

**Technical Publication**

**EMA # 411**

**Water Budget Analysis  
for Stormwater Treatment Area 1 W**

**(May 1, 2002 to April 30, 2003)**

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**by**

**Wossenu Abtew and Anna Reardon**

**Resource Assessment Division  
Environmental Monitoring and Assessment Department  
South Florida Water Management District  
3301 Gun Club Road  
West Palm Beach, FL 33406**



## 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 was operated for five years (1994 to 1999) and STA-1W started operation on July 1, 1999. STA-1W covers 2,700 hectares (ha) (6,670 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 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 ( $\text{mg L}^{-1}$ ). STA-1W is one of the large-scale constructed wetlands that followed the successful operation of the ENR Project. This report presents the fourth annual water budget for STA-1W. Water budget analyses for five years of the ENR Project and three years of STA-1W were reported in the South Florida Water Management District's (SFWMD's) technical publications (Guardo et al., 1996; Abteu and Mullen, 1997; Abteu and Downey, 1998; Abteu et al., 2000; Abteu et al., 2001; Abteu et al., 2002).

The total inflow into STA-1W through the inflow spillway for the study period was 73,006 hectare-meters (ha-m) (591,845 acre-feet [ac-ft]), and the total outflow through the outflow pumps was 73,518 ha-m (595,996 ac-ft). Estimated seepage inflow from the L-7 levee through the roadside culverts was 396 ha-m (3,210 ac-ft). The seepage recirculation pump had a total flow of 1,431 ha-m (11,601 ac-ft). The areal average rainfall for the study period was 107.4 centimeters (cm), or 42.3 inches (in), and the total areal average evapotranspiration (ET) was 129.7 cm (51.1 in). A comparison with the previous three years of water budget shows that the surface water inflow for this period was the largest which indicates the highest hydraulic loading during this period. The sum of the errors and unknowns (remainders) was 1,378 ha-m which represents 2 percent of the total inflow into the system. Rainfall (4 percent) and ET (5 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 7.4 centimeters per day ( $\text{cm d}^{-1}$ ), (2.91 inches per day [ $\text{in d}^{-1}$ ]). The mean hydraulic retention time was 8.2 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 61 cm (24 in) and total area of 2,700 ha (6,670 ac). The estimated mean hydraulic retention time was the lowest and the hydraulic loading rate was the highest for both the ENR and STA-1W operations.

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## LIST OF ABBREVIATIONS AND ACRONYMS

<b>ac</b>	acre
<b>ac-ft</b>	acre-foot
<b>BMP</b>	Best Management Practice
<b>cm</b>	centimeter
<b>cm d<sup>-1</sup></b>	centimeter per day
<b>cfs</b>	cubic foot per second
<b>EAA</b>	Everglades Agricultural Area
<b>ENR</b>	Everglades Nutrient Removal
<b>ET</b>	evapotranspiration
<b>ft</b>	foot
<b>ha</b>	hectare
<b>ha-m</b>	hectare-meter
<b>HW</b>	headwater
<b>in</b>	inch
<b>in d<sup>-1</sup></b>	inch per day
<b>m</b>	meter
<b>m<sup>3</sup>s<sup>-1</sup></b>	cubic meter per second
<b>MAX</b>	maximum
<b>MIN</b>	minimum
<b>mm</b>	millimeter
<b>NGVD</b>	National Geodetic Vertical Datum
<b>P</b>	phosphorus
<b>Q</b>	discharge
<b>rpm</b>	revolution per minute
<b>SFWMD</b>	South Florida Water Management District
<b>STA</b>	Stormwater Treatment Area
<b>TW</b>	tailwater
<b>UVM</b>	ultrasonic velocity meter
<b>WCA</b>	Water Conservation Area

## CONVERSION FACTORS

<b>Metric</b>	<b>English</b>
mm	0.03937 in
cm	0.3937 in
m	3.2808 ft
ha	2.47 ac
m <sup>3</sup> s <sup>-1</sup>	35.33 cfs
ha-m	8.1068 ac-ft

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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 2,700 hectares (ha) (6,670 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 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 initial outflow total P concentration of 0.05 milligrams per liter ( $\text{mg L}^{-1}$ ). STA-1W is one of the large-scale constructed wetlands that followed the successful operation of ENR Project. This report presents the fourth annual water budget for STA-1W (May 1, 2002 to April 30, 2003). Water budget analyses for five years of the ENR Project and three years of STA-1W were reported in the South Florida Water Management District's (SFWMD's) technical publications (Guardo et al., 1996; Abteu and Mullen, 1997; Abteu and Downey, 1998; Abteu et al., 2000; Abteu et al., 2001; Abteu et al., 2002).

## 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 2, the largest cell, Cell 5, has been added to the north and operates parallel to the other cells. The total area of STA-1W is 2,700 ha (6,670 ac). The area and average ground elevation for each cell are presented in Table 1.

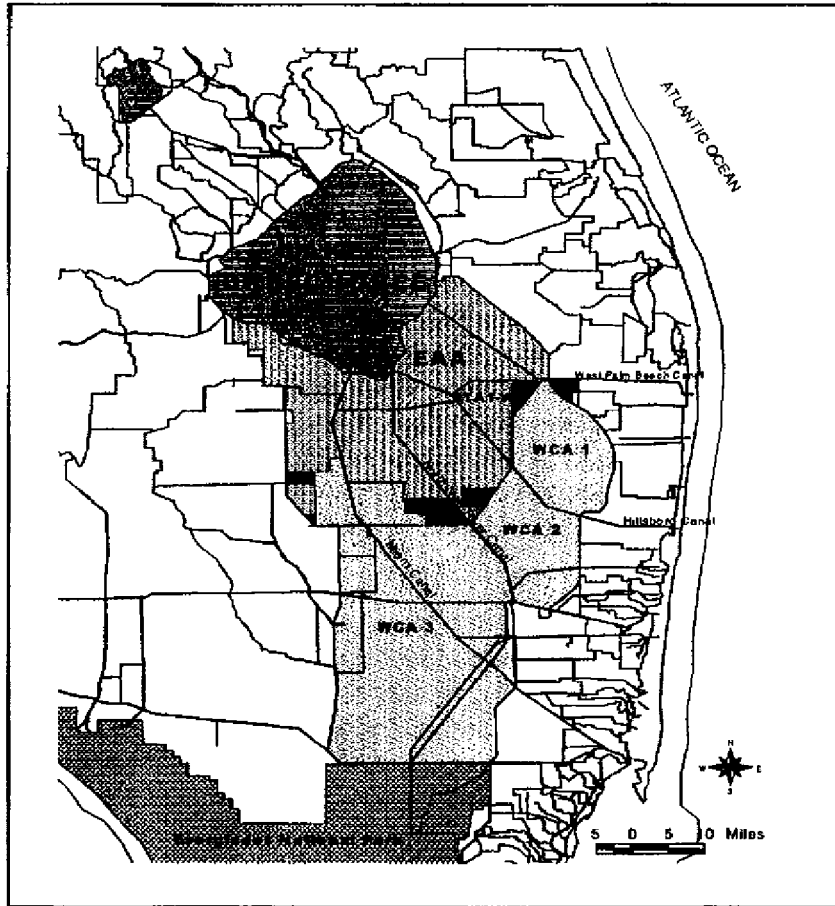


Figure 1. Location of Stormwater Treatment Area 1 West (STA-1W)

Table 1. Site characteristics of STA-1W.

Cell	Area		Average ground Elev.	
	ha	ac	m NGVD	ft NGVD
Cell 1	603	1,490	3.13	10.27
Cell 2	381	941	2.94	9.65
Cell 3	415	1,026	3.10	10.17
Cell 4	145	358	3.00	9.84
Cell 5	1,156	2,855	2.90	9.51
<b>Total</b>	<b>2,700</b>	<b>6,670</b>		
<b>Average</b>			<b>2.99</b>	<b>9.82</b>

