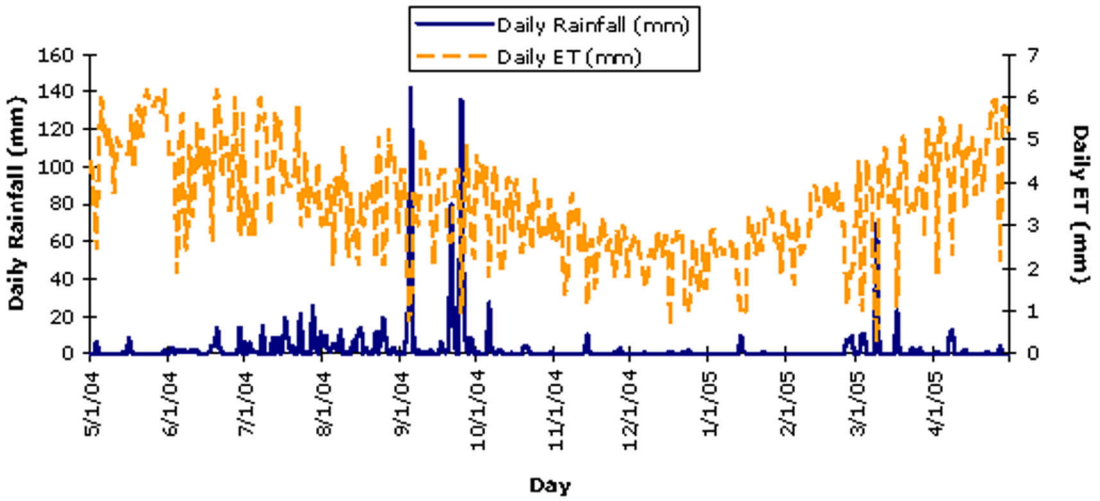

Figure 3. Daily distribution of areal average rainfall and evapotranspiration in STA-1W

Table 5. STA-1W monthly flows, areal weighted rainfall and ET

Year	Month	Inflow	Outflow	Rainfall		ET		Seepage	Seepage
		G302	G251+G 310					Pump	L7 Culverts
		ha-m	ha-m	cm	in	cm	in	ha-m	ha-m
2004	5	1232	631	1.90	0.75	15.89	6.25	84	0
2004	6	2741.671	2559.815	5.918	2.33	13.12	5.166	98.872	0
2004	7	2461.051	2247.319	14.63	5.76	12.86	5.064	95.494	0.101
2004	8	9785.533	11061.38	12.93	5.09	10.86	4.277	139.228	20.938
2004	9	13557.96	15470.86	45.41	17.88	10.11	3.981	89.35	45.883
2004	10	5646.775	8216.977	4.597	1.81	10.26	4.039	298.62	69.634
2004	11	343.369	262.277	1.549	0.61	7.736	3.046	81.855	58.369
2004	12	2109.888	1409.155	0.61	0.24	6.838	2.692	100.142	29.837
2005	1	856.794	1731.128	1.295	0.51	7.688	3.027	93.878	27.52
2005	2	732.317	527.932	2.311	0.91	8.324	3.277	278.488	14.001
2005	3	2113.497	3149.719	12.06	4.75	11.18	4.4	420.613	18.598
2005	4	493.777	58.118	3.15	1.24	13.8	5.432	82.297	20.301

1 ha-m = 8.1068 ac-ft

Flows

Database keys for STA-1W flow structures and stage gages are listed in Table 6. The total inflow spillway discharge for the study period was 42,075 ha-m (341,094 ac-ft), and the total outflow through the outflow pump stations was 47,326 ha-m (383,663 ac-ft). In the past, inflows through G302 were underestimated. In July 2003, new flow data for the period of record was loaded into the database after recalibration of the flow computation equations for G302 spillway. The daily discharge rates of the inflow spillway and outflow pumps are shown in Figure 4. The estimated seepage from L-7 levee flowing through the roadside culverts and the daily seepage recycling pumping is presented in Figure 5. The total seepage and recirculation pumping was 1,863 ha-m (15,104 ac-ft). The L-7 seepage through the roadside culverts was estimated using a regression equation developed from 42 data points. Guardo (1996) developed relationship between the seepage from L-7 through the roadside culverts, the stage rise in WCA-1 above 4.57 m (15 ft) NGVD, and the difference in stages between WCA-1 and the eastern cells of the ENR (Equation 1). The regression had a coefficient of determination (R^2) of 0.93 and a standard error of 0.30 $m^3 s^{-1}$. The total estimated seepage from L-7 through roadside culverts was 305 ha-m (2,477 ac-ft). The monthly flow data for the study period are presented in Table 5.

$$\mathbf{L7a = 0.217 * \Delta WCA^{1.311} * \Delta h^{2.025}} \qquad \mathbf{(1)}$$

Where L-7a is seepage in $m^3 s^{-1}$, ΔWCA is rise in stage in WCA-1 above 4.57 m (15 ft) NGVD and Δh is the difference in stage between WCA-1 and the eastern cells of STA-1W.

Water Levels

Daily water levels or water surface elevations (stages) in each cell of STA-1W are dependent upon rainfall, evapotranspiration, seepage and daily operational decisions. Water levels have been regulated based on water depth, operation status of the S5A pump station, tests, maintenance and other operational decisions. The minimum, maximum and mean of the daily average stage observations for the study period

are shown in Table 7. The mean observed stage in Cell 1 was **Error! Not a valid link.** m (**Error! Not a valid link.**ft) NGVD. The mean stage in Cell 2 was **Error! Not a valid link.** m (**Error! Not a valid link.**ft), and the mean stage in Cell 3 was **Error! Not a valid link.** m (**Error! Not a valid link.**ft). The mean stage in Cell 4 was **Error! Not a valid link.** m (**Error! Not a valid link.**ft) NGVD, and the mean stage in Cell 5 was **Error! Not a valid link.** m (**Error! Not a valid link.**ft) NGVD. The average daily stages for Cell 5 were computed from the stage readings for G304 tailwater and G306 headwater. The average daily water level observations in Cell 1 and 3 of STA-1W and WCA-1 are shown in Figure 6. Water levels for cells 2 and 4 are shown in Figure 7 and the daily water levels for Cell 5 are shown in Figure 8. The mean water depths for cells 1, 2, 3, 4 and 5 were **Error! Not a valid link.** cm (**Error! Not a valid link.**in), **Error! Not a valid link.** cm (**Error! Not a valid link.**in), **Error! Not a valid link.** cm (**Error! Not a valid link.**in), **Error! Not a valid link.** cm (**Error! Not a valid link.**in) and **Error! Not a valid link.** cm (**Error! Not a valid link.**in), respectively.

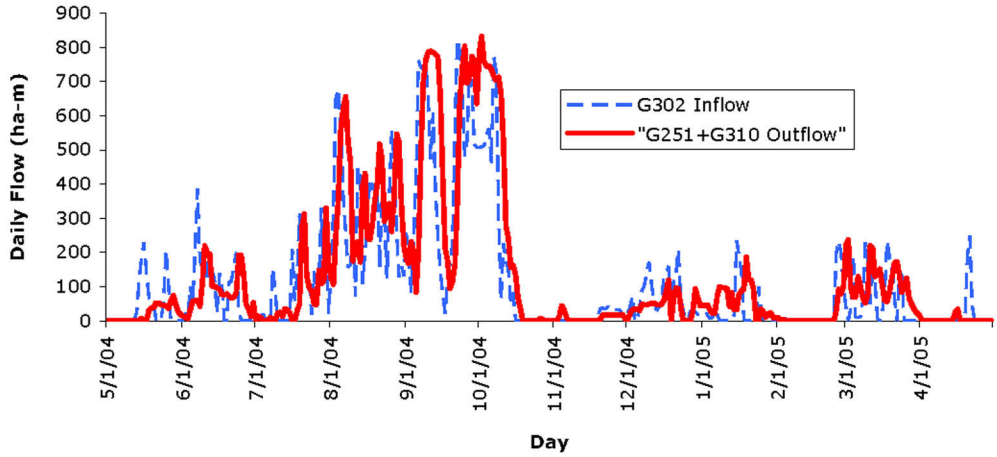

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Figure 4. Daily STA-1W inflows and outflows

Table 6. Flow control structures, stage recorders and database retrieval keys used in the water budget analysis for STA-1W

Station	Description	Location	DBKEY	Remark
G302	spillway	I & D / Supply Canal	JW221	inflow
G250S	pump	Seepage Canal/Cell1	JK278	seepage return, recirculation
G251	pump	Cell 3/WCA1	JW222	outflow
G310	pump	Discharge Canal/WCA-1	M2901	outflow
ENR101	stage	Cell 1	15850	center of cell
ENR203	stage	Cell 2	15873	center
ENR301	stage	Cell 3	15876	center
ENR401	stage	Cell 4	15727	center of cell
G304E_H	stage	Supply Canal/Cell 5	OH559	Cell 5 stage close to WCA-1
G304E_T	stage	Supply Canal/Cell 5	OH560	tailwater
G306A_H	stage	Cell 5/Discharge Canal	L9951	headwater
G306J_H	stage	Cell 5/Discharge Canal	L9954	headwater
G251_T	stage	G251 Tailwater	16219	WCA-1
G301_T	stage	Inflow and Distribution/WCA-1	KS686	tailwater