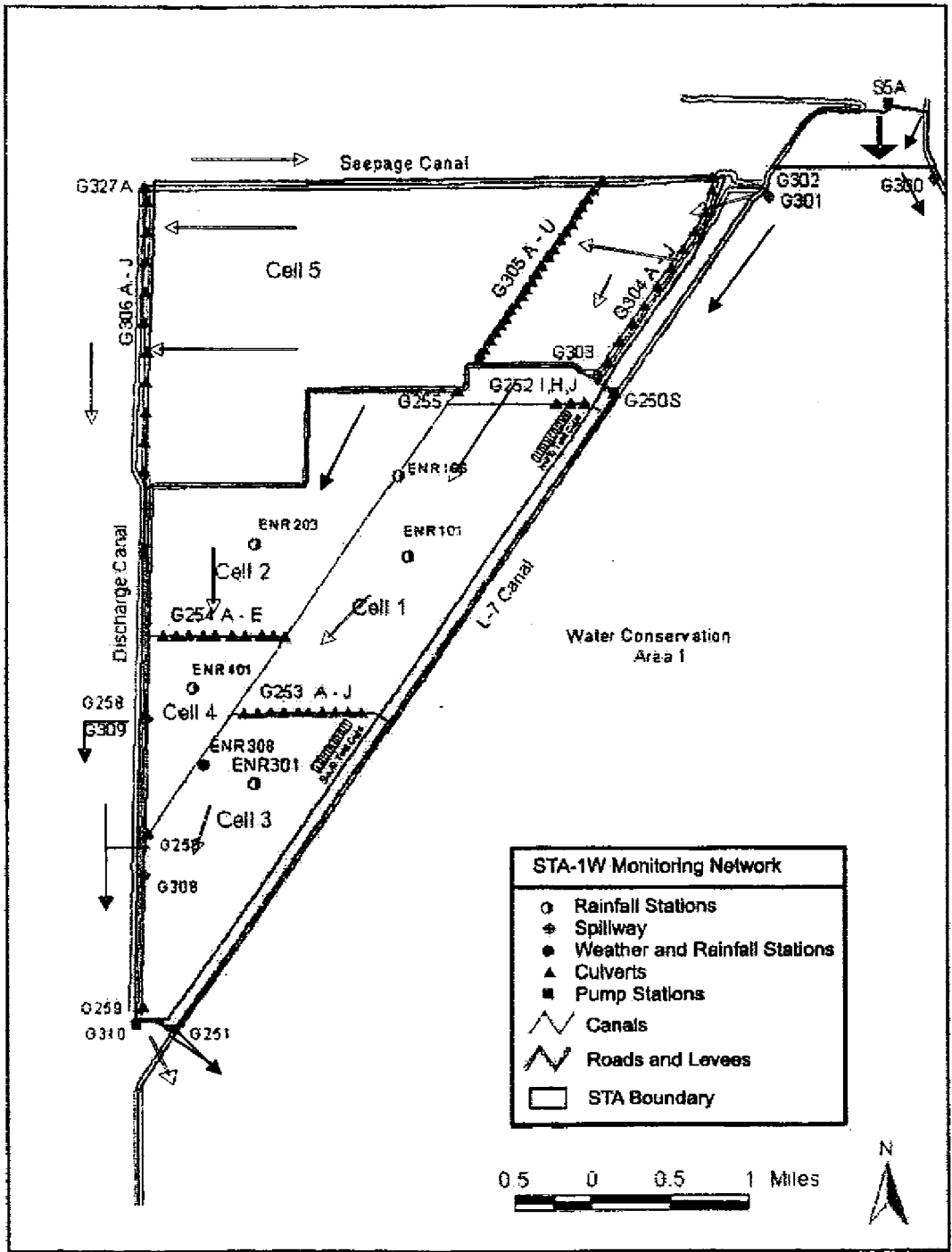


Figure 2. STA-1W structures and monitoring network

## 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 the 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 amount 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 new 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 ( $\text{m}^3 \text{s}^{-1}$ ) (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. Structure information for the STA-1W stations is provided in Table 2. Structure locations are shown in Figure 2.

## 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  $0.232 \text{ m s}^{-1}$  ( $0.76 \text{ ft s}^{-1}$ ) and  $0.418 \text{ m s}^{-1}$  ( $1.37 \text{ ft s}^{-1}$ ) (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  $50.4 \text{ m}^3 \text{ s}^{-1}$  (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 evenness 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 4 and 3 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  $41.6 \text{ m}^3 \text{ s}^{-1}$  (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  $5.66 \text{ m}^3 \text{ s}^{-1}$  (200 cfs), and three supplemental pumps from the old ENR inflow pump station G250 with a combined capacity of  $8.49 \text{ m}^3 \text{ s}^{-1}$  (300 cfs).

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

The outflow from Cell 5 to the discharge canal occurs through ten corrugated metal pipe culverts which are 183 cm (72 in) in diameter and 39.6 m (130 ft) long have a combined discharge capacity of  $41.6 \text{ m}^3 \text{ s}^{-1}$  (1,470 cfs). G327A is a gated culvert which is 213 cm (84 in) in diameter, and 39.6 m (130 ft) long with  $2.83 \text{ m}^3 \text{ s}^{-1}$  (100 cfs) discharge capacity. G327C is a culvert 39.3 m (129 ft) long and has a discharge capacity of  $2.83 \text{ m}^3 \text{ s}^{-1}$  (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  $15.85 \text{ m}^3 \text{ s}^{-1}$  (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  $15.85 \text{ m}^3 \text{ s}^{-1}$  (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  $12.74 \text{ m}^3 \text{ s}^{-1}$  (450 cfs). G310 is equipped with six pumps of three different capacities, with a total capacity of  $86 \text{ m}^3 \text{ s}^{-1}$  (3,040 cfs). G310 has two electric pumps with a combined discharge capacity of  $5.66 \text{ m}^3 \text{ s}^{-1}$  (200 cfs), two diesel pumps, with a combined discharge capacity of  $26.6 \text{ m}^3 \text{ s}^{-1}$  (940 cfs), and two diesel pumps with a combined discharge capacity of  $53.8 \text{ m}^3 \text{ s}^{-1}$  (1,900 cfs).

Table 2. Structure information for STA 1-W

Station	G-300	G-301	G-302	G-303	G-304	G-306	G-308	G-309	G-327A	G-310	G-251
Type	spillway	spillway	spillway	spillway	culvert	culvert	spillway	spillway	culvert	pump	pump
Units	2	3	2	2	10	10	1	1	1	6	6
Max Q			92 m <sup>3</sup> s <sup>-1</sup> (3250 cfs)	50.4 m <sup>3</sup> s <sup>-1</sup> (1780 cfs)	41.6 m <sup>3</sup> s <sup>-1</sup> (1470 cfs)	41.6 m <sup>3</sup> s <sup>-1</sup> (1470 cfs)	28.3 m <sup>3</sup> s <sup>-1</sup> (1000 cfs)	28.3 m <sup>3</sup> s <sup>-1</sup> (1000 cfs)	5.7 m <sup>3</sup> s <sup>-1</sup> (200 cfs)	86 m <sup>3</sup> s <sup>-1</sup> (3040 cfs)	12.7 m <sup>3</sup> s <sup>-1</sup> (450 cfs)
Min Q	-28.3 m <sup>3</sup> s <sup>-1</sup> (-1000 cfs)	-28.3 m <sup>3</sup> s <sup>-1</sup> (-1000 cfs)	0	0	0	0	0	0	0	0	0
Design Q	54.3 m <sup>3</sup> s <sup>-1</sup> (1920 cfs)	81.5 m <sup>3</sup> s <sup>-1</sup> (2880 cfs)	92 m <sup>3</sup> s <sup>-1</sup> (3250 cfs)	50.4 m <sup>3</sup> s <sup>-1</sup> (1780 cfs)	41.6 m <sup>3</sup> s <sup>-1</sup> (1470 cfs)	41.6 m <sup>3</sup> s <sup>-1</sup> (1470 cfs)	15.8 m <sup>3</sup> s <sup>-1</sup> (560 cfs)	15.8 m <sup>3</sup> s <sup>-1</sup> (560 cfs)	2.83 m <sup>3</sup> s <sup>-1</sup> (100 cfs)	86 m <sup>3</sup> s <sup>-1</sup> (3040 cfs)	12.7 m <sup>3</sup> s <sup>-1</sup> (450 cfs)
Design HW	5.79 m (19 ft)	5.79 m (19 ft)	5.49 m (18 ft)	4.79 m (15.7 ft)	4.79 m (15.7 ft)	3.51 m (11.5 ft)	3.58 m (11.75 ft)	3.84 m (12.6 ft)	2.74 m (9 ft)	2.74 m (9 ft)	
Design TW			4.79 m (15.7 ft)	4.41 m (14.46 ft)		2.74 m (9 ft)	2.29 m (7.5 ft)	2.38 m (7.8 ft)	2.65 m (8.7 ft)		
Bypass stage	6.1 m (20 ft)	6.1 m (20 ft)			5.75 m (18.8 ft)	5.73 m (18.8 ft)	5.03 m (16.5 ft)	5.03 m (16.5 ft)	5.33 m (18.8 ft)		
Flow Min. Elevation	3.35 m (11 ft)	2.35 m (7.7 ft)	2.87 m (9.4 ft)		3.43 m	2.38 m (7.8 ft) inv	2.26 m (7.4 ft)	2.32 m (7.6 ft)	0.15 m (0.5 ft)		
Flow Width	6.1 m (20 ft)	6.71 m (22 ft)	6.1 m (20 ft)	4.88 m (16 ft)	1.83 m (6 ft) dia.	1.83 m (6 ft) dia.	4.27 m (14 ft)	4.27 m (14 ft)	2.13 m (7 ft) dia.		0.91 m (3 ft) dia.
Flow Height	2.56 m (8.4 ft)	3.57 m (11.7 ft)					2.04 m (6.7 ft)	2.04 m (6.7 ft)			

**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.	18.8 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



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.

## 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 treatment 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 inflow to the G250S pumps. In return, the pumps convey the seepage return flow into Cell 1 that also receives inflow from G303 as well. Thus, flow is primarily direct surface flow and partly through the remaining culverts G252 (H, I, and J). 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.

## HYDROLOGY AND HYDROLOGIC MONITORING

### Rainfall

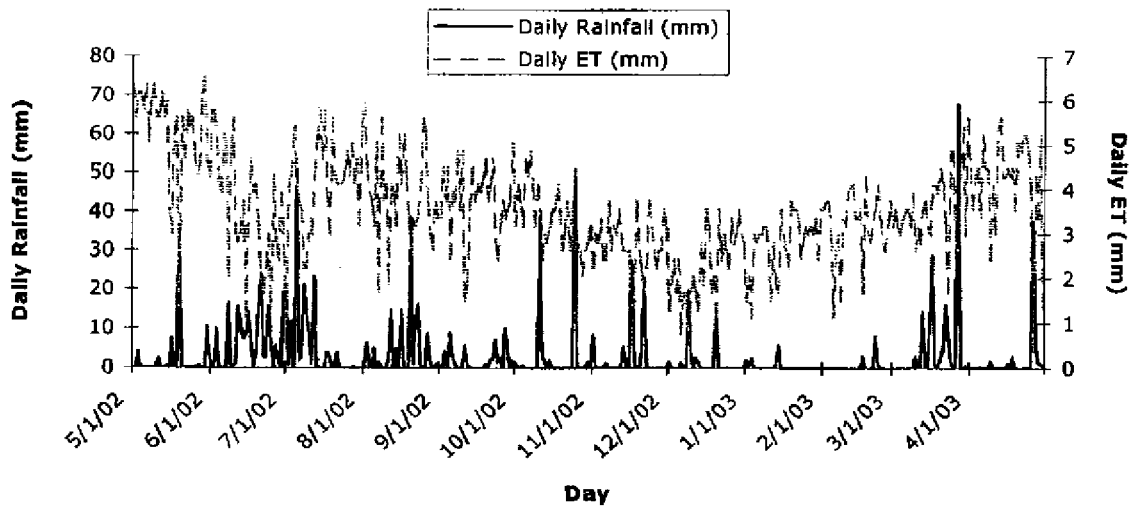
STA-1W has a six-gage rainfall monitoring network. The rainfall gauging stations along with their corresponding database keys and Thiessen weights are presented in Table 4. The gage locations are depicted in Figure 2. The areal average rainfall on the project site was computed using a Thiessen-weighted 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 Thiessen 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 107.4 cm (42.3 in). The eight year (July 1, 1994 to June 30, 2002) average areal rainfall for the previous ENR constructed wetland and the current STA-1W was 136.4 cm (53.5 inches).

**Table 4. Rainfall stations in STA-1W, database retrieval keys and Thiessen 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 129.7 cm (51.1 in). The seven-year (July 1, 1995 to Jun 30, 2002) average areal ET for the previous ENR and current STA-1W was 133.3 cm (52.5 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+G310	cm	in	cm	in	Pump	L7 Culverts
		ha-m	ha-m	cm	in	cm	in	ha-m	ha-m
2002	May	2089	1567	6.53	2.57	16.40	6.46	147	0
2002	Jun	7527	7247	19.09	7.52	10.66	4.20	186	6
2002	Jul	7312	8521	16.62	6.54	12.76	5.02	127	49
2002	Aug	8802	8332	13.32	5.24	12.06	4.75	126	29
2002	Sep	9115	9248	5.90	2.32	11.21	4.41	128	53
2002	Oct	9168	9769	10.07	3.96	10.34	4.07	113	43
2002	Nov	4486	4251	7.37	2.90	8.18	3.22	104	49
2002	Dec	9579	9428	4.75	1.87	6.98	2.75	116	57
2003	Jan	8046	7797	1.19	0.47	8.59	3.38	107	52
2003	Feb	2505	3030	1.25	0.49	8.99	3.54	89	26
2003	Mar	2855	3105	16.17	6.36	11.19	4.40	98	21
2003	Apr	1521	1223	5.26	2.07	12.42	4.89	90	12

“1 ha-m = 8.1068 ac-ft”

## Flows

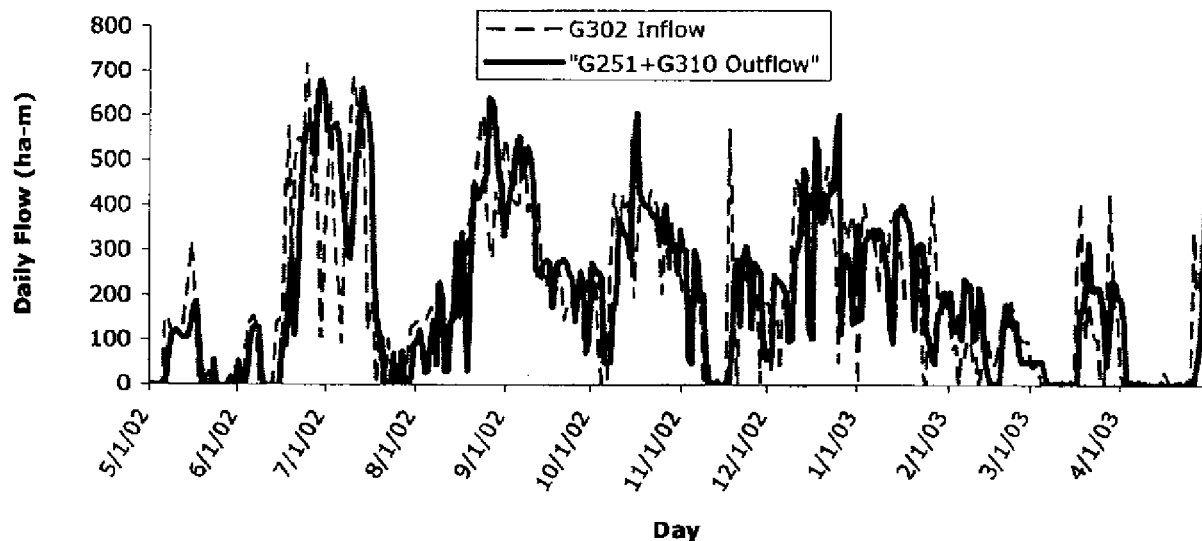
Database keys for STA-1W flow structures and stage gages are listed in Table 6. The total inflow spillway discharge for the study period was 73,006 ha-m (591,845 ac-ft), and the total outflow through the outflow pump stations was 73,518 ha-m (595,996 ac-ft). In the past, inflows through G302 were underestimated. In July 2003, new flow data for the period of record was loaded to 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 1,431 ha-m (11,601 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  $0.30 \text{ m}^3 \text{ s}^{-1}$ . The total estimated seepage from L-7 through roadside culverts was 396 ha-m (3,210 ac-ft). The monthly flow data for the study period are presented in Table 5.

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

Where L-7a is seepage in  $\text{m}^3 \text{ s}^{-1}$ ,  $\Delta WCA$  is rise in stage in WCA-1 above 4.57 m (15 ft) NGVD and  $\Delta h$  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 3.79 m (12.44 ft) NGVD. The mean stage in Cell 2 was 3.73 m (12.25 ft) and the mean stage in Cell 3 was 3.65 m (11.98 ft). The mean stage in Cell 4 was 3.68 m (12.06 ft) NGVD, and the mean stage in Cell 5 was 3.42 m (11.22 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 66 cm (26.1 in), 79 cm (31.3 in), 55 cm (21.7 in), 68 cm (26.6 in) and 52 cm (20.5 in) respectively.

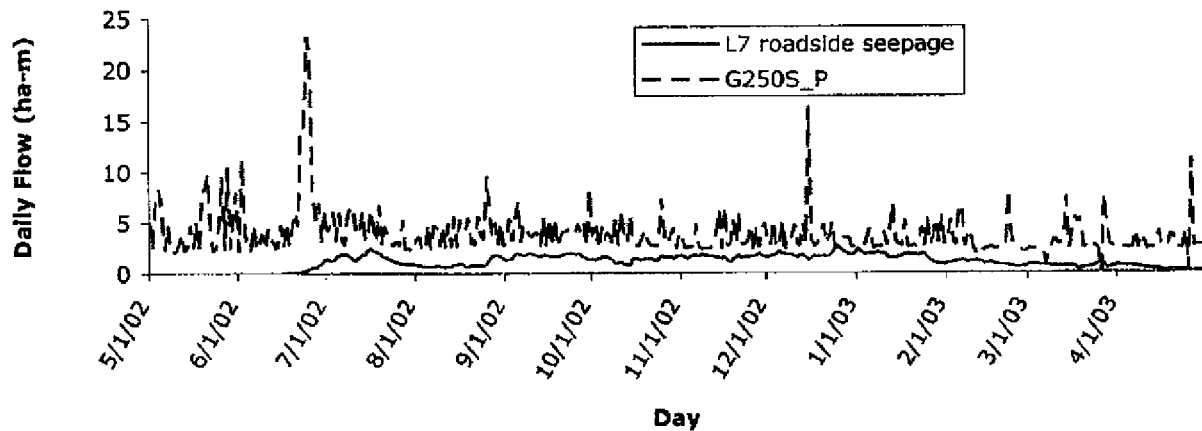


**Figure 4. Daily STA-1W inflows and outflows**

"1 ha-m = 8.1068 ac-ft"

**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



**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)**

Table 7. Observed water surface elevations (stages) and depths in STA-1W

Cell	Water Surface Elevation						Depth	
	Min		Max		Mean		Mean	
	m	ft	m	ft	m	ft	cm	in
Cell 1	3.44	11.29	4.42	14.49	3.79	12.44	66	26.1
Cell 2	3.44	11.27	4.36	14.30	3.73	12.25	79	31.3
Cell 3	3.42	11.22	4.25	13.96	3.65	11.98	55	21.7
Cell 4	3.41	11.20	4.30	14.12	3.68	12.06	68	26.6
Cell 5	2.78	9.13	3.91	12.84	3.42	11.22	52	20.5