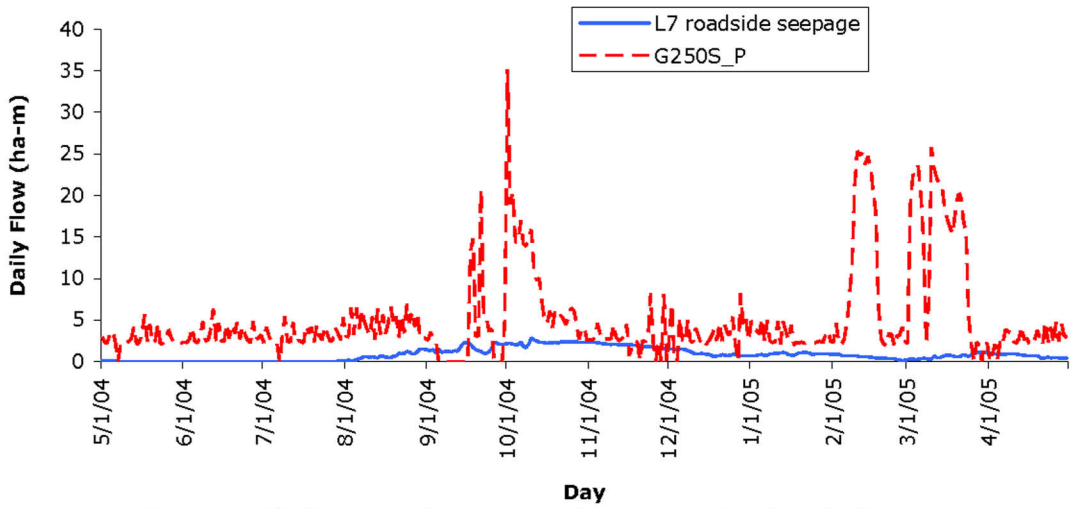

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Figure 5. Daily pumping rates of seepage/recirculation pump and seepage through L-7 roadside seepage collection culverts to STA-1W (1 ha-m = 8.1068 ac-ft)

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Table 7. Observed water surface elevations and depth in STA-1W

Cell	Water Surface Elevation						Depth	
	Min		Max		Mean		Mean	
	m	ft	m	ft	m	ft	cm	in
Cell 1	3.43	11.24	4.32	14.16	3.74	12.28	61	24.1
Cell 2	0.00	0.00	4.06	13.32	3.40	11.15	46	18.0
Cell 3	3.34	10.95	4.08	13.38	3.60	11.81	50	19.7
Cell 4	0.00	0.00	3.94	12.93	3.34	10.95	34	13.3
Cell 5	0.00	0.00	4.02	13.18	3.26	10.70	36	14.2

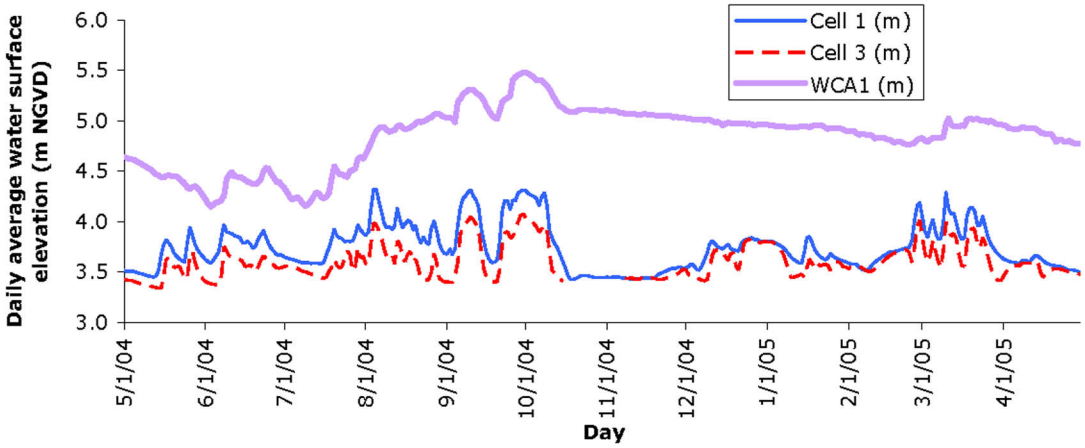

Figure 6. Daily mean water level in Cell 1 and 3 of STA-1W and Water Conservation Area 1

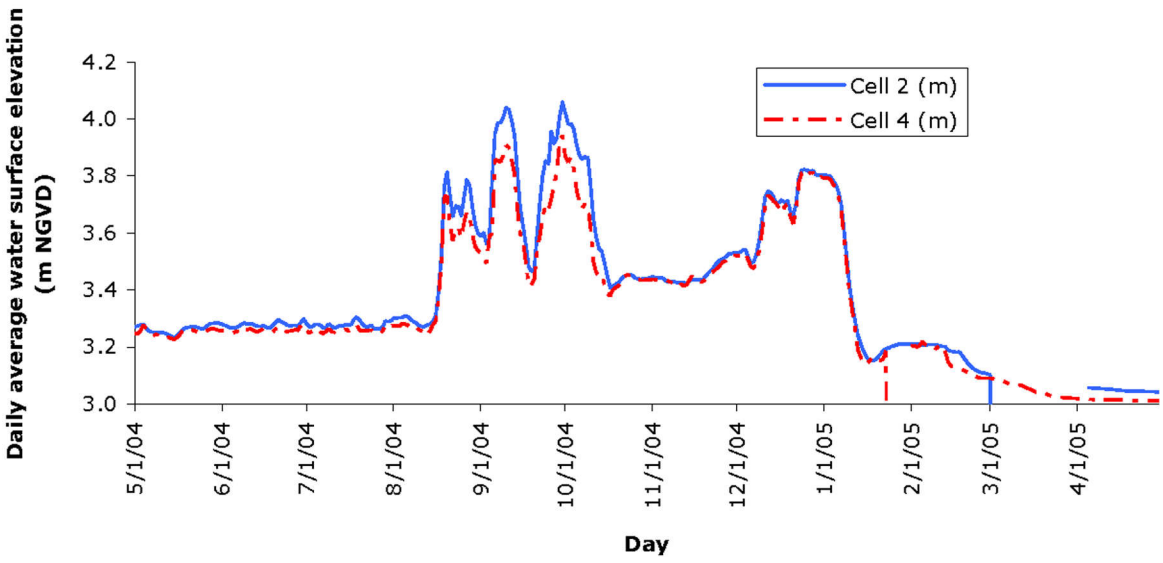

Figure 7. Daily mean water level in Cell 2 and 4 of STA-1W

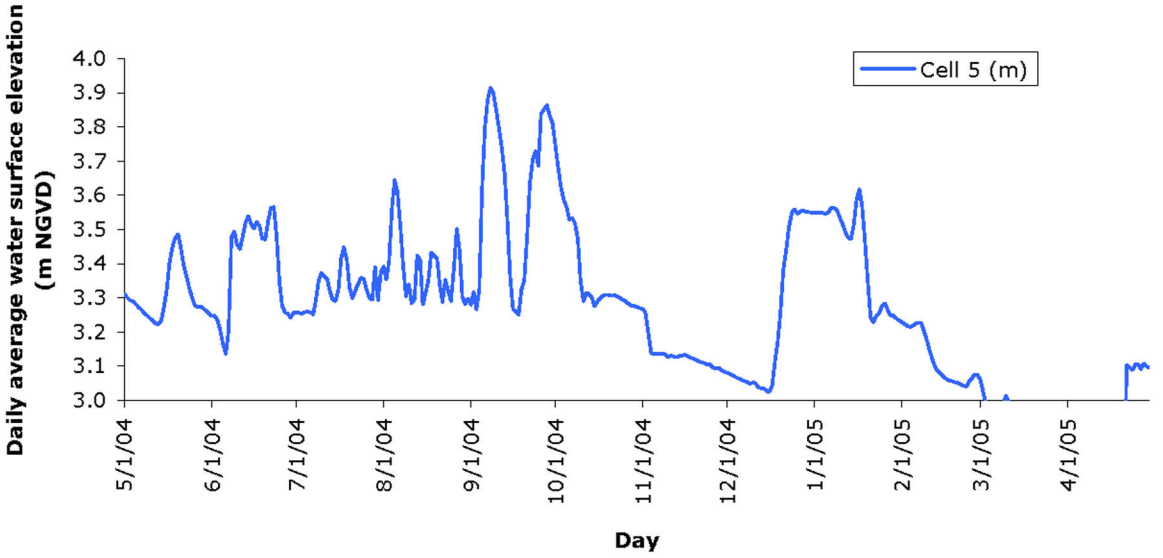

Figure 8. Daily mean water level in Cell 5 of STA-1W

WATER BUDGET COMPUTATIONS

STA-1W Water Balance Model

A schematic hydrologic model for STA-1W is depicted in Figure 9. The inflow supplied through the G302 spillway accounts for about 83% of the inflow to the system. The known inflows to the system are G302 spillway inflows, rainfall and seepage through the roadside L-7 levee culverts (L-7a). Rainfall accounts for 6%, and seepage through the roadside culverts (L-7a) accounts for 1%. Outflow pumping (G251 and G310) accounts for 93.0% of the outflows, with evapotranspiration constituting 7% of the total outflows. The unknowns in the system are ungaged subsurface inflows, outflows and errors that account for 10% of the total inflows. The schematic model (Figure 9) and the following set of water balance equations represent the hydrologic system of STA-1W for water budget analysis purposes.