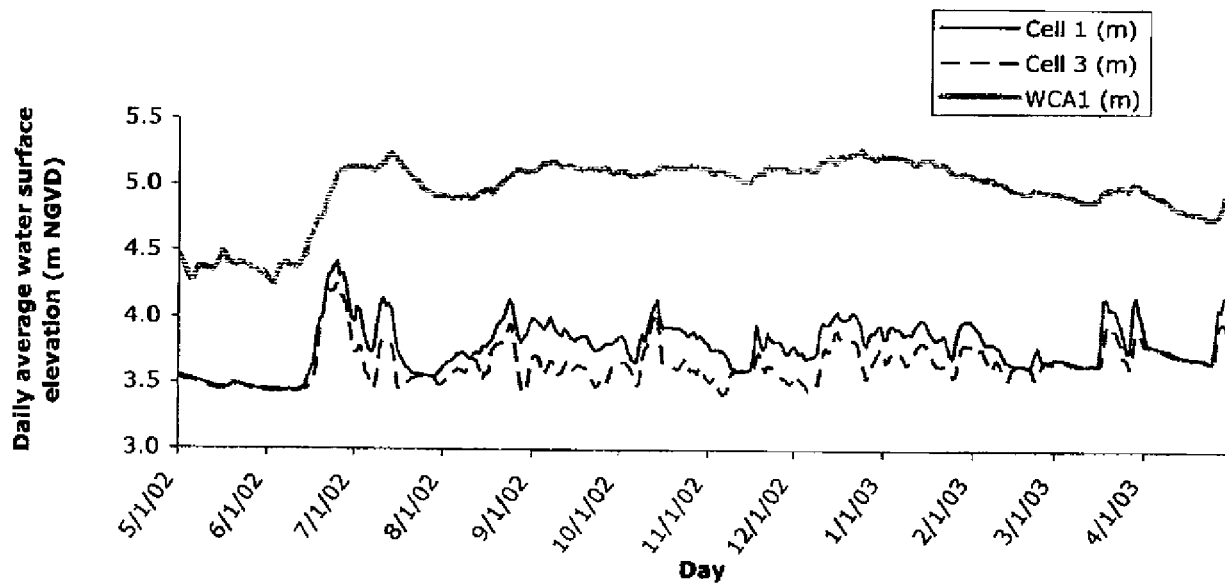
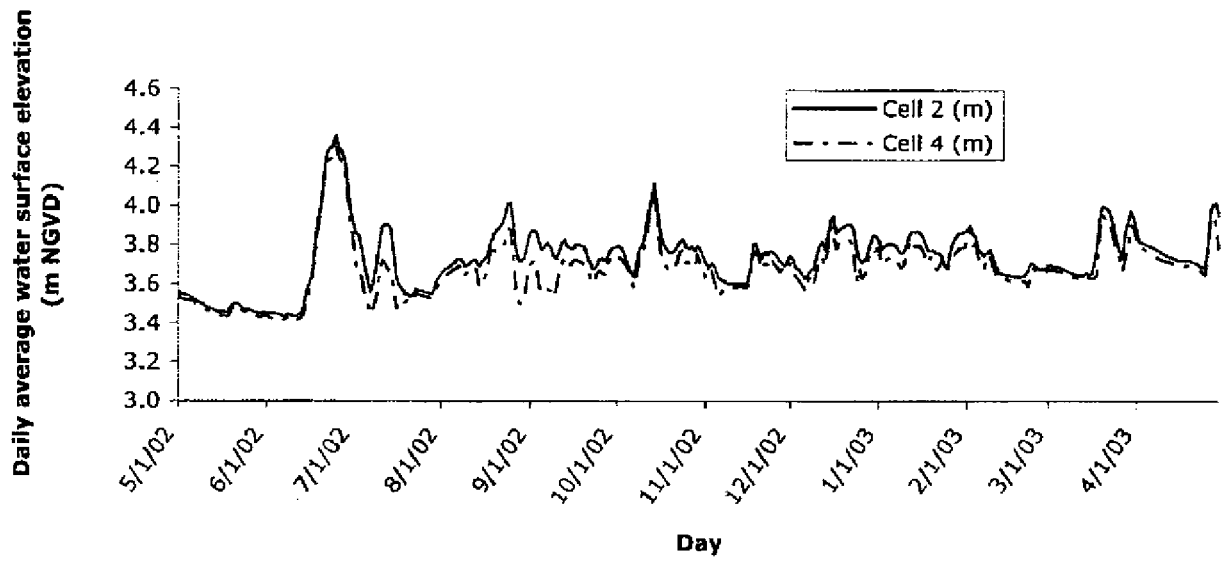
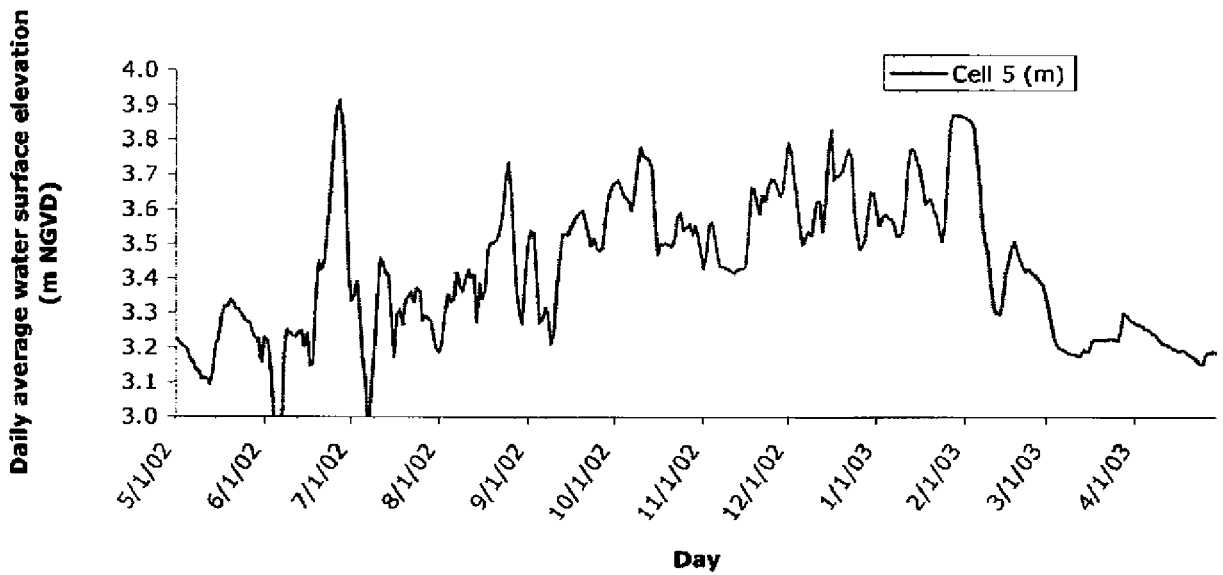


Figure 6. Daily mean water level in Cell 1 and Cell 3 of STA-1W and WCA1



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



**Figure 8. Daily mean water levels 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 94% 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 4%, and seepage through the roadside culverts (L-7a) accounts for 1%. Outflow pumping (G251 and G310) accounts for 95% of the outflows, with evapotranspiration constituting 5% of the total outflows. The unknowns in the system are ungaged subsurface inflows, outflows and errors that account for 2% 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.

$$\text{INFLOW} - \text{OUTFLOW} = \Delta S + \epsilon_T \quad (2)$$

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.  $\Delta S$  is the change in storage in the system during the time interval of interest. The sum of all errors is represented by  $\epsilon_T$ . Because all inflows and outflow cannot be entirely quantified, the following equation is introduced to represent the remainders, errors and unknowns:

$$\text{REMAINDERS} = \epsilon_T + \text{UNKNOWNNS} \quad (3)$$

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:

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

Where  $\Delta S$  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;  $\epsilon_T$  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:

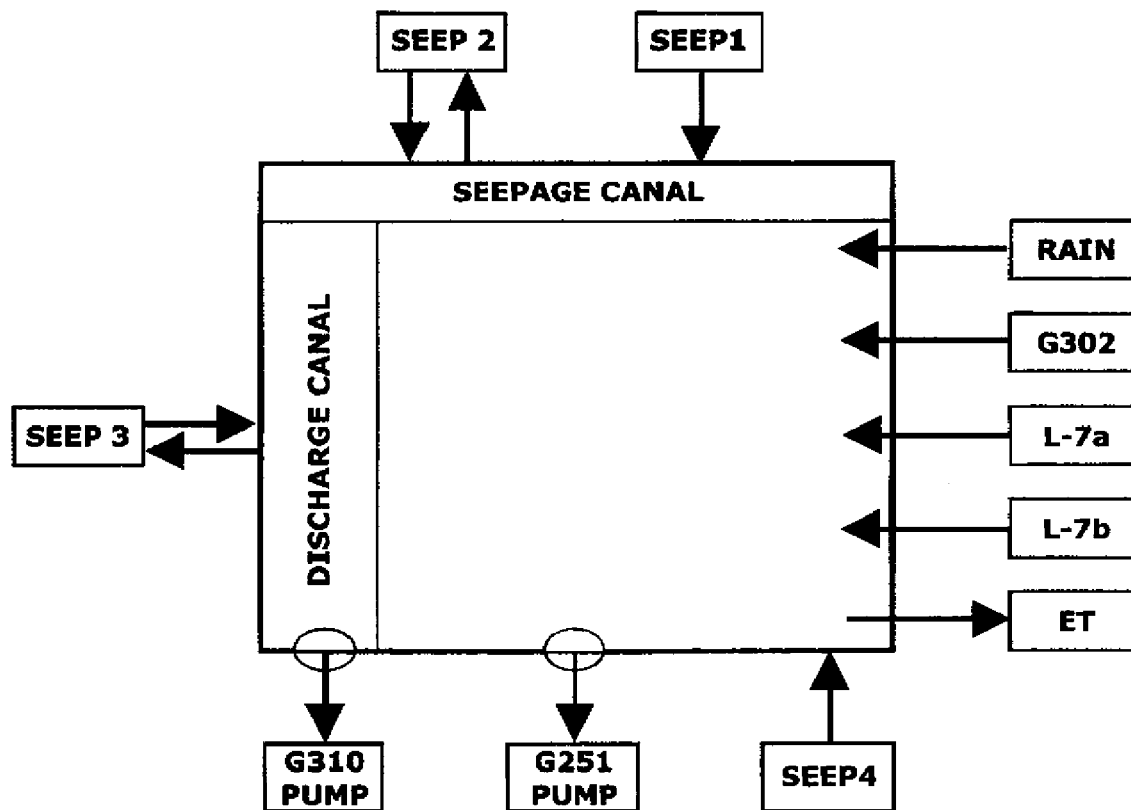


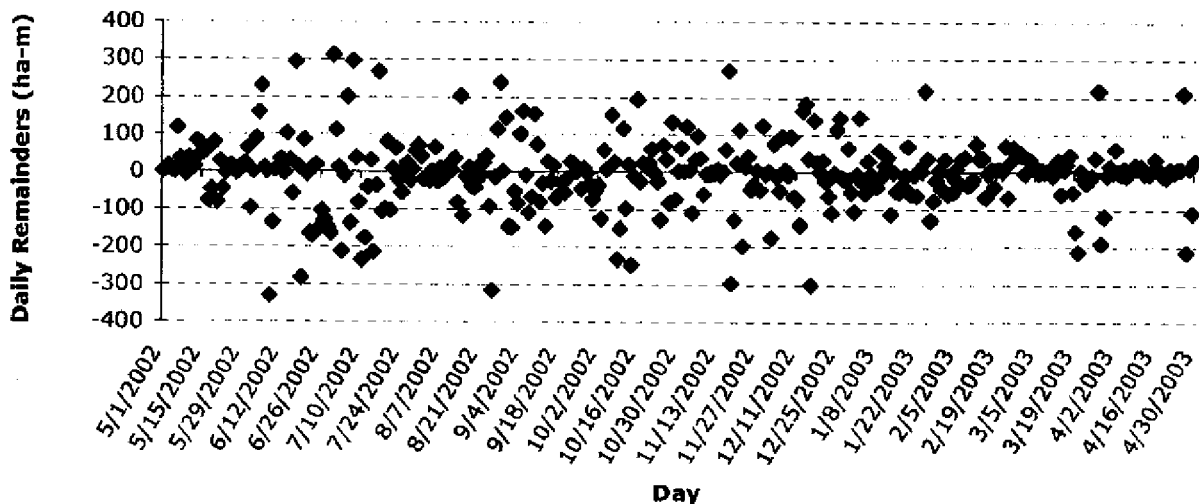
Figure 9. Schematic hydrologic model for STA 1-W

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

## Discussion

The total inflow through the inflow spillway was 73,006 ha-m (591,845 ac-ft) and total outflow through the outflow pumps was 73,518 ha-m (595,996 ac-ft). Seepage inflow from L-7 levee through the roadside culverts was a total of 396 ha-m (3,210 ac-ft). The seepage and recirculation pump had a total flow of 1,431 ha-m (11,601 ac-ft). Total average areal rainfall for the study period was 107.4 cm (42.3 inches) and the total average areal evapotranspiration was 129.7 cm (51.1 inches). For the study period, the mean daily remainders (errors and unknowns) was 3.78 ha-m d<sup>-1</sup> (30.6 ac-ft d<sup>-1</sup>), with total remainder being 1,378 ha-m d<sup>-1</sup> (11,171 ac-ft d<sup>-1</sup>). The standard deviation of the remainders is 92.1 ha-m d<sup>-1</sup> (746.6 ac-ft d<sup>-1</sup>), 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 7.4 centimeters per day (cm d<sup>-1</sup>), or 2.91 inches per day (in d<sup>-1</sup>). 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 61 cm (24 inches) and a total area of 2,700 ha (6,670 ac). The estimated mean hydraulic retention time was 8.2 days.