$$\mathbf{INFLOW - OUTFLOW = \Delta S + \varepsilon_T} \quad (2)$$

Where INFLOW is the amount of water that enters the system from external sources, and OUTFLOW is water that leaves the system boundary and is not recirculated. ΔS is the change in storage in the system during the time interval of interest. The sum of all errors is represented by ε_T. Because all inflows and outflows cannot be entirely quantified, the following equation is introduced to represent the remainders, errors and unknowns:

$$\mathbf{REMAINDERS = \varepsilon_T + UNKNOWNS} \quad (3)$$

Figure 9 shows the possible inflows and outflows to and from the STA-1W system. The seepage canal, which encompasses the northern side of STA-1W, is designed to capture seepage from STA-1W to the neighboring area and to recirculate discharge from the discharge canal when needed. Seepage through the former ENR supply canal is represented as SEEP1, and seepage in and out of the seepage canal to the north is represented as SEEP2. SEEP3 represents the two seepage possibilities into or out of the discharge canal to the west, regardless of the magnitude. SEEP4 represents the possible seepage loss or gain through the southern levee from WCA-1. The unmeasured inflow from WCA-1 into STA-1W from the east is represented by L-7b.

In computing the water balance for STA-1W, it is essential to identify quantifiable variables from unquantifiable variables, making reasonable assumptions to reduce the quantity of unknowns as much as possible. Since the purpose of the seepage canal is to recirculate seepage and recycle water, it is assumed that the seepage return pump flows are recirculation in the system. This assumption does not rule out the possibility of external seepage inflow being part of recirculation flow or seepage loss out of the seepage canal. The change in storage is represented as follows:

$$\mathbf{\Delta S = G302+R+L7a+L7b-G251-G310-ET+SEEP1+SEEP2+SEEP3+SEEP4+\varepsilon_T} \quad (4)$$

Where ΔS is change in storage in the system; G302 is inflow; R is rainfall; L-7a is seepage flow from WCA-1 through the roadside culverts; L-7b is unknown subsurface seepage flow from WCA-1 into STA-1W; ET is evapotranspiration losses. G310 and G251 represent outflow pumping; ε_T represents total error in inflow and outflow terms.

The daily change in storage for STA-1W was computed as the sum of storage changes in each of the five cells (cells 1, 2, 3, 4, and 5). The change in storage volume in each cell was computed based on the area of the cell and change in stage in the cell. The remainders in the computation of daily water balances are the sum of all errors and unknowns in the system. Daily remainders were computed for the one-year study period based on the following equation:

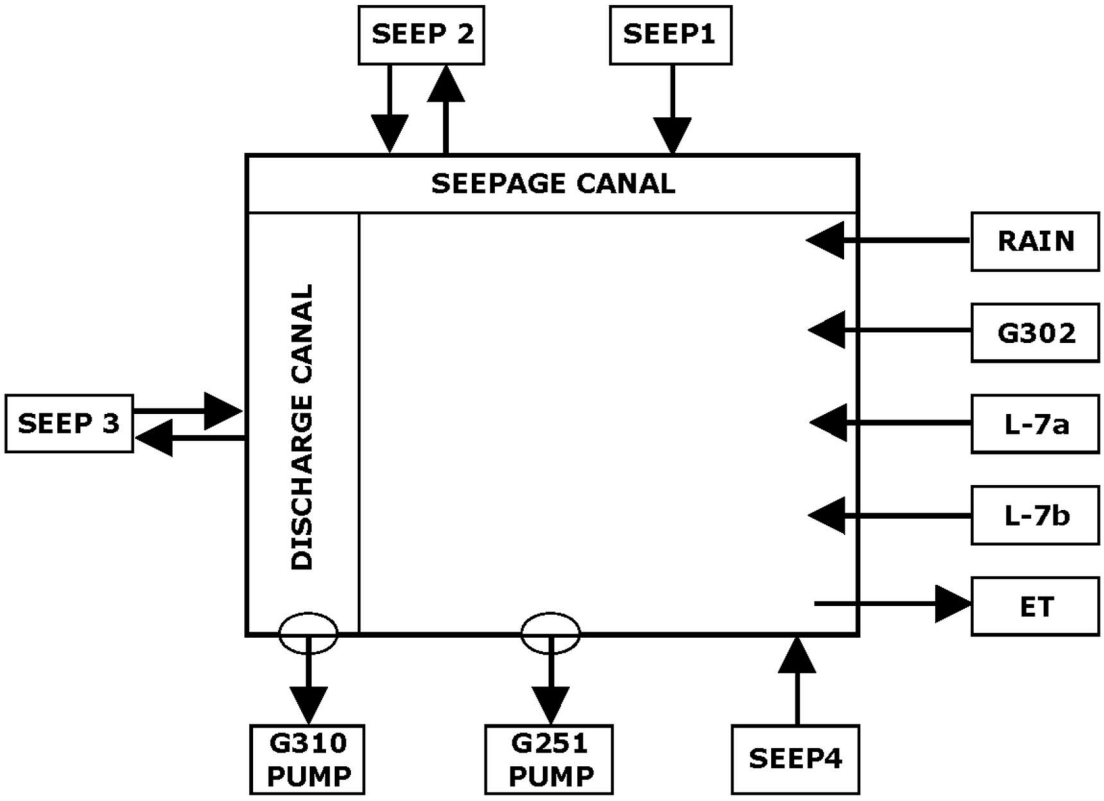

Figure 9. Schematic hydrologic model for STA 1-W

$$\text{REMAINDERS} = \Delta S - \text{INFLOWS} + \text{OUTFLOWS} \quad (5)$$

Discussion

The total inflow through the inflow spillway was**Error! Not a valid link.**ha-m (**Error! Not a valid link.**ac-ft) and total outflow through the outflow pumps was**Error! Not a valid link.**ha-m (**Error! Not a valid link.**ac-ft). Seepage inflow from L-7 levee through the roadside culverts was a total of**Error! Not a valid link.**ha-m (**Error! Not a valid link.**ac-ft). The seepage and recirculation pump had a total flow of**Error! Not a valid link.**ha-m (**Error! Not a valid link.**ac-ft). Total average areal rainfall for the study period was**Error! Not a valid link.**cm (**Error! Not a valid link.**inches) and the total average areal evapotranspiration was**Error! Not a valid link.**cm (**Error! Not a valid link.**inches). For the study period, the mean daily remainders (errors and unknowns) was **Error! Not a valid link.** ha-m d^{-1} (**Error! Not a valid link.**ac-ft d^{-1}), with total remainder being **Error! Not a valid link.**ha-m d^{-1} (**Error! Not a valid link.**ac-ft d^{-1}). The standard deviation of the

remainders is **Error! Not a valid link.**ha-m d^{-1} (**Error! Not a valid link.**ac-ft d^{-1}), which signifies high variation. Figure 10 depicts the daily remainder distribution. The remainder is 2 percent of the total inflows. The known outflow from the system is higher than the known inflow and the remainder is accounted as inflow.

A summary of the one-year water budget is shown in Table 8. Details of the daily water balances terms and calculations results are shown in Appendix I. The mean hydraulic loading rate for the study period, based on the average inflow, was**Error! Not a valid link.**centimeters per day (cm d^{-1}), or **Error! Not a valid link.**inches per day (in d^{-1}). The mean retention time was computed as the ratio of the mean estimated water volume of STA-1W and the average daily flow rate, inflow and outflow. The estimated mean volume was computed from the area-weighted (by cell) mean depth of **Error! Not a valid link.**cm (**Error! Not a valid link.**inches) and a total area of **Error! Not a valid link.**ha (6,847 ac). The estimated mean hydraulic retention time was **Error! Not a valid link.** days.

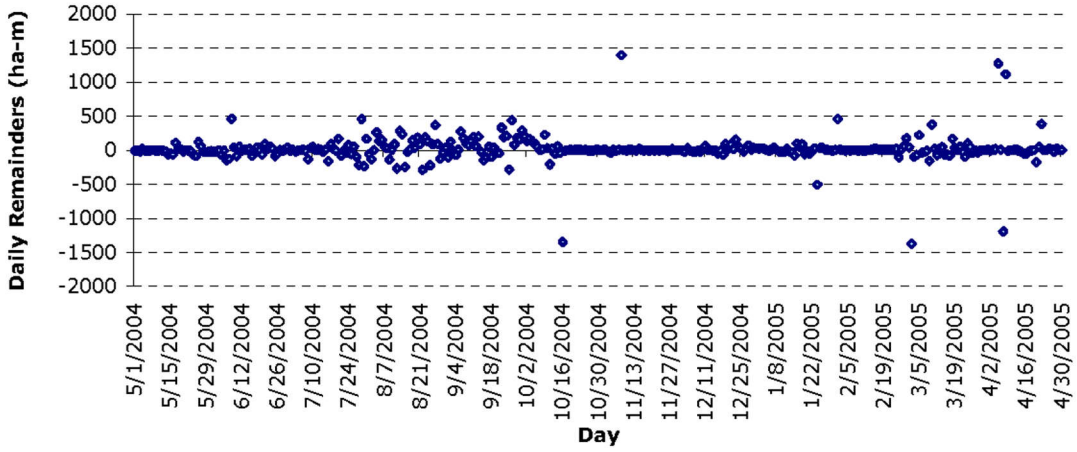

Figure 10. Distribution of daily remainders (errors and unknowns) from STA-1W water balance

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1 ha-m = 8.1068 ac-ft

WATER BUDGET SUMMARY

This water budget study covers the sixth year of operation of STA-1W. The period of analysis is from May of previous year to April of current year in order to coincide with the reporting period of the South Florida Environment Report. For the period of analysis, the total inflow through the spillway (G302) was 42,075 ha-m, or 341,094 ac-ft. The total outflow through the outflow pump stations (G251 and G310) was 47,326 ha-m (383,663 ac-ft). Seepage inflow from L-7 levee through the roadside culverts was 305 ha-m (2,477 ac-ft). The seepage and recirculation pump had a total flow of 1,863 ha-m (15,104 ac-ft). Total areal average rainfall for the study period was 106.4 cm (41.9 in), and the total areal average evapotranspiration was 128.7 cm (50.7 in). The sum of the errors and unknowns was 5,166 ha-m (1,881 ac-ft), which represents 10 % of the total inflows to the system.

The mean hydraulic loading rate for the one-year period, based on the average flow, was 4.2 cm d^{-1} (1.6 in d^{-1}). The mean hydraulic retention time was computed as the ratio of the estimated mean volume of STA-1W and the average daily flow rate. The estimated mean volume was computed using the area-weighted (by cell) mean depth of 45 cm (17.6 inches) and a total area of 2,772 ha (6,847 ac). The estimated mean hydraulic retention time was 10.1 days. Due to construction work, Cell 2, Cell 4 and Cell 5 were at times offline during the water year (Pietro et al., 2005). When a cell is offline, it results in reduction of effective treatment area and retention time. The change in storage was -397 ha-m (-3,220 ac-ft). A comparison with the previous five years of water budget shows that surface water inflow and outflow for this period was the second largest following water year 2003.

Inflow through the G302 spillway that was used for the previous three water budgets for STA-1W was underestimated by the flow computation equations. In July 2003, after recalibration of the flow equations, new flow data for the G302 spillway was loaded into the database for the period of record. Comparison of previous years' and current year water budgets are shown in Table 9. Inflows into STA-1W through the G302 spillway were updated based on the new dataset in DBHYDRO.

Table 9. Comparison of STA-1W water budget components to previous reporting years[#]

Year	(7/1/1999 - 4/30/2000)*	(5/1/2000 - 4/30/2001)	(5/1/2001 - 4/30/2002)	(5/1/2002 - 4/30/2003)	(5/1/2003 - 4/30/2004)	(5/1/2004 - 4/30/2005)
Inflows (ha-m)						
Spillway inflow	14,296	11,573	34,398	73,006	36,104	42,075
Rain	2,623	2,467	3,704	2,901	2,337	2,949
L-7 Culverts (L7a)	541	288	440	393	429	305
Remainders				1,374	562	5,166
Total	17,460	14,328	38,542	77,674	39,432	50,495
Outflows (ha-m)						
Outflow pump	13,379	11,166	33,012	73,518	36,710	47,326
ET	2,955	3,946	3,715	3,595	3,495	3,566
Remainders	1410	331	1,313			
Total	17,744	15,443	38,040	77,113	40,205	50,893
Change in Storage (ha-m)	(284)	(1,113)	503	654	(785)	(397)
Seepage Pump (ha-m)	5,475	3,386	1,449	1,431	1,294	1,863
Loading Rate (cm/d)	1.70	1.14	3.40	7.41	3.65	4.16
Average Depth (cm)	54.3	53.4	57.5	61.1	59.0	44.7
Retention Time (days)	38.7	46.3	16.8	8.2	16.0	10.1

1 ha-m = 8.1068 ac-ft

water budget for previous years was recalculated to reflect the updated G302 spillway inflows

* 10-month period

REFERENCES

Abtew, W. 1996a. Evapotranspiration Measurements and Modeling for Three Wetland Systems in South Florida. Journal of American Water Resources Association, 32(3): 465-473.

Abtew, W. 1996b. Lysimeter Study of Evapotranspiration from a Wetland. C. R. Camp, E. J. Sadler and R. E. Yoder (eds.). In: Evapotranspiration and Irrigation Scheduling. Proceedings of the ASAE International Conference. November 3-6, 1996. San Antonio, TX.

Abtew, W. and V. Mullen. 1997. Water Budget Analysis for the Everglades Nutrient Removal Project (August 20, 1996 to August 19, 1997). Technical Memorandum WRE # 354. South Florida Water Management District, West Palm Beach, FL.

Abtew, W. and D. Downey, 1998. Water Budget Analysis for the Everglades Nutrient Removal Project (August 20, 1997 to August 19, 1998). Technical Memorandum WRE # 368. South Florida Water Management District, West Palm Beach, FL.

Abtew, W., J. Raymond and M. Imru. 2000. Water Budget Analysis for the Everglades Nutrient Removal Project and Stormwater Treatment Area 1 West (August 20, 1998 to June 30, 2000). Technical Publication EMA # 388. South Florida Water Management District, West Palm Beach, FL.

Abtew, W., J. Raymond and M. Imru. 2001. Water Budget Analysis for Stormwater Treatment Area 1 West (July 1, 2000 to June 30, 2001). Technical Publication EMA # 398. South Florida Water Management District, West Palm Beach, FL.

Abtew, W., M. Imru and J. Raymond. 2002. Water Budget Analysis for Stormwater Treatment Area 1 West (July 1, 2001 to June 30, 2002). Technical Publication EMA # 406. South Florida Water Management District, West Palm Beach, FL.

Abtew, W. and A. Reardon. 2003. Water Budget Analysis for Stormwater Treatment Area 1 W (May 1, 2002 to April 30, 2003). Technical Publication EMA # 411. South Florida Water Management District, West Palm Beach, FL.

Abtew, W. 2004. Water Budget Analysis for Stormwater Treatment Area 1 West (May 1, 2003 to April 30, 2004). Technical Publication ERA # 420. South Florida Water Management District, West Palm Beach, FL.

Guardo, M., W. Abtew, L. Fink and A. Cadogan. 1996. Water Budget Analysis for the Everglades Nutrient Removal Project (August 19, 1994 to August 19, 1996). Technical Memorandum WRE # 347. South Florida Water Management District, West Palm Beach, FL.

Guardo, M. 1996. Hydrologic Balance of a Subtropical Wetland Constructed for Nutrient Removal. Presented at AWRA 32nd Annual Conference and Symposium on GIS and Water Resources. September 22-26, 1996.

Hutcheon Engineers. 1996. Everglades Construction Project Stormwater Treatment Area 1-W, Detailed Design Report, Report submitted to the South Florida Water Management District, West Palm Beach, FL.

Jammal and Associates, Inc. 1991. Geotechnical Services SFWMD Everglades Nutrient Removal Project. (draft) Report submitted to the South Florida Water Management District, West Palm Beach, FL.

Pietro, K., R. Bearzotti, M. Chimney, G. Germain, N. Iricanin and T. Piccone. 2005. Chapter 4: Stormwater Treatment Area Performance, Compliance and Optimization. South Florida Environmental Report 2006 (in production). South Florida Water Management District. West Palm Beach, FL.

Redfield, G., J. Van Arman, K. Rizzardi and M. Chimney. 1999. Chapter 1: Introduction to the Everglades Interim Report. Everglades Interim Report. South Florida Water Management District, West Palm Beach, FL.

Whalen, B. M. and P. J. Whalen. 1994. Nonpoint Source Regulatory Program for the Everglades Agricultural Area. ASAE Paper FL94-101.