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

"1 ha-m = 8.1068 ac-ft"

**Table 8. Summary of water budget for STA-1W (May 1, 2002 to April 30, 2003)**

<b>Inflows</b>	<b>ha-m</b>	<b>Percent of total</b>	<b>Outflows</b>	<b>ha-m</b>	<b>Percent of total</b>
Spillway inflow	73,006	94%	Outflow pump	73,518	95%
Rain	2,978	4%	ET	3,595	5%
L- 7 Culverts (L7a)	396	1%			
Remainders	1,378	2%			
<b>Total</b>	<b>77,758</b>	<b>100%</b>	<b>Total</b>	<b>77,113</b>	<b>100%</b>

Change in storage	645
Seepage/recirculation seepage pump (ha-m)	1,431
Loading rate (cm/d)	7.41
Average depth (cm)	61
Retention time (days)	8.2

“1 ha-m = 8.1068 ac-ft”

## **WATER BUDGET SUMMARY**

This water budget study covers the fourth year of operation of STA-1W. The period of analysis was changed to May of previous year to April of current year in order to coincide with the reporting period for the Everglades Consolidated Report. For the period of analysis, the total inflow through the spillway (G302) was 73,006 ha-m, or 591,845 ac-ft. The total outflow through the outflow pump stations (G251 and G310) was 73,518 ha-m (595,996 ac-ft). Seepage inflow from L-7 levee through the roadside culverts was 396 ha-m (3,210 ac-ft). The seepage and recirculation pump had a total flow of 1,431 ha-m (11,601 ac-ft). Total areal average rainfall for the study period was 107.4 cm (42.3 in), and the total areal average evapotranspiration was 129.7 cm (51.1 in). The sum of the errors and unknowns was 1,378 ha-m (11,171 ac-ft), which represents 2 % of the total inflows to the system.

The mean hydraulic loading rate for the one-year period, based on the average flow, was 7.2 cm d<sup>-1</sup> (2.83 in d<sup>-1</sup>). 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 61 cm (24 inches) and a total area of 2,700 ha (6,670 ac). The estimated mean hydraulic retention time was 8.2 days and the change in storage was 645 ha-m (5,229 ac-ft). A comparison with the previous three years of water budget shows that surface water inflow and outflow for this period was the largest indicating highest hydraulic loading and smallest hydraulic retention time.

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<sup>#</sup>

Year	7/3/1999 to 4/30/2000*	5/1/2000 to 4/30/2001	5/1/2001 - 4/30/2002	5/1/2002 - 4/30/2003
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**Inflows (ha-m)**

Spillway inflow	14,296	11,573	34,398	73,006
Rain	2,623	2,467	3,704	2,978
L-7 Culverts (L7a)	541	288	440	396
Remainders				1,378
<b>Total</b>	<b>17,460</b>	<b>14,328</b>	<b>38,542</b>	<b>77,758</b>

**Outflows (ha-m)**

Outflow pump	13,379	11,166	33,012	73,518
ET	2,955	3,946	3,715	3,595
Remainders	1,410	331	1,313	
<b>Total</b>	<b>17,743</b>	<b>15,442</b>	<b>38,039</b>	<b>77,113</b>

Change in storage (ha-m)	(284)	(1,113)	503	645
Seepage/Recirculation Seepage Pump (ha-m)	5,475	3,386	1,449	1,431
Loading rate (cm/d)	1.70	1.14	3.40	7.41
Average depth (cm)	54.3	53.4	57.5	61
Retention time (days)	38.7	46.3	16.8	8.2

"1 ha-m = 8.1068 ac-ft"

\* 10-month period

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

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**APPENDIX I: WATER BALANCE TERMS WITH CALCULATED  
REMAINDERS**

Date	Change in storage	Inflow Spillway G302	Seepage Pump G2505	Outflow Pump G251/G31	Seepage L7a	Rain	ET	Remainders
	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m
5/1/2002	-19.138	0.000	4.982	0.000	0.000	0.000	17.602	1.536
5/2/2002	-20.754	0.000	2.374	0.000	0.000	0.000	15.551	5.203
5/3/2002	-19.727	0.000	7.831	0.000	0.000	11.970	17.103	14.594
5/4/2002	-19.938	0.000	8.265	0.000	0.000	0.000	17.103	2.835
5/5/2002	-17.362	0.000	5.552	0.000	0.000	0.000	16.050	1.312
5/6/2002	-45.640	155.288	2.326	64.971	0.000	0.000	17.602	118.355
5/7/2002	-16.185	141.880	4.691	108.322	0.000	0.000	13.999	35.744
5/8/2002	-43.450	118.475	2.215	120.501	0.000	0.000	16.577	24.847
5/9/2002	-11.913	119.454	2.193	121.475	0.000	0.000	17.602	-7.710
5/10/2002	-42.681	124.352	2.195	114.113	0.000	0.000	15.551	37.369
5/11/2002	-7.345	123.163	2.961	107.196	0.000	7.041	15.551	14.802
5/12/2002	-14.523	124.230	3.975	107.375	0.000	0.000	17.103	14.275
5/13/2002	-30.008	178.424	2.289	108.843	0.000	0.000	15.551	84.038
5/14/2002	37.357	234.754	2.509	134.051	0.000	1.408	16.577	48.177
5/15/2002	84.348	319.817	4.774	174.734	0.000	0.000	9.841	50.894
5/16/2002	23.769	256.429	2.509	186.065	0.000	20.419	8.288	58.726
5/17/2002	75.378	105.136	5.054	91.777	0.000	0.000	14.498	-76.517
5/18/2002	27.034	0.000	2.405	3.367	0.000	0.000	15.551	-45.952
5/19/2002	18.763	0.000	7.993	0.000	0.000	101.389	3.631	78.995
5/20/2002	65.691	0.000	8.388	0.000	0.000	0.000	15.551	-81.242
5/21/2002	-8.669	33.563	9.824	0.000	0.000	0.000	12.945	29.287
5/22/2002	-26.325	0.000	3.959	55.400	0.000	0.000	16.050	-45.125
5/23/2002	-11.526	0.000	2.299	0.000	0.000	0.000	15.024	-3.498
5/24/2002	-31.047	0.000	2.440	0.000	0.000	0.000	15.551	15.496
5/25/2002	-30.873	0.000	4.746	0.000	0.000	0.000	13.472	17.401
5/26/2002	-13.718	0.000	9.577	0.000	0.000	0.704	11.920	2.502
5/27/2002	-7.267	0.000	2.336	0.000	0.000	1.408	12.446	-3.771
5/28/2002	-45.476	0.000	10.571	16.899	0.000	0.000	17.103	11.474
5/29/2002	-27.912	0.000	2.487	0.000	0.000	0.000	18.129	9.783
5/30/2002	-7.385	0.184	5.705	0.000	0.000	28.868	12.945	23.492
5/31/2002	-67.811	54.250	7.967	52.310	0.000	7.745	11.920	65.576
6/1/2002	80.244	0.000	2.266	0.000	0.000	0.000	16.050	-96.294
6/2/2002	-15.926	0.000	11.396	0.000	0.000	0.000	16.050	-0.124
6/3/2002	-64.803	51.889	3.816	40.742	0.000	27.459	13.999	89.410
6/4/2002	-135.465	141.521	2.382	106.105	0.000	0.000	11.393	159.488
6/5/2002	-229.178	140.141	2.359	128.059	0.000	0.000	10.894	230.366
6/6/2002	-3.851	154.777	4.787	132.558	0.000	0.000	14.498	11.572
6/7/2002	-2.863	136.625	2.371	126.938	0.000	0.704	13.472	-0.218
6/8/2002	349.506	0.000	3.181	21.773	0.000	46.470	5.710	-330.519
6/9/2002	123.154	0.000	3.894	0.000	0.000	1.408	13.472	-135.218
6/10/2002	-18.667	0.000	2.429	0.000	0.000	1.408	15.551	4.524
6/11/2002	-18.443	0.000	4.446	0.000	0.000	2.112	8.288	12.267
6/12/2002	1.884	0.000	3.397	0.000	0.000	43.654	7.762	34.008
6/13/2002	33.731	9.527	3.023	0.000	0.000	29.572	8.288	-2.920
6/14/2002	39.212	132.664	2.479	0.000	0.000	20.419	10.367	103.504
6/15/2002	38.394	149.049	4.873	98.589	0.004	23.235	3.105	32.200
6/16/2002	108.480	108.192	2.681	87.018	0.028	39.429	9.841	-57.690
6/17/2002	-36.976	435.567	5.049	185.916	0.100	19.715	12.945	293.497