APPENDIX I: WATER BALANCE TERMS WITH CALCULATED REMAINDERS

Date	Change in storage	Inflow Spillway G302	Seepage Pump G250S	Outflow Pump G251/G310	Seepage L7a	Rain	ET	Remainders
	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m
1-May-04	-16.076	0.000	2.908	0.000	0.082	0.000	12.446	-3.712
2-May-04	-19.864	0	2.221	0	0.071	0	9.84	-10.095
3-May-04	-8.357	0	2.186	0	0.054	17.602	6.736	-19.277
4-May-04	2.514	0	3.383	1.17	0.046	0	13.472	17.11
5-May-04	-26.054	0	3.612	0	0.039	0	16.576	-9.517
6-May-04	-26.156	0	2.3	0	0.016	0	14.497	-11.675
7-May-04	-21.523	0	0	0	0.007	0	13.472	-8.058
8-May-04	-17.549	0	2.229	0	0	0	14.497	-3.052
9-May-04	-16.815	0	2.09	0	0	0	13.472	-3.343
10-May-04	-18.047	0	2.265	0	0	0	10.367	-7.68
11-May-04	-14.911	0	2.369	0	0	0	13.998	-0.913
12-May-04	-19.577	0	2.692	0	0	0	13.472	-6.105
13-May-04	-3.478	26.275	4.174	0	0	0	13.472	-16.281
14-May-04	38.974	122.248	2.058	7.514	0	2.112	13.472	-64.4
15-May-04	130.722	190.65	2.265	0	0	0.704	12.945	-47.687
16-May-04	177.134	229.77	3.244	0	0	23.235	12.945	-62.926
17-May-04	199.746	135.739	5.668	30.613	0	2.112	15.551	108.059
18-May-04	52.208	70.384	2.446	37.642	0	0	11.919	31.385
19-May-04	-0.882	41.07	4.476	39.656	0	0	15.551	13.255
20-May-04	-46.275	41.882	2.233	52.55	0	0	16.05	-19.557
21-May-04	-64.73	0	2.424	51.882	0	0	13.998	1.15
22-May-04	-74.137	0	4.547	47.143	0	0	16.05	-10.944
23-May-04	-74.682	0	2.049	44.691	0	0	17.103	-12.888
24-May-04	-74.453	55.434	2.167	43.543	0	0	16.05	-70.294
25-May-04	69.8	209.161	2.336	36.362	0	0	16.05	-86.949
26-May-04	158.216	109.821	3.81	56.386	0	0	16.05	120.831
27-May-04	-35.339	0	2.971	73.814	0	0	16.576	55.051
28-May-04	-88.338	0	2.353	48.934	0	0	16.576	-22.828
29-May-04	-70.105	0	2.164	27.305	0	0	15.551	-27.249
30-May-04	-51.538	0	2.383	18.35	0	5.633	17.103	-21.718
31-May-04	-41.268	0	2.217	13.797	0	1.408	14.497	-14.382
1-Jun-04	-35.781	0	2.326	9.151	0	0.704	12.945	-14.389
2-Jun-04	-18.403	22.179	2.267	6.241	0	8.449	12.945	-29.845
3-Jun-04	-29.957	10.051	2.691	30.209	0	0	12.945	3.146
4-Jun-04	-20.738	100.952	4.033	56.222	0	5.633	5.184	-65.917
5-Jun-04	-25.863	49.557	2.304	58.272	0	2.816	13.472	-6.492
6-Jun-04	-15.386	194.799	2.261	59.29	0	7.041	15.551	-142.385
7-Jun-04	211.111	385.518	2.857	42.019	0	4.224	7.263	-129.349
8-Jun-04	524.885	175.451	4.84	108.96	0	3.52	6.736	461.61
9-Jun-04	-36.313	153.566	2.484	218.948	0	4.224	13.472	38.317
10-Jun-04	-75.799	210.448	2.555	199.614	0	4.929	8.815	-82.747
11-Jun-04	-22.454	125.923	3.897	194.65	0	2.816	9.84	53.297
12-Jun-04	29.422	151.77	6.381	101.187	0	6.337	15.024	-12.474
13-Jun-04	39.169	144.77	2.44	101.239	0	0	11.919	7.557
14-Jun-04	11.059	122.304	4.646	95.922	0	0	14.497	-0.826
15-Jun-04	-61.282	20.699	2.475	91.356	0	0	10.894	20.269
16-Jun-04	-40.763	137.464	2.376	76.948	0	0	13.472	-87.807
17-Jun-04	33.246	117.825	4.534	76.177	0	3.52	11.393	-0.529
18-Jun-04	-28.024	0	2.814	78.186	0	12.673	7.263	44.752
19-Jun-04	-78.476	0	4.364	72.047	0	10.561	16.05	-0.94
20-Jun-04	2.531	110.619	3.397	65.945	0	39.428	17.103	-64.468
21-Jun-04	127.836	116.662	4.758	69.672	0	7.041	15.024	88.829
22-Jun-04	90.866	162.939	2.681	81.489	0	1.408	11.393	19.401
23-Jun-04	45.961	199.238	4.205	191.837	0	0	13.998	52.558
24-Jun-04	-152.367	28.922	3.134	191.259	0	0	13.998	23.968

1 ha-m = 8.1068 ac-ft

Date	Change in storage	Inflow Spillway G302	Seepage Pump G250S	Outflow Pump G251/G310	Seepage L7a	Rain	ET	Remainders
	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m
25-Jun-04	-225.859	0	2.478	134.046	0	0	9.314	-82.499
26-Jun-04	-111.716	0	2.258	47.994	0	0	10.367	-53.355
27-Jun-04	-48.696	0	4.783	35.264	0	0	16.576	3.144
28-Jun-04	-33.678	0	2.611	12.246	0	0	12.945	-8.487
29-Jun-04	-10.443	0.015	2.825	52.936	0	38.724	7.761	11.515
30-Jun-04	25.325	0	3.197	0.489	0	0	15.551	41.365
1-Jul-04	-13.364	0	2.254	13.511	0	18.306	8.288	-9.871
2-Jul-04	-12.778	0	4.148	8.855	0	0	10.367	6.444
3-Jul-04	-9.909	0	2.971	0	0	16.194	7.761	-18.342
4-Jul-04	4.864	19.351	2.399	0	0	3.52	9.314	-8.693
5-Jul-04	-3.422	0.404	2.436	0	0	3.52	7.761	0.415
6-Jul-04	-15.624	0	2.198	9.053	0	1.408	14.497	6.518
7-Jul-04	-24.692	0	0	0	0	0	16.576	-8.116
8-Jul-04	45.032	152.012	3.174	0	0	40.133	15.024	-132.089
9-Jul-04	80.6	85.377	5.372	22.448	0	0	15.551	33.222
10-Jul-04	11.832	0	2.304	24.753	0	0	11.919	48.504
11-Jul-04	-24.106	0	2.342	12.852	0	0	8.288	-2.966
12-Jul-04	-7.631	0	4.681	34.721	0	22.531	10.894	15.453
13-Jul-04	-44.981	0	2.375	31.658	0	0	15.551	2.228
14-Jul-04	-38.096	0	2.548	23.27	0	24.643	13.998	-25.471
15-Jul-04	-5.956	0	2.367	0	0	0	15.024	9.068
16-Jul-04	44.677	209.629	2.206	0	0	4.929	10.367	-159.514
17-Jul-04	162.423	58.938	4.253	28.095	0	53.51	12.446	90.516
18-Jul-04	111.584	130.195	3.399	48.518	0	21.826	10.894	18.975
19-Jul-04	25.174	311.726	4.097	272.452	0	3.52	10.894	-6.726
20-Jul-04	-21.527	119.422	2.28	312.132	0	12.673	10.894	169.404
21-Jul-04	-101.659	120.961	4.356	131.587	0	0.704	12.446	-79.291
22-Jul-04	-2.348	116.929	3.067	94.598	0	0.704	16.05	-9.333
23-Jul-04	29.536	108.471	2.563	88.606	0	59.143	8.288	-41.184
24-Jul-04	36.01	19.118	4.216	48.346	0	0.704	9.84	74.374
25-Jul-04	26.543	142.94	3.291	47.779	0	0	12.945	-55.673
26-Jul-04	-58.755	42.124	2.391	147.327	0	2.816	8.815	52.447
27-Jul-04	-94.249	117.666	2.554	107.752	0	0.704	10.894	-93.973
28-Jul-04	56.689	329.354	4.027	117.597	0	71.112	10.367	-215.813
29-Jul-04	257.066	129.454	3.36	330.313	0.022	10.561	9.84	457.182
30-Jul-04	-188.367	226.775	2.601	166.416	0.041	0.704	12.446	-237.025
31-Jul-04	84.831	20.205	5.264	124.68	0.038	31.684	8.288	165.872
1-Aug-04	-12.644	151.124	2.99	106.237	0.075	11.265	8.815	-60.056
2-Aug-04	-30.193	327.642	2.946	246.476	0.142	27.459	8.288	-130.672
3-Aug-04	285.88	648.8	6.409	357.423	0.101	4.929	10.894	0.367
4-Aug-04	379.77	678.989	3.208	552.432	0.1	4.224	10.894	259.783
5-Aug-04	96.427	573.586	6.407	621.742	0.181	15.49	5.71	134.622
6-Aug-04	-137.797	366.742	3.948	655.464	0.316	8.449	11.393	153.553
7-Aug-04	-219.119	255.355	6.217	526.187	0.434	4.929	10.367	56.717
8-Aug-04	-256.685	155.594	4.752	463.285	0.569	33.796	9.314	25.955
9-Aug-04	-164.436	162.763	3.881	174.448	0.57	0	13.472	-139.849
10-Aug-04	45.448	264.439	3.15	217.372	0.468	0	10.894	8.807
11-Aug-04	-76.888	71.357	5.43	230.484	0.573	2.112	6.209	85.763
12-Aug-04	-4.09	447.132	2.662	171.911	0.472	0	10.367	-269.416
13-Aug-04	354.409	447.759	6.336	391.642	0.408	19.01	7.263	286.137
14-Aug-04	-92.701	107.573	3.246	431.332	0.617	5.633	8.288	233.096
15-Aug-04	-260.31	203.625	5.696	243.765	0.628	31.684	5.71	-246.772
16-Aug-04	66.22	302.541	3.354	236.948	0.519	39.428	10.367	-28.953
17-Aug-04	139.115	415.321	4.663	280.565	0.466	0.704	8.288	11.477
18-Aug-04	177.554	384.334	6.6	352.424	0.476	9.153	9.314	145.329