"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
6/18/2002	269.978	577.692	2.730	283.232	0.166	0.704	10.894	14.458
6/19/2002	455.485	287.920	4.530	112.784	0.111	10.561	11.393	-281.070
6/20/2002	224.589	494.006	6.135	217.659	0.119	42.949	8.815	86.011
6/21/2002	222.349	545.763	4.646	391.967	0.163	66.888	5.184	-6.686
6/22/2002	194.578	549.746	14.386	523.009	0.205	7.745	4.657	-164.548
6/23/2002	122.972	531.875	14.415	578.147	0.270	7.041	6.209	-168.142
6/24/2002	169.594	719.362	23.279	567.105	0.326	43.654	8.288	18.355
6/25/2002	240.071	650.958	21.600	579.740	0.428	19.715	3.631	-152.341
6/26/2002	1.084	419.135	7.787	510.822	0.588	0.000	11.920	-104.103
6/27/2002	11.138	526.813	5.260	654.143	0.623	16.194	7.762	-129.413
6/28/2002	-190.121	342.987	6.988	679.481	0.791	4.929	6.736	-147.389
6/29/2002	-397.910	104.135	3.152	655.616	1.055	0.000	10.894	-163.410
6/30/2002	-513.144	317.004	6.123	565.226	1.328	52.807	7.263	311.794
7/1/2002	-195.445	435.034	4.161	566.944	1.452	50.694	2.578	113.103
7/2/2002	46.498	640.148	4.611	572.199	1.343	2.112	11.920	12.986
7/3/2002	49.888	398.094	6.119	582.177	1.321	32.388	11.920	-212.182
7/4/2002	-274.587	280.076	3.218	551.204	1.587	0.000	15.024	-9.978
7/5/2002	-295.888	215.677	6.012	441.689	1.785	140.818	11.393	201.086
7/6/2002	-157.054	92.041	3.232	381.980	1.906	4.929	10.367	-136.417
7/7/2002	-249.399	334.908	2.797	287.049	1.912	7.041	9.841	296.370
7/8/2002	149.095	413.620	5.630	281.155	1.862	58.439	6.209	37.462
7/9/2002	333.142	609.447	6.704	393.411	1.647	40.837	6.209	-80.831
7/10/2002	435.266	685.793	6.032	502.244	1.357	24.643	8.288	-234.005
7/11/2002	238.264	639.311	3.876	572.280	1.321	2.816	8.288	-175.384
7/12/2002	-60.541	504.191	3.898	660.617	1.633	64.776	11.920	-41.396
7/13/2002	-45.585	616.743	6.091	618.916	1.870	0.000	13.999	31.283
7/14/2002	-29.669	373.563	3.208	602.932	1.894	0.000	16.050	-213.856
7/15/2002	-381.574	123.009	3.786	530.373	2.324	0.000	12.945	-36.411
7/16/2002	-350.405	186.258	6.237	255.851	2.489	0.000	16.050	267.251
7/17/2002	109.682	153.492	4.658	153.015	2.292	11.265	10.894	-106.542
7/18/2002	-11.732	0.000	3.067	112.662	2.149	7.745	8.288	-99.324
7/19/2002	-79.172	115.735	6.785	99.347	2.051	0.000	15.551	82.060
7/20/2002	93.079	0.000	2.710	0.000	1.788	0.000	11.920	-103.211
7/21/2002	-6.939	0.000	4.639	0.000	1.632	11.265	11.393	8.443
7/22/2002	23.673	105.532	3.435	7.570	1.553	0.000	11.393	64.449
7/23/2002	-12.376	46.122	3.034	69.241	1.441	0.000	11.393	-20.695
7/24/2002	44.087	0.000	2.766	0.000	1.243	0.000	11.920	-54.764
7/25/2002	-17.469	0.000	3.186	0.000	1.080	0.000	13.472	5.077
7/26/2002	-110.277	0.000	2.730	75.157	1.057	0.000	11.920	24.257
7/27/2002	9.000	0.000	5.254	0.000	1.003	0.000	13.999	-21.996
7/28/2002	-17.313	0.000	2.353	0.000	0.946	0.704	11.393	7.570
7/29/2002	-7.607	78.333	2.523	17.144	0.878	0.000	12.945	56.729
7/30/2002	-40.272	131.585	2.315	92.560	0.910	0.000	8.815	71.392
7/31/2002	-14.840	133.735	2.334	93.637	0.909	0.000	15.024	40.823
8/1/2002	23.615	141.562	3.436	122.980	0.867	0.000	16.577	-20.743
8/2/2002	71.253	137.410	3.601	87.327	0.829	17.602	12.446	-15.185
8/3/2002	125.208	137.454	2.330	27.892	0.778	2.112	10.894	-23.650
8/4/2002	92.898	137.603	2.296	32.609	0.704	0.000	10.367	2.433
8/5/2002	-9.198	155.212	4.826	104.091	0.712	14.082	8.815	66.298
8/6/2002	40.971	173.636	2.348	145.103	0.707	0.000	13.999	-25.730
8/7/2002	109.957	165.466	4.715	46.379	0.656	4.225	4.657	9.354

"1 ha-m = 8.1068 ac-ft"



Date	Change in storage	Inflow Spillway G302	Seepage Pump G2505	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
8/8/2002	-57.762	170.597	4.476	228.390	0.751	0.704	15.551	-14.127
8/9/2002	-48.216	144.046	2.742	189.104	0.787	0.000	10.367	-6.422
8/10/2002	59.866	124.455	4.592	32.064	0.660	0.000	11.393	21.792
8/11/2002	64.795	99.724	2.536	32.113	0.607	6.337	5.184	4.576
8/12/2002	-12.319	139.037	4.947	143.480	0.686	40.837	11.393	38.006
8/13/2002	12.132	91.535	2.587	150.747	0.712	0.000	10.894	-81.526
8/14/2002	-229.916	284.739	5.547	317.067	0.874	14.082	8.815	203.729
8/15/2002	155.153	206.680	2.600	154.987	0.882	0.704	14.498	-116.372
8/16/2002	-31.010	264.317	5.353	338.639	0.942	40.837	11.393	-12.926
8/17/2002	55.038	269.766	4.203	189.363	0.942	1.408	14.498	13.217
8/18/2002	259.299	265.533	4.261	32.805	0.692	0.000	11.920	-37.799
8/19/2002	85.004	331.451	5.543	278.884	0.710	0.000	9.314	-41.041
8/20/2002	64.999	407.763	2.964	446.871	0.780	107.022	6.736	-3.041
8/21/2002	28.446	441.170	2.839	416.038	0.835	2.816	9.314	-8.977
8/22/2002	76.453	503.007	5.649	427.505	0.868	35.204	8.815	26.306
8/23/2002	143.600	596.272	3.621	445.449	0.859	45.062	9.314	43.830
8/24/2002	211.565	600.674	3.385	472.519	0.788	2.112	11.393	-91.903
8/25/2002	44.333	382.995	9.620	639.037	0.897	0.000	15.551	-315.029
8/26/2002	-324.338	304.499	5.861	629.884	1.326	0.000	14.498	-14.219
8/27/2002	-383.937	281.064	3.633	565.238	1.681	23.939	10.367	115.016
8/28/2002	-284.624	432.244	4.987	476.209	1.857	4.929	8.288	239.157
8/29/2002	-67.758	379.690	2.752	440.414	1.784	0.704	7.263	2.259
8/30/2002	-6.993	479.876	4.895	332.990	1.692	0.704	10.367	145.908
8/31/2002	308.389	552.672	2.745	385.420	1.443	3.520	9.314	-145.488
9/1/2002	227.824	518.730	3.040	431.848	1.318	1.408	9.314	-147.530
9/2/2002	50.567	459.943	5.382	450.621	1.363	0.704	12.446	-51.624
9/3/2002	-26.300	413.160	3.218	526.517	1.492	11.970	10.367	-83.962
9/4/2002	-264.467	401.407	5.465	552.601	1.868	0.000	12.446	102.695
9/5/2002	-199.530	407.763	7.104	463.567	1.968	24.643	6.736	163.601
9/6/2002	70.488	555.298	3.106	492.699	1.849	8.449	10.894	-8.485
9/7/2002	97.033	522.424	4.861	529.265	1.766	3.520	10.367	-108.955
9/8/2002	-67.996	384.730	4.270	507.030	1.860	0.000	13.472	-65.916
9/9/2002	-195.418	407.227	3.794	437.833	2.010	0.000	9.841	156.981
9/10/2002	27.907	371.241	3.525	256.923	1.942	0.000	13.472	74.881
9/11/2002	191.767	342.899	3.959	245.061	1.825	16.194	4.158	-80.068
9/12/2002	171.654	404.002	3.948	261.376	1.756	2.112	5.184	-30.344
9/13/2002	100.303	236.175	2.666	273.154	1.723	0.704	9.841	-144.696
9/14/2002	-50.956	264.814	5.390	276.907	1.818	0.000	12.446	28.235
9/15/2002	-33.708	222.821	2.662	272.998	1.848	0.000	10.367	-24.988
9/16/2002	27.449	227.582	5.232	173.942	1.733	0.000	11.393	16.531
9/17/2002	56.115	249.250	2.651	253.348	1.673	0.000	10.894	-69.434
9/18/2002	15.269	239.304	5.460	272.843	1.677	0.000	11.920	-59.051
9/19/2002	8.286	260.243	2.611	273.071	1.693	2.816	12.945	-29.550
9/20/2002	-6.142	226.848	3.634	280.166	1.740	0.704	10.367	-55.099
9/21/2002	-113.559	143.720	4.095	270.358	1.853	6.337	11.393	-16.282
9/22/2002	-107.775	172.077	4.125	247.995	1.946	6.337	12.945	27.195
9/23/2002	-81.212	167.245	4.374	238.133	2.029	19.715	7.762	24.306
9/24/2002	41.462	186.522	4.284	144.107	1.967	4.225	6.736	0.409
9/25/2002	19.643	214.904	3.911	190.740	1.939	7.745	8.815	5.390
9/26/2002	7.820	222.760	4.886	252.287	1.943	0.000	10.367	-45.771
9/27/2002	-8.168	207.008	4.066	224.977	1.903	28.164	9.314	10.952
9/28/2002	150.486	214.698	4.979	72.013	1.655	12.674	9.841	-3.313