1 ha-m = 8.1068 ac-ft

Date	Change in storage	Inflow Spillway G302	Seepage Pump G250S	Outflow Pump G251/G310	Seepage L7a	Rain	ET	Remainders
	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m
19-Aug-04	31.281	398.957	4.272	394.842	0.607	0.704	10.367	36.222
20-Aug-04	46.967	391.48	5.44	516.662	0.681	0	10.894	182.362
21-Aug-04	-242.361	154.143	2.937	471.198	0.948	0.704	10.894	83.936
22-Aug-04	-177.386	375.127	5.537	291.353	0.932	32.388	6.209	-288.271
23-Aug-04	131.306	296.713	3.405	341.018	0.967	0	13.998	188.642
24-Aug-04	-73.965	124.851	6.852	342.009	1.164	22.531	10.894	130.392
25-Aug-04	-65.795	368.464	4.68	261.258	1.126	52.806	5.71	-221.223
26-Aug-04	281.321	555.251	6.02	368.484	0.886	19.01	7.761	82.419
27-Aug-04	281.421	471.81	4.162	546.032	0.895	0	14.497	369.245
28-Aug-04	-183.242	263.049	5.818	523.341	1.213	0	12.446	88.283
29-Aug-04	-340.696	128.942	2.726	343.905	1.514	9.857	12.945	-124.159
30-Aug-04	-101.756	161.481	2.684	219.636	1.458	1.408	10.894	-35.573
31-Aug-04	-21.485	130.589	2.8	181.504	1.432	0.704	7.761	35.055
1-Sep-04	-29.301	256.617	2.512	167.556	1.327	0	11.919	-107.77
2-Sep-04	72.26	190.395	3.509	231.042	1.328	0	11.919	123.498
3-Sep-04	-112.066	83.61	2.799	202.421	1.406	21.826	9.84	-6.647
4-Sep-04	144.814	224.933	2.408	83.466	1.054	76.041	2.079	-71.669
5-Sep-04	636.285	438.449	0	202.499	1.507	394.284	3.105	7.649
6-Sep-04	540.244	761.014	0	485.031	1.08	2.816	10.367	270.732
7-Sep-04	208.083	740.415	0	701.146	1.144	0.704	8.815	175.781
8-Sep-04	71.196	736.131	0	763.727	1.187	7.041	8.288	98.852
9-Sep-04	23.474	750.618	0	786.716	1.174	0	13.998	72.396
10-Sep-04	-13.08	652.8	0	788.794	1.149	2.112	12.945	132.598
11-Sep-04	-122.038	474.051	0	785.192	1.291	0.704	11.919	199.027
12-Sep-04	-126.085	606.48	0	780.169	1.22	0.704	11.393	57.073
13-Sep-04	-191.862	383.355	0	772.428	1.571	4.929	9.314	200.025
14-Sep-04	-436.723	244.724	0	656.367	2.072	0.704	5.71	-22.146
15-Sep-04	-423.854	144.966	0	417.344	2.273	0.704	8.288	-146.165
16-Sep-04	-243.219	77.988	0	210.5	2.161	0	11.393	-101.475
17-Sep-04	-95.054	21.91	12.968	176.584	2.086	18.306	11.919	51.147
18-Sep-04	-79.783	119.657	14.8	93.744	1.692	3.52	11.919	-98.989
19-Sep-04	85.251	167.624	2.98	114.147	1.411	1.408	8.815	37.77
20-Sep-04	50.977	222.985	2.964	164.918	1.308	11.969	7.263	-13.104
21-Sep-04	372.843	549.807	20.814	349.236	1.226	221.081	7.263	-42.772
22-Sep-04	539.411	822.413	5.638	636.963	0.979	32.388	10.367	330.961
23-Sep-04	228.447	785.434	5.411	736.151	0.971	0.704	11.919	189.408
24-Sep-04	57.977	662.785	3.624	803.904	1.15	0	11.919	209.865
25-Sep-04	-127.825	481.139	3.926	695.658	1.509	375.274	2.578	-287.511
26-Sep-04	293.721	523.312	0	709.641	2.191	48.581	7.761	437.039
27-Sep-04	33.612	727.72	0	773.406	2.215	9.153	13.472	81.402
28-Sep-04	100.905	684.966	0	762.027	2.057	0	9.84	185.749
29-Sep-04	51.674	514.773	0	635.524	2.057	23.235	7.761	154.894
30-Sep-04	8.851	506.89	4.997	784.556	2.087	0.704	6.209	289.935
1-Oct-04	-129.008	506.726	35.102	832.711	2.161	0.704	12.89	207.002
2-Oct-04	-127.718	508.869	18.925	759.433	2.16	1.408	11.143	130.421
3-Oct-04	-74.177	509.031	20.373	744.497	2.094	0.704	12.224	170.715
4-Oct-04	-77.532	544.275	14.338	746.111	1.997	0.704	10.201	131.804
5-Oct-04	-86.114	561.884	14.506	734.903	2.015	0	12.03	96.92
6-Oct-04	-127.415	462.008	16.92	714.767	2.313	75.336	4.962	52.657
7-Oct-04	63.712	772.2	14.119	703.324	1.822	4.224	8.926	-2.284
8-Oct-04	21.6	729.474	13.872	713.201	1.643	0.704	12.169	15.149
9-Oct-04	-148.551	292.994	14.78	661.08	2.072	1.408	11.698	227.753
10-Oct-04	-436.87	60.873	15.843	526.429	2.8	7.041	6.57	25.415
11-Oct-04	-260	227.198	11.045	276.266	2.595	2.112	5.184	-210.455
12-Oct-04	-41.097	174.499	9.78	241.624	2.441	0.704	6.68	29.563

1 ha-m = 8.1068 ac-ft

Date	Change in storage	Inflow Spillway G302	Seepage Pump G250S	Outflow Pump G251/G310	Seepage L7a	Rain	ET	Remainders
	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m
13-Oct-04	-66.085	148.76	9.984	155.249	2.263	0	11.254	-50.605
14-Oct-04	-61.914	53.758	7.066	162.464	2.279	0.704	11.337	55.146
15-Oct-04	-97.108	83.074	4.92	132.324	2.231	1.408	7.928	-43.569
16-Oct-04	-1422.597	0	4.633	67.196	2.186	0	10.727	-1346.86
17-Oct-04	-51.05	0	6.07	34.332	2.242	0	11.254	-7.706
18-Oct-04	-6.345	0	4.105	0	2.254	0	8.454	-0.145
19-Oct-04	7.415	0	6.167	0	2.262	0.704	6.486	10.935
20-Oct-04	5.798	0	5.505	0	2.189	11.969	7.318	-1.042
21-Oct-04	13.431	0	5.539	0	2.337	10.561	9.064	9.597
22-Oct-04	17.542	11.152	5.14	0	2.342	2.816	9.591	10.823
23-Oct-04	-0.607	0	4.424	0	2.354	0	6.68	3.719
24-Oct-04	-6.52	0	5.159	0	2.347	0.704	11.31	1.739
25-Oct-04	-10.039	0	6.447	6.936	2.336	0.704	10.367	4.224
26-Oct-04	-16.897	0	6.097	4.13	2.357	0	7.401	-7.723
27-Oct-04	-11.986	0	4.633	0	2.339	0	8.177	-6.148
28-Oct-04	-9.329	0	2.672	0	2.314	0	7.401	-4.242
29-Oct-04	2.334	0	3.809	0	2.306	0.704	7.623	6.947
30-Oct-04	-3.547	0	4.067	0	2.288	0	10.007	4.172
31-Oct-04	-4.982	0	2.58	0	2.295	2.112	7.346	-2.043
1-Nov-04	0.413	0	2.578	0	2.328	0.704	9.12	6.501
2-Nov-04	-14.689	0	2.579	13.755	2.291	0	7.318	4.093
3-Nov-04	-71.271	0	2.789	43.83	2.274	0	8.454	-21.261
4-Nov-04	-72.62	0	4.576	30.762	2.253	0	7.817	-36.294
5-Nov-04	-5.182	0	3.266	7.839	2.189	0	3.825	4.293
6-Nov-04	-6.4	0	2.544	0	2.101	0	4.712	-3.789
7-Nov-04	-2.507	0	2.719	0	2.107	0	9.064	4.45
8-Nov-04	1387.292	0	2.718	0	2.07	0	10.367	1395.589
9-Nov-04	-5.732	0	2.62	0	2.023	0	8.593	0.838
10-Nov-04	-13.237	0	4.427	0	2.066	0	9.536	-5.767
11-Nov-04	-0.847	0	2.918	0	2.059	0	6.736	3.83
12-Nov-04	-3.449	0	2.474	0	2.027	0	6.791	1.315
13-Nov-04	-5.522	0	2.684	0	1.998	2.816	8.399	-1.937
14-Nov-04	22.489	0	3.005	0	2.003	28.163	3.105	-4.572
15-Nov-04	13.576	0	4.486	0	2.023	0	7.152	18.705
16-Nov-04	-4.14	0	0.707	0	2.012	0	7.457	1.305
17-Nov-04	-5.909	0	1.663	0	1.974	0	4.186	-3.697
18-Nov-04	-5.703	0	2.475	0	1.942	0	6.376	-1.269
19-Nov-04	-4.146	16.432	2.307	5.454	1.926	0	7.623	-9.427
20-Nov-04	13.214	37.038	0.133	16.882	1.875	0	8.759	-0.058
21-Nov-04	9.354	36.967	2.475	16.804	1.819	0	7.928	-4.7
22-Nov-04	9.146	34.107	2.37	16.941	1.796	0	6.736	-3.08
23-Nov-04	10.879	42.758	2.533	16.965	1.784	0	7.401	-9.297
24-Nov-04	12.689	32.14	8.14	16.975	1.775	0	6.486	2.235
25-Nov-04	16.763	32.237	2.224	17.029	1.7	2.112	4.934	2.677
26-Nov-04	0.078	33.289	0	17.134	1.622	0	8.122	-9.577
27-Nov-04	4.717	31.503	2.387	17.176	1.654	9.153	6.32	-14.097
28-Nov-04	21.252	32.389	0	17.222	1.572	0	8.288	12.801
29-Nov-04	-0.297	14.509	8.058	7.509	1.547	0	7.817	-1.027
30-Nov-04	-4.097	0	0	0	1.559	0	5.017	-0.639
1-Dec-04	-4.028	21.886	2.532	19.424	1.527	0	6.736	-1.281
2-Dec-04	-11.31	35.438	6.82	32.609	1.503	0	7.152	-8.49
3-Dec-04	6.809	71.46	0	33.908	1.39	0	7.734	-24.399
4-Dec-04	-13.298	0	0	34.006	1.44	0	7.207	26.475
5-Dec-04	-46.795	0	5.307	30.224	1.494	0	6.154	-11.911
6-Dec-04	-26.867	39.71	2.496	47.896	1.495	0	5.793	-14.383
7-Dec-04	14.064	88.802	2.237	46.274	1.423	1.408	4.241	-27.054

1 ha-m = 8.1068 ac-ft

Date	Change in storage	Inflow Spillway G302	Seepage Pump G250S	Outflow Pump G251/G310	Seepage L7a	Rain	ET	Remainders
	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m
12/8/2004 0:00	43.317	102.384	4.978	46.465	1.298	0.704	5.128	-9.476
12/9/2004 0:00	68.726	145.827	2.399	48.606	1.187	0	6.736	-22.946
12/10/2004 0:00	138.21	171.923	2.32	50.502	1.01	0.704	6.625	21.7
12/11/2004 0:00	111.146	104.238	3.997	51.353	0.909	0	6.154	63.506
12/12/2004 0:00	5.732	54.48	3.043	47.74	0.895	0	7.817	5.914
12/13/2004 0:00	-26.336	29.182	2.152	46.117	0.947	0	7.623	-2.725
12/14/2004 0:00	-22.174	38.682	2.538	48.109	0.921	0	6.32	-7.348
12/15/2004 0:00	-27.069	46.423	2.036	58.407	0.839	0	7.678	-8.246
12/16/2004 0:00	-8.643	128.174	2.52	85.374	0.837	0	6.32	-45.96
12/17/2004 0:00	19.594	139.627	3.024	117.749	0.738	3.52	1.802	-4.74
12/18/2004 0:00	85.415	159.648	3.869	0	0.548	0.704	7.401	-68.084
12/19/2004 0:00	80.573	51.801	2.502	57.644	0.667	0	7.318	93.067
12/20/2004 0:00	21.667	110.514	4.628	96.45	0.692	0	8.094	15.005
12/21/2004 0:00	124.912	139.404	2.488	93.135	0.82	0	7.872	85.695
12/22/2004 0:00	180.688	208.645	4.327	41.789	0.741	2.816	7.096	17.371
12/23/2004 0:00	214.889	60.927	3.281	0	0.71	0	3.16	156.412
12/24/2004 0:00	88.364	30.224	3.29	0	0.732	5.633	2.689	54.464
12/25/2004 0:00	22.124	3.036	5.353	0	0.853	0.704	3.992	21.523
12/26/2004 0:00	-19.985	5.207	2.091	0	0.829	0.704	7.318	-19.407
12/27/2004 0:00	2.311	28.066	0	27.802	0.683	0	7.152	8.516
12/28/2004 0:00	5.058	30.85	8.227	92.903	0.648	0	3.881	70.344
12/29/2004 0:00	-33.561	25.732	4.127	65.994	0.682	0	5.017	11.036
12/30/2004 0:00	-2.064	18.516	5.027	43.585	0.697	0	7.096	29.404
12/31/2004 0:00	-0.546	19.082	2.533	45.09	0.682	0	4.241	29.021
1/1/2005 0:00	-3.654	25.164	4.875	45.197	0.661	0	5.655	21.373
1/2/2005 0:00	3.08	26.5	3.846	45.241	0.657	0	7.734	28.898
1/3/2005 0:00	-5.473	15.84	3.707	32.103	0.729	0	8.094	18.155
1/4/2005 0:00	-23.206	6.036	3.302	22.549	0.819	0	6.431	-1.081
1/5/2005 0:00	-28.167	7.864	5.187	22.385	0.821	0	6.32	-8.147
1/6/2005 0:00	-28.047	35.447	2.383	70.77	0.71	0	6.902	13.468
1/7/2005 0:00	-42.301	17.075	4.989	99.254	0.745	0.704	6.376	44.805
1/8/2005 0:00	-96.741	0	2.51	97.285	0.886	0	6.985	6.643
1/9/2005 0:00	-121.246	0	2.259	95.964	0.935	0	6.958	-19.259
1/10/2005 0:00	-124.002	0	2.378	94.451	0.975	0	7.263	-23.263
1/11/2005 0:00	-73.893	0	4.837	41.88	0.982	0	6.015	-26.98
1/12/2005 0:00	-70.24	0	2.129	81.528	1.012	0	6.791	17.067
1/13/2005 0:00	-53.838	0	4.804	32.519	1.067	0	4.103	-18.283
1/14/2005 0:00	-21.261	16.42	3.619	32.237	1.029	27.459	2.966	-30.966
1/15/2005 0:00	83.297	235.187	2.58	77.131	0.811	4.929	2.439	-78.06
1/16/2005 0:00	201.18	189.348	4.366	86.84	0.753	0	2.855	100.774
1/17/2005 0:00	82.806	139.365	1.95	94.048	0.703	0	8.87	45.656
1/18/2005 0:00	-107.289	3.154	2.317	187.117	0.889	0	8.51	84.295
1/19/2005 0:00	-187.27	0	2.197	120.288	1.027	0	7.678	-60.331
1/20/2005 0:00	-139.195	1.343	2.333	119.474	1.037	0	6.376	-15.725
1/21/2005 0:00	-156.956	0	2.146	91.929	1.08	0	8.454	-57.653
1/22/2005 0:00	-20.47	0	2.328	0	1.054	0.704	6.68	-15.548
1/23/2005 0:00	24.729	0	2.227	0	0.969	2.112	7.512	29.16
1/24/2005 0:00	-449.434	99.521	2.236	34.748	0.825	0	9.314	-505.718
1/25/2005 0:00	32.625	38.53	2.237	25.086	0.876	0	9.369	27.674
1/26/2005 0:00	16.776	0	2.322	10.719	0.933	0	9.231	35.793
1/27/2005 0:00	-16.693	0	2.468	20.469	0.927	0	7.928	10.777
1/28/2005 0:00	-24.228	0	2.263	23.434	0.923	0	7.152	5.435
1/29/2005 0:00	-16.449	0	3.078	8.514	0.944	0	7.678	-1.201
1/30/2005 0:00	-25.432	0	3.698	8.328	0.902	0	5.239	-12.767