"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
9/29/2002	127.888	207.686	2.709	103.619	1.491	0.000	10.367	-32.697
9/30/2002	55.328	262.154	8.127	271.779	1.353	4.929	13.999	-72.670
10/1/2002	27.160	231.710	3.591	251.467	1.383	3.520	8.815	-50.829
10/2/2002	18.923	244.973	5.037	250.792	1.347	0.000	11.393	-34.788
10/3/2002	-43.761	77.851	2.460	236.917	1.505	0.000	10.367	-124.167
10/4/2002	-118.149	0.000	4.530	51.936	1.567	1.408	8.815	60.373
10/5/2002	-70.261	0.000	3.270	51.657	1.575	0.000	12.945	7.234
10/6/2002	-73.350	0.000	3.956	51.238	1.608	0.000	11.920	11.800
10/7/2002	-75.938	269.981	3.611	180.347	1.529	0.000	13.472	153.629
10/8/2002	205.119	428.379	2.732	184.682	1.253	0.000	11.393	28.438
10/9/2002	238.677	384.708	5.208	370.180	0.999	0.000	8.815	-231.965
10/10/2002	75.561	287.024	2.699	351.822	1.072	0.000	11.393	-150.680
10/11/2002	73.379	427.828	6.188	335.559	1.065	107.726	9.841	117.840
10/12/2002	162.722	393.917	3.501	329.499	0.924	7.745	6.736	-96.371
10/13/2002	110.504	419.485	2.963	285.865	0.807	5.633	8.288	21.268
10/14/2002	59.198	358.878	5.642	539.162	0.821	0.000	7.762	-246.423
10/15/2002	-401.801	193.924	2.822	606.022	1.355	5.633	8.815	-12.124
10/16/2002	-325.528	309.698	2.765	431.782	1.549	0.000	9.841	195.152
10/17/2002	10.669	402.280	2.673	409.074	1.370	0.000	9.841	-25.934
10/18/2002	-22.001	410.660	3.203	398.808	1.365	0.000	11.393	23.825
10/19/2002	-18.116	408.328	4.250	400.880	1.406	0.000	9.841	17.129
10/20/2002	-12.947	401.177	3.218	384.676	1.440	0.000	7.263	23.625
10/21/2002	-9.964	436.051	2.765	376.348	1.450	0.000	8.288	62.829
10/22/2002	48.375	421.494	2.788	368.371	1.358	0.000	10.367	-4.261
10/23/2002	94.573	394.042	2.693	318.606	1.282	0.000	7.263	-25.118
10/24/2002	31.050	281.077	2.699	368.518	1.377	0.000	9.841	-126.955
10/25/2002	-134.199	202.795	7.340	400.249	1.683	141.522	7.263	72.687
10/26/2002	9.347	373.725	3.678	324.275	1.632	0.000	7.762	33.973
10/27/2002	27.345	249.351	2.857	299.918	1.608	0.704	7.263	-82.863
10/28/2002	-89.268	362.284	3.617	313.006	1.606	0.000	5.710	134.442
10/29/2002	80.909	263.818	4.429	250.845	1.466	0.704	7.263	-73.029
10/30/2002	-67.286	281.309	2.337	344.565	1.659	4.225	7.762	2.152
10/31/2002	-123.680	251.584	3.944	301.844	1.709	0.000	8.815	66.314
11/1/2002	-92.925	190.733	3.693	300.104	1.764	23.235	6.209	2.344
11/2/2002	7.700	195.012	2.508	59.283	1.615	0.000	8.288	121.356
11/3/2002	133.770	194.383	2.575	50.262	1.502	0.000	7.762	4.091
11/4/2002	-8.386	189.764	2.657	300.315	1.643	0.000	9.314	-109.836
11/5/2002	-111.959	199.751	2.616	274.011	1.762	0.000	6.736	32.725
11/6/2002	-89.625	196.595	4.791	187.173	1.799	3.520	6.736	97.630
11/7/2002	-48.302	201.212	2.680	203.113	1.712	0.000	10.367	37.746
11/8/2002	-11.971	12.838	2.461	78.666	1.850	0.000	7.263	-59.270
11/9/2002	-1.670	0.000	2.470	0.000	1.804	0.000	8.815	-5.341
11/10/2002	-7.172	0.000	2.507	7.250	1.759	0.000	8.288	-6.607
11/11/2002	-9.210	0.000	2.508	0.000	1.703	0.000	9.841	1.072
11/12/2002	-8.586	0.000	2.609	6.063	1.676	2.112	8.288	-1.977
11/13/2002	16.719	14.110	3.961	0.000	1.518	15.490	7.263	7.136
11/14/2002	1.282	0.000	6.198	0.000	1.544	0.000	7.263	-7.001
11/15/2002	-1.081	15.436	2.405	9.160	1.500	0.000	7.263	1.594
11/16/2002	14.680	0.000	6.437	0.000	1.611	76.042	2.079	60.894

"1 ha-m = 8.1068 ac-ft"

Date	Change in storage	Inflow Spillway G302	Seepage Pump G250S	Outflow Pump G251/G31	Seepage L7a	Rain	ET	Remainders
	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m
11/17/2002	221.306	572.843	2.684	83.008	1.226	4.929	4.158	270.526
11/18/2002	402.620	376.436	2.853	260.427	1.046	0.000	10.367	-295.932
11/19/2002	-47.689	109.430	5.221	279.127	1.349	0.000	7.263	-127.922
11/20/2002	-150.448	0.000	2.850	134.017	1.591	11.970	6.209	23.783
11/21/2002	-81.188	254.643	5.882	284.348	1.775	64.776	4.657	113.377
11/22/2002	170.767	286.278	2.857	309.783	1.528	2.112	6.209	-196.841
11/23/2002	-62.067	236.594	2.857	277.678	1.609	0.000	10.367	12.225
11/24/2002	49.517	227.697	3.276	128.732	1.574	0.000	8.815	42.207
11/25/2002	3.794	235.297	4.598	273.423	1.663	0.000	7.263	-47.520
11/26/2002	-22.245	209.394	1.982	260.899	1.697	0.000	6.209	-33.772
11/27/2002	-65.156	193.845	4.460	250.547	1.771	0.000	7.263	2.962
11/28/2002	-66.392	4.203	2.535	113.660	1.924	0.000	7.263	-48.404
11/29/2002	-5.288	187.278	4.377	59.699	1.713	0.000	9.841	124.739
11/30/2002	119.036	182.586	4.850	60.347	1.640	0.000	8.815	-3.972
12/1/2002	122.373	184.203	3.111	62.620	1.540	4.929	3.631	2.048
12/2/2002	-44.239	28.443	2.685	244.956	1.736	0.000	5.184	-175.722
12/3/2002	-158.551	158.579	5.068	235.035	1.758	0.000	6.736	77.117
12/4/2002	-65.968	156.971	2.574	231.548	1.859	0.000	4.657	-11.407
12/5/2002	-142.981	31.171	2.578	219.477	2.129	0.000	6.736	-49.932
12/6/2002	-106.089	192.416	4.983	207.025	1.928	4.225	2.079	95.554
12/7/2002	47.231	153.659	2.461	97.823	1.854	0.000	4.657	5.802
12/8/2002	50.119	148.743	2.550	102.481	1.869	0.000	4.657	-6.645
12/9/2002	9.249	337.379	3.436	288.182	1.835	54.919	1.552	95.150
12/10/2002	231.822	462.104	4.778	303.432	1.715	10.561	4.657	-65.531
12/11/2002	175.417	448.877	2.918	341.311	1.555	0.000	5.710	-72.006
12/12/2002	25.643	362.039	2.694	482.002	1.674	7.745	4.657	-140.844
12/13/2002	-141.340	420.520	4.827	399.229	1.809	4.225	3.631	165.034
12/14/2002	158.763	474.773	3.016	125.561	1.554	0.000	7.762	184.241
12/15/2002	295.232	440.409	16.402	104.111	1.300	0.000	5.184	37.182
12/16/2002	119.240	376.773	3.225	549.355	1.424	0.000	9.841	-300.239
12/17/2002	-277.143	390.744	2.658	521.773	1.716	0.000	8.815	139.015
12/18/2002	17.718	408.039	2.852	361.905	1.612	0.000	4.657	25.371
12/19/2002	10.963	379.771	3.664	364.807	1.656	0.000	5.710	-0.053
12/20/2002	27.690	431.493	4.728	416.517	1.700	44.358	3.105	30.239
12/21/2002	71.971	488.582	2.849	432.078	1.635	0.000	9.841	-23.673
12/22/2002	16.102	391.439	3.461	435.144	1.735	0.000	6.736	-64.808
12/23/2002	-93.964	353.346	4.950	550.602	1.929	0.000	8.288	-109.651
12/24/2002	-316.838	285.400	2.604	602.357	2.430	0.704	7.263	-4.248
12/25/2002	-182.236	50.928	2.538	115.295	2.676	0.000	6.209	114.336
12/26/2002	-129.301	311.428	2.522	289.819	2.415	0.000	9.314	144.011
12/27/2002	85.113	364.193	3.470	289.938	2.133	0.000	7.762	-16.487
12/28/2002	79.962	321.987	3.460	257.297	2.020	0.000	8.288	-21.540
12/29/2002	149.505	360.417	3.396	138.340	1.841	0.000	9.841	64.572
12/30/2002	126.742	381.155	2.608	302.054	1.794	0.000	8.288	-54.135
12/31/2002	26.930	282.557	2.561	356.368	1.946	0.000	7.762	-106.557
1/1/2003	-139.129	0.000	2.839	149.237	2.413	5.633	4.158	-6.220
1/2/2003	-125.162	338.874	2.642	314.696	2.105	0.704	5.710	146.439
1/3/2003	109.591	404.514	2.641	326.856	1.878	7.041	3.105	-26.119
1/4/2003	37.044	327.850	3.478	340.707	1.879	0.704	8.288	-55.606
1/5/2003	-32.365	348.446	4.340	346.300	1.924	0.000	7.762	28.673
1/6/2003	-2.096	321.855	2.499	325.009	1.884	0.000	8.288	-7.462
1/7/2003	-24.694	295.541	2.532	346.391	1.926	0.000	8.288	-32.518