1 ha-m = 8.1068 ac-ft

Date	Change in storage	Inflow Spillway G302	Seepage Pump G250S	Outflow Pump G251/G310	Seepage L7a	Rain	ET	Remainders
	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m
31-Jan-05	-16.782	0	2.307	9.64	0.839	0	9.231	1.25
1-Feb-05	451.091	0	2.354	0	0.857	0	8.454	458.688
2-Feb-05	-5.311	0	4.616	6.158	0.85	0	7.983	7.98
3-Feb-05	-6.041	0	2.38	0.164	0.848	0	6.847	0.122
4-Feb-05	-6.092	7.169	2.042	0	0.729	0	4.518	-9.472
5-Feb-05	-10.918	0	2.654	0	0.663	0	8.87	-2.711
6-Feb-05	-11.754	0	4.476	0	0.706	0	7.207	-5.253
7-Feb-05	-7.594	0.005	7.418	0	0.703	0	6.486	-1.816
8-Feb-05	-7.395	0	11.614	0	0.688	0	6.847	-1.236
9-Feb-05	-19.214	0.015	21.16	0	0.707	0	7.263	-12.673
10-Feb-05	-9.176	0	25.309	0	0.649	0	7.567	-2.258
11-Feb-05	-16.824	0	24.816	0.372	0.548	0	10.727	-6.273
12-Feb-05	-14.618	0	25.063	0	0.55	0	10.922	-4.246
13-Feb-05	-8.447	0	23.681	0	0.558	0	10.727	1.722
14-Feb-05	-4.087	0	24.643	0	0.539	0	8.87	4.244
15-Feb-05	6.215	0	23.565	0	0.496	0	10.007	15.726
16-Feb-05	8.674	0	20.374	0	0.455	0	9.84	18.059
17-Feb-05	4.674	0	17.957	0	0.419	0	11.032	15.287
18-Feb-05	2.75	0	6.609	0	0.363	0	9.536	11.923
19-Feb-05	-4.034	0	2.704	0	0.363	0	10.423	6.026
20-Feb-05	-2.994	0	2.064	0	0.374	0	9.231	5.863
21-Feb-05	-1.242	0	1.913	0	0.36	0	11.088	9.486
22-Feb-05	-1.706	0	3.392	0	0.313	0	9.314	7.295
23-Feb-05	-2.101	0	3.157	0	0.302	0	9.785	7.382
24-Feb-05	-15.567	0.778	1.848	28.355	0.308	0.704	7.734	18.732
25-Feb-05	16.398	195.193	3.047	91.665	0.231	19.714	3.326	-103.749
26-Feb-05	185.429	232.194	3.134	78.071	0.148	18.306	4.768	17.62
27-Feb-05	178.973	198.386	4.105	100.727	0.131	25.347	5.35	61.186
28-Feb-05	44.557	98.577	2.393	222.42	0.143	0	6.015	174.272
1-Mar-05	-161.951	40.353	2.135	236.239	0.224	0	10.478	44.189
2-Mar-05	-1484.687	0	18.78	98.136	0.265	0	12.474	-1374.342
3-Mar-05	-109.737	34.711	22.485	68.228	0.275	27.459	2.8	-101.154
4-Mar-05	75.156	193.287	22.397	69.375	0.223	28.163	5.793	-71.349
5-Mar-05	92.208	10.606	23.553	128.382	0.247	0	12.529	222.266
6-Mar-05	-143.701	8.59	19.994	99.506	0.312	0	10.838	-42.259
7-Mar-05	-93.173	11.384	14.524	65.708	0.368	0	10.561	-28.656
8-Mar-05	-3.744	58.564	2.067	51.701	0.347	0.704	3.576	-8.082
9-Mar-05	188.28	232.158	7.333	76.04	0.238	191.51	0.721	-158.865
10-Mar-05	328.98	181.135	25.765	219.751	0.261	2.816	12.446	376.965
11-Mar-05	-154.371	49.127	23.193	211.349	0.63	0	10.145	17.366
12-Mar-05	-73.892	142.264	21.991	129.799	0.475	0	13.416	-73.416
13-Mar-05	-16.37	112.085	21.405	133.28	0.441	0	12.862	17.246
14-Mar-05	-111.234	5.987	21.135	151.32	0.555	0	9.73	43.274
15-Mar-05	-179.784	0	18.247	101.517	0.667	0	10.561	-68.373
16-Mar-05	-108.806	26.033	16.988	58.527	0.799	0	10.727	-66.384
17-Mar-05	12.942	87.684	16.102	56.442	0.728	63.367	2.994	-79.401
18-Mar-05	307.571	234.458	15.313	86.037	0.643	2.112	11.393	167.788
19-Mar-05	77.216	186.101	18.061	129.18	0.581	0	14.082	33.796
20-Mar-05	-21.51	158.4	20.113	168.728	0.55	0	13.527	1.795
21-Mar-05	-66.069	63.836	20.14	172.716	0.608	0	9.12	51.323
22-Mar-05	-169.027	0	17.179	135.712	0.817	0	9.425	-24.707
23-Mar-05	-35.979	142.267	15.548	82.465	0.738	9.857	9.73	-96.646
24-Mar-05	126.672	134.33	5.423	98.019	0.592	0	9.175	98.944
25-Mar-05	-85.751	0.137	2.093	124.176	0.777	0	10.672	48.183
26-Mar-05	-105.524	0	0	66.273	0.88	8.449	10.672	-37.908

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Date	Change in storage	Inflow Spillway G302	Seepage Pump G250S	Outflow Pump G251/G310	Seepage L7a	Rain	ET	Remainders
	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m
27-Mar-05	-68.051	0	2.337	49.139	1.066	0	11.753	-8.225
28-Mar-05	-74.107	0	1.916	34.454	1.094	0	7.457	-33.29
29-Mar-05	-40.867	0	0	23.628	1.067	0	14.553	-3.753
30-Mar-05	-31.818	0	2.208	17.758	1.062	0	13.305	-1.817
31-Mar-05	-20.47	0	2.188	6.134	1.068	0	12.28	-3.124
1-Apr-05	-0.909	0	0	0	1.047	0	13.638	11.682
2-Apr-05	-7.341	0	0.826	0	0.975	3.52	5.294	-6.542
3-Apr-05	-10.701	0	2.085	0	0.876	0	15.273	3.696
4-Apr-05	-1.115	0	0.364	0.807	0.87	0	15.024	13.846
5-Apr-05	1260.233	0	2.661	0	0.844	0	14.082	1273.471
6-Apr-05	-5.957	1.067	2.191	0	0.843	0	12.64	4.773
7-Apr-05	-1175.124	2.77	3.862	0	0.862	26.755	11.337	-1194.174
8-Apr-05	1150.434	3.257	3.589	0	0.902	36.612	6.376	1116.039
9-Apr-05	-24.106	2.738	3.387	0	0.876	0	13.583	-14.137
10-Apr-05	-12.728	2.535	2.371	0	0.874	0	12.862	-3.275
11-Apr-05	-11.352	1.26	2.199	0	0.89	0.704	14.775	0.569
12-Apr-05	7.644	4.054	2.755	0.024	0.811	0	11.753	14.556
13-Apr-05	-6.091	0.281	4.199	0	0.782	5.633	9.48	-3.307
14-Apr-05	-59.423	0	2.619	24.11	0.734	0	13.361	-22.686
15-Apr-05	-94.615	0	2.805	33.177	0.705	0	13.278	-48.865
16-Apr-05	-66.618	0	1.929	0	0.706	0	14.082	-53.242
17-Apr-05	-28.053	0	2.329	0	0.688	0	10.312	-18.429
18-Apr-05	-15.714	0	2.643	0	0.698	0	12.28	-4.132
19-Apr-05	-10.279	0	3.742	0	0.699	0	13.278	2.3
20-Apr-05	-0.377	185.084	2.587	0	0.473	0	10.561	-175.373
21-Apr-05	283.538	246.894	2.008	0	0.298	0	12.446	48.792
22-Apr-05	417.832	43.837	4.76	0	0.449	2.112	13.943	385.377
23-Apr-05	-15.432	0	2.315	0	0.483	0	14.775	-1.14
24-Apr-05	-18.244	0	4.09	0	0.42	0	16.216	-2.448
25-Apr-05	7.27	0	2.154	0	0.437	0	16.438	23.271
26-Apr-05	-7.06	0	4.706	0	0.462	0	13	5.478
27-Apr-05	-16.695	0	2.429	0	0.411	11.969	6.015	-23.06
28-Apr-05	15.793	0	4.592	0	0.39	0	15.966	31.369
29-Apr-05	-17.677	0	3.193	0	0.396	0	16.022	-2.051
30-Apr-05	-12.64	0	2.907	0	0.4	0	14.359	1.319

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