"1ha-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
1/8/2003	-100.072	205.406	2.664	337.553	2.076	0.000	8.815	-38.814
1/9/2003	-20.144	341.478	2.560	295.262	1.953	0.000	8.815	59.498
1/10/2003	33.645	286.261	4.018	255.183	1.900	0.000	7.263	-7.930
1/11/2003	107.509	257.354	2.758	129.742	1.761	0.000	4.158	17.706
1/12/2003	222.507	364.694	4.472	95.910	1.467	0.000	7.762	39.982
1/13/2003	109.508	370.412	6.742	372.007	1.510	2.816	5.184	-111.961
1/14/2003	19.237	392.038	3.040	386.222	1.525	16.194	4.657	-0.359
1/15/2003	-20.813	335.454	2.856	399.748	1.590	0.000	9.841	-51.732
1/16/2003	-72.957	254.736	2.666	373.326	1.710	0.000	8.288	-52.211
1/17/2003	-140.236	192.252	5.178	362.893	1.878	0.000	7.263	-35.790
1/18/2003	-128.970	193.251	2.663	328.014	1.898	0.000	6.209	-10.104
1/19/2003	-9.382	194.670	2.540	125.568	1.785	0.000	10.367	69.902
1/20/2003	-4.218	253.576	2.796	309.182	1.817	0.000	9.841	-59.412
1/21/2003	-41.031	274.762	2.555	315.499	1.796	0.000	9.841	-7.751
1/22/2003	-5.764	247.374	3.205	308.379	1.760	0.000	9.314	-62.795
1/23/2003	-108.238	25.218	4.518	120.743	1.953	0.000	6.736	7.930
1/24/2003	-110.875	0.000	2.643	104.033	1.884	0.000	7.762	0.964
1/25/2003	7.698	292.422	5.335	59.807	1.530	0.000	8.815	217.632
1/26/2003	330.663	422.497	2.690	48.833	1.283	0.000	8.288	35.996
1/27/2003	292.740	330.776	3.337	158.975	1.094	0.000	8.815	-128.660
1/28/2003	101.245	195.771	5.188	163.646	0.991	0.000	8.288	-76.417
1/29/2003	21.090	215.043	2.909	206.392	0.926	0.000	9.314	-20.827
1/30/2003	-4.237	189.143	5.580	182.984	0.865	0.000	6.736	4.525
1/31/2003	3.032	174.238	2.797	207.473	0.846	0.000	9.841	-45.262
2/1/2003	-21.460	142.135	2.934	120.362	0.948	0.000	9.841	34.340
2/2/2003	6.004	79.647	5.204	121.822	0.994	0.000	10.367	-57.552
2/3/2003	-65.981	92.423	3.116	154.339	1.045	0.000	10.367	-5.257
2/4/2003	-58.079	0.000	2.720	102.247	1.114	0.000	8.288	-51.342
2/5/2003	-172.922	74.191	6.212	236.520	1.173	0.000	3.105	8.661
2/6/2003	-141.157	61.025	6.567	225.515	1.222	0.000	7.762	-29.873
2/7/2003	-158.052	106.952	2.614	222.486	1.225	0.000	8.288	35.455
2/8/2003	-43.064	99.357	3.391	100.098	1.053	0.000	4.158	39.218
2/9/2003	-31.242	46.643	4.094	104.140	1.097	0.000	9.314	-34.472
2/10/2003	-129.960	63.733	2.483	217.509	1.144	0.000	8.815	-31.487
2/11/2003	-170.758	0.000	1.903	180.724	1.219	0.000	10.894	-19.641
2/12/2003	-95.311	46.702	2.569	55.070	1.142	0.000	11.393	76.692
2/13/2003	-17.525	51.750	2.212	21.051	1.068	0.000	11.393	37.899
2/14/2003	63.637	111.074	2.321	1.532	0.917	0.000	9.314	37.508
2/15/2003	102.403	48.872	2.460	4.443	0.996	0.000	9.314	-66.292
2/16/2003	33.322	41.192	2.590	2.887	1.023	0.000	9.841	-3.835
2/17/2003	56.423	65.586	2.387	6.151	0.897	8.449	4.657	7.701
2/18/2003	24.137	104.862	2.421	109.097	0.821	0.000	11.920	-39.471
2/19/2003	-36.214	157.069	2.461	179.679	0.782	0.000	8.288	6.098
2/20/2003	-36.214	157.072	2.427	179.072	0.800	0.000	7.762	7.252
2/21/2003	-25.745	130.322	2.460	146.297	0.763	0.000	9.314	1.219
2/22/2003	4.082	188.348	7.926	126.452	0.697	22.531	9.841	71.201
2/23/2003	68.371	148.117	3.909	140.647	0.661	3.520	11.393	-68.113
2/24/2003	-17.899	86.311	2.446	66.579	0.631	0.000	9.314	28.948
2/25/2003	-18.140	107.923	2.448	51.512	0.553	0.000	7.762	67.342
2/26/2003	-12.565	98.121	2.380	51.512	0.581	0.000	7.263	52.492
2/27/2003	-17.294	97.378	2.155	51.243	0.589	0.000	8.815	55.203

"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
2/28/2003	-7.820	98.185	2.096	51.317	0.598	0.000	10.367	44.919
3/1/2003	-15.677	40.691	2.439	51.512	0.860	0.000	8.815	-3.099
3/2/2003	-57.018	39.964	2.371	51.510	0.844	0.000	9.841	36.475
3/3/2003	-47.238	45.883	2.367	51.507	0.798	0.000	8.815	33.597
3/4/2003	-53.561	22.319	2.267	51.505	0.827	0.000	8.288	16.914
3/5/2003	-38.489	0.000	2.355	18.115	0.796	0.000	9.314	11.856
3/6/2003	-13.383	0.000	2.273	6.070	0.785	0.000	9.841	-1.743
3/7/2003	-17.544	0.000	0.922	1.385	0.766	0.000	9.841	7.084
3/8/2003	-12.050	0.000	2.382	3.433	0.734	0.000	8.815	0.536
3/9/2003	-18.742	0.000	2.561	3.416	0.705	0.000	10.894	5.137
3/10/2003	-8.717	0.000	3.344	2.488	0.668	8.449	7.263	8.083
3/11/2003	-5.540	0.066	2.937	5.292	0.661	0.000	8.815	-7.840
3/12/2003	-14.950	0.000	2.813	0.037	0.657	0.000	7.762	7.808
3/13/2003	-3.837	0.000	3.266	2.094	0.647	40.133	9.841	32.682
3/14/2003	43.072	0.061	7.432	5.686	0.680	0.000	10.367	-58.384
3/15/2003	-14.041	0.000	2.423	0.000	0.678	0.000	8.815	5.904
3/16/2003	1.622	0.000	3.865	3.325	0.714	35.909	8.288	23.388
3/17/2003	145.927	287.878	5.427	165.559	0.594	80.970	11.393	46.563
3/18/2003	287.282	409.916	4.939	164.700	0.317	0.000	11.393	-53.142
3/19/2003	176.555	236.317	5.327	205.538	0.388	0.000	10.894	-156.282
3/20/2003	-1.561	108.202	2.487	315.841	0.471	6.337	12.446	-211.716
3/21/2003	-24.709	188.546	2.554	213.959	0.495	14.786	11.393	3.184
3/22/2003	-16.665	140.358	2.995	210.899	0.503	45.062	8.815	-17.126
3/23/2003	-68.828	103.984	2.617	218.212	0.587	20.419	4.657	-29.051
3/24/2003	-91.758	103.313	2.656	205.367	0.696	6.337	13.472	-16.735
3/25/2003	-142.092	0.000	2.376	139.529	0.876	0.000	13.472	-10.033
3/26/2003	-89.103	0.000	0.000	42.986	0.884	0.000	8.288	38.713
3/27/2003	-19.356	134.738	7.597	118.605	0.930	187.992	6.736	217.675
3/28/2003	371.478	426.659	4.996	232.838	0.475	0.000	12.446	-189.628
3/29/2003	135.510	259.034	2.864	226.650	0.412	0.000	15.024	-117.738
3/30/2003	-32.213	160.781	2.635	194.993	0.605	1.408	8.288	-8.274
3/31/2003	-76.953	146.622	2.281	192.301	0.595	0.000	15.551	16.318
4/1/2003	-132.392	25.005	2.356	143.363	0.760	0.000	12.446	2.348
4/2/2003	-77.804	0.000	2.400	5.566	0.753	0.000	9.841	63.150
4/3/2003	-13.287	0.000	2.436	0.991	0.724	0.000	11.920	1.100
4/4/2003	-17.337	0.000	2.539	8.157	0.700	0.000	12.446	-2.566
4/5/2003	-18.147	0.000	2.374	0.000	0.659	0.704	9.314	10.196
4/6/2003	-11.676	0.000	2.543	7.120	0.640	0.000	14.498	-9.302
4/7/2003	-18.962	0.000	3.981	2.244	0.630	0.000	12.446	4.902
4/8/2003	-21.590	0.000	2.415	5.317	0.582	0.000	12.446	4.409
4/9/2003	-21.697	0.000	3.635	0.000	0.547	4.929	6.736	20.437
4/10/2003	-22.729	0.000	2.973	2.131	0.467	0.000	11.393	9.672
4/11/2003	-23.691	0.000	2.316	0.000	0.435	0.000	8.288	15.838
4/12/2003	-13.041	0.000	2.513	0.000	0.405	0.000	15.024	-1.578
4/13/2003	-14.942	0.000	2.393	0.000	0.391	0.000	15.551	-0.218
4/14/2003	-15.396	0.000	3.285	5.659	0.390	0.000	11.920	-1.793
4/15/2003	-16.211	0.000	4.050	0.000	0.367	0.000	11.920	4.658
4/16/2003	-12.775	31.215	2.408	0.000	0.254	3.520	12.446	35.318
4/17/2003	-4.449	15.938	2.438	0.000	0.164	0.704	11.920	9.335
4/18/2003	-1.408	0.000	2.541	0.000	0.176	8.449	12.446	-2.413
4/19/2003	-0.660	0.000	3.765	0.000	0.225	0.704	9.841	-8.252
4/20/2003	-6.682	0.000	3.567	5.877	0.318	0.000	13.999	-12.876
4/21/2003	-20.152	0.000	2.375	0.078	0.299	0.000	13.472	6.901

"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
4/22/2003	-19.518	0.000	2.440	0.000	0.280	0.000	14.498	5.300
4/23/2003	-22.888	0.000	2.410	7.100	0.244	0.000	14.498	1.534
4/24/2003	-20.348	0.000	3.992	0.000	0.243	0.000	13.472	7.119
4/25/2003	-18.997	0.000	0.000	0.000	0.268	0.000	11.393	7.872
4/26/2003	198.945	342.425	11.303	35.474	0.139	104.205	1.026	211.324
4/27/2003	354.515	215.112	2.582	74.885	0.123	13.378	11.920	-212.707
4/28/2003	23.656	204.973	2.800	165.581	0.184	4.225	9.314	10.831
4/29/2003	51.597	338.302	2.763	384.275	0.202	2.816	14.498	-109.050
4/30/2003	-54.235	347.651	2.739	369.162	0.197	2.112	3.105	31.928

